2005 USAID Summer Seminar Series

July 12: Geographic Information Systems: Improving Management, Getting Results, and Communicating the U.S. Foreign Assistance Story
Presenters: Carrie Stokes, DCHA/CMM; Rebecca Maestri, ANE/SPO; Charles North, PPC/P; Lisa Glufling, PPC/SPP
Materials: Presentation 1; Presentation 2 (not included); Notes (see below); Q&A (see below)

Synopsis

USAID's Economic Growth, Agriculture, and Trade Bureau is enlisting geospatial information systems (GIS) to measure and manage a range of activities, particularly in the area of natural resource management. A GIS can collect, organize, analyze, and display spatially related information, including remotely sensed data, output from global positioning systems, statistics, and digital maps.

This session will present a vision for tracking results using GIS technology. Through applications in USAID's development work, GIS can offer tools to support an over-arching management information system for the agency. Discussion will focus on how a GIS can help track ongoing activities, measure output, evaluate programs, assist partners, communicate results, and make improved decisions. A question and answer period will follow the presentation, to further explore GIS features, discuss recent lessons, and pose additional possibilities for application in USAID's planned and ongoing activities.

Notes

The well attended second session of the 2005 USAID Summer Seminar Series, "Geographic Information Systems: Improving Management, Getting Results, and Communicating the U.S. Foreign Assistance Story," was presented by Carrie Stokes, Geospatial Information Technology Advisor, EGAT/ESP/GCC; Rebecca Maestri, General Business Specialist, ANE/SPE/SPPM; Charles North, Supervisory Program Officer, PPC/P; and Lisa Glufling, EIS Functional Project Manager, PPC/SPP.

Stokes started the session on geospatial information systems (GIS) by giving a detailed overview of the technology and its uses. She introduced geospatial tools, which are devices to "collect, analyze, organize, and display spatially related information." This includes global positioning systems (GPS), paper maps, geographic feature and statistical databases, and equipment for collecting remotely sensed data. Together, these geospatial tools can generate vast amounts of data causing a problem of representing the large amount of geospatial information on a two dimensional map.

GIS is a system that can create, query, analyze and display geospatial information. Essentially GIS is a "database with a map on top of it," said Stokes. A GIS displays data in "layers" such as climate zones, elevations, forests, land cover, political boundaries, per capita income, and population density which allows the user to view relevant information and see the "whole picture". The limitless list of information and layering that can be displayed and managed make GIS a powerful computerized decision support tool. Despite the power of the technology behind GIS, Stokes emphasized that people and human input remain its most important components.

GIS has a wide range of applications relevant to USAID. The capabilities of GIS can help the agency visualize distances between rural farmers and the nearest market towns where they can sell produce. GIS can be used to analyze average rainfall levels within a specified radius, or display demographic indicators such as the income levels of various ethnic groups. Stokes said that GIS can also allow USAID and its partners to "get a better sense of what is going on and where."

Stokes provided examples of how GIS technologies had already been implemented and utilized within USAID. The Famine Early Warning Systems (FEWS) began in Africa and is now available in other regions. FEWS uses imagery collected by NASA's Landsat program, and it can be used to monitor land use change, crop health, and potential famine conditions. In the area of forest

management and conservation, the Central African Regional Program for the Environment (CARPE) tracks illegal logging and deforestation trends in a forest that serves as a massive carbon storage reservoir for regulating the global climate. USAID has also used GIS in Afghanistan to improve and encourage farming techniques for legal crops.

Stokes explained the usefulness of GIS as a communications tool for USAID. Present realities require that the agency be able to report its activities to the world and Washington. A GIS generated map can display different USAID activities and their funding levels over a geographic area so that leadership and the public can quickly grasp where and how the agency is spending its money.

GIS also has important uses as a management tool within the agency. Stokes listed the potential applications of a GIS coupled to a Management Information System (MIS). Such a combination could be used to track ongoing activities, generate summary reports, measure output results and strategically plan where to place to new projects. An example of the latter use was the USAID mission in Ivory Coast, where GIS technology was used to guide the placement of new village health care centers based on population density levels.

Maestri briefed the audience on the Asia/Near East (ANE) GIS pilot program. She expanded upon Stoke's description of the contemporary challenges facing USAID, including the increasing need to report real-time data to the public and leaders in Washington. She also noted that when USAID officers are able to provide "senior management with photos and maps that also have overlays" there tends to be "greater receptivity [to USAID programs] among the NSC [National Security Council], Congress, DOD [Department of Defense] and the State Department." The utility of GIS to USAID thus increases as the agency expands its cooperation and coordination with DOD and NSC.

Maestri is now part of a team of experts examining the use of GIS in ANE missions. The team's objectives include finding how best to harness GIS to "improve planning and reporting requirements." The panel of experts commissioned a MIS/GIS assessment that included around 10 missions that were at various stages of implementing GIS. The commission found that the missions' systems were not integrated with Washington or each other, and that each system cost roughly $500,000 to build from scratch.

Following the study of the current state of MIS/GIS, the team of experts drafted a "scope of work that portends to launch a pilot activity." The pilot program will identify country missions that have a particular interest in GIS or a need for it. The pilot program will result in a program that "lends itself to organic growth and expansion," said Maestri. The pilot program envisions using existing and off-the-shelf technology to realize cost savings.

North followed up with descriptions of his firsthand experience implementing and using GIS in two USAID missions, El Salvador and Russia. GIS was used to plot rehabilitated houses by USAID following Hurricane Mitch in 1998. GIS allowed the mission to show the government of El Salvador and the public exactly where and how USAID was contributing to the country's post-hurricane reconstruction. Following a magnitude 7.6 earthquake in 2001, USAID again utilized GIS in managing its recovery assistance. The mission's GIS tracked different rebuilding activities, and allowed for better coordination among activity managers, donors, and implementers. Another example of GIS use in El Salvador involved superimposing data from soil samples on top of the location of USAID housing projects. This use of GIS convinced the mission to relocate housing projects based on landslide hazard information.

North then presented a series of GIS generated maps created by the USAID mission in Russia that demonstrated the usefulness of GIS to convey information about large land masses. The mission in Russia was able to visualize its broad range of activities through GIS. One use of GIS was the monitoring of assistance to Russian orphans. North showed a map that showed aid to individual orphanage centers and partnerships with the provincial governments. The mission also employed GIS to track the Eurasia Foundation's use of $10 million in USAID civil society grants. GIS was also linked to demographic information purchased from the Russian statistical bureau. When this data was entered into the missions GIS, mission managers were able to visualize youth "bulges" and see the population concentrations in relation to local instability and unemployment levels. The ability to visualize demographic information could be used to predict population crises.

North then described some of the challenges he had encountered implementing and using GIS in the

field. As noted by Maestri and Stokes, GIS can be expensive and require a lot of effort when starting from scratch. GIS operators and their managers must be trained to understand the capabilities of the technology. Issues of standardization can also make it difficult to combine maps from other countries when trying to obtain a more regional or global view. Lastly, mission directors must be willing to champion and invest in GIS.

Glufling gave an update on the work of the executive information system (EIS) development team, which includes Glufling and George Moore, Computer Scientist, M/AA. EIS is part of USAID 's Business Systems Modernization (BSM) initiative and is in the prototype phase. EIS and GIS are related because EIS is an initiative to organize USAID specific data so that it can be displayed in a GIS.

The first step in the development of EIS was the integration of the USAID accounting system in Washington with those of the missions. EIS is being built with commercially available, off-the-shelf tools, including a business intelligence tool called Cognos that will display a unified picture of accounting data. The development team plans on integrating other data sources into EIS including the accounting system, annual report database, budgeting system, and procurement system. The goal is to standardize data so that the various systems can be interoperable. Glufling added that EIS is not a data entry stem but a tool to bring together information in a "coherent and unified" way.

EIS is currently is its second pilot release, and a third prototype that will incorporate the annual report is scheduled for release later this summer. Glufling encouraged all interested USAID staff to visit the agency's intranet to learn more.

Question and Answer Session

Who is producing this software and what does it cost?
Stokes: There are a number of GIS software companies. The most well known in the commercial world is Environmental Systems Research Institute (ESRI). They have produced a number of software programs ranging from ArcView to today's latest and greatest package, ArcGIS. There is another software company called Intergraph, and they produce Geomedia. Geomedia and ArcGIS are very similar in their functionality. They are competitors in the market place and they both can do the same thing. There is another developer called MapInfo. The prices range depending on the functionality from around $500 to $2500. With this agency and where I think we want to go, I am trying to bring those prices down.

Given how difficult it is to operate these GIS programs even at the most basic level, how does USAID management actually access GIS?
Stokes: The data is key in all of this, and you cannot do good analysis if you do not have good data. Getting the data can be very time consuming. Now there is a user community that usually shares data, but it is not easy. There are communities of practice now that are internationally organizing to share information. At USAID there is currently no centralized place in Washington that makes maps. Individual missions may have this capability. In fact 10 to 15 USAID missions currently have a full-time staff person or a contract organization to maintain it for them. We are trying to get a handle on the individual needs of our missions and how can we assist them. The reality is that most AID staff will not be making the maps themselves. The mission that I mentioned earlier that has created a combined MIS/GIS has a full-time staff in place and has designed a system, where all of the staff and the public can log on to the web site and generate a few simple maps. I envision that we will probably do something similar for the whole agency since it is not feasible for everyone to get trained in how to use GIS.

How closely are you working with the research institutes around the world to get data and GIS products that have already been developed so you can reduce your own costs?
Stokes: In the last five years costs have come down greatly. There are many more GIS users today than there used to be for a couple of reasons. The software and hardware are less expensive, and most of the people who are the GIS technical people are ones who were trained at university. Now we have trained people all around the world, not just here but also in developing countries. Part of what I do in my position is to help build capacity of people in the countries where we work, and I also form partnerships with data and natural resource organizations. Working with satellite imagery is expensive to work with but these costs are also coming down. NASA is now making available a lot of the imagery that they have collected, and USGS [U.S. Geological Survey] also has something called

the EROS [Earth Resources Observation System] Data Center, where they process a lot of imagery and usually make it available at cost. We then pass along these images to our partners in the countries where we work. As a U.S. government agency, we are required by OMB [Office of Management and Budget] and the executive orders that are in place to reproduce and provide geospatial information at cost to those who ask us for it.

North: Concerning cooperation with research institutes, the base map that we used in El Salvador came from a coffee institute that we had actually helped set up their own GIS. We were then able to get their help and use their base map. With the help of USGS and the State Department's geographer, we were also able to help correct the coffee institute's original map.

You alluded to buying data [from the Russian government]. Was it even worth the $100 you paid for it? How are you checking to ensure that the data collected is valid, accurate, and not manipulated? How do we ensure that the information that will guide future decision-making around the world is valid?
North: In terms of the data from Russia, yes, you have to be skeptical about data and you have to understand what data you are getting. The database that we got was huge, and we were also aware that we would never use much of the data that it contained. There were only certain statistics that we thought would be useful and others that we didn't. So you have to look at the data and whether it is useful. However, on the other hand, you have to get data where you can find it.

What feedback are you getting at the moment from those missions that have adopted the use of GIS?
North: The missions I have worked with have found it to be a very powerful tool. I was out in Guinea in February, and they have a GIS that is very sophisticated and it has been a very useful tool.

Regarding GIS, are you finding any ways to push its adoption across the agency?
North: My supervisor made a point that he was going to invest in GIS because he anticipated that this was going to be the next PowerPoint. He said, "Everybody uses PowerPoint today, and soon everyone will use GIS." However, one of the things I have learned from doing GIS and database work in general is the necessity of asking the right question. You need to know your focus and the question that you are trying to answer before you start filling a massive database.
Stokes: One of the first things that I did in my new position was to get a sense of who is already using it in our agency, and I did a needs assessment. Following from that effort, I've organized a week-long training event focused on mission staff. From this I have learned who already has map making ability, who wants to start GIS yesterday, who already has an MIS and wants to "marry" it to a GIS, and everyday I learn more about people in this agency who have done things and are trying to reduce the costs to the agency as a whole while taking advantage of what we have already learned so far.

Maestri: At the Asia Near East Bureau, what we have found is a cultural resistance to change at first, which I think is natural. Once, however, the GIS/MIS applications began to prove their utility then there was what I call the "AHA!" What we found in specific countries is that after our implementing partners saw GIS's utility, they then began coming on board.

Could you address the issue of coordinating the data collection and data sharing with the missions and mission partners?
Stokes: We are working on this now, and the system that I have envisioned will hopefully reduce data duplication. Setting this up takes time since we have a huge, disparate, and decentralized organization, and if we can get a system that Lisa [Glufling] was talking about, then hopefully the information will be there, and it will be accessible. We are really looking forward to working with our partners, and we hope to make this ultimately easier for all parties. This is what I am trying to do, but I am not doing this alone. We have an incredible panel here that is also working on the various pieces of putting this together, and we really look forward to the input from all of you, whether you are a partner or an office within USAID.

Could you describe the ANE [Asia/Near East] pilot program? How many missions are involved, what are the results that you hope to achieve, and whether the pilot is designed in a way that has wider applications and potential for integration with systems beyond the region?
Maestri: We don't know yet how many countries will participate in the pilot. We will be going forward with a needs assessment survey. Concerning integration with other systems, yes, that is something

we are planning. A bureau that designs a MIS/GIS platform that operates in a vacuum is not going to be cost effective. To create a platform that is integrated with performance standards and works for IRM, PPC, EIS requires a huge coordinated effort. Our implementing partners and stake holders need to be considered in this. Training will be a huge challenge. Another challenge will be knowledge culture and change management. People do not like change and do not usually adapt to it well. So it will be our job to provide incentives to do that and to lead by example.

North: I wanted to add that part of the cultural issues or resistance that one faces some of the times in this agency is the bad experiences that we have had with MIS and the systems that failed. People who get burned like that have a fear of coming back to it. Concerning regional platforms for pursuing GIS, when I was in El Salvador with USAID we knew that the regional office in Ivory Coast had a great database. It was huge and so forth, but the regional office couldn't keep it up and so it collapsed. The challenge is keeping a database manageable.

GEOGRAPHIC INFORMATION SYSTEMS:

Improving Management, Getting Results, and Communicating the U.S. Foreign Assistance Story

Carrie Stokes

EGAT/NRM Office

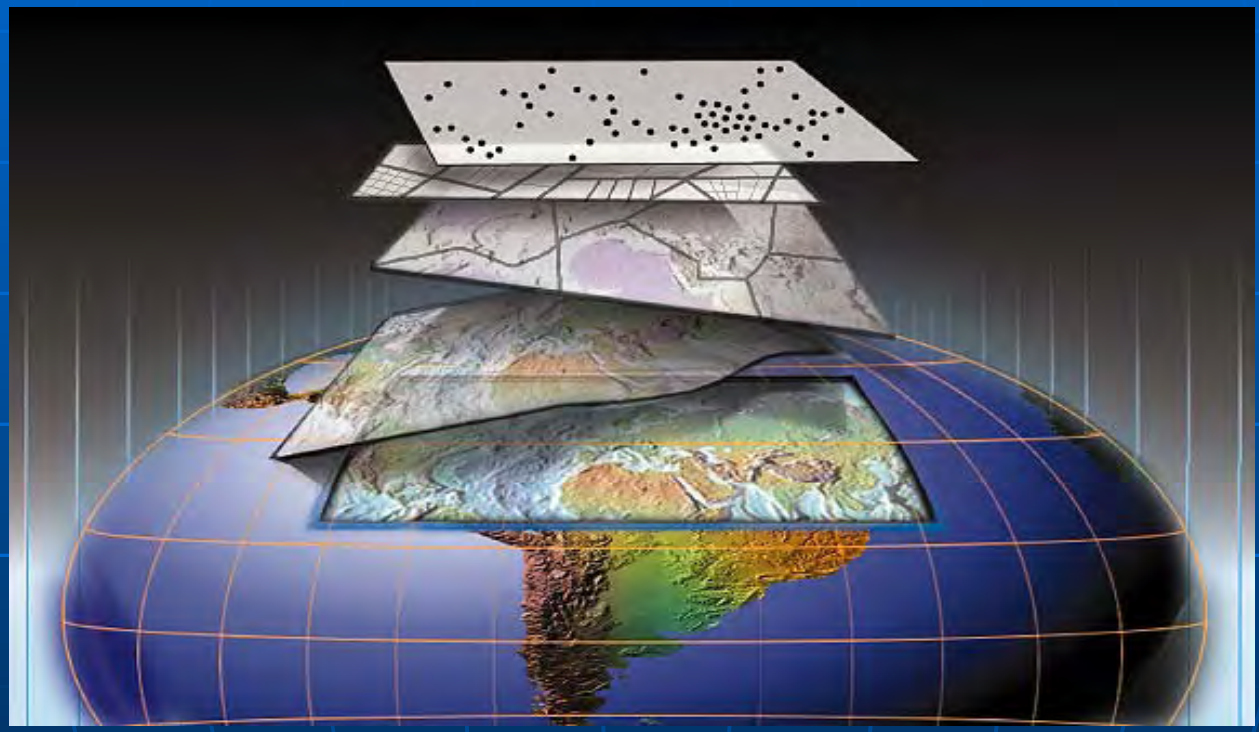
July 12, 2005

USAID
FROM THE AMERICAN PEOPLE

Geospatial Information Technology includes tools to collect, organize, analyze and display spatially related information:

- Remotely sensed data (satellite / aerial imagery)
- Global Positioning Systems
- Paper maps
- Statistical data
- Geographic feature data (roads, rivers, etc)
- Geographic Information Systems (GIS)

A Geographic Information System (GIS) is a computerized, decision-support system that includes software, hardware, people, and geographic information



It can create, query, analyze, and display data "layers" such as land cover, elevation, climate zones, forests, political boundaries, population density, per capita income, etc.

Measuring & Integrating the Parts …

Population Data

Socio-economic Data

Agriculture

Soils

Land Cover
Political Boundaries

. . . Means Seeing the Whole

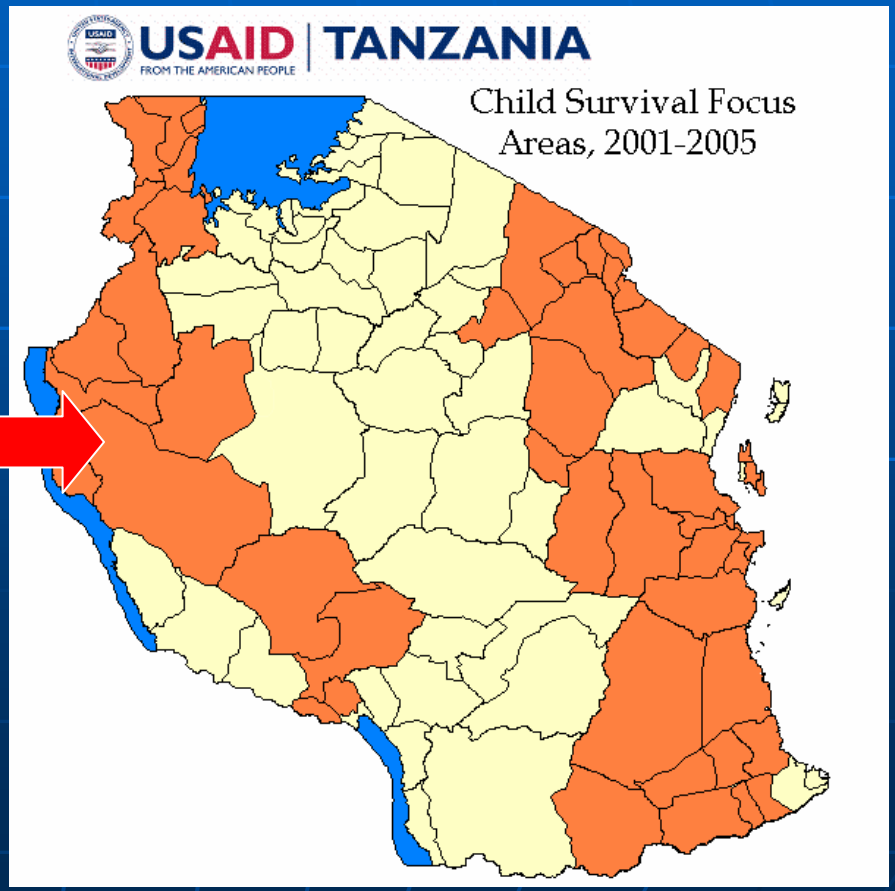
The Simple Definition of a GIS is:

It's a map with a database underneath,
or
It's a database that you can display on a map.

It can be used to visualize different kinds of information, conduct spatial analysis, and manage information

Maps Can be Linked to Statistical Information in a Database

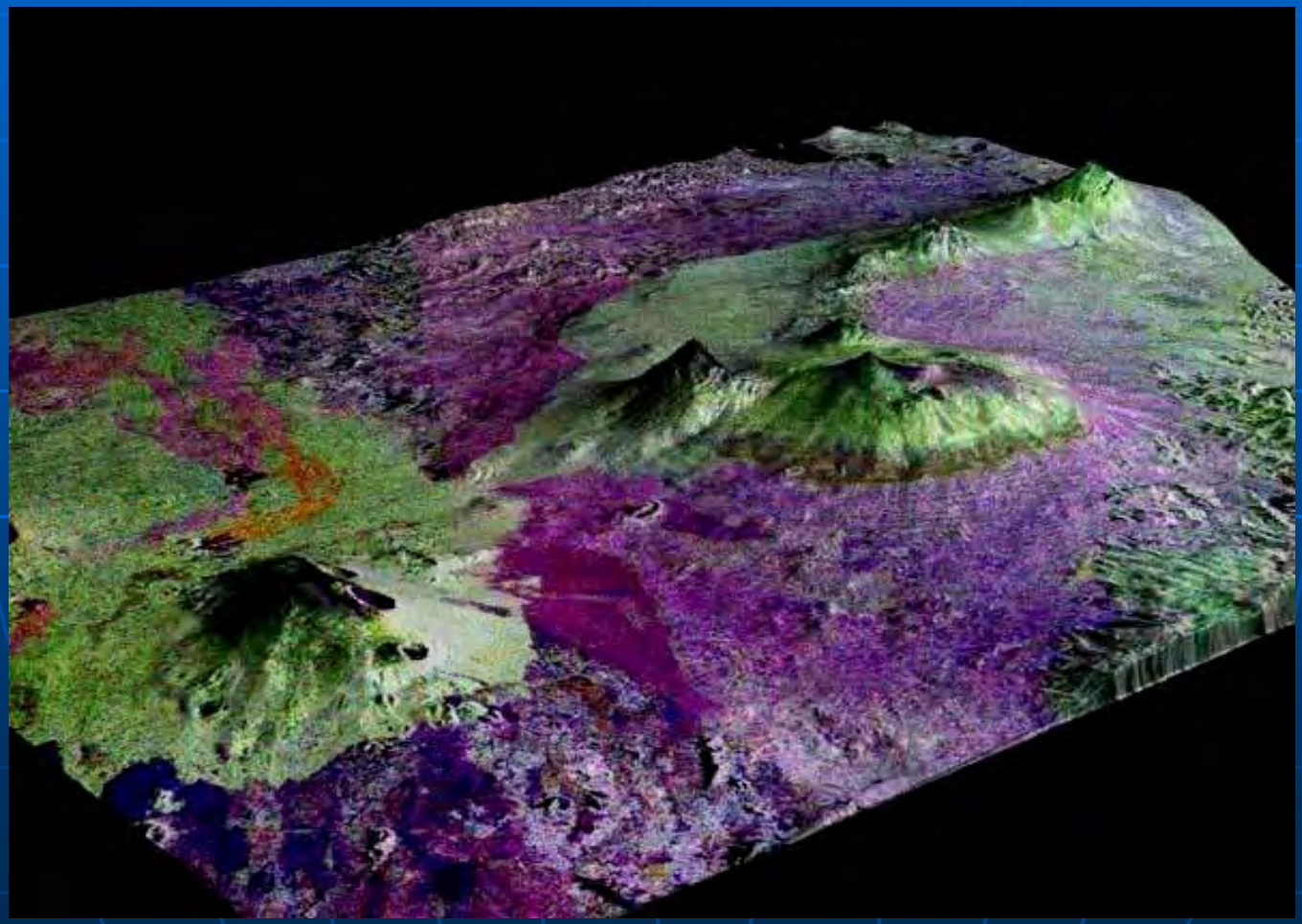
	District	Region		District	Region
☐	*Regional coverage*	*Arusha Region*	☐	*Regional coverage*	*Kilimanjaro*
☐	Arumeru	Arusha	☐	Hai	Kilimanjaro
☐	Arusha Urban *(Municipality)*	Arusha	☐	Moshi Rural	Kilimanjaro
☐	Babati	Arusha	☐	Moshi Urban	Kilimanjaro
☐	Hanang-Katesh	Arusha	☐	Mwanga	Kilimanjaro
☐	Karatu	Arusha	☐	Rombo	Kilimanjaro
☐	Kiteto	Arusha	☐	Same	Kilimanjaro
☐	Mbulu	Arusha	☐	*Regional coverage*	*Lindi Region*
☐	Monduli	Arusha	☐	Kilwa Masoko	Lindi
☐	Ngorongoro	Arusha	☐	Lindi Rural	Lindi
☐	Simanjiro	Arusha	☐	Lindi Urban *(Town Council)*	Lindi
☐	Ilala *(Municipality)*	Dar es Salaam	☐	Liwale	Lindi
☐	Kinondoni *(Municipality)*	Dar es Salaam	☐	Nachingwea	Lindi
☐	Temeke *(Municipality)*	Dar es Salaam	☐	Ruangwa	Lindi
☐	*Regional coverage*	*Dodoma Region*	☐	*Regional coverage*	*Mara Region*
☐	Dodoma Rural	Dodoma	☐	Bunda	Mara
☐	Dodoma Urban *(Municipality)*	Dodoma	☐	Musoma Rural	Mara
☐	Kondoa	Dodoma	☐	Musoma Urban *(Town Council)*	Mara
☐	Kongwa	Dodoma	☐	Serengeti	Mara
☐	Mpwapwa	Dodoma	☐	Tarime	Mara
☐	*Regional coverage*	*Iringa Region*	☐	*Regional coverage*	*Mbeya Region*
☐	Iringa	Iringa	☐	Chunya	Mbeya
☐	Iringa Urban	Iringa	☐	Ileje	Mbeya



The Database Can Include Ground Activity Information and Aerial Imagery

Microenterprise Activities				
Date	City	District	# trained	# of which women
2/14/2005	Bagamoyo	Bagamoyo	323	121
3/1/2005	Giyankula	Chunya	119	50
3/4/2005	Mbeya	Mbeya	213	77

Imagery Can Be Draped Over Elevation Models for 3-Dimensional Viewing of the Terrain

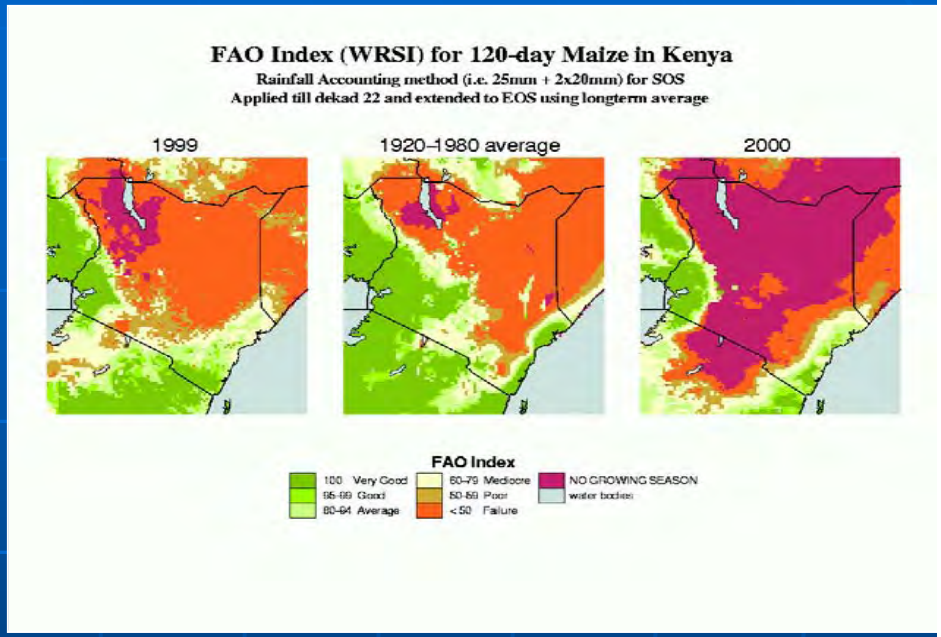


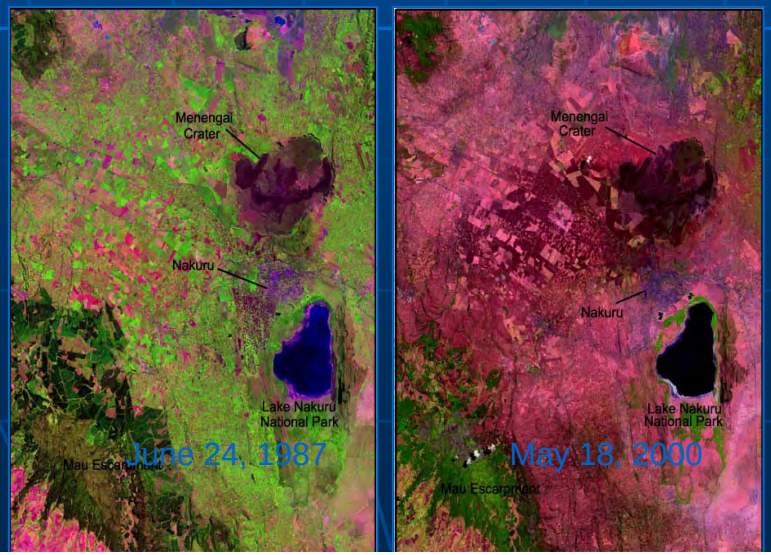
In Terms of Spatial Analysis, a GIS Can Determine for Each Village:

- Distance to the nearest market town
- Average rainfall within a 20km radius
- Demographic indicators
- Village level estimates of income poverty

Famine Early Warning System

***Water Requirement Satisfaction Index*: Forecasts the potential crop yield based on the availability of water supply and crop demand throughout the growing season using rainfall, evapotranspiration, soil type, crop specific information.**





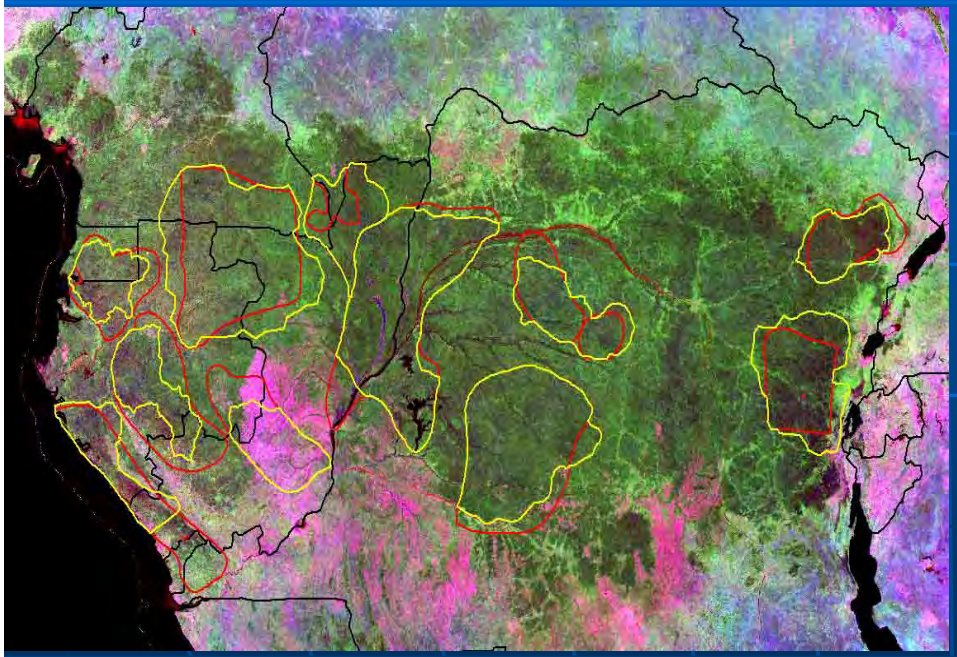
USGS

National Mapping Division EROS Data Center

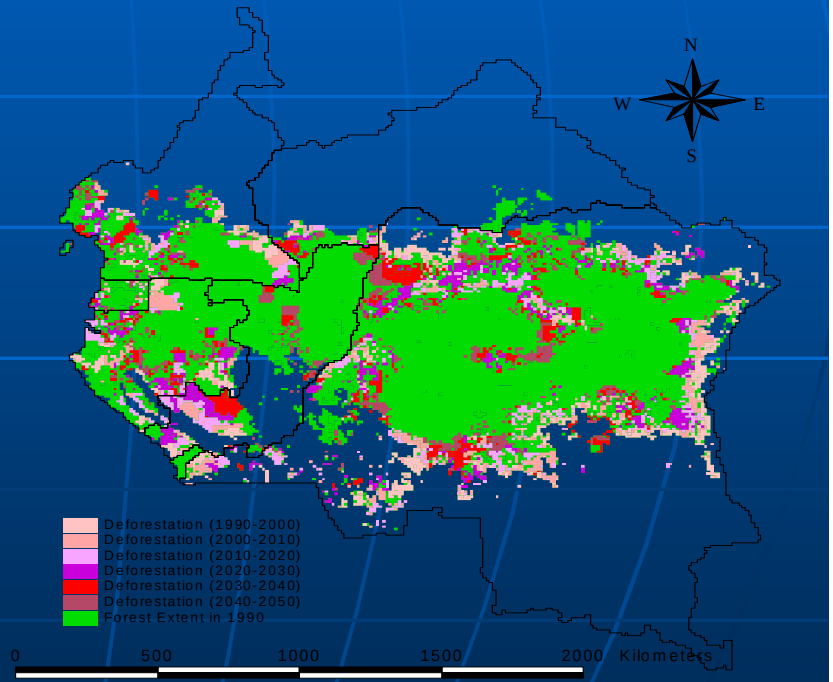
Landsat images (30 m res) show ag. conditions in Kenya during a year of good rains (left) with those of the drought of 2000 (right). Light green portrays healthy crops, dark green parcels are tea. Pink tones are associated with bare soil.

Forest Management and Conservation

Identifying Protected Areas and Logging Concessions



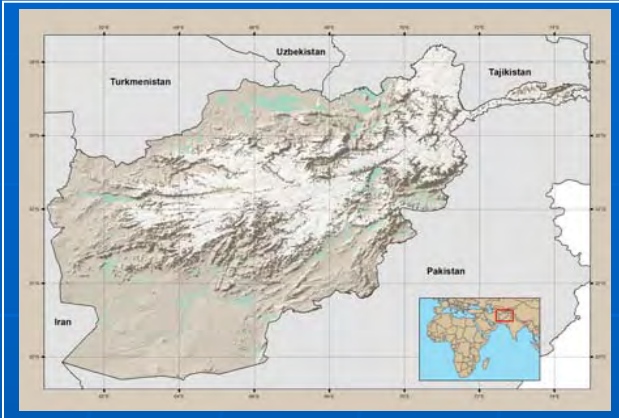
Assessing Deforestation Trends



NASA

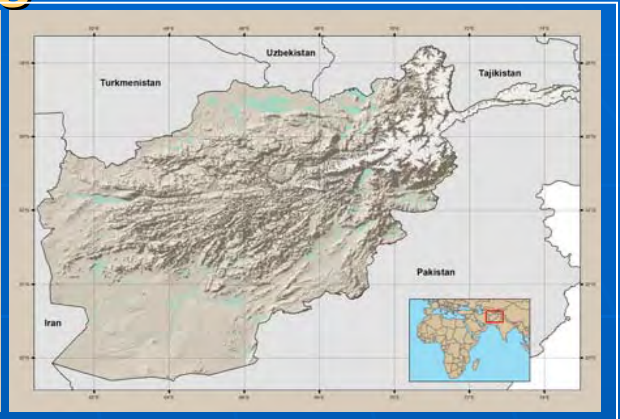
CARPE

Monitoring Snow Cover in Afghanistan



February 10 - 17 2003

April 07 -14 2003



May 25 – 01 June 2003

Source:

MODIS 8-day Snow Cover Extent provided by the National Snow and Ice Data Center (NSIDC)
Major irrigation areas derived from the 1993 Agricultural Land Cover provided by FAO, UNDP, and the Afghan Geodesy and Cartography Office.

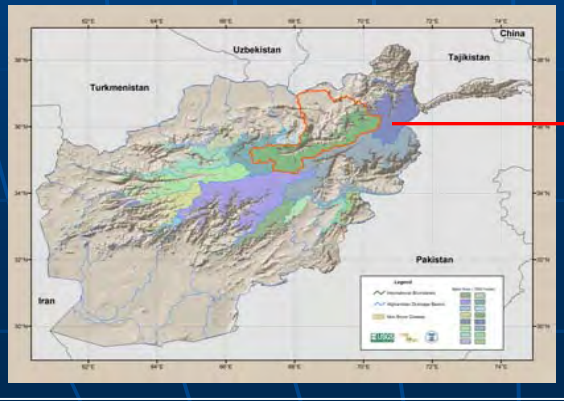
Maps produced by USGS/EROS Data Center

MODIS 8-day Snow Cover Extent

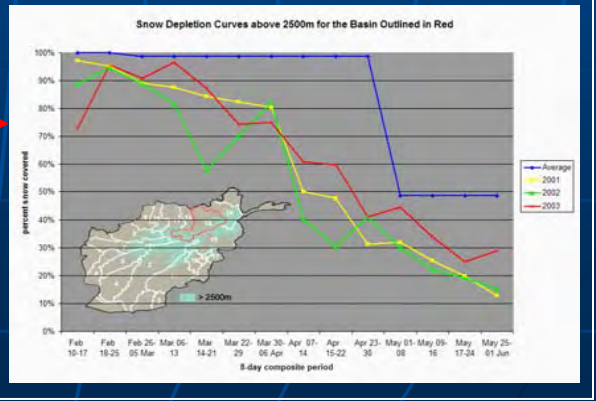
Major Irrigation Areas

Using MODIS 8-day snow cover extent products from the National Snow and Ice Data Center (NSIDC), USGS/SAIC International Program scientists were able to monitor snow cover depletion for Afghanistan in support of Famine Early Warning System Network (FEWS NET) activities in the region. Approximately 80% of Afghanistan's annual wheat crop is dependent on irrigation, much of which is supplied through snowmelt. Using a basin delineation derived from the USGS HYDRO 1K Global Topographic Database, this analysis concentrated on watersheds upstream of important irrigation areas. An elevation threshold of 2500 meters was applied to identify areas, within each basin, where historical average snow extent is approximately 100 percent in March. Monthly averages (1966 – 2001) of snow cover extent were taken from the NSIDC historical snow cover database at 25-kilometer resolution. The NASA MODIS 8-day snow cover extent product, at 500-meter resolution, was used to track incremental changes in snow cover extent throughout the snowmelt season.

Basin areas above 2500 meters



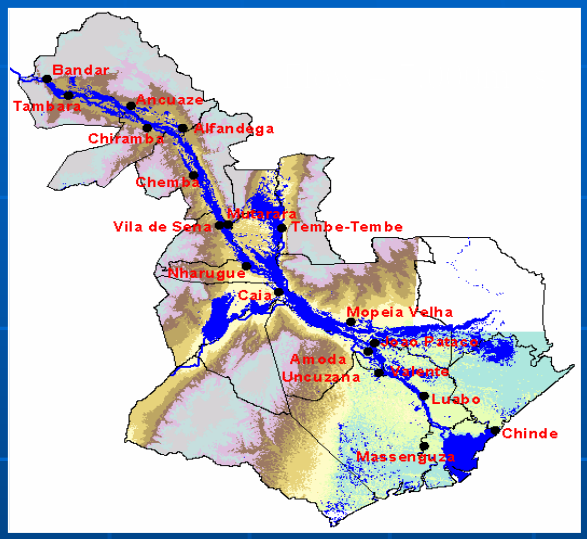
Seasonal Snow Depletion

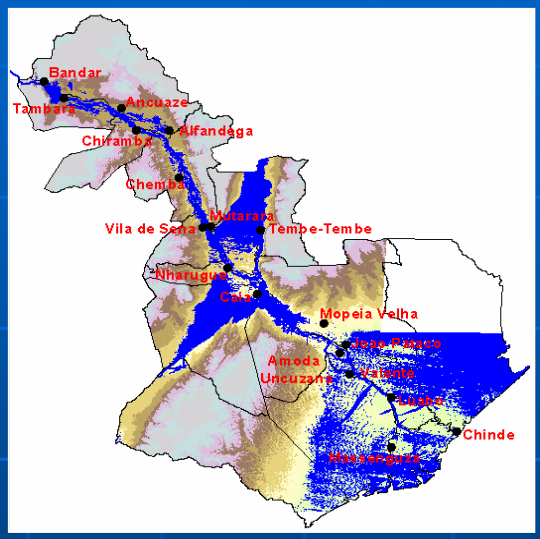


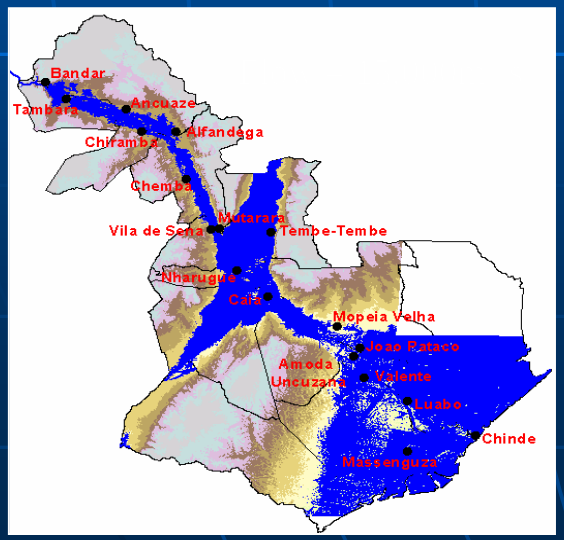
USGS science for a changing world

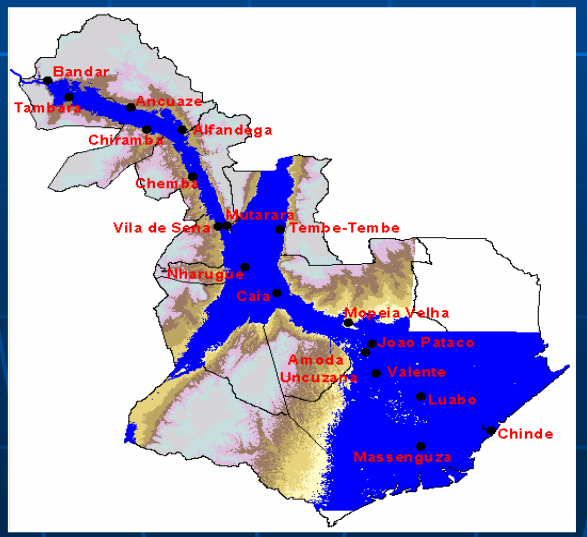
FEWS NET

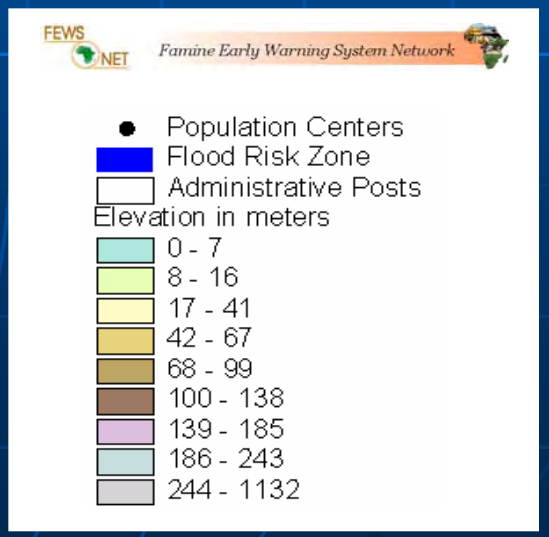
Modeling the Effects of a Dam Release









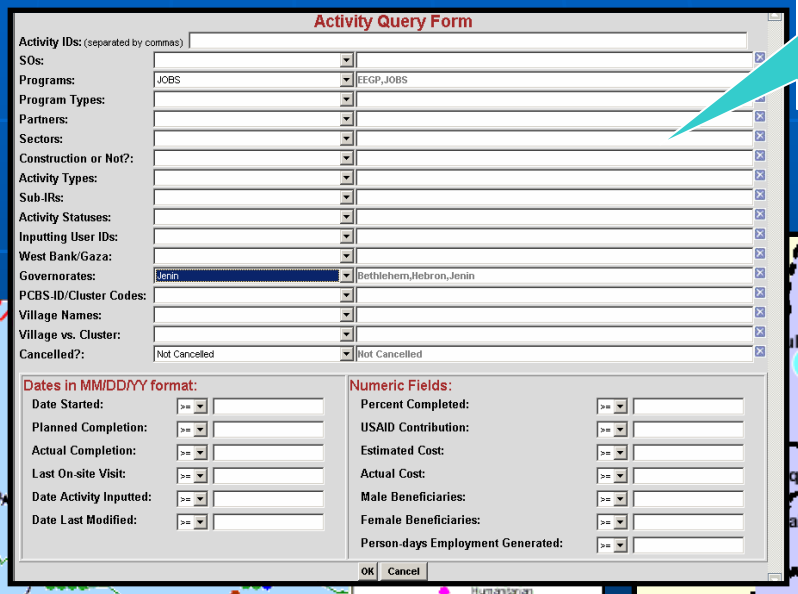


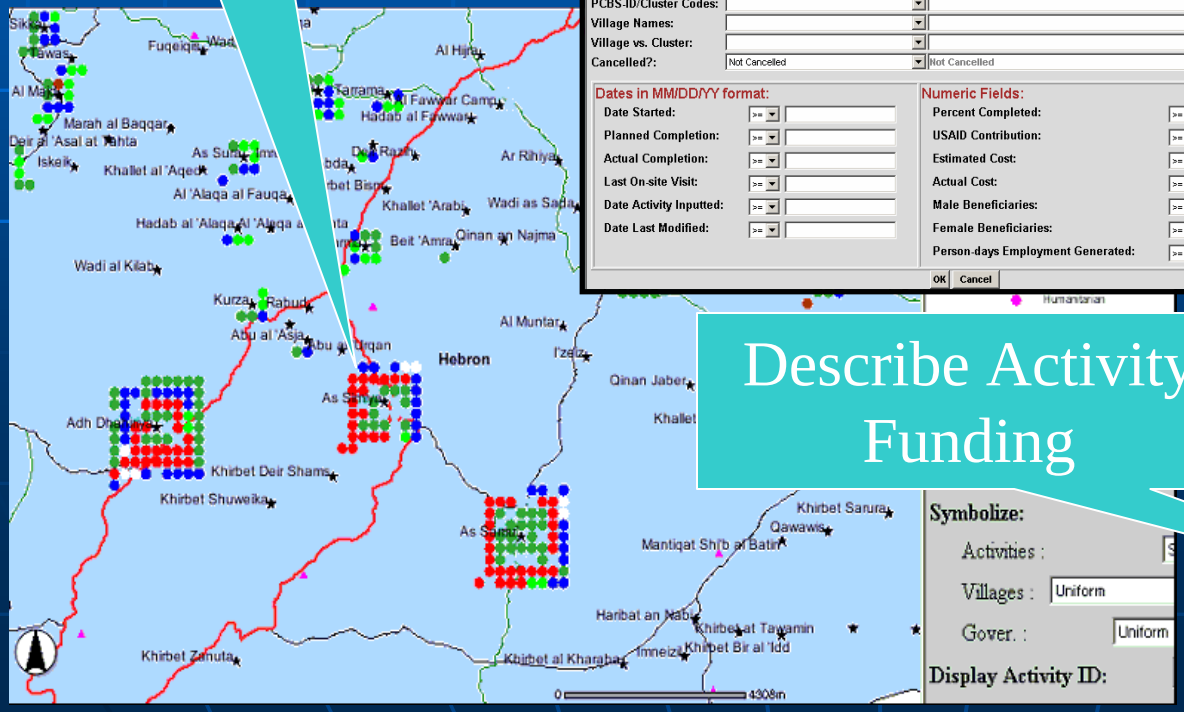
Using GIS as a Management and Communication Tool for USAID

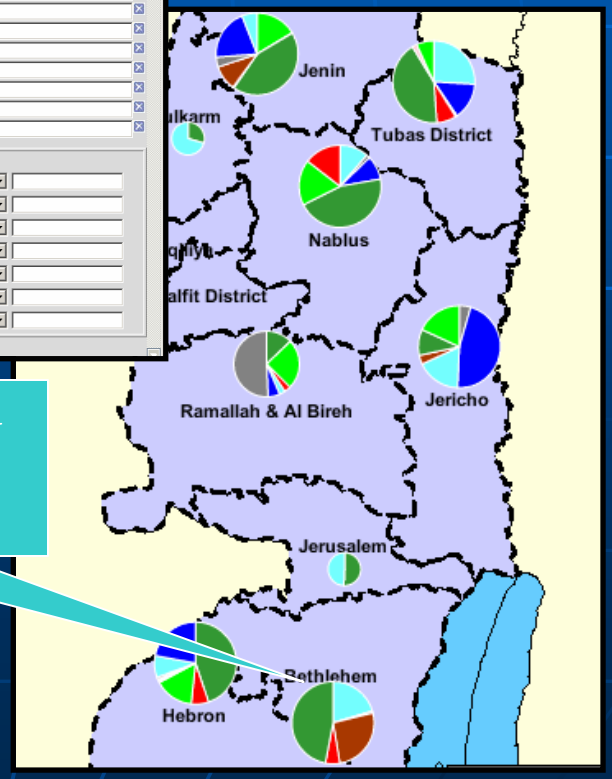
Data Query

Locate Activities

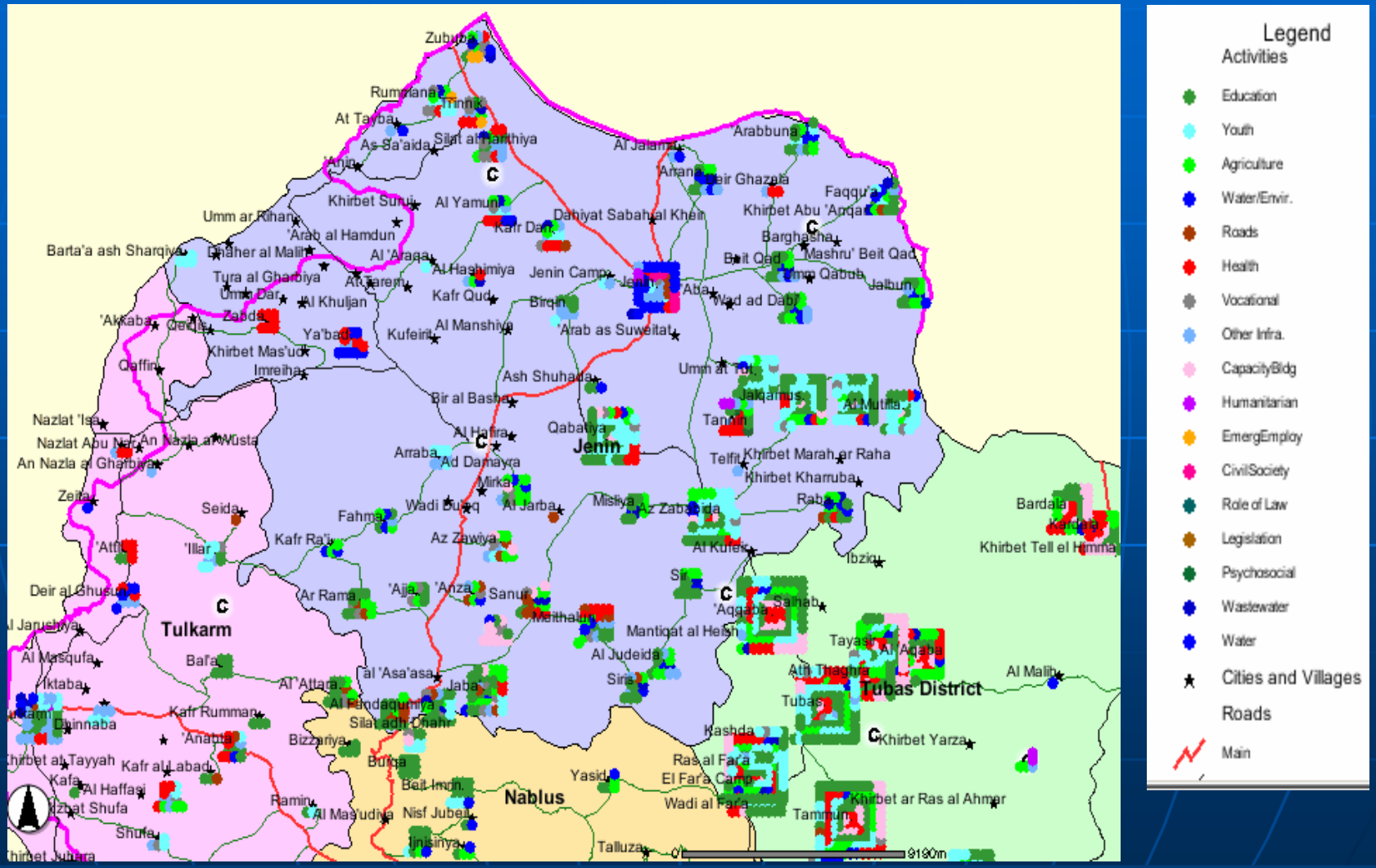
Describe Activity Funding







Track Ongoing Activities



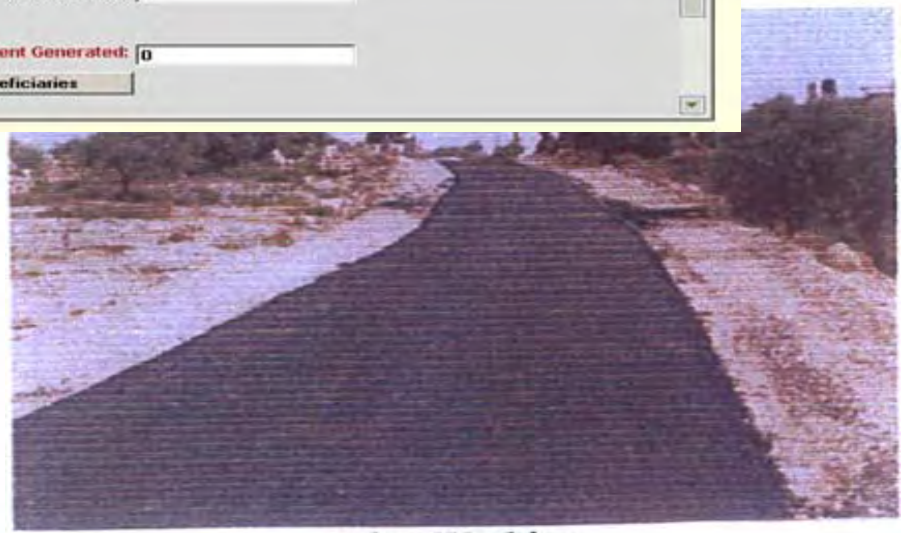
Review Activity Status: Road Building Project

Act. Details - Microsoft Internet Explorer provided by USAID

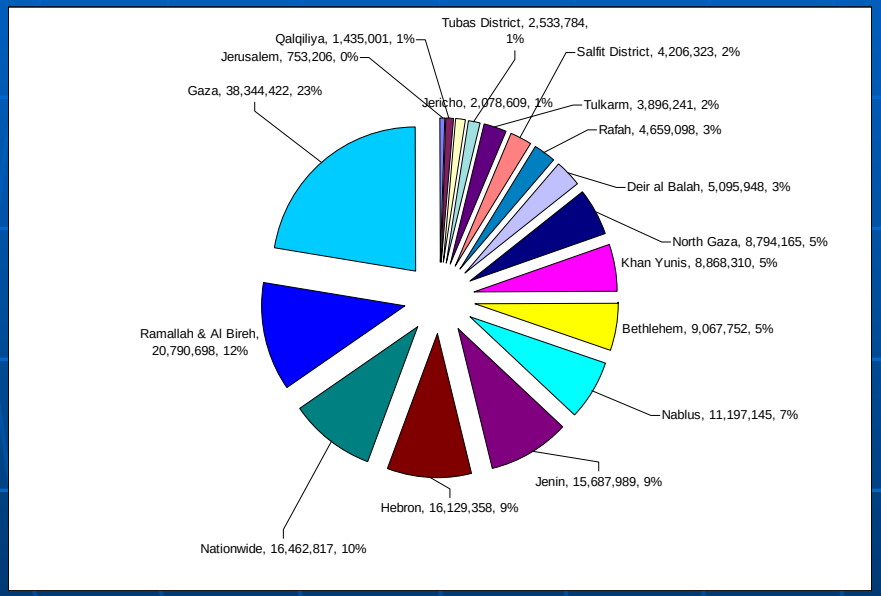
Update Activity

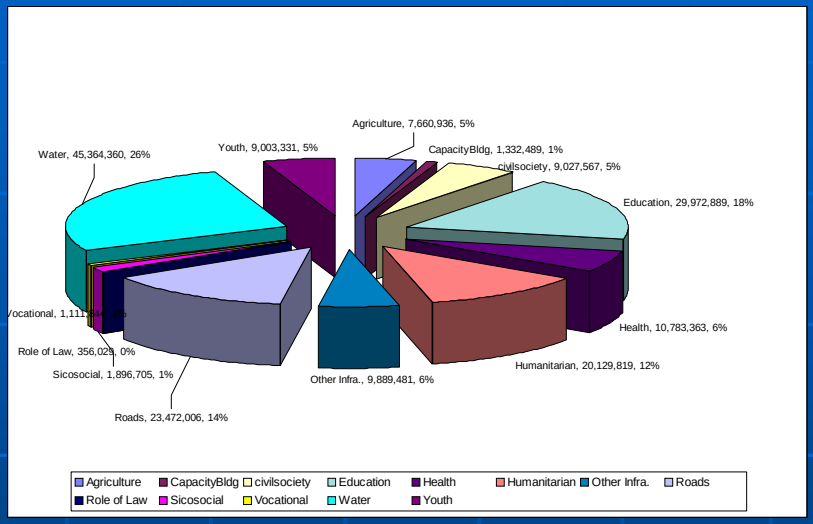
		Activity ID:	4824
SO:	SO2	Partner:	MUNI
PCBS ID or Cluster Code:	151090	Village Name or Cluster Name:	Beit Furik
Program:	Cash_T1		
AT Code:	SO8-A051	Sector Code:	Roads
Activity Type Description:	Construction / improvement of interior and connecting roads (other than agricultural)		
Activity Description:	Rehabilitation & paving of internal roads		
Activity Status:	On Time	Percent Completed:	80 %
Estimated Cost:	200000	USAID Contribution:	200000
Actual Cost:	0		
Start Date:	09/12/2003 set clear	Planned Completion Date:	12/31/2003 set clear
Last On-site visit:		Actual Completion Date:	set clear
Comments:			
Specific UM#1:	No. of Linear meters of interior and connecting roads constructed		
UM#1 Planned Qty:	8000	UM#1 Actual Qty:	0
Specific UM#2:	No. of square meters of side walks		
UM#2 Planned Qty:	0	UM#2 Actual Qty:	0
Specific UM#3:	No. of linear meters of retaining walls, fences, and terraces		
UM#3 Planned Qty:	0	UM#3 Actual Qty:	0
Male Beneficiaries:	0	Person-days Employment Generated:	0
Female Beneficiaries:	0	Interpreting Beneficiaries	

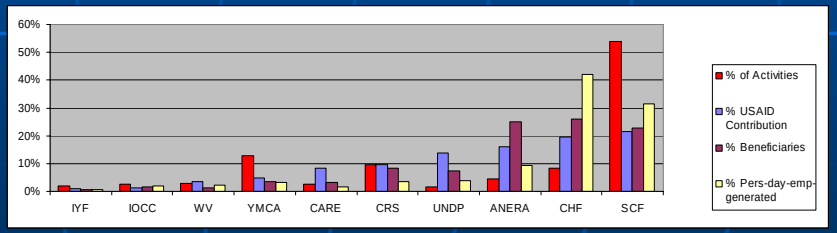
Before Working



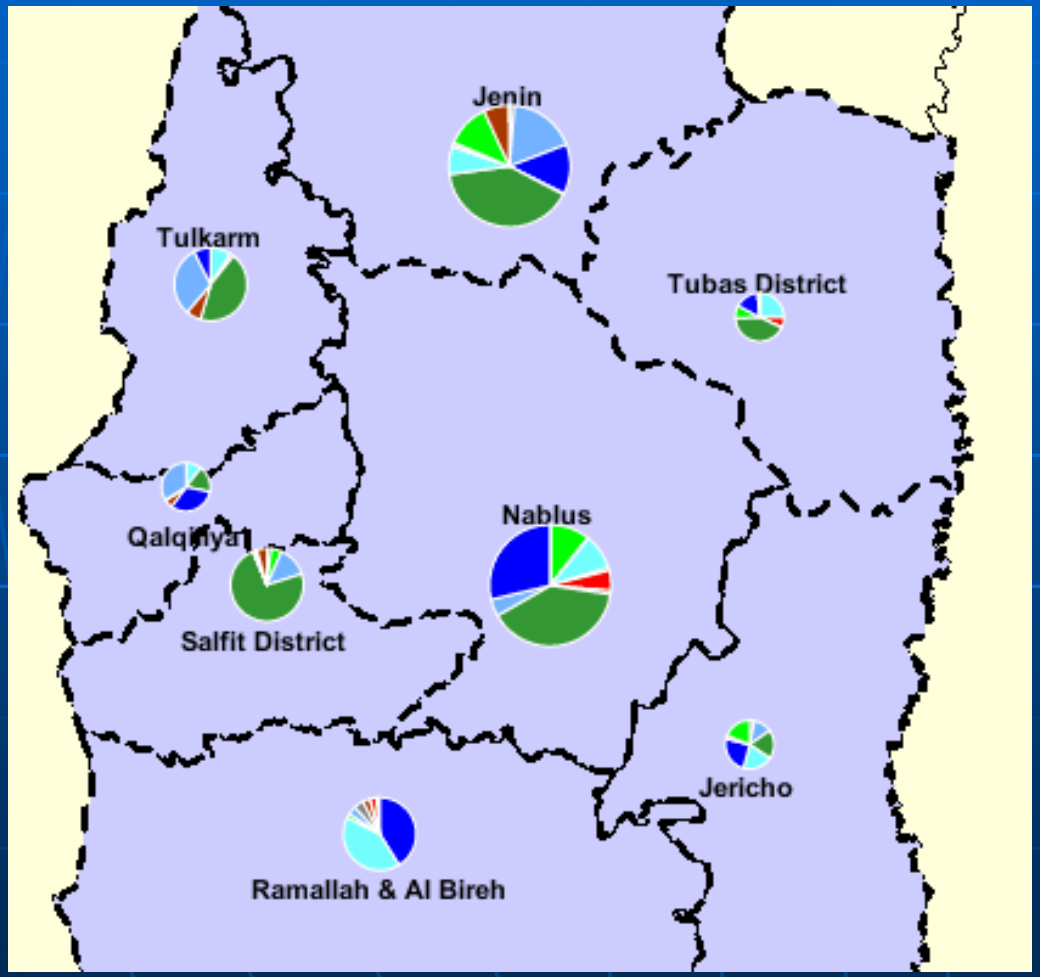
Measure Output Results



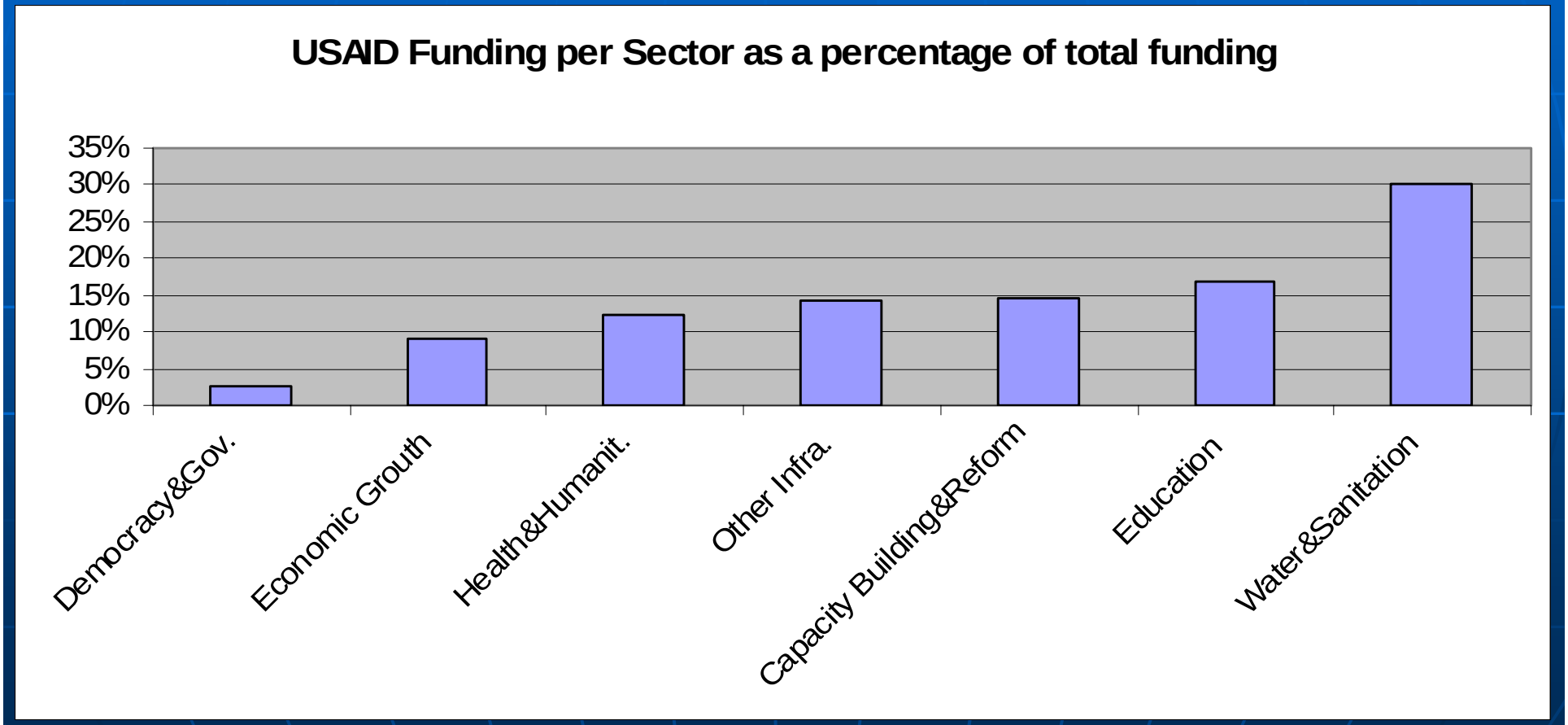




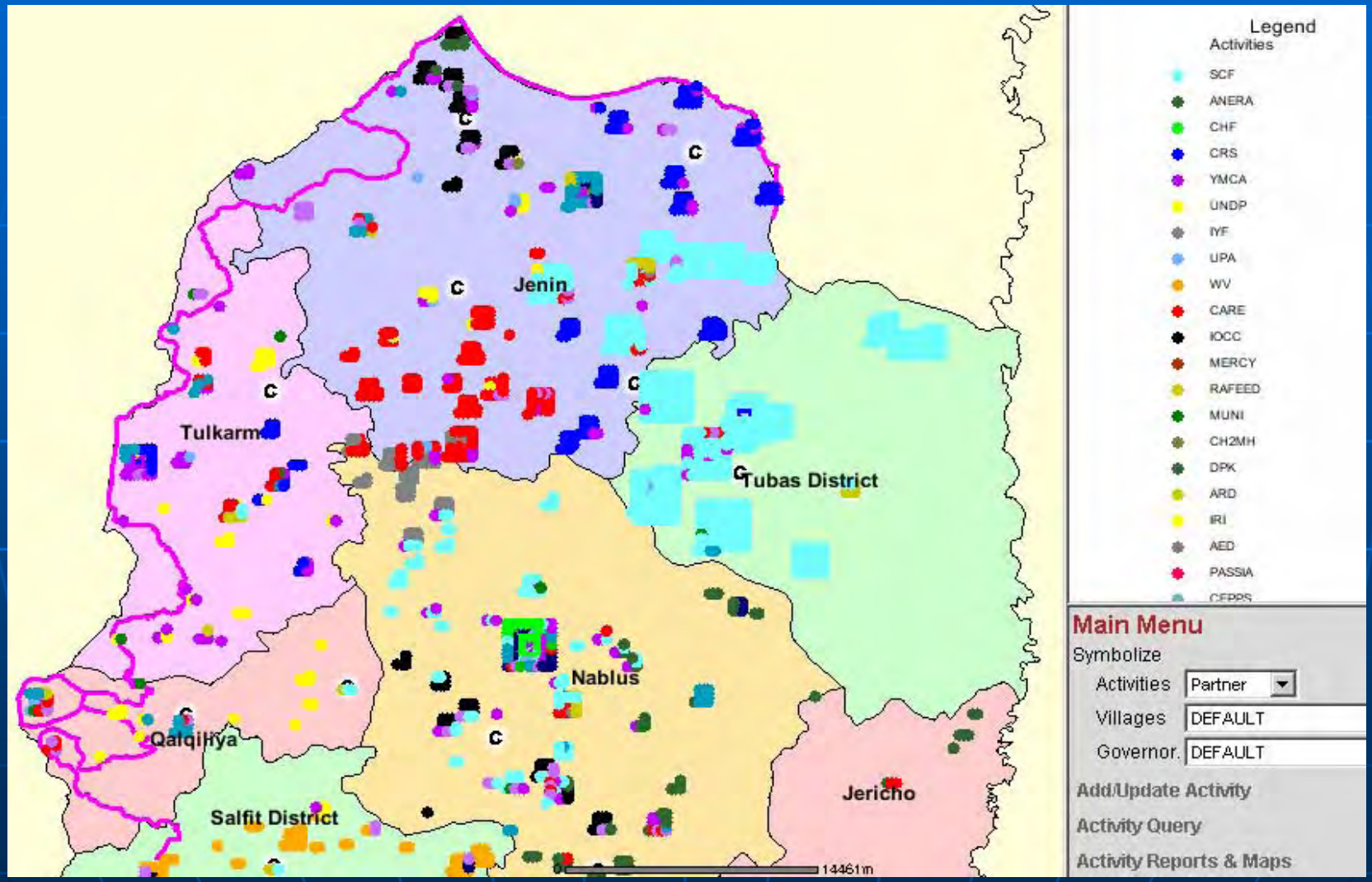
Proportionate Funding by Sector and Region



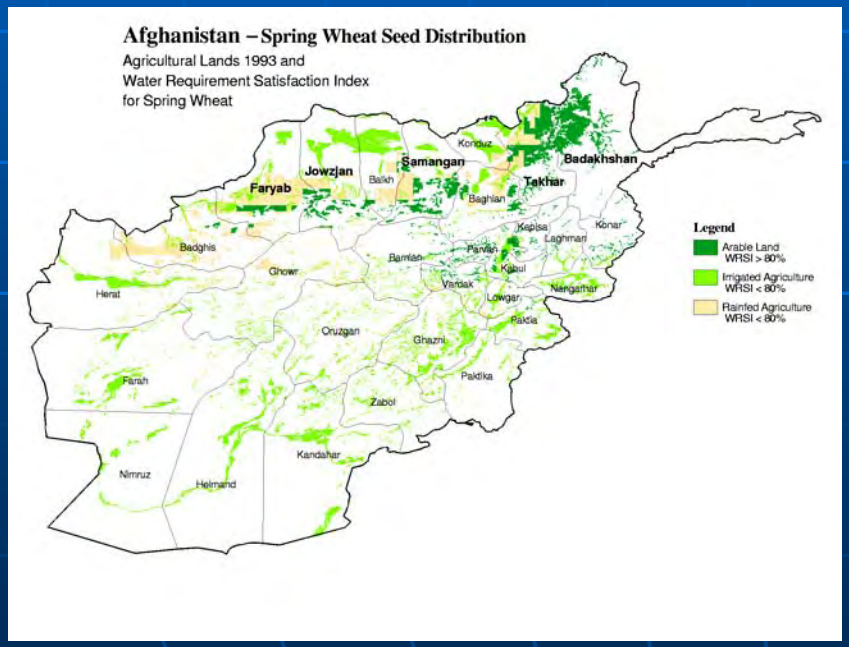
Generate Summary Reports

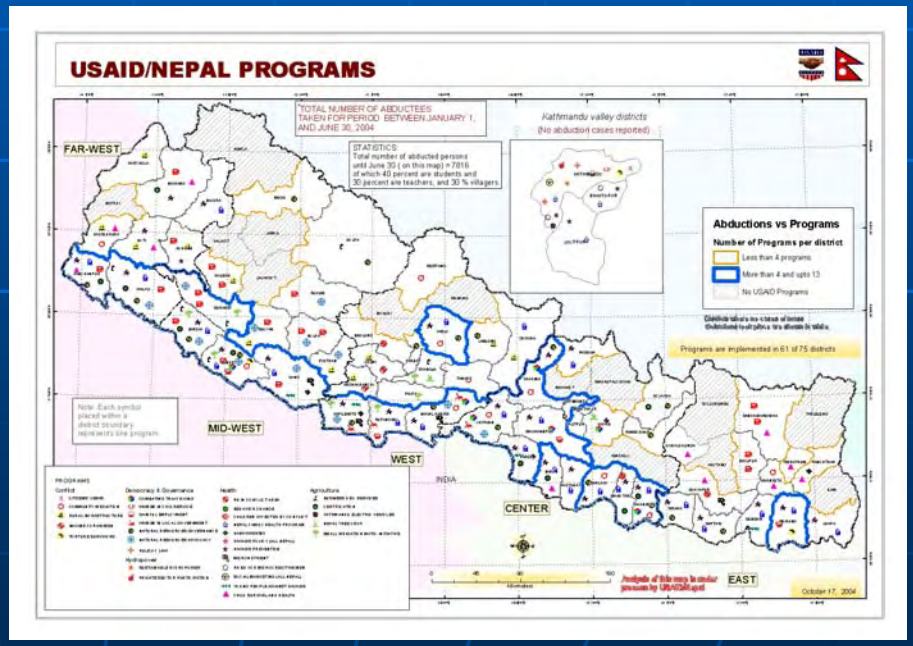


Show Distribution of Partners



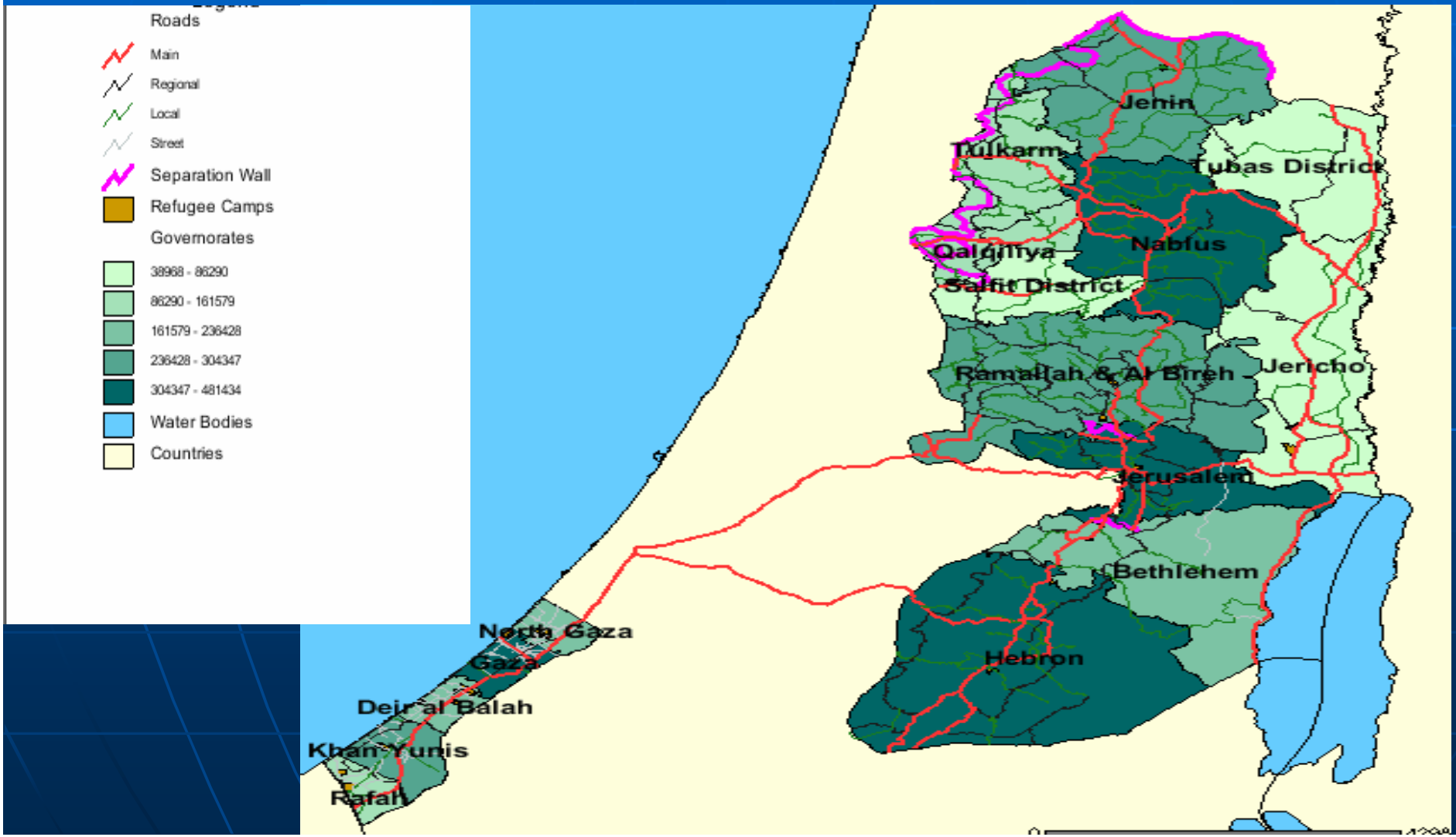
Summarize Programs





Strategically Plan: Use Demographic and Infrastructure Information to Determine Where to Put New Projects

Population Density per Governorate



Additional Uses of GIS for Development

Ivory Coast

- **Tax assessment and collection in Abidjan boroughs by combining geo-information on land, population, & economic activity**

- **Placement of new village health care centers based on population locations**

- **Improved allocation of revenues to local jurisdictions with more precise info of size and boundaries of nearby forest concessions**

GIS Use for Development

Mozambique

Determines spatial distribution of land mines for removal and safe passage

Senegal

Census data and village location data monitors progress of national poverty alleviation program

Gambia

Land use data combined with human settlement info to determine waste disposal facility sites

South Africa

Data on population centers, rivers, roads, mountain ranges combined to delineate boundaries of electoral wards for 1999 elections

Geospatial Information Technology allows us to integrate different sources of information to better understand our world and show us how interconnected we really are...