FINAL REPORT

INTEGRATING GIS INTO eHEALTH INITIATIVES IN AFRICA

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1.0 GLOSSARY and KEY WEBSITES

AARSE	African Association for Remote Sensing of the Environment (http://www.itc.nl/aarse/)
Acacia Program	Information and Communications Technologies for Africa (http://www.idrc.ca/acacia/)
AfricaGIS 2009	Annual Meeting in Kampala October 25-30, 2009 (http://www.africagis2009.org/)
Africa OSGEO network	Subgroup of OSGeo (http://wiki.osgeo.org/wiki/Africa)
AGIRN	African Geospatial Information Research Network (http://www.agirn.org/)
Arc2earth	Tool for converting from ArcGIS to KML/Google Earth (http://www.arc2earth.com/)
ARCOS network	Albertine Rift Conservation Society Network (http://www.arcosnetwork.org/)
CDTs	Community Development Trainers – volunteers in P.E.A.C.E. Program, Saddleback Church in Karongi Rwanda
CGIAR-CSI	Consultative Group on International Agricultural Research, Consortium for Spatial Information (http://csi.cgiar.org/)
CGIS-NUR	Centre for Geographic Information Science, Training and Research, National University of Rwanda (http://www.cgisnur.org/)
CHW	Community Health Worker
CommCARE	Mobile-phone based application that will enable CHWs to provide better, more efficient care (http://www.dimagi.com/content/commcare.html)
COTS	Commercial-Off-the-Shelf-Software
DFGFI	Dian Fossey Gorilla Fund International (http://www.gorillafund.org/)
DFGFI/EH	Ecosystem Health Program (http://www.gorillafund.org/people/ecosystem_health.php)
Dimagi	See CommCARE
D-Tree	See CommCARE
DWP grant	Department of Water and Power, Los Angeles grant to University of Redlands and partnering with CGIS-NUR, LLUSPH, etc.(see)
EBM Tools Network	Ecosystem-Based Management Tools Network (http://www.ebmtools.org/)
EIS-Africa	Environmental Information Systems Africa (http://www.eis-africa.org/EIS-Africa)
EMR	Electronic Medical Record
NRM	Natural Resource Management
ENVI	ENVI software is a spectral image processing and image analysis software (http://www.ittvis.com/ProductServices/ENVI.aspx)
ERDAS Imagine	Image processing and image analysis software from LeicaGeosystems (http://www.erdas.com/Products/ERDASProductInformation/tabid/84/currentid/1050/default.aspx)
ESRI	Environmental Systems Research Institute (http://www.esri.com/)
EU	European Union
FAO-GLTC	Global Land Cover Network - LCCS – Land Cover Classification System (http://www.glcn.org/index_en.jsp)
FOSS	Free and Open-Source Software
GBIF	Global Biodiversity Information Facility (http://www.gbif.org/)
GECHH	Global Environmental Change and Human Health (http://www.ihdp.unu.edu/article/GECHH?menu=49)
Geo-IT	Geospatial Information Technology)
GDAL	Geospatial Data Abstraction Library (http://www.gdal.org/)
Geonetwork	FAO OpenSource site (http://geonetwork-opensource.org/)
GeoPDF Publisher	Toolbar to geo-enable PDF publishing (http://www.terragotech.com/solutions.php)
GeoServer	Open source software server written in Java that allows users to share and edit geospatial data. (http://geoserver.org/)
GIS	Geographic Information System (http://www.gis.com/whatisgis/)
GISc	Geographic Information Science or geospatial science
GloVis	USGS Global Visualization Viewer to access satellite imagery (http://glovis.usgs.gov/
GLCF	Global Land Cover Facility, University of Maryland (http://www.landcover.org/index.shtml)
GML	Geographic Markup Language (http://www.iso.org/iso/search.htm?qt=GML+Geographic+Markup+Language&searchSubmit=Search&sort=rel&type=simple&published=on)
GoogleDocs	Web-based *documents*, spreadsheets, and presentations (http://www.google.com/) go to "Google Documents"
Google Earth API	*Google Earth API* is a free service, available for any web site that is free to consumers. Please see the terms of use for more information (http://code.google.com/apis/earth/)
Google Fusion Tables	New tools to link tables to Google Maps and Google Earth, Map Maker etc (http://tables.googlelabs.com/)
GoogleMapMaker	Tool for online map making (go HERE)

Google SketchUp Pro	SketchUp *Pro*, LayOut and Style Builder (http://sketchup.google.com/)
GPS	Global Positioning System - The Global Positioning System (*GPS*) is a navigation and precise-positioning tool. Developed by the Department of Defense in 1973… (http://scign.jpl.nasa.gov/learn/gps1.htm)
GRASS GIS	Geographic Resources Analysis Support System**;** *the official GRASS site in UNITED STATES (US)* (grass.osgeo.org/) *(mirror sites)*
GSDI	Global Spatial Data Infrastructure Association (http://www.gsdi.org/)
gvSIG	A desktop GIS replacement from Spain (www.gvsig.gva.es)
HealthyGIS	ESRI-published Newsletter for Health Sector and GIS (http://www.esri.com/library/newsletters/healthygis/healthygis-summer09.pdf)
HL7	Global authority on standards for interoperability of health information technology (http://www.hl7connection.com/) and (http://www.hl7.org/)
ICT4D	Information and Communications Technologies for Development
ICT4D Atlas	(http://www.geog.mcgill.ca/atlas/welcome.php)
IDRC	International Development Research Center (http://www.idrc.ca/)
IDRC/GI-Wiki	Workspace for GIS workshops held by IDRC/Acacia Program in Africa (wiki (http://idrc-gisworkshop.pbworks.com/)
IDRISI/Clark Labs	Clark University, Geography Department, Software for Geospatial Analysis (http://www.clarklabs.org/)
IIH	Innovations in International Health (http://iih.mit.edu/innovation.htm)
IRD	Interactive Research and Development, Karachi, Pakistan (http://www.youtube.com/user/IRDResearch)
ISO	International Organization for Standardization (http://www.iso.org/iso/home.htm)
ISO/TC-211	Geographical Information/Geomatics Technical ISO Committee (http://www.isotc211.org/)
ITC	International Institute for Geo-Information Science and Earth Observation (http://www.itc.nl/)
JavaROSA	See also OpenROSA a member of the Open Mobile Consortium. JavaROSA has been designed for a wide and ever increasing variety of applications (http://www.open-mobile.org/technologies/javarosa-open-rosa-consortium)
Kml2shp	Transformation of Google Earth KML files to ESRI Shapefiles (http://www.zonums.com/kml2shp.html)
KRC	Karisoke Research Center (http://www.gorillafund.org/karisoke/research_center.php)
LCCS	Land Cover Classification System – tool from FAO – see also GeoVIS and other software (http://www.glcn.org/sof_0_en.jsp)
LLUSPH	Loma Linda University School of Public Health, Health Geoinformatics Program (http://www.llu.edu/public-health/geoinformatics/index.page)
MapServer 5.4.2	MapServer is an Open Source platform for publishing spatial data and interactive mapping applications to the web (http://mapserver.org/)
MDGs	Millennium Development Goals (http://www.un.org/millenniumgoals/)
MOH/Rwanda	Ministry of Health, Rwanda
MOU	Memorandum of Understanding
MVP	Millennium Village Project (http://www.unmillenniumproject.org/mv/index.htm and http://www.millenniumpromise.org/site/PageServer?pagename=home and http://www.undp.org.rw/MDGs12.html)
NASA-SERVIR	(http://www.servir.net/)African node of SERVIR
NASA World Wind	WCS compliant Earth Browser (http://worldwind.arc.nasa.gov/)
NGO	Non-governmental Organization
NRM	Natural Resource management
OASIS	*Open Architecture Standards and Information Systems (OASIS) II - Developing Capacity, Sharing Knowledge and Good Principles Across eHealth Projects in Africa* (http://www.idrc.ca/en/ev-116782-201-1-DO_TOPIC.html)
ODK	Open Data Kit is a suite of open-source tools to help with linking data via Google Android mobile platform (http://code.google.com/open-data-kit and http://www.android.com/)
OGC	Open Geospatial Consortium (http://www.opengeospatial.org/)
Open Layers	*OpenLayers* makes it easy to put a dynamic map in any web page. It can display map tiles and markers loaded from any source (http://openlayers.org/)
OpenJUMP GIS	Free, Java-based and open source Geographic Information System for the World (http://www.openjump.org/)
OpenMRS	Open Medical Record System (http://openmrs.org/wiki/OpenMRS)
OpenROSA	Consortium formed to create open source, standards-based tools for mobile data collection, aggregation, analysis, and reporting (http://www.openrosa.org/)
OSGeo	OpenSource Geospatial Foundation (http://www.osgeo.org/)

OSS	OpenSource organization (http://www.opensource.org/)
P.E.A.C.E Plan	Saddleback Church health and development program in Rwanda (http://www.saddleback.com/aboutsaddleback/signatureministries/thepeaceplan/index.html)
PATools	Protected-Area Management Tools - Steve Schill, TNC (The Nature Conservancy) (http://gg.usm.edu/pat/) and (http://www.nature.org/)
PCI Geomatics	PCI Geomatics is the developer of Geomatica®— desktop software that features remote sensing, digital photogrammetry, geospatial analysis, map production, mosaicking and automated product systems capabilities (http://www.pcigeomatics.com/)
PEPFAR	U.S. President's Emergency Plan for AIDS Relief (http://www.pepfar.gov/)
PHIT-DDCF	Partnership of Brigham and Women's Hospital, Harvard University, Partners In Health and the Government of *Rwanda* will implement a PHIT Partnership for: **"***Strengthening and Studying Community-Based, Integrated Primary Health Care Systems in Rural Rwanda***"** *(http://www.ddcf.org/page.asp?pageId=822*) of the Doris Duke Charitable Foundation (http://www.ddcf.org/)
PIH/Rwanda	Partners in Health/Rwanda (http://www.pih.org/where/rwanda/Rwanda.html)
PNILP	*Programme Nationale de Lutte contre le Paludisme* (The National Malaria Program) (http://www.pnlprwanda.org.rw/)
PostGIS	Spatial database extension for PostgreSQL (http://postgis.refractions.net/)
PostgreSQL	Sophisticated open-source Object-Relational DBMS supporting almost all SQL constructs, including subselects, transactions, and user-defined types (http://www.postgresql.org/)
PPGIS@URISA	Participatory GIS forum of URISSA (http://www.crssa.rutgers.edu/ppgis/)
PPgis.net	Electronic forum on participatory uses of geo-spatial information systems in developing countries *PPGIS*, PGIS, P3DM and counter mapping (http://www.ppgis.net/)
PPGIS	Public Participation GIS (see PPgis.net and PPGIS@URISSA)
QuantumGIS	Quantum GIS (QGIS) (www.qgis.org) is a user friendly Open Source Geographic Information System (GIS) licensed under the GNU General Public License. QGIS is an official project of the Open Source Geospatial Foundation (OSGeo). It runs on Linux, Unix, Mac OSX, and Windows and supports numerous vector, raster, and database formats and functionalities.
RCMRD	Regional Center for Mapping of Resources for Development (www.**rcmrd**.org/) It is an Inter-Governmental organizational which promotes the development and use of Geo-Information and Information Technology for much of eastern/southern Africa like RECTAS does for West Africa ()
RDGG	Rwanda Development Gateway Group (http://www.rwandagateway.org/article.php3?id_article=55)
RECTAS	The *West Africa* Regional Centre for Training in Aerospace Surveys in Ile-Ife, Nigeria (http://www.rectas.org/index.htm).
RS	Remote Sensing
SCGIS	Society for Conservation GIS (http://www.scgis.org/)
SEI/Oxford	Stockholm Environment Institute (Oxford University branch)
Shp2kml	Transformation of ESRI Shapefiles to Google Earth (http://www.zonums.com/shp2kml.html)
TatukGIS Editor	GIS mapping & data editing support for KML files (www.TatukGIS.com)
TerraGO	Producer of what was first called GeoPDF Publisher (http://www.terragotech.com/solutions.php)
TerraLook	*TerraLook* provides access to satellite images for users that lack prior experience with remote sensing or Geographic Information System (GIS) technology (http://terralook.cr.usgs.gov/)
TOR	Terms of Reference
TRACPlus	National centre for infectious diseases control and prevention in Rwanda (http://www.tracrwanda.org.rw/index.htm)
uDig	See also (http://postgis.refractions.net/)
UofR, MSGIS	University of Redlands, Masters in GIS Program (http://www.spatial.redlands.edu/msgis/) and Environmental Studies (http://www.redlands.edu/x25609.asp)
URISA	Urban and Regional Information Systems Association - academic and professional geospatial organization (http://www.urisa.org/)
WHO/HMN	World Health Organization, Health Metrics Network (http://www.who.int/healthmetrics/en/)
WIKI	GIS workshops wiki (http://idrc-gisworkshop.pbworks.com/)
WMS	Web-Map Service specification from OGC--see also WFS, WCS (http://www.opengeospatial.org/standards/wms)

2.0 Background to Consultancy:

As outlined in the TOR[1], this report is part of a consultancy which first of all contributes to a series of GIS workshops that the **IDRC Acacia Program** (http://www.idrc.ca/acacia/), which supports research on the intersection of information and communication technologies (ICTs) with social and economic development in Africa, has organized to support its research partners to understand and utilize GIS within their respective thematic projects , e.g. health, NRM and telecom regulatory policy. Through targeted workshops, the intention is to stimulate awareness, utilization and integration of spatial data technologies throughout the research cycle - from the research planning process, through the data collection and analysis stages, and carrying through to the communication of findings to influence changes in policy and practice. A secondary purpose of the workshop series is to disseminate the ***IDRC ICT4D Atlas*** (http://www.geog.mcgill.ca/atlas/welcome.php) and to encourage African researchers to use it and populate it for their research purposes.

The first workshop in this series was held in Dakar on May 15-16, 2009. It was twinned with an Acacia-funded workshop on NRM) and ICTs in order to inform and expose researchers to GIS concepts and practices that could enhance their own work. Similarly, the second workshop, which was held on September 17, 2009 in Cape Town, South Africa, was twinned with the *Open Architecture Standards and Information Systems (OASIS) II - Developing Capacity, Sharing Knowledge and Good Principles Across eHealth Projects in Africa* project. This research project is a network of networks based on open principles, which encourage capacity building, collaboration and quality in the pursuit of improved health outcomes. There is a WIKI space (http://idrc-gisworkshop.pbworks.com/) that was made to capture lessons from all the GIS workshops.

Tasks of the Consultancy:

1) In consultation with the IDRC-Acacia Program Officer (Chaitali Sinha), develop an agenda for the workshop.
See final version which was used at the workshop in the Appendix.

2) Review and get familiarized with the OASIS II proposal document before the workshop. *See various documents/powerpoints regarding OASIS II from Chris Seebregts and Neal Lesh on the Wiki as well as other background material provided by Chaitali Sinha, IDRC Program Officer.*

3) Co-Chair the workshop (with Chaitali Sinha) and deliver presentations as indicated on the agenda.
See final versions of presentations which were given at the workshop in the Appendix.

4) Author a workshop report including recommendations on how to move forward with GIS integration in parts of the OASIS II network, and on how to utilize the IDRC ICT4D Atlas and the GIS workshop wiki (http://idrc-gisworkshop.pbworks.com/) to enable greater participation and knowledge sharing by developing country researchers.

3.0. Purpose and Structure of this Report

This report is organized to discuss the following issues and make recommendations for the future; observations and analysis will follow more or less in this order:

1. Describe briefly the history of the joint collaboration between CGIS-NUR and the eHealth and NRM communities in Rwanda and how that has led to the current partnership with IDRC/Acacia.

[1] Much of the "background" comes from the TOR (Terms of Reference) prepared by IDRC, Chaitali Sinha, September 3, 2009 to guide the lead consultant on the workshop—Dr. Robert E. Ford – see more about him at his website (http://geobobford.com/rwanda.html).

2. Present a brief overview of the types of health and GIS projects CGIS-NUR has done which has informed this collaboration and discuss key lessons emerging from its own work using GIS in eHealth which in many respects led to the GIS workshop--the focus of this report.

3. Discuss the rationale for how GIS fits into the mandate and goals of the IDRC-Acacia program with a specific emphasis on eHealth and EMR (Electronic Medical Record) IT systems as well as NRM (Natural Resource Management) and other Applications in ICT4D.

4. Describe the workshop's objectives, who participated, and give an overview of the learning and other group-sharing processes included that were designed to extract the maximum of "lessons-learned" possible in a short period of time.

5. Summarize the key highlights of the workshop and make recommendations that inform the soon-to-be-launched OASIS II project, and specifically, recommend a process for assessing the existing IDRC-ICT4D Atlas webmapserver portal website, and make recommendations on how it could better serve OASIS-II partners who may want to integrate GIS into their activities.

We should state that though many non-specialists use the term "GIS" loosely for all types of mapping and related work—including Remote Sensing and GPS--what we're talking about is much broader than GIS *per se*. It includes use of all types of geographic Information (place-based) tools, data, and methods. So we prefer the term GIScience (GISc) or ***geospatial*** tools, data, methods…not just "GIS".

4.0. Collaboration between IDRC-Acacia and CGIS-NUR (Rwanda)

CGIS-NUR started about two years ago to expand from its usual focus of GIS support and research which emphasized traditional partner needs in urban and regional planning and other national infrastructure or socio-economic needs within the Vision 2020 established by Rwanda to guide its efforts in ICT and other sectors. But it soon became clear that many of the geospatial tools, data, and methods CGIS-NUR uses has much to contribute to non-traditional GIS problems in the public health, social development, and conservation sectors where NGOs as well as government are important actors.

Over the last year (2008-2009) since Dr. Robert Ford (http://geobobford.com/rwanda.html)) came to NUR (National University of Rwanda) Butare as a Research Professor and Adviser to CGIS-NUR (http://www.cgisnur.org/), he and other colleagues have been leading a series of small pilot efforts to demonstrate the beneficial uses of GISc in the health sector in Rwanda. These efforts--and others started earlier by CGIS-NUR and partners such as the LLUSPH Health Geoinformatics program, MVP/Rwanda, PIH/Rwanda, and the University of Redlands--had begun to build capacity, implement small pilot studies, and thus help stimulate interest within government, the private sector, and among key partner NGOs to the potential uses GISc in eHealth.

Crucial to this process was an effort launched in December 2008 working with PIH/Rwanda (Partners in Health) to produce a "conceptual framework and roadmap/planning document" (which we include in Appendix III) that explains the fundamental rationale of our approach, presents what was needed for implementing a "pre-pilot study" to test use of GIS/GPS within the new OpenMRS system they were implementing, and to put on the ground two graduate students who field tested and built with CGIS-NUR help the basic geodatabases and data-gathering methods, and trained local staff at PIH--that demonstrated the usefulness of integrating GISc with Health IT systems. That project was carried out from January-June 2009 in Rwinkwavu, eastern Rwanda (the WIKI contains a very good Powerpoint presentation summarizing the results of that pilot effort).

In addition, you can see the full "proposal/planning document" and other supporting documents from partners such as ESRI/Redlands Health and Human Services Industry Group--that laid out the conceptual framework and plan for the "pre-pilot" as we called it in Appendix III. The following statement from that

document encapsulates succinctly, I believe, why GISc can and should be included in Health IT systems—and in many respects it was this pilot effort's success that led to the workshop. In the next section we discuss further some of the lessons-learned from these earlier CGIS-NUR and partner eHealth activities. Here is the quote which I believe says it all in terms of why GISc should be an integral part of any eHealth initiative (see more in the Appendix III):

> The integration of geographically-relevant health data within the framework of human health practice and public health IT systems, has enormous positive potential for mapping indicators related to primary care, system strengthening, and improving access to care. *Where* people live, work, and play have large and important roles in a) how healthy people will actually be, b) what risks to health they will face in the years ahead, and c) how effective delivery of services will work. Making health interventions work in local communities is still a function of information transfer, so building sustainable informational "best practices" remains critical to measuring health indicators and social outcomes efficiently and effectively.
>
> This new capacity (which GIS brings) to link health outcomes and interventions to high-resolution spatial scale variables at the landscape-level, addresses a major health information and knowledge management problem around the world—that is most health data-gathering and reporting systems only list where patients/clients are served or were treated—usually at clinics or hospitals-- NOT where they live or contract the disease. Furthermore, rarely can "stovepiped" health data systems cross-tab with what may be crucial, non-health associated factors that may better explain what is required for efficient and effective prevention, early detection, diagnosis, treatment, and rehabilitation--*geography is destiny – in fact medical destiny!*

The implementation of the activities discussed in the document cited above (and results of other work as well) led us to make contact with IDRC/Acacia and OASIS-II who were already working on related ICT4D activities with many of the same partners we were working with. As a consequence, two of us from CGIS-NUR (Robert Ford and Clarisse Kagoyire) were invited to the first IDRC-Acacia GIS workshop in May 2009, which took place in conjunction with a workshop examining research issues on NRM and ICTs. It was at that workshop where we had a number of discussions with Chaitali Sinha and Heloise Emdon (Acacia Team Leader) on the synergies between the work we have been involved with in Rwanda and the GIS exploration that was being planned for an upcoming workshop twinned with the Acacia-funded OASIS health informatics research network.

In the following months, a group of us worked closely with Chaitali to design the workshop agenda, suggest speakers and link our partners to a set of resources and tools. The partnership that has evolved between CGIS-NUR and IDRC is demonstrative of IDRC's mandates of capacity development and local engagement in a very productive and supportive manner.

5.0. Key Lessons-learned from Prior CGIS-NUR Projects

Below we list briefly some of the CGIS-NUR projects we've been working with that included use of geospatial data, tools, and methods within their implementation. A much more detailed table with contact information, lessons-learned and much more is found in Appendix I entitled:*TABLE I - Summary of Select Health-related GIS Projects CGIS-NUR has worked with in Rwanda 2007-2009.* The text box below lists a few of the major projects and summarizes some of the key issues and lessons we learned that are relevant for making future plans; and it was some of this which led to doing the workshop.

Name and Brief Description of Project	Key Lessons-Learned
A. PIH/Rwinkwavu "pre-pilot" GIS/GPS project (January-June 2009) which tested the feasibility of integrating geospatial data with the OpenMRS IT system being used to	• Including GISc data and tools into the EMR (Electronic Medical Record) system is feasible and actually improves the quality of the regular clinical and M&E systems.

track patients, improve M&E, and prepare for later more advanced geospatial analytical work in a proposed Doris Duke Charitable Foundation grant that began in September 2009 which was focused on broader "community public health work".	• Local-level volunteers and frontline CHWs and others can do very well at collecting field data using GPS—they actually love doing it! • Some of the privacy, technical and "community acceptance" fears some had turned out to be the opposite—including local community leaders and clients in the process was a major plus for building support for other efforts. • There are technical and data access challenges that still need working out, but again feasibility and actual benefits were shown in spite of difficult resource and field logistics constraints—including major financial limitations (see Powerpoint on the WIKI).
DFGFI "Ecosystem Conservation and Health" activities in the buffer zone of Volcanoes National Park in northwest Rwanda. This was a primary health care-focused project whose goal is to both improve human quality of life of residents living near the park (to get more "buy-in" for conservation), and it was to also mitigate/reduce transmission of parasites between humans and primates, e.g. the mountain gorillas. The focus was on provision of very basic water and sanitation, establishing of a simple financing system for access to needed basic drugs and other primary care services, and health education).	• Linking improvements in human health and well-being as a "carrot" for local-level support for conservation definitely works! • Finding funding support is often difficult because what is actually needed is not currently the focus of most global health funding, i.e. the needs are for very basic primary care needs, e.g. medicines, education that don't fit the "disease-focused" funding mechanisms of higher profile problems such as HIV/AIDS, TB, malaria, etc. • Though conservation agencies and a few funders and government understand conceptually the benefits of linking health with conservation, the way "stovepiped" funding and government agencies work it is often difficult to get real commitment due to organizational challenges, impermeable barriers, culture... • NGO volunteers and creative development of local-level solutions for this can work, but much wider benefits could be achieved if larger donor funding and other support services were willing to "think beyond" their current limitations in ways of working, funding, thinking, etc.
CGIS-NUR and TRAC+ (National Malaria Unit) study of the geospatial aspects of malaria risk in Rwanda. This was a "pilot" project done for one year that had various goals, e.g. build a malaria geodatabase for improving disease surveillance systems and implementation of malaria mitigation, prevention and treatment programs, as well as start doing basic research on the links between geography, ecology, climate and malaria.	• Substantial progress in building an integrated geodatabase was achieved and many of the visualizations, maps, and other decision-support products were well received and excellent visualizations. • Working out some problems of data access, sharing, archiving, and quality-control of data and finding "missing-data" were shown to be significant barriers to achieving all benefits desired—much more is needed here. • Considerable capacity-building and training on-the-job and through other formal education programs was achieved but much more is needed—particularly in the "continuing education" mode. • Getting GISc integrated into the normal disease surveillance and monitoring systems

	as a basic function rather than being seen as just a "one-off project" is now understood, but implementation is still to be fully achieved. • CGIS-NUR itself found out that it needs more specialized staff who are able to cross the boundaries between GIS analysis and epidemiology…so further training is needed.
MVP/Rwanda (Mayange) and the University of Redlands (UofR) Mayterm Project. CGIS-NUR, MVP, LLUSPH, and UofR established an MOU to help MVP do "water-related" mapping/GPS data collection and other geospatial data analysis under a DWP grant from the Los Angeles (Department of Water & Power) to identify and map all water-related geographic features, all boundaries of lowest administrative areas (*Imidugudu*) and then build a geodatabase that could link other health, socio-economic and environmental data collected by the MVP for long term monitoring and research. Some of the work was in direct support of the MVP clinic and others to broader community-level health and socio-economic work that was to address and monitor achievement of MDGs at the "village level".	• Due to complexities of the higher research goals established for MVP projects, getting "integration" of the GISc work into the OpenMRS system the Mayange MVP site was using, has taken longer than planned. • UofR was able to demonstrate that mapping Imidugudu boundaries down to the lowest level, and all relevant water, health, and socio-economic geographic features is feasible, but very time-consuming and costly. • Recognizing this difficulty we are trying to find ways of using P-GIS methods (Participatory GIS) tools and approaches linked to high-resolution imagery interpretation to speed up the mapping process and reduce costs. • Some of the lessons-learned are that what is needed for and by "researchers" is not necessarily transferable or cost-effective broader implementation as a regular system that can be scaled-up to a national level.
Karongi District (Kibuye) Rwanda P.E.A.C.E Program of the Saddleback Church with RDGG/CGISNUR. The goal was to test the benefits of using "churches" and associated lay volunteers in community-based HIV/AIDS and other social and health-oriented outreach programs as "extension agents", educators, etc.	• All potential field partners (which are primarily churches and schools) are not yet fully participating in some cases due to some unwillingness of some local church leaders to work across denomination boundaries; some suspicions need to be alleviated and cultural barriers broken down. • A huge amount of baseline data has been collected but there are not sufficient technically savvy GIS volunteers or paid workers to manage geodatabases effectively. • Church-based volunteers need to be found or trained that understand and appreciate better "evidence-based" data gathering and analysis for monitoring and evaluation that will be credible to outside independent observers. • There is some suspicion by church-based laity of "science-based" work in general and this can inhibit acceptance by outsiders (government, secular experts, etc.) that these church-based efforts actually work better than non-sectarian approaches. • Mutual understanding between laity and church leaders with experts from secular government , NGOs, and Universities is still a problem; much more sensitization is needed on both sides to improve mutual tolerance and collaboration. • It has yet to be proven that using churches for

	achieving major public health outreach goals is actually more effective than traditional non-church ways—though there is a strong "belief" anecdotally—particularly from the faith-based community--that this could be very effective..

6.0 How does GIS Contribute to the ICT4D Goals of the Acacia Program?

The Acacia research program, like all programs at IDRC, run on a five-year programming cycle. This cycle is guided by a prospectus document. The 2006-2011 Acacia Prospectus[2] cites participatory GIS as among the critical emerging ICT4D research issues to be addressed on the African continent. The focus on GIS is not a technologically deterministic one. Rather, the focus on GIS is one that balances the political, technological, economic and social actors and factors present when creating, accessing or communicating information for development purposes.

Chaitali Sinha, IDRC Program Officer for the Acacia Program stated the following[3]:

> It is generally accepted that a large portion of all information is spatial in nature. Given this, it is not surprising that data with a locational or geographic component underpin the majority of the knowledge generation in the information society. Geographic Information Systems (GIS) can be defined as a system of creating, storing, analyzing, retrieving and representing spatial data. Effective GIS requires strong human capacity to design, analyze and use spatial data for targeted purposes.
>
> The interest in GIS in the context of a development approach originates from the understanding that information with spatial attributes is necessary for social and political decision-making. Maps and other visual representations of spatial data have long played an enormous role in the distribution of resources and the contestation of power. In addition, the recent phenomenon of online community sharing and collaboration has fostered the neo-geographer and mash-up movements in the Web-mapping community. These communities are made up of non-expert users who are rapidly appropriating, combining, and customizing spatial data solutions to solve problems often at very local levels. Led by free and open source software and an ever-growing cache of spatial data on the Web, the opportunities for citizens of developing countries to adopt, appropriate, and develop locally relevant GIS applications and analyses is growing at a tremendous pace.

7.0. GIS and eHealth Workshop Objectives, Participants and Processes:

All of the above activities helped lay the foundation for the IDRC-sponsored GIS workshop held September 17 in South Africa and stimulated a call for sharing of lessons-learned, planning for future support, and preparation of resources and new tools to be targeted to eHealth users in Africa and elsewhere. Thanks to IDRC's Acacia Program it was possible to invite many of the participants and beneficiaries of the "precursor programs" discussed in TABLE I and Section 6.1 above to come share what they had learned and make plans for the future. The full Agenda is in Appendix; the key objectives and questions driving the discussion and planning were the following (see textbox below) and TABLE II summarizes the key Presentations and findings:

[2] The 2006-2011 Acacia Prospectus is available for download here: http://www.idrc.ca/acacia/ev-113431-201-1-DO_TOPIC.html.

[3] From TOR prepared originally by Chaitali Sinha, IDRC Program officer.

The Workshop Objectives:

1) To learn about GIS and more generally about how geospatial data collection, analysis and representation could be used strategically and appropriately to enhance the research planning, implementation and communication processes in eHealth initiatives.

2) To share the outcomes, challenges and opportunities from specific case studies of GIS applied in health initiatives in resource constrained settings.

3) To initiate a discussion about how members of the OASIS II network could tap into GIS concepts, tools and resources for the purposes of their research.

Key Questions:

a. What are the USE-CASES (applications) for which geospatial data, analytic tools, APIs, visualizations or other products/webservices are/were most useful in adding value to clinical, outreach, public health, research, and other related community-development applications?

b. Who are/were the most important USERS for which the geospatial applications, analytic tools, data, webservices, visualizations were most relevant?

c. What are/were the most significant issues/problems/constraints in making GIS work to full advantage within site-specific clinical, community, and regional/national settings, etc:

-Technical, e.g. software, hardware, instrumentation, connectivity, integration of systems, architecture and design, geodatabases, analytic tools, APIs, etc.
-Logistics, e.g. travel, communications, scheduling, coordination, etc.
-Human capacity, e.g. training, availability of personnel, etc.
-Data & Webservices, e.g. access, availability, quality-control, appropriateness, validity, reliability, timeliness, etc
-Cost/funding sustainability issues
-Institutional, e.g. legal, administrative, policy constraints, privacy, etc.

d. What are the next steps and needs that must be addressed in order to better integrate GIS tools, data, visualizations, webservices into OpenMRS, CommCARE, OpenROSA, OpenJAVA, (assuming you believe it is needed, etc).

8.0 Who were the Presenters and Participants at the eHealth and GIS Workshop?

Presenters were chosen both from users and implementers in the eHealth community—including some of those mentioned earlier, e.g. PIH, MVP, CGIS-NUR, as well as others invited from elsewhere who are already using GIS quite effectively such as a Peru-based TB research program, the MOH (Ministry of Health) from Rwanda, a large and impressive rural-based health delivery program in Pakistan (IRD) which is using Google tools/maps for various primary care and community-based programs, and of course MVP and PIH with its partners from LLUSPH and University of Redlands.

Several outside specialists in GIS were also invited to give advice directly—and to educate the participants on "what GIS is and what it can do". Among the specialists who attended the workshop included **Tom McConnell** a retired GIS professor from the US and **Rolf de By** one of the leading Geo-IT experts based at **ITC/Netherlands**--one of the largest earth observation and geospatial analysis training centers in the world (http://www.itc.nl/). Below are some screenshots from some of the presentations and a few photos from the workshop and from work in the field by the participants, e.g. PIH, CommCARE, etc.

Other GIS experts participated remotely from Europe, Mesoamerica, Canada, Africa, Asia, and the US via prior and subsequent discussions online. Several OSS GIS "gurus" (e.g. **Markus Neteler**/Italy, **Chris Nicholas**/US) and others gave expert assistance that is continuing). Other "spatial epidemiology" experts also contributed, e.g. **Sam Soret, Seth Wiafe, and Donn Gaede** from the LLUSPH Health Geoinformatics Program.

All of the above and others (including GIS experts from the "conservation world" such as **Steve Schill/TNC**, and **Joel Masselink/WCS** Congo) contributed to the creation of one of the requested "deliverables" that came from the workshop, i.e. design of a **Comparative Matrix** assessing the advantages/disadvantages of various software geospatial tools—both COTS and OSGeo. This resource is now online as a "living document" as a GoogleDoc file (Tom McConnell is hosting and updating the document/matrix).

There were other participants who came as specialists in web-mapping and Geo-IT in Africa, e.g. **Deo Rutamu** who led the RDGG data gathering efforts in Karonji/Rwanda for the Saddleback Church effort and who with other staff in his department will help improve and redesign the **IDRC ICT4D Atlas** (http://www.geog.mcgill.ca/atlas/welcome.php). **Clarisse Kagoyire**, one of their web-mapping specialists attended the Acacia Research and Learning Forum (ARLF) funded by IDRC in Dakar (October 4-8) - http://acaciaforum.net/ - to meet many other IDRC/Acacia researchers and to discuss ways that CGIS-NUR could better support them with geospatial tools, training, maintenance and improvement of a "geoportal" of data, etc. **Dr. Robert Ford** represented others who could not attend and chaired/ led the workshop discussions jointly with **Chaitali Sinha**, program officer in charge of the OASIS project from IDRC/Canada.

And because the GIS workshop was sandwiched between the annual **global OpenMRS Implementers meeting** and the smaller **OASIS-II research planning meeting**, key PIs such as **Chris Seebrechts, Hamish Fraser, Neal Lesh** and **Andy Kanter** who are funded by IDRC under the Acacia Program were there to learn and to help us all think through how GIS could best help their programs in eHealth-IT achieve their goals for Africa.

In addition, a select number of potential users of GIS who are from the **CommCARE, JavaROSA** and **OpenMRS** communities were invited to listen and learn—particularly those who had expressed a strong interest in adding GIS-capacity to their current portfolio. These attendees were exposed to new ideas, tools, and applications. In turn, some of the GIS/Geo-IT specialists who had not worked before with the medical informatics or eHealth world before were exposed to the needs of this unique community. We hope that all can in the future help each other out more effectively.

9.0 Summary: Workshop Presentations and Discussions:

The presentations were used as a springboard to discuss **USER NEEDS** and to **THINK ABOUT NEXT STEPS** for the benefit of eHealth systems' use of geospatial tools, data and methods. IDRC itself will use the results of this workshop to expand and design further capacity-building efforts around the use of GIS not only for eHealth but also in other sectors such as social justice and ENRM within the OASIS-II project that is just getting started under IDRC-Acadia--the ***Open Architecture Standards and Information Systems (OASIS) II - Developing Capacity, Sharing Knowledge and Good Principles Across eHealth Projects in Africa*** project.

All the presentations are available online at the **WIKI** (http://idrc-gisworkshop.pbworks.com/) as well as agendas and background materials. There are also materials from the first workshop on GIS held by IDRC back in June 2009 in Dakar—which focused more on ENRM needs and introduced participants to various OSS tools such as MapServer, Open Layers, PostGIS, PostGres, Shp2kml, Kml2shp, Google Earth APIs, the world of the OGC (Open Geospatial Consortium and OSGeo)—see **Glossary**[4]. These

[4] It should be added that back in August 2009 two other capacity-building workshops were held at CGIS-NUR in Butare, Rwanda. One focused on use of geospatial tools for advanced web-mapping using both commercial software such as ArcGIS Server as well

and other participants who came to some eco-oriented workshops held in August 2009 by CGIS-NUR--will also contribute to sharing resources via the **WIKI** above and have linked us to others via a network they work with – the **EBM Tools Network** (http://www.ebmtools.org/).

TABLE I
Summary of Presentations, Discussions and Lessons-learned

Presenter & Organization	Key Outputs & Activities	Lessons, Insights, Suggestions
1. **PIH Rwanda**: GPS/Field Data Collection Project - use of GIS in M&E improvement of OpenMRS **Cheryl Amoroso**, John Deriggi, Donn Gaede and others… **Pre-Pilot to PHIT-DDCF Partnership Project**: **"***Strengthening and Studying Community-Based, Integrated Primary Health Care Systems in Rural Rwanda***"** (*http://www.ddcf.org/page.asp?pageId=822*) of the **Doris Duke Charitable Foundation** (http://www.ddcf.org/) and **Partners in Health/Rwanda** (http://www.pih.org/where/rwanda/Rwanda.html)	1. Framework for a "pre-pilot" GIS/GPS project at PIH/Rwanda from Feb-June 2009; see "planning document" in Appendix and presentation by C. Amoroso/PIH. 2. Goal - test use of GPS/geospatial data & visualization tools for integration with OpenMRS. 3. Lay foundations for inclusion of geospatial tools in PHIT-DDCF grant to begin Sep 2009 . **Key outputs**: -Mapped all of the 48 villages, 14 schools,100+ water sources, homes of 157 CHWs, homes of 600+ HIV, TB and chronic care patients. -Developed Kinyarwanda GIS training guide. -Informal and formal (by CGIS-NUR) training for community health workers supervisors to collect GPS data	1. This work is possible – but we need to resource it 2. There is an opportunity for GIS to integrate with OpenMRS 3. The community is interested in GIS technology, and capable of understanding and using it with some initial support 4. Plans: -Continue to map villages in District Hospital catchment area -Link GIS data with primary care data in EMR. -Make the technical architecture a reality. -Produce sharable products related to GIS and OpenMRS - Feedback was given to the LLUSPH Health Geoinformatics Program on ways to improve training and field supervision of graduate students including the need to prepare them to use both OSS and COTS tools, data, and methods.

as OSGeo tools such as OpenLayers etc. That workshop was led by a Geo-IT specialist from Southern Mississippi University (**Dr. George Graber**) who manages and designs "geoportals" that serve users in the conservation world of Mesoamerica. A key user-partner—**Dr. Steve Schill**—Senior Scientist for The Nature Conservancy in Mesoamerica, also attended and led a second workshop on "Ecological GAP assessment". They manage and distribute online various geospatial tools via a website called PATools - http://gg.usm.edu/pat/ One of the important updates to their tools has just been released via this URL (http://gg.usm.edu/pat/files/patv3_93.zip). Their network serves thousands of users dealing with protected-area management and biodiversity conservation. Many of the tools they introduced, e.g. Marxan, PATtools, ArcGIS spatial ecology tools, can also be adapted for the eHealth community such as creation of "risk surfaces"…

2. **Pakistan: Experience with Google Earth…** Aamir Khan MD PhD Executive Director, Interactive Research & Development; Executive Director, Indus Hospital Research Center; Associate Faculty, Johns Hopkins University	**Key outputs & Activities:** 1. OpenMRS MDR-TB Module implementation and scale-up 2. Primary Health Care service delivery and M&E 3. Low-cost, real-time surveillance for dog bite and rabies in Pakistan 4. Real time data visualization See YouTube example online (http://www.youtube.com/user/IRDResearch) and Powerpoint on the WIKI	1. IRD at first experimented with commercial COTS software, e.g. ArcGIS and others but found the licensing and other training and data costs too prohibitive. 2. They have used now the Google APIs and other tools, e.g. mobile cell-phone SMS platform/tools very effectively. 3. They have developed a very strong methodology for doing initial baseline measurement and mapping (including numbering of houses) within a target area that has paid off in ease of subsequent M&E. 4. They are limited in the spatial analysis they can do with the Google tools and are searching for easy-to-use and effective OSgeo (FOSS) analytic tools, e.g. linking "R" with spatial analysis. 5. They could benefit by having more access to technical geospatial expertise focused on M&E but also advanced epidemiological analysis. 6. They would welcome ways for the various eHealth initiatives to more easily learn from each other via some online mechanism. 7. Like many projects, getting access to better quality high-resolution imagery is always a need, as well as better non-spatial data, e.g. census data
Peru TB case-mapping **Dave Thomas, PIH**	Have just launched longitudinal research study to track TB cases and are using GPS for tracking and monitoring follow-up etc.	1. One of the major needs presented is for easier ways to "track" client/patient compliance with the strict scheduling of follow-up visits, testing, protocol compliance that research projects require. 2. Some type of geospatial "logistics/network analysis" tools that better manage time/space requirements is needed, i.e. to develop easier ways to report back to both field workers and patients via GIS-enable SMS mobilve phone and GPS systems. 3. In the "fishbowl" discussions there were some suggestions by the GIS experts attending on possible "solutions" that could be designed for dealing with this and other "space-time" management issues in eHealth care delivery.
GIS, a tool deployed by Rwanda HIV/ AIDS program to support	1. When you don't know **where** something is happening on time, it is	**GIS future areas of action for Ministry of Health**

decision making: the case of TRACnet System. By Daniel Murenzi and Gilbert Uwayesu "Monitoring of drug supplies by facility, district and region to prevent shortages and stock-outs"	not easy to give an appropriate solution or make a rapid intervention. **2.** GIS is helping us in understanding the **"where" problem.** 3. To respond to an effective management of **Anti-Retroviral drugs** and be able to monitor on time the **stock level** at health facilities level; there is a need of having a tool which allows the central level to access the a information on ARVs stock level in order to provide a **rapid response** in terms of drugs distribution in case there is a shortage or **stock-out** at a particular ART Health Facility. 4. We are using Geographic Information System (GIS) as a tool with other processes that captures, stores, analyzes, manages, and presents data that is linked to location contributes to respond to those needs mentioned. 5. GIS is helping our Malaria control Unit in **malaria surveillance** as an approach to predict malaria epidemics, control malaria vectors.....	• Determining geographic distribution of diseases • Analyzing spatial and temporal trends • Mapping populations at risk • Assessing resources allocation • Planning and targeting interventions • Monitoring diseases and interventions over time. • GIS integration into EMR. • Tracking Trends in Health Care with GIS **Challenges** • No enough skilled personnel to implement GIS projects in health sector. • No tools to run GIS applications (Software and Hardware). • Getting spatial data is still an issue…(too expensive).
Other Reports (Bob Ford and Deo Rutamu) – Summary of diverse projects, e.g.	**NOTE –** See report **TABLE I** by Robert Ford on GECHH, PNILP, MVP, and DFGFI—Ecosystem Health projects.	**NOTE –** See report in **TABLE I** by Robert Ford on GECHH, PNILP, MVP, and DFGFI—Ecosystem Health projects.

Saddleback, GECHH, PNLP, MVP/ Mayange (Ted Kaberuka, Donn Gaede), DFGFI-- Ecosystem Health Projects, climate change research et al…		
"GIS" Experts Presentations:		
Integrating Geo-IT and Health – Geo IT Standards and Tools Rolf de By, ITC Netherlands	**NOTE: see full extensive presentation in WIKI.**	**NOTE: See notes below from "Fishbowl" discussion**. Key issues presented/discussed: 1. Needs of public and private users and providers in health systems for GIS 2. Modes of data acquisition today… 3. Characteristics of current "neogeography" and how it is changing spatial tools, etc 4. Important role of SDI and "geoservices" for health care industry 5. What are "Geoservices" 6. Critical role of "standards" "architecture" and "open geospatial community", e.g. OGC, OSGeo etc. 7. Review of OpenSource Software 8. Cell phone infrastructure as the "web extension cord" and 9. Challenges of integrating GIS with Cell phones...
Analytics, Ontologies and Health Standards Tom McConnell, retired GIS professor	**NOTE: see full extensive presentation in WIKI.** 1. Intro to the ArcGIS Toolbox 2. Examples of some more advanced "spatial analysis" that cannot be done with many current OSS tools	Tom McConnell proposed to assist in the review of the advantages/disadvantages for spatial analysis using most robust OSS software available now…e.g. "R" compared to use of ArcGIS Spatial Analyst, etc… Tom has started to produce an online **Google Docs MATRIX** that compares various commercial (COTS) and OSS tools. On **WIKI = or Contact Tom for access to the MATRIX** (email: gisprof@gmail.com).
FISHBOWH Q&E: Respondents: Chris Seebregts, Andy Kanter, Neal Lesh, John DeRiggi, Dave Thomas, et al		1. Access to better quality and higher resolution "baseline/framework" spatial datasets needed by all but it needs to target the specific countries where the community works, e.g. Mozambique, East Africa, southern Africa, etc. 2. Maybe the **IDRC ICT4D Atlas** (which few participants knew much about or had ever used) could be made more into a

		"geoportal linking eHealth community to some of the free datasets, but which they don't know where to find currently. 3. More joint training and interactions between the "medical informatics" community and the "GIS world" is needed and could be beneficial to both. 4. Some of the specialized needs of the health research community may come from other sectors, e.g. logistics and tracking/network analysis used in FEDEX for dealing with **TIME/SPACE** management needs 5. There is a specific need for developing better "patient schedule management" for eHealth—TB research protocol compliance and scheduling of visits, testing via cell-phones and with GPS functionality. 6. Some of the barriers to collaboration between the GIS and eHealth world are cultural, institutional, philosophical, and use of different "jargon". 7. Some of the "standards" issues that the medical informatics world is now experiencing—particularly in OpenMRS, CommCARE, JavaROSA--could benefit from learning how the OGC/OSGeo world dealt with their "data integration" issues in the past which led to the ISO standards for GML, OGC, etc. 8. Cost concerns and needs for flexibility in adapting tools for various levels of use are needed. One-size-fits-all approaches won't work for the eHealth world. 9. Some users present were willing and are able to afford more advanced "Smart Phone" technology with built-in GPS functionality while others still can only afford the most basic "frontlineSMS". 10. There are/were important developments and questions regarding applications from the "spatial epidemiology" world that could not be addressed in this workshop and need exploration in the future. 11. Even some of the most advanced users of GIS for monitoring/tracking and M&E (e.g. IRD Pakistan) still do not have access to or

		sufficient OSS tools that will do **ADVANCED SPATIAL ANALYSIS** very easily without a lot of difficult juxtaposition of tools, e.g. linking from a desktop to "R" and back to spatial visualization; it is not very easy right now. 12. Capacity building within institutions and finding ways to get remote technical support from GIS experts is still a big need.

From my perspective as one of the organizers and Chair of the workshop, these were things I observed and learned—some new and surprising and others not—that are worth discussing briefly. Here are some overarching observations and recommendations that lay the foundation for more specific analyses and recommendations coming in later sections of this report. These overarching observations include:

A. **Comment & Analysis**: It became clear to me over-and-over that the GIS experts we brought and some of the strong adopters/users of GIS technologies at all levels still don't do as well as they should at understanding the needs of the "non-GIS" user world—even those who have strong IT skills but who don't know GIS—and there is a particular worrying gulf between the medical informatics and even epidemiological research world and the GIS world that needs to be bridged.

   Recommendation: Efforts like this workshop to get these disparate communities of practice together to learn each other's own special languages, skills, and tools would help everyone and of course the true beneficiaries would be the populations in Africa we're all trying to help get better health care at lower cost and in a timely, geographically targeted manner. In this regard this workshop was a great success and several times it was good to observe instances where people began to understand "where each other was coming from" and learn new things and even break down misunderstandings or apprehensions about using new tools and integrated systems.

B. **Comment & Analysis**: In spite of the very enthusiastic, committed, and talented community that the OpenMRS network of networks has become (including other related groups such as CommCARE, JavaROSA, IRD, etc…) and the very impressive results they have produced so far to create EMR systems that work in very difficult environments in Africa--I was surprised (and not surprised) at how communities such as OpenMRS work in ways that don't learn as well as it could from evaluating the successes and failures of other like communities, i.e. the geospatial world--OGC. The laudatory and much needed efforts the eHealth world is going through to build "interoperable" systems and tools that use common "standards" is impressive. But, many of the issues they face have been resolved by other groups or at least they could learn from each other more on how to tackle their similar "integration" problems.

   Recommendation: Maybe one of the benefits and goals for Acacia is to help these communities to come together more often and learn from each other—and to help break down some of the cultural, professional, and professional language barriers that reduce "cross-fertilization" in the ICT world. I was impressed by some of the unique "group process" methods used, e.g. the "Fish-bowl" discussion process, and will try it more often in my own community.

C. **Comment & Analysis**: This is not a revolutionary observation, but many of those who have studied and observed new organizations form or new technologies get adopted, have observed that the difference between those which truly succeed in moving beyond the "early enthusiastic adopter" phase to scale-up to true solutions with appropriate "business cases" that work to solve real problems beyond the start-up phase and create a self-sustaining solution that works—is most often NOT the technical or even financial constraints, but the "human/organizational" impediments and barriers.

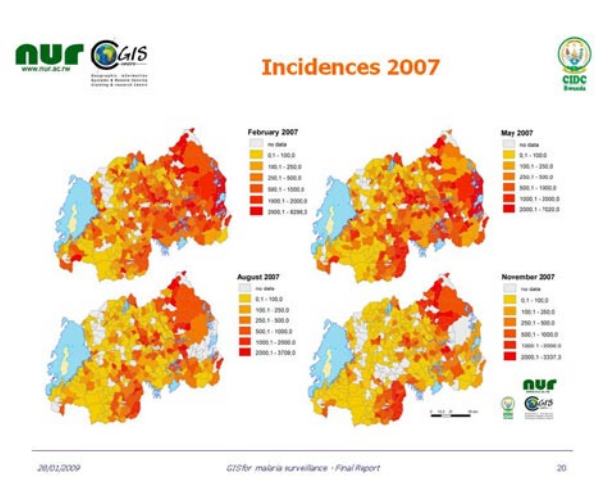
Recommendation: Several times in discussions during the workshop, and later in the follow-up OASIS-II PI planning meeting, it came out that having some social science and other "organizational design" specialists on board to help these enthusiastic "early adopters" to move "to the next level" is what might make the difference between success and failure in an institutional and organizational sense. I laud IDRC/Acacia for fomenting research and support to help address these critical "birth pains" of getting new organizations and technologies to the level of truly being self-sustaining. Much more is needed, and it will be required here as well when two disparate communities—eHealth and GIS—try to work together using different histories and experiences to solve common health IT problems for the benefit of common clients and users.

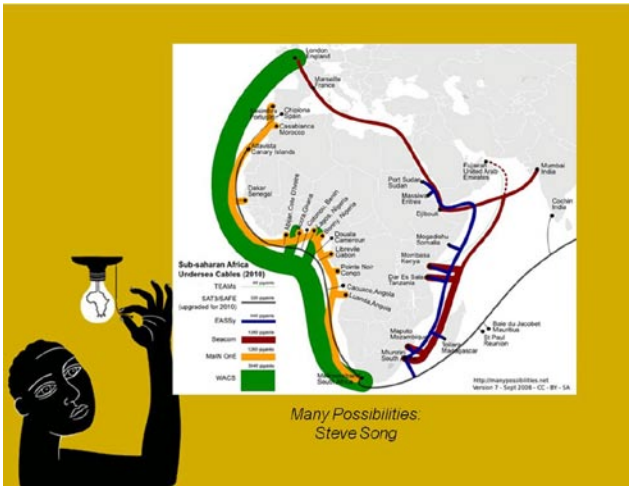
D. **Comment & Analysis**: Finally, I was so impressed by the commitment, talent, and focus of all the groups involved on trying to find innovative ways to improve the lives of the poor and vulnerable in some of the most difficult areas in the world—through appropriate uses of technology that is cost-effective, culturally appropriate, and sustainable.

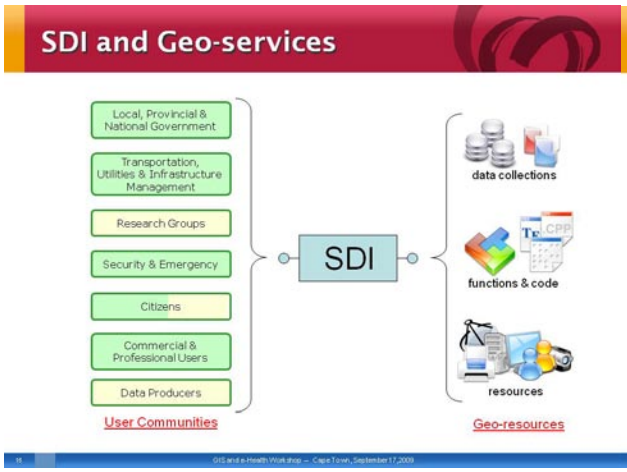
Recommendation: All I can say to IDRC/Acacia and its many eHealth partners—**KEEP UP THE GOOD WORK--**and we from the **GISc** world look forward to assisting you in making what you do so well work even better for the benefit of all from local to global!

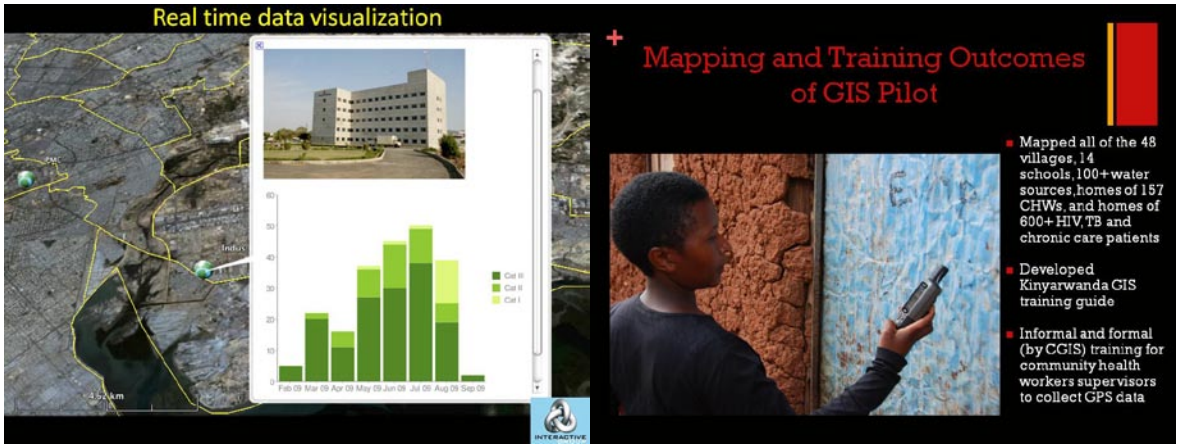
SELECT PHOTOS, SCREENSHOTS AND GRAPHICS FROM PRESENTATIONS

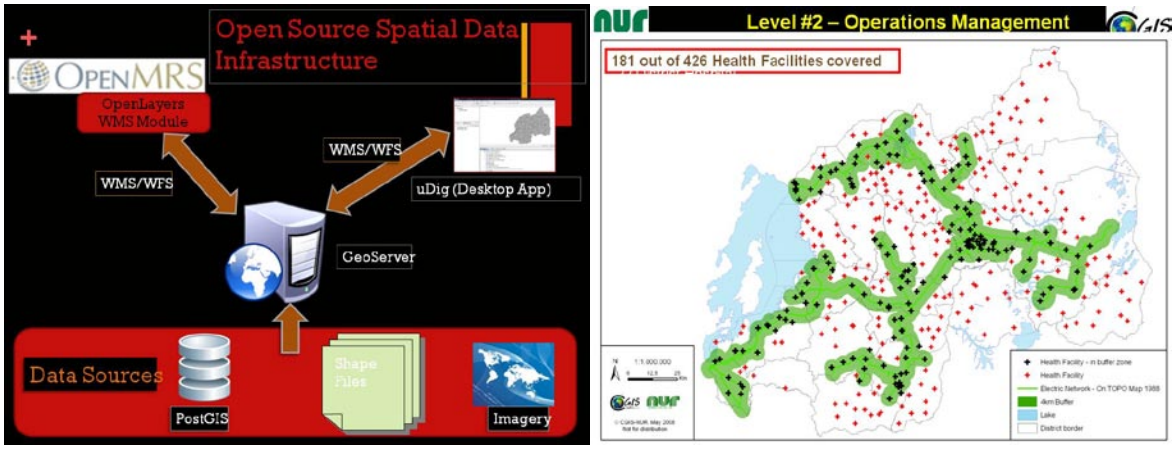
(More available on the GIS workshops WIKI http://idrc-gisworkshop.pbworks.com/)











10.0 General Conclusions from Discussions and Presentations:

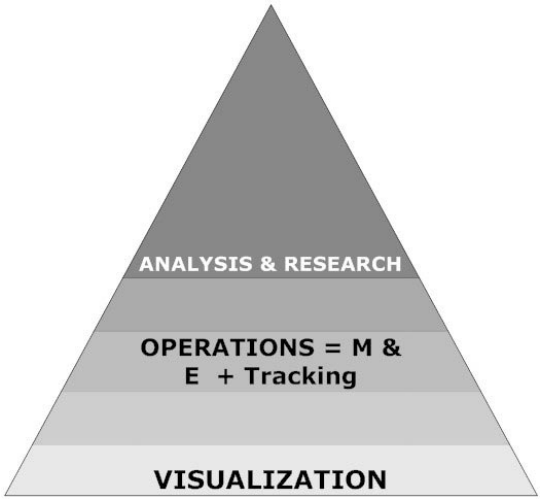
1. It is clear that there is a significant demand and interest in the sustainable development, NRM, and eHealth community for more cost-effective and efficient use of geospatial tools, data and methods.

2. Barriers to effective use of GISc generally fall within these major areas:

a. **Financial constraints**, e.g. high cost of purchasing high-resolution imagery which is now available but usually out of reach of many NGOs.
b. **Human capacity and training**—lack of qualified personnel or persons with the wrong skills
c. **Technical constraints**, e.g. software and hardware design and decision-making issues—how to create truly useful DSS tools (Decision-Support-Systems).
d. **IT integration** issues across platforms, tools, e.g. from mobile to client to server.
e. **Access to quality, timely, specific spatial data** for baseline use, e.g. base maps, imagery
f. **Help in defining "what works best"** to solve specific "domain/research" and applied questions…where to get expert advice for "your needs".
g. **Guidance on best practice methods/approaches to field data collection** including how to deal with privacy and ethical issues vis-à-vis patient data.
h. Some specialized **research users needs** in **advanced analytical tools and methods.**

3. Users are very diverse and have varying needs—from simple visualization to more advanced analysis—and all users need to be treated with respect…recognizing that "one-size does not fit all".

Figure 1
Typical Levels of Sophistication and Types of Usage of Geospatial Data, Tools, Methods



4. There are still major capacity-building challenges at all levels (local, national, regional, global) whether it is helping the "GIS world" and its experts to better understand and interact with the broader medical informatics world and even the broader IT world or vice-versa.

5. There are still language and culture barriers that separate potential partners from users, implementers and data/tools providers.

6. The financial, technical, and human resource challenges span the gamut—which requires flexibility and open-mindedness by those helping as well as donors, government, NGOs, and the business/private sector world who may fund these efforts.

7. Finding the right "business cases" for GIS that makes economic sense within eHealth are still very unclear and untested though there is much more political will now to tackle this issue.

8. GIS will need to demonstrate that it can increase health outcomes and reduce costs in an age when there are never enough resources for the health sector.

9. Some users will require only OpenSourceSoftware (OSS) solutions (whether simple or complex) while others will require commercial tools, while many will find that “hybrid” solutions works best.

10. Experts who can and want to really help will need to be ready to assist users of various levels of capacity, differences in ability, or willingness to use high-end commercial solutions while others for various reasons want only OpenSource for various philosophical, technical, and financial reasons.

11. The GIS experts who will be most useful are those who can be “fair-and-balanced” in helping find solutions to specific problems and “use-cases” that fit within the limitations and capacity of the users.

12. Capacity-building and training will be paramount; not just in specific “one-off” events like this workshop, but must become something “more-on-demand” via online support or as part of more long term training programs designed within educational programs in developing country higher education, e.g. build on experiences from the IDRC Java/OpenMRS training now being formalized in Rwanda.

There are other recommendations that could be listed that are very specific and technical; I would rather not list all those here, but would rather think through ways to create support networks that continuously create and support specific “user communities” that can over time meet technical needs as the problems arise. But I will concentrate in the next section on outlining some specific recommendations for “next steps” that could build on the first two workshops, and help design the next ones to be most effective.

11.0 Recommended Next-Steps:

A. Recommendations for Expanding GISc online support to the NRM and eHealth Communities within and outside the OASIS-II netowork:

Because of the very diverse types of partners IDRC/Acacia works with from local to regional, and global, and, the very wide differences in levels of capacity, connectivity, donor requirements, understanding and ability to use GIS, as well as cost/benefit issues—as discussed in the previous section—I would start first on doing the following (see below).

Analysis & Recommendations:

1) The first step would be to encourage “early adopters/users” into joining some known and effective “user-groups”—focusing on those who we know about already or who have already expressed a need or interest in the integration of GIS with OpenMRS, JavaROSA, CommCARE, etc.

2) Initially use simple already existing online social network tools (e.g. LinkedIN, / Facebook) to organize simple informal webinars that solve specific user needs we know about now or which responds to initial queries and questions—there will be more “buy-in” when we target real issues that come up in actual implementation.

3) Maybe IDRC/Acacia already has the ability to organize such specialized targeted “webinars”--if so, then we need to start using that capacity for the eHealth and GIS work.

4) Use the initial social network interactions to inform the design of some very targeted follow-on face-to-face training events/workshops that meet specific user-groups needs and suggestions that will come out in the next few weeks and months (some from reactions to this report).

5) Develop some specialized training events on topics such as those listed below, but only after specific feedback and some time for finding who the real users are who want help:

   a) Field public health GPS data collection and design of simple monitoring and tracking geodatabases or even just visualization via Google Fusion Tables.

b) One target could be the small group of health planners, medical researchers, epidemiologists and disease surveillance specialists that we know want to learn more about "spatial epidemiology" tools and methods and who need more training.

c) Design some special workshops/task forces around specific known problems, e.g. linking SMS and other Cell Phone applications to geoservers and tools such as GoogleAPIs, Google Fusion Tables, Google Map Maker, MapServer, iDIG, QGIS, PostGIS, uDig, gvSIG, etc.

d) Design some small events that target training people in more advanced "spatial analysis" options using "R" linked to GRAS-GIS along with existing tools such as ESRI ArcGIS Spatial Analyst—maybe do this in conjunction with already planned future OpenMRS meetings?

6) Create a general "entry point" for getting help, i.e. assign some key people to support an **"Ask Mr. eHealth Mr. NRM"** site linked to the proposed redesign of the current **ICT4D portal** such as what the **SCGIS** (Society for Conservation GIS) List Serve and Web forum does for a broad community of conservation GIS users--see (http://www.scgis.org/) or CGIAR-CSI (http://csi.cgiar.org/) or the (EBM) Ecosystem-Based Management Tools Network (http://www.ebmtools.org/).

7) Evaluate and learn how the SCGIS or EBM Networks support their communities so it can serve as a model for the eHealth and NRM needs within the Acacia network. They are some of the best, most used, and most effective online technical support sites for many beyond its target audience of "conservation and biodiversity".

8) This "webservice" could be broken down into smaller "user-groups" on LinkedIN or other social networks (see Global Public Health Forum on LinkedIN) or a central service could point people to the various "user-groups" (where they can get help)—even for support questions that are "non-spatial" in nature.

9) Where possible make access to these support systems also accessible via the same IDRC/Acacia ICD4D Atlas and "redesigned" geoportal service (see suggestions under "B" below).

10) Bring into this online support system specific GIS and Remote Sensing experts who know both the commercial tools and software that might be useful as well as those that are FOSS-GIS.

11) The comparative **MATRIX** of various geospatial tools that Tom McConnell has put on GoogleDocs could be a good starting point and could be linked to specific persons who are willing to be "gurus" on use of specific tools, e.g. Asseffa on MASPSERVER, Chris Nicholas on GRASS GIS, Neal Lesh or others on JavaROSA, Amir Khan on GoogleAPIs for health reporting etc…and links to Android phones.

12) Help the OpenMRS world to become more engaged with the broader OpenGeosptial Consortium and the OSGeo standards and tool-making world, and become more active in standards development—this could be one of the "user-groups" that is developed first and could be a theme of a specific event in the near future—maybe in combination with OpenMRS.

In summary, there needs to be a way of segmenting and channeling information and support questions to specific "experts" because the opportunities, application needs, and tools are so diverse and vast!

B. Issues Regarding the IDRC ICT4D Atlas:

The current **IDRC ICT4D Atlas** (http://www.geog.mcgill.ca/atlas/welcome.php) does not seem to be used effectively by the current OASIS and Acacia community. At AfricaGIS (Kampala October 25-30) and at our eHealth & GIS workshop as well as informal discussions with attendees at the Acacia meetings in Dakar we found very few if any people who knew the site even exists. The few people

who had looked at the site did not give any indication that they would continue to use it unless it was made more useful for more than just visualizing a few interesting development issues and statistics, which by the way can be gotten better and more up-to-date at other sites on the web.

Analysis & Recommendations:

1) The current online maps could have some utility for very broad user groups, particularly if more data was being shown and if it was refreshed more frequently, and if it cross-referenced other available online complementary resources.

2) But it is very difficult to even track users at the moment, and it is not as user-friendly as could be for allowing users to critique or contribute their own data, or make suggestions or improvements.

3) In talking with CGIS-NUR staff (Deo and Clarisse) and Yewondwossen Assefa (who designed the current webmaps)--they all agreed that getting more "user-input" is needed via some more formal assessment and review of the user community and building into the site some better "feedback" tools.

4) CGIS-NUR (with input from those who attended the eHealth & GIS and earlier GIS workshops) suggest that a much stronger user-base could be developed if we link other needed services to it such as:

   -Link to technical support and software tools
   -Provide metadata services and catalog webservices showing where to get free data
   -Allow search and discovery via both text and graphical interfaces (map interface or place names)

5) Link the new site to existing geoportals (both at CGIS-NUR and others across Africa, e.g. SERVIR-Africa, RCMRD, RECTAS, EIS-Africa, GoogleMaps, ESRI-Online and others where they can get many free datasets for basemaps, imagery, analysis, and eventually "computing in the cloud"…

6) Provide an expanded interface that searches and locates free or contributed spatial data resources either via Google and other map-interface search tools that would show either existing or contributed datasets by the user community.

7) Where possible actually link to datasets or at least give metadata (via a catalog service) to show users where they can get the data, evaluate quality etc.

8) The online archive and catalog would start first addressing specific map needs of the eHealth and Conservation/NRM communities in countries and among partner groups Acacia works with now.

9) Design this expanded (redesigned Atlas site) into an eHealth "spatial data clearinghouse" so it can grow organically as driven by user feedback and needs—some of which we now know specifically from the workshops.

10) In the redesign, consider ways for **users to provide links to their own data** via a "metadata clearinghouse" such as the Geoportal that CGIS-NUR has now developed (using open-source tools or as the **CGIAR-CSI** (Consortium for Spatial Information) had developed for the agricultural research community – see (http://csi.cgiar.org/).

11) CGIS-NUR (Deo and Clarisse) will develop a more specific proposal to improve the current site and other resources that would attract more traffic to it.

12) Adding GIS support resources to the **EMR/OpenMRS Implementers Network** would also be helpful; then link it to some of the other well-developed networks in conservation, NRM, remote sensing that have applicability to the eHealth world such as:

-**NASA-SERVIR** (http://www.servir.net/), the
-**ARCOS** network (http://www.arcosnetwork.org/), or
-**EBM Tools** Network (http://www.ebmtools.org/) or
-**PATools** (http://gg.usm.edu/pat/) could help the eHealth community get access to needed data, tools, expertise, imagery, policy guidance, etc.

C. General User Issues/Needs and Recommendations:

There are some broader policy implications to what was learned in the first workshops that need to be thought through and looked at in terms of next steps—besides those "overarching observations" provided earlier. Some of this is more in the form of advice that could guide future funding and collaboration with other donors by IDRC/Acacia. These include:

Analysis & Recommendations

1. Share some of the successes and failures at broader GIS meetings where expertise, donors, and users come together, e.g. a presentation on this effort will be given at the upcoming **AfricaGIS** conference in Kampala (October 25-30) – see = http://www.africagis2009.org/

2. Get more of the eHealth community engaged with the broader GIS world via **EIS-Africa** (http://www.eis-africa.org/EIS-Africa) and **AARSE** (http://www.itc.nl/aarse/) and others on the global level such as **GSDI** (more listed in the Resources and Links in the Appendix).

3. Help key bilateral and multilateral donor agencies to better understand the critical role GIS can play in sustainable development—particularly as it addresses the cross-cutting and often at-odds demands of various sectors, e.g. agriculture vs. ICT, vs. democracy and governance, vs conservation vs. eHealth. GIS can be the "integrative" tool that makes many sectoral investments much more effective and results-oriented.

4. Help donors and implementers to better assess client needs in the health sector vs. accepting without question some demands that may or may not be realistic vis-à-vis current technologies, standards, and the fast evolving ICT world.

5. There is a lot to be learned from what other industry groups have gone through to adopt and use standards effectively and it would speed-up adoption and avoidance of mistakes or maximizes collaboration across multi-sector areas (see the OGC, HL& communities).
   .
6. Get spatial and non-spatial data standards groups working together on "standard data dictionaries" and "ontologies" so that classification systems work together more effectively?

7. The OpenMRS group is now dealing with many of these "standard vocabulary and meaning" issues and could learn from what others are doing in the "spatial data dictionary" world to avoid future problems when EMR systems include spatial datasets. This issue is frequently mentioned by other ISO standards groups (see links to ISO and standards groups in the Glossary).

12.0 Personal Conclusions:

As one of the participants in this process, I would like to end by saying there are great opportunities to be gained here by everyone involved: users, implementers, technology companies (commercial or OSS), government, NGOs, and even individuals and local communities. My hope is that this effort will start a longer-term process that will provide many benefits to achieving better human health and well-being to all across the globe, but particularly for those in the developing world who face countless challenges each day in surviving and living full and productive lives.

Sometimes it seems that complex tools and methods such as GIS don't really have a true "demand/killer ap" that makes their use a "given". I think this perception may be primarily caused by the GIS world itself not being willing to adapt to and listen to the "real users" out there. Everything in final analysis is related to or linked to somewhere (place). Average people know that and it is why maps are so attractive to most common people; the GIS world needs to build on that innate understanding of reality that people have and produce the products that actually sell themselves!

Robert E. Ford, Consultant: November 6, 2009
CGIS-NUR, National University of Rwanda

APPENDIX

I. TABLE I - Summary of Select Health-related GIS Projects CGIS-NUR has worked with in Rwanda 2007-2009

Project Name & Key Contacts	Other Partners & Supporters	Key Outputs Activities	Key Lessons-Learned and Future Plans
GIS – EMR Pilot Project (PIH) Partners in Health – Rwanda **NOTE: See more under Table II below**	IDRC/Java training project/Kigali, LLUSPH, MOH, ESRI/Redlands, CGIS-NUR, local gov't entities, etc.	**NOTE: See more under Table II below**	**NOTE: See more under Table II below**
MVP/Rwanda (Mayange): (Teddy Kaberuka, Andy Kanter, Donn Gaede, Didace Kayiranga, Max Baber, Wendy McIntyre, Katherine Noble-Goodman, etc…) University of Redlands (UofR) Mayterm – 2008-2009 working with CGIS-NUR under an MOU signed in December 2008 did "ater-related" work under DWP grant (Los Angeles) at MVP/Mayange, Rwanda http://www.unmillenniumproject.org/mv/index.htm and ***HealthyGIS*** (newsletter) – summer 2009 (http://www.esri.com/library/newsletters/healthygis/healthygis-summer09.pdf)	LLUSPH, UR-MSGIS Prog, OpenMRS, Columbia Earth Institute, ESRI/Redlands,	1.Mapping of water resources, poverty, health, food security, and other development variables; 2. Testing of integration of GPS data with OpenMRS EMR and "address-matching" down to Umudugudu level (lowest administrative level) for better analysis of health outcomes, and, 3. Linking health outcomes and "encounter forms" to other spatial data such as food, poverty, education, agriculture, water, demography, environment, landuse/land cover, etc.	1. Mapping of detailed polygon vector data of the lowest-level administrative boundaries (*Imidugudu*) is found to be time-consuming and costly; 2. Now considering ways to speed-up mapping with use of *Thiessen Polygon* calculations, use of hi-resolution imagery coupled to PGIS work to increase accuracy and reduce cost; 3. Analysis and linking of mapped data of *Umudugudus* to OpenMRS data still being worked on—check back for future results.
Karongi District (Kibuye) Rwanda P.E.A.C.E Program of the Saddleback Church with RDGG/CGISNUR	University of Maryland HIV/AIDS community education and treatment	Dr. Robert Ford & Geo-IT Unit at CGIS-NUR—Deo Rutamu and students from NUR (National University of Rwanda) helped collect +700 GPS points of	1.Key idea is to test benefits of using "churches" and lay volunteers in community-based HIV/AIDS and other social and health

Deo Rutamu, Robert Ford, Moses Ndahiro, Larry Smith, and other Saddleback Church community development specialists Saddleback Church - Rwanda (http://www.saddleback.com/aboutsaddleback/signatureministries/thepeaceplan/index.html)	program, PEPFAR, LLUSPH, etc.	schools, churches, water points, and other features and provided training to CDTs on use of GPS and creation of simple databases and maps to link to baseline survey data for future monitoring and evaluation efforts. Project data jointly being collected by CGIS-NUR with P.E.A.C.E Program volunteers with funding for data gathering from Ministry of Education/Rwanda and RDGG/Rwanda.	work; could be revolutionary method of outreach and M&E. 2. All potential field partners (which are primarily churches and schools) are not yet fully participating in some cases due to some unwillingness of some local partners (church leaders) to work across denomination boundaries; some suspicions need to be alleviated. 2. A huge amount of baseline data has been collected but there are not sufficient technically savvy GIS volunteers or paid workers to manage geodatabases effectively. 3. Getting full agreement from all church-based groups to "buy-in" into importance of rigorous science-based data gathering is not fully appreciated yet; 4. Full collaboration with what some church groups see as "secular" gov't , NGOs, and Universities still a perceived problem--some sensitization work is needed.
CGIS-NUR Malaria GIS pilot study with PNILP (The National Malaria Program) *Principal investigators:* Nicole Ueberschär, Laurent Iyikirenga, *Collaborators* Alphonse Mutabazi, Olivier Briët, *Supervisors* Jean Pierre Bizimana, Dr. Corine Karema	See Final Report In WIKI *Development of a geographical information system applied to malaria surveillance in Rwanda* Huye, January 2009	1. One-year pilot study to map malaria incidence and services. 2.Begin process of doing better mosquito vector ecology epidemiological research 3.Establish data linkages with TRAC+ (MOH Disease Surveillance Unit) 4. Demonstrate value of GIS data in disease surveillance and M&E, etc.	1. The geodatabase can still be improved substantially. 2. Data concerning health facilities has not been completed, the estimations of catchment areas are still only provisional. 3.Spatial analysis of relationships between environmental factors and malaria incidence, i.e. epidemiological data must

The general objective of this study is to improve malaria surveillance by a geographical approach so that control efforts and intervention strategies would be more effective and best targeted.		5.Key objectives: □ setup GIS data base of malaria, including environmental data; □stratify malaria according to environmental and epidemiological parameters; □estimate malaria epidemics risks over time and space. □Internal capacity building programme at the Malaria Unit of TRACplus on epidemiology monitoring using GIS technologies. **NOTE**: This study has become basis for further grant proposal writing and research with the EU and SEI.	be updated. 4. Four members of the TRACplus Malaria Unit have been trained to use GIS. 5. TRACplus Malaria Unit was advised to acquire equipment like a printer, computer, GPS devices and software. 6. Other data that should be considered for further analysis i.e. temperature, elevation change, climate, entomology, parasites, survey data (MIS, DHS, malaria-metrical data), as well as data about malaria control interventions (ITN, HBM, Larvicide, IRS, etc.) to complete the GIS.
Karisoke Research Center "Ecosystem Conservation and Human Health" Projects Dian Fossey Gorilla Fund International (DFGFI) Karisoke Research Center (KRC) (http://www.gorillafund.org/karisoke/research_center.php)	Over last 2-3 years DFGFI been working both in Congo and Rwanda to build confidence and "buy-in" by local residents of the "buffer zones" and improve people's daily lives around the Volcanoes National Park and other preserves Congo. Some training in GIS tools has also occurred with help from TNC that will both benefit biodiversity conservation as wells as eHealth efforts.	1. Primary goals are to reduce poaching and increase "buy-in" and support by "buffer-zone" peoples and communities, increase wildlife protection, and to reduce the potential of disease transmission between humans and primates (and vice-versa). 2. Discussions on how to link effort to research under START/ GECHH (Global Environmental Change and Human Health) science plan; 3. Focus would be on "climate mitigation and adaptation efforts" linked to human health and well-being.	1. Strategy of linking human health and well-being is now a well-proven but difficult to fund concept in many conservation settings. 2. Some critics feel the approach lacks long-term sustainability because focus primarily on immediate "buffer zones" issues ignoring broader demographic, policy, and environmental forces that will overwhelm the viability of the parks/preserves. 3. Conservation NGOs generally lack the technical or financial resources to fully use GIS technologies as well as they would like to.

			4. OSS solutions, tools, and training is greatly needed, particularly for small NGOs.

II. Final Agenda – GIS and eHealth Workshop:

INTEGRATING GIS INTO eHEALTH INITIATIVES IN AFRICA

Chairs: Robert Ford, CGIS-NUR/Rwanda and Chaitali Sinha, IDRC
Cape Town, South Africa, September 17th, 2009
Workshop Agenda and Programme

Guiding Questions for Presenters and Discussion:

NOTE: Throughout the session the leads/organizers will compile thoughts/ideas onto flipcharts around the following key themes/issues. **Presenters should try to address these as much as possible—these questions/themes will also be the focus of discussions**:

Workshop Objectives:

1) To learn about GIS and more generally about how geospatial data collection, analysis and representation could be used strategically and appropriately to enhance the research planning, implementation and communication processes in eHealth initiatives.

2) To share the outcomes, challenges and opportunities from specific case studies of GIS applied in health initiatives in resource constrained settings.

3) To initiate a discussion about how members of the OASIS II network could tap into GIS concepts, tools and resources for the purposes of their research.

Key Questions:

a. What are the USE-CASES (applications) for which geospatial data, analytic tools, APIs, visualizations or other products/webservices are/were most useful in adding value to clinical, outreach, public health, research, and other related community-development applications?

b. Who are/were the most important USERS for which the geospatial applications, analytic tools, data, webservices, visualizations were most relevant?

c. What are/were the most significant issues/problems/constraints in making GIS work to full advantage within site-specific clinical, community, and regional/national settings, etc:

-**Technical**, e.g. software, hardware, instrumentation, connectivity, integration of systems, architecture and design, geodatabases, analytic tools, APIs, etc.
-**Logistics**, e.g. travel, communications, scheduling, coordination, etc.
-**Human capacity**, e.g. training, availability of personnel, etc.
-**Data & Webservices,** e.g. access, availability, quality-control, appropriateness, validity, reliability, timeliness, etc
-**Cost/funding sustainability** issues
-**Institutional, e.g.** legal, administrative, policy constraints, privacy, etc.

d. What are the next steps and needs that must be addressed in order to better integrate GIS tools, data, visualizations, webservices into OpenMRS, CommCARE, OpenROSA, OpenJAVA, (assuming you believe it is needed, etc)

INTEGRATING GIS INTO eHEALTH INITIATIVES IN AFRICA

Cape Town, South Africa, September 17th, 2009

AGENDA

15:30 – 15:40	Welcome & Overview by IDRC (**Chaitali Sinha**)
15:40 – 16:00	Potentials for Geospatial Tools in Health IT Systems – Workshop Overview (**R. Ford**)
	SHARING EXPERIENCES
16:00 – 16:10	**PIH Rwanda**: GPS/Field Data Collection Project - use of GIS in M&E improvement of OpenMRS (**Cheryl Amoroso**, John Deriggi, Donn Gaede)
16:10 – 16:20	**Pakistan**: Experience with Google Earth, etc. (**Aamir Khan**) - Interactive Research & Development (IRD) in Karachi, Pakistan
16:20 – 16:30	**Peru TB case-mapping (Dave Thomas, PIH**
16:30 – 16:40	**Rwanda eHealth & TRAC Experience** – current, and potential plans/experiences in the use of geospatial data & technologies (**Gilbert Uwayesu, Daniel Murenzi**)
16:40 – 17:00	**Other Reports (Bob Ford and Deo Rutamu)** – Summary (Saddleback, GECHH, PNLP, etc), MVP Mayange (Ted Kaberuka, Donn Gaede)
17:00 – 17:30	**FISHBOWL: QUESTIONS & DISCUSSIONS**
17:30 – 17:45	**BREAK**
17:45 – 18:20	FISHBOWL: **Integrating Geo-IT and Health – Geo IT Standards and Tools (Rolf de By,** Respondents: Chris Seebregts, Andy Kanter, Neal Lesh, John DeRiggi, Darius Jazayeri, others)
18:20 – 18:55	FISHBOWL: **Analytics, Ontologies and Health Standards (Tom McConnell,** Respondents: Deo Rutamu, Aamir Khan, Daniel Murenzi, others)
18:55 – 19:30	**SUMMATION - ROUNDTABLE DISCUSSION** • What is needed to build capacity among African partners? • Does the use of GIS fit the goals of OASIS-II? • If yes, which components of OASIS II can realistically include GIS within their research design within the timeframe of the project? And how? • Who else needs to be involved to move forward on selected strategic applications of GIS in OASIS II? • How will we continue discussions and planning?

	• What is the "product" of this meeting and who will compile/circulate it?
19:30 – 2100	**DINNER**

WIKI = There is a wiki space (http://idrc-gisworkshop.pbworks.com/) that was made to capture lessons from all the GIS workshops.

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III. Planning Document Prepared by CGIS-NUR, LLUSPH and other partners to lead the "Pre-Pilot" efforts leading up to implementation of the Doris Duke Charitable Foundation grant with PIH/Rwanda

PLANNING DOCUMENT BY CGIS-NUR AND ASSOCIATED PARTNERS TO PROVIDE TECHNICAL ASSISTANCE TO THE PHIT CONSORTIUM AND OTHERS IN THE DESIGN OF SPATIALLY-ENABLED HEALTH-IT SYSTEMS IN RWANDA

Robert E. Ford, PhD, MPH and others – CGIS/NUR - Rev. February 20, 2009

ABSTRACT:
Geographical Information Systems (GIS) technology has many clinical and public health applications. Chief among them is enhancing monitoring and evaluation activities by facilitating spatial analysis of various health issues. Geographic data may be utilized to strengthen and improve primary care systems, service delivery, and operations research. Additionally, it affords clinicians, managers, planners, researchers, and community leaders the ability to link proposed outcomes and performance measures to explanatory variables not traditionally considered including the physical environment, livelihood patterns, demography, ethnicity, settlement/infrastructure barriers (travel/logistics), agriculture and food security, water, and poverty. There is strong national support for GIS. Several initiatives now exist which can quickly be utilized as a platforms for supporting GIS research and applying the results including TRACPlus, eHealth, Malaria Disease Surveillance (PNLIP), PIH OpenMRS activities, and the WHO's OpenHealth. Furthermore, there is a strong cadre of spatial analysis professionals available locally and internationally who can collaborate on projects, provide technical support, and contribute to capacity-building efforts.

PROPOSAL:

Background, Significance and Problem Overview:

The integration of geographically-relevant health data within the framework of human health practice and public health IT systems, has enormous positive potential for mapping indicators related to primary care, system strengthening, and improving access to care. *Where* people live, work, and play have large and important roles in a) how healthy people will actually be, b) what risks to health they will face in the years ahead, and c) how effective delivery of services will work. Making health interventions work in local communities is still a function of information transfer, so building sustainable informational "best practices" remains critical to measuring health indicators and social outcomes efficiently and effectively.

This new capacity to link health outcomes and interventions to high-resolution spatial scale variables at the landscape-level, addresses a major health information and knowledge management problem around the world—that is most health data-gathering and reporting systems only list where patients/clients are served or were treated—usually at clinics or hospitals--NOT where they live or contract the disease. Furthermore, rarely can "stovepiped" health data systems cross-tab with what may be crucial, non-health associated factors that may better explain what is required for efficient and effective prevention, early detection, diagnosis, treatment, and rehabilitation--*geography is destiny – in fact medical destiny!*

Rwanda is currently one of the most receptive countries for testing, designing, and applying health information management systems on the ground in Africa. There is strong national support, several initiatives now exist which can quickly be utilized as a platforms for supporting the study and applying the results, e.g. TRACPlus, eHealth, Malaria Disease Surveillance (PNLIP), PIH OpenMRS activities, WHO's OpenHealth , and there is a strong cadre of spatial analysis/statistical professionals available locally and in the region or available internationally who know Rwanda and who can provide technical support.

The Operational Plan and Goals:

The project will take place in Rwanda starting September 2009 and its central goal will be to support the stated operational deliverables of the (DDCF) "PHIT" consortium led by PIH (Partners in Health). The pilot study will help to *design, field-test, and integrate the use of spatial data (geographic variables) within the current health information system — OpenMRS which currently focuses on clinic-based services -- and extend their application to planned community-based public health outreach and service delivery programs that coordinate with other non-health interventions, e.g. agriculture, poverty reduction, education, social welfare, etc.*

Adding this spatial-analytic and geographical visualization component to health IT services—facilitating the easy, transparent, user-friendly production of mapping products both online (via web-enabled services) and in paper copy to users of various types--will not only improve traditional health service delivery and access, but will provide managers, planners, researchers, and community leaders (e.g. field workers such as CHWs) ability to link proposed outcomes and performance measures to

explanatory variables and hypotheses not traditionally considered such as environment, livelihood patterns, demography, ethnicity, settlement/infrastructure barriers (travel/logistics), agriculture and food security, water, and poverty.
The first steps will focus on defining and deciding, with some technical assistance from Health-GIS and "interoperability" GEO-IT specialists, on what the "use cases" really are—that is--define *who needs what information, when (and how often) and for what purpose, and in what data formats, that are interoperable with other statistical datasets; this* will be the critical goal *of the pilot study*. Getting this "right" will require direct interaction with users/clients on the ground and the service-provider community--clinicians, CHWs, extension agents, health researchers/planners, and clients and community leaders themselves--to ensure that potential "mapping products/web-services" actually provide the most useful "information" in a timely, spatially targeted (right scale), clinically-relevant, and cost-effective manner, and that the mechanisms are in place for capacity-building and training.

Key Activities/Products:

1. Carry-out a field-based pilot project in Rwanda to define use cases in two target areas (around Rwinkwavu, eastern Rwanda, and Burera, Northwest Rwanda) with the assistance of two global health graduate students from LLUSPH and other students and staff from the PHIT/Rwanda Consortium and CGIS-NUR (Butare).
2. Develop and test procedures for collecting field spatial data with GPS—that builds on already available data from CGIS-NUR and other agencies—starting first around the PIH/Rwinkwavu sector public health activities that are needed for monitoring implementation of a TB-control program, as well as those needed to better monitor related food security, agriculture, and other community-based public health outreach activities. In this phase, the students will also collaborate closely with a planned "health economics" survey that is being launched by Mathew Bonds (Harvard).
3. Integrate IT systems and mapping products with a planned Google Grant which PIH has requested—and if received--will also be utilized as a vehicle for testing/defining visualization of geographically accurate health data products to be collected and maintained by a wide variety of governmental and non-governmental organizations.
4. With the assistance of others--CGIS-NUR staff and students, ITC/Netherlands, and University of Redlands (MSGIS Program who will visit Rwanda in April/May 2009)—we will start production of prototype mapping products that will enhance the ability of health providers and community leaders to visualize, design, evaluate and monitor systems and outcomes.
5. Build capacity of users within the PHIT consortium, via technical assistance and training by outside health spatial data experts funded largely via CGIS-NUR and the Rwanda Development Gateway--on how to both systematically *organize geographic datasets* and how to incorporate widely accepted geographic standards within existing health information system standards, such as HL7 Version 3.0 (Health Data Model)--see attachments from ESRI[5]**.** The goal is to enhance the efficiency and effectiveness of health data collection, facilitate data interoperability, and seamlessly integrate GIS tools and databases of various types using both OpenSource Software (OSS) and COTS (Commercial-of-the-Shelf)[6] solutions.
6. The results, products, training and recommendations will become key inputs to design of "scaling-up" activities for the national "roll-out" of health IT systems in Rwanda via the eHealth initiative and provide lessons for similar endeavors in other countries across the African continent..

Key Question to be Answered:
Which types of high-resolution spatial data provides health managers and researchers with the most cost/effective information and knowledge that cannot be gathered by more conventional health information systems that are hospital and clinic-based. We will make it easier for health researchers, providers, and planners to ask, visualize, and answer "place-related" health questions they may not have done before or even thought of before! The goal is to improve quality control and data interoperability that is essential for rigorous spatial analysis as well as operations research and monitoring and evaluation.

Key Output Expected:

[5] See attached document in the Appendix that explains more of ESRI's work over many years with some of the largest health NGO's as well as some of the largest information technology companies in the world, which can provide access to a network of relationships that can be leveraged to help meet the health informatics needs of countries such as Rwanda, Malawi, Lesotho and other countries in Africa.

[6] It should be added that frequently, to be truly cost-effective, hardware and software systems and database structures need to **interface** with a mixture of both OSS and COTS software and hardware systems to reduce costs, increase robustness, and add flexibility for multiple user needs, e.g. one may use COTS systems for higher-powered servers and special analytic purposes, while also doing simpler web-based applications for non-specialist or public access. Determining what is the right mixture of systems is a critical task for the pilot phase.

The above partners will work together in the field with PIH and other MOH staff, community health workers (CHWs), and local government administrative cadre, e.g. agricultural extension or nutrition health workers, to better define and map with simple GIS/GPS tools the *most essential health-related location data* not already available at the national or regional level (points, polygons, lines) such as *Umudugudu* boundaries (or centroids of essential health services or household clusters). The choice of these data inputs will come from direct interaction with health providers, users and consumers "on-the-ground"**.**

Other Outputs:

1. Based upon a field definition of realistic "use-cases" the current working OpenMRS system will be reworked slightly to be interoperable with full GIS, i.e. create a "cleaned" address hierarchy and geocoded "lookup table" to allow current patient, clinical, and community data to be visualized in various GIS software and tools.
2. We will explore several different options for visualization and analysis of spatial data (from OSS to COTS) and make recommendations on utility, cost, technical support and training needed, etc.
3. With input from partners at the University of Redlands and Loma Linda University (jointly working with CGIS-NUR) sample spatial analysis products based on existing datasets from Rwanda will be produced to demonstrate to users at PIH and MOH how tools such as ArcGIS linked to Google Earth and GPS, can produce more sophisticated analytic results to supplement decision-making functions at various levels.
4. Recommendations about institutionalizing new Health-GIS production and analysis capacity will be made directly to key stakeholders such as the **MOH, MINILOC, RITA, TRAC-NET,** and **NISR** to ensure that the lessons-learned contribute to improving *spatial data standards* and *human capacity* needs in Rwanda.
5. Plans and mechanisms will be put in place to build the technical capacity at NUR, within government partners, and among the PHIT/NGO consortium, and others working with PEPFAR, ACCESS/Health and others, to design, maintain, and apply the new spatial analysis and visualization tools/products to better serve various users in the health community.

Summary:

The most essential result will be to define and implement a health-related SDI plan that is interoperable with broader geographical global, regional, and national standards for reporting, monitoring, and tracking systems that requires health information to fit into other indicator and statistical systems, e.g. MDGs (Millennium Development Goals), WHO and Rwanda national health and medical reporting guidelines, UNEP/UNDP Indicator systems, national statistical data integration, national mapping standards, and of course to best serve the needs of the PHIT DDCF grant.

Budget Overview Explanation - Pilot Phase: Rwanda September 1, 2009 > September 1, 2011:
We would anticipate some initial funding needs to help CGIS students and staff to participate in field definition of "use-cases"(most will be covered with the "seed grant" from LLU and CGIS-NUR support via the Rwanda Development Gateway) and other funds as they become available (during the February 1-September 1, 2009 period). In the earliest phase ("pre-pilot") some of the partners and potential technical assistants/trainers from abroad will need some travel assistance; we will try initially to use already planned travel and/or outside sources (e.g. via RDGG-CGIS-NUR—Rwanda Development Gateway)—more below. Local partners will contribute housing and other local travel logistics out of existing resources. CGIS eventually will need some minimal indirect assistance for management, technical support and supervision—some of this is being donated in this early "pre-pilot" phase. Some short term consulting by outside experts to assess and design systems, and offer critical early technical advice will be needed; we will try to combine this with planned "capacity-building" events being organized via RDGG. The goal of these early "capacity-building" events (workshops) will be to teach web-mapping skills using both OSS and COTS tools and methods, and give input on SDI processes and needs. More of this will follow as the full DDCF grant starts (after September 1, 2009) and hopefully, after the next phase of the NPT program with ITC-NUR begins.
As the lessons are first learned in Rwanda, follow-up plans will be designed for doing similar "pilot study" work in Lesotho and Malawi—this will depend on demand and other funding that will be sought. Finally, once results and recommendations are clearer, programs/activities will shift to "scaling-up" results and data standards, tools, products, and improved health information systems to national levels, in partnership with the responsible government agencies in each target country—starting first in Rwanda via our PHIT partners in the NGO and government sectors.
Budgets for later "scale-up" activities (starting September 1, 2009) will be refined after the initial pilot phase in Rwanda is complete, when PIH knows better the actual start of funding (and amounts) that will come from the DDCF grant, though for purposes of this proposal the total amount requested from the PHIT consortium will be limited to the $20,000 outlined below. By early 2010 actual costs will be better understood, recognizing that conditions will vary in the other target countries and adaptation will be required; and we will likely know then whether another phases of NPT will occur, and whether other sources of funds from MOH/eHealth, etc…might become available. We will be in a better position after September 1, 2009 to plan/revise the "pilot" using the advice learned in the "pre-pilot" phase and also include the consultations provided by the technical experts who will come for training workshops. All this will also help identify better what initial sample products are required for which users. And we will be in a position to identify more specifically the longer-term capacity-building needs of the participating PHIT partnership.

Simplified Budget:

COST CATEGORY	REQUESTED FROM PHIT GRANT	VALUE PAID BY or DONATED BY OTHERS (in-kind, voluntary, etc.)	NOTES and COMMENTS
Personnel:	$3,500	~$30,000	Some salary support to CGIS for technical assistance by students, CGIS-staff, and others.
Indirect Costs:	$1,500	~$10,000	Administrative costs to CGIS and others for project management, Reporting, accounting.
Training and Technical Support:	$10,000	~$20,000	Two-four workshops events (EST. $5,000 each) + donations of in-kind venues, lodging, etc… Some cost s split between PHIT and RDGG-CGIS and other RW/agencies and outside supporters, e.g. ESRI
Logistics/Travel: **-International and** **-In-country**	$3,000	**$30,000**	**International travel (6-8 RT tickets) to be paid by RDG-CGIS and others…as part of shared efforts with other planned "capacity-building" events/efforts. PHIT grant requested to cover in-country travel…**
Equipment and Software (donated + purchase):	$1,000	~$30,000	Initial use of personal/loaned GPS equipment and already purchased equipment; potential purchase of 2-3 new GPSs by PIH; as much as possible, software will be OSS, with some select COTS purchase or licensing via planned RW/Government-wide licenses.
Data Purchase and Analysis/Production (including	$500	~$30,000	Public domain or use of data from other sources…. If needed, some purchase of critical missing data possible, after initial pilot phase makes

donations)			recommendations and sample products are made.
Publication, Dissemination and Communications:	$500	~$10,000	Variable… will expect most of publication costs will be covered by participating institutions, individuals, and organizations as part of their normal efforts of sharing what they do via academic journals and PR efforts.
TOTALS	**$20,000**	**150,000**	

Budget / Cost Explanations (starting September 1, 2009 or whenever the DDCF begins):

A. Personnel Participation (supplement for select stipends, honoraria, minimal salary support, volunteer efforts):

EST. = $3,500 (PHIT grant and others as available) -

1. **CGIS-NUR:**
   -Giselle / Clarisse and Deo Rutamu - (GEO-IT/CGIS-NUR)
   -Felicia Akinyemi / Robert Ford, CGIS-Directorate
   -Nicole & Alphonse – CGIS/PNLIP ?
   -JP Bizimana – CGIS/SLM
   -NUR student assistants (agriculture, health, medicine, public health, geography)

2. **ESRI/Germany/Redlands**
   -Bill Davenhall, ESRI/Redlands Health Industry Manager (Dan Sheres, CDC/JHU).
   -ESRI/Africa specialists, e.g. Maputo/US (Health/Medical GIS Spatial analysts specialists)
   -Stefan Kappeler (CGIS/ESRI-Kigali Office)

3. **OGC (Open Geospatial Consortium) OSS specialists in webmapping for health, use of Google Earth, OSS Mapping.**
   - Martin Huber (Bern/Basel, Switzerland and UNIGIS and Condesys, Inc.)
   -Luis Soto (Bolivia) – Dacorpsoft, LTd (specialists with IDB/WB and GPC, Inc. – OGC/OSS specialists)
   -Sherif Amer and T.M. Loran, "Yola", and others at ITC Netherlands via NPT Project with NUR
   -Steve Schill, Science Director, TNC (Mesoamerica) – for ArcGIS/Google Earth and other applications that link with environment, biodiversity, including Remoe Sensing (RS).

4. **Loma Linda University, SPH and University of Redlands/MSGIS program/Andy Kantor (Columbia U./MVP):**
   -Seth Wiafe, Donn Gaede, Suzanne Montgomery, Brad Jamison (LLU) – Health Geoinformatics / Epidemiological research specialists
   -Max Baber (UR), Katherine Noble-Goodman (University of Redlands, Master's in GIS, GIS spatial Analysis Specialist who has worked on Umudugudu mapping and analysis with MVP/Mayange, Rwanda.
   -LLU Graduate Global Health Students (Nicole Grey and Danielle Richey)

5. **MOH/NISR/MINILOC/NUR-Medicine & SPH:**
   -Dr. Agnes Binagwaho, MOH
   -_____, Acting Director, NISR
   -Mrs. Grace Gasani, Innovation and Research at RITA (Rwanda Information Technology Authority)
   -Professor, Longin Barango, School of Medicine, NUR
   -Professor, Kakoma, Director, SPH, NUR
   -Verdiana Masanja, Director of Research, NUR
   -Shabani CISHAHAYO**,** Director of Surveillance, Bioinformatics and IT Unit**,** TRAC *Plus*-CIDC
   -Laurent Iyikirenga, PNILP Counterpart for GIS Malaria Project, TRAC *Plus*-CIDC
   -Gilbert Uwayezu, Health IT Office/MOH, MPH

   PIH (Boston, Rwanda, etc.) & other OpenMRS participants
   -Hamish Fraser, PIH/Boston, Head of Informatics
   -Michael Rich, PIH/Rwanda Country Director

-Cheryl Amoroso, PIH/Rwanda, EMR Program Director
-Patrick Manyika, EMR Program Manager
-Francis Karimbizi, PIH/Rwanda OpenMRS Programer
-Darius (Boston/PIH, OpenMRS developer)
-Lisa Hirschhorn, PHIT Monitoring & Evaluation
-Andy Kantor (MVP/Columbia University – Health Informatics)
-MVP/Mayange (Rwanda) – Shadrack Dusabe + Didace ? (Science Director)

B. Indirect Costs (administrative support and management/accounting services)

EST. = $1,500 (PHIT grant)

C. Training and Technical Support (workshops/capacity-building):

EST. = $10,000 (PHIT + most likely from RDGG, ESRI, and others)

NOTE: Some of the costs of trainers/technical specialists will be shared by RDGG (Rwanda Development Gateway Group) with some covered "in-kind" by hosts such as RITA (Rwanda Information Technology Agency, MOH, TRAC-NET, etc). Training events/consultation will not only serve PHIT needs but other planned projects dealing with web-mapping needs, e.g. Rwanda trade map, ecosystem services/ecological data sharing, infrastructure management, national SDI needs, etc. Every effort will be made to use "in-kind" donation of facilities for training at RITA/NUR-SPH, PIH, etc as well as travel costs for participants).

1. **Workshop #1: training event** on **web-enabled mapping, web-services design for health and other economic/social/ecological sectors** (including both OSS and COTS) methods and tools.

   EST. = (lodging, *per diem*, food, materials, etc….for attendees and trainers, etc) = $5,000

2. **Workshop #2:** training event on **health geoinformatics and spatial statistical analysis and use of HDL7 (health data model)** with focus on standards and interoperability of databases and software tools/systems (including both OSS and COTS). Proposed use of Dan Sheres, MPH, GIS Software and Data Expert.

   EST. = (lodging, *per diem*, food, materials, etc….for attendees and trainers, etc) = $5,000
   NOTE: More workshops will be attempted than two, depending on future grant funding and "in-kind" donations.

D. Logistics/Travel (local and International travel, lodging, food, miscellaneous expenses):

EST= $30,000 (RDGG) - . International travel (6-8 Round Trips from Europe, Latin /America, and the US)
EST. = $3,000 (PHIT and others) - Local in-country travel, auto rental

E. Equipment and Software (GPS/GIS software and hardware):

EST. = $1,000

NOTE: Some donations will be sought from various vendors and/or special rates for software will be available via new arrangements being negotiated now with RITA/ESRI, TRAC-NET, e.g. ArcGIS, arcGIS Server, ERDAS/Imagine, GARMIN GPSs, etc.. Initial pilot study work will use available/donated equipment from participating institutions already purchased; heavy emphasis on using OSS and only COTS software and tools where needed, after assessment during pilot phase will also be explored so that it fits within the OpenMRS approach the PIH/MOH has chosen.

F. Data Purchase and Analysis/Production (Imagery, Data rights Purchase/Licensing, etc.)

EST. = $500

NOTE: Most data (shapefiles/raster files, geodatabases are in the public domain or owned by RW/CGIS, NISR, etc; most satellite imagery needed is already available--some imagery is free; other high-resolution commercial imagery (Quickbird) expected as donation from US State Department and others). Minimal purchases of imagery are expected but may not be clear what to purchase until the initial pilot phase is near completion to see what is missing vs. what will need to be developed new from field data gathering with GPS.

G. Publication, Dissemination and Communications:

EST. = $500

NOTE: Publication and presentation costs at conferences/symposia will be largely covered by the institutions and faculty/organization s participating, e.g. UR, LLU, CGIS, PIH, MOH, etc.

Contact:

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ATTACHMENT

ESRI/Redlands: Africa eHealth Collaboration

Proposed Contribution

The many activities that are surfacing within Africa that encourage the broader use of modern and progressive information systems for improving personal health present significant opportunities for local, district, and national health and human service agencies to have greater insight and knowledge about the impact of various public health interventions being proposed throughout various regions of Africa.

Many of the proposed activities will incorporate a wider variety of new information technology ideas such as OpenMRS, OpenHealth, and certainly will continue to leverage the educational value of COTS products and services as well as the sustaining capacities of private organizations over the long-term.

One of the many opportunities that exist within the Doris Duke Charitable Foundation initiative is to greatly enrich the value of geographical information within the electronic health record. The project planners envision the wider use of the OpenMRS at the local levels, not only generating valuable caregiver information and service coordination but very precise and accurate district level and national level reporting. This project will bring the value of health information to a much higher level while guaranteeing that information that is used at a wider level and will be more credible and useful to the very people that should benefit the most – the health seeking "consumer".

Over the last three (3) years, ESRI has worked closely with the HL7 community in redefining the role of geographic information within the electronic medical record. In 2008, a new geographic standard was proposed and passed by the HL7 body for inclusion within Version 3.0. This means that OpenMRS is capable of collecting, storing, and generating highly accurate geographic information that will support the many different analytical activities that health ministries will face. Activities such as conducting local needs assessments, determining accessibility to services, identifying specific geographic disparities, routing health service workers, patients, and assets, and ultimately providing the type and sophistication of data and it's analysis that guide disease outbreak analysis and community interventions, are very much geographically relevant.

Several specific tasks that ESRI is willing to assist the PHIT partnership's eHealth agenda include:

1. Working with OpenMRS to assure that the new HL7 geographic standard is implemented within this open source work.

2. Preparing a white-paper to describe the value and usefulness of the new HL7 geographic data standard and make suggestions how the data and subsequent spatial intelligence can be used by health and human service workers in developing nations.

3. Assisting local distributors within the various regions of Africa to begin to develop Health Tracks within their annual user conference agenda. This will assure GIS users within the various health ministry's that access to GIS domain specific educational activities will be part of an on-going process – of gathering GIS users and providing outlets for coordinated education, presentation, and development of best practices.

4. Supporting specific educational programs targeted at increasing the use of GIS best practices in public health by offering seminars and workshops within the various African regions.

ESRI's Global Network

The ESRI distributor network, an indigenously owned and operated "local" business functions as a de facto professional social network within the countries served by each distributorship. Every ESRI distributor has a natural incentive to make sure that the technical knowledge gap is narrowed among the various governmental and non- governmental users of ESRI technology. In many African nations, an ESRI sponsored GIS conference is the only GIS specific conference that public health professionals can

attend to access educational and operational information about GIS – face-to-face. As of December 2008, the network of eight distributors in Africa covers 45 nations. We would suggest that organizations that desire to leverage scarce technology dollars consider engaging with this in-place network. As a "back-stop" ESRI maintains a regional office in Europe that supports more directly the work of distributors in Africa and can bring into play a wide variety of educational resources to any initiates being considered across Africa. Presently over 10,000 users across Africa are ESRI technology users.

Global Health Footprint

ESRI is a global player across 25 specific industries – from conservation to utilities. One of those "industries" is the Health and Human Services. As of 2008, ESRI technology is being used at various levels within 94 distinct national health ministries. ESRI software is typically used in Centers for Disease control and increasingly within environmental health related ministries where in addition to human disease tracking is carried out using GIS, tracking livestock and processed foods are also being monitored. Many large urban environments have ESRI technology at work tracking disease and various vectors that drive human disease. In developed nations, ESRI is typically the GIS of choice within a national health ministry.

OpenMRS - HL7 and ESRI

Increasingly, the development of open source health and medical applications include use of geographic data (evidenced by the new geographic standard for HL7, Version 3.0). Health data collection and reporting tools such as the WHO's OpenHealth can provide the necessary quality control for the rigorous spatial statistical programs essential for managing and evaluating disease outbreaks and interventions in the developing world. ESRI's work over many years with some of the largest health NGO's as well as some of the largest information technology companies in the world, provides a network of relationships that can be leveraged to help meet the health informatics needs of Africa.

PHIT and the Role of GIS

Within the context of the PHIT initiative being launched in 2009 and beyond, ESRI has a great deal of African experience to bring to the project. From supporting drug donation programs with effective GIS monitoring tools – to supporting establishment of geo-health informatics training programs in local Africa Universities. In reviewing the scope of work outlines in the grant planning document there is ample evidence for the need of "professional level" GIS – from the need to be efficient operationally in the identification and distributions of CHW's, conducting effective contact tracings – to facilitating the informational data exchanges of referrals, and establishing various networks of arrangements driven by situational and geographical logistics. The many proposed field teams will require training in the use of data collection tools so the lessons learned from hundreds of thousands of customers doing similar field data collection activities can be leveraged into this program. ESRI software that allows easily documented workflows and model building offer tremendous opportunities to replicate and share not only more accurate data but labor saving procedures and workflows.

ESRI would welcome those specific project specialists that have been assigned to data collection and data analysis functions and activities to make a connection with our organization and allow us to help connect them to our local African distributors so that we can leverage our knowledge about these functions and perhaps team them with individuals working in or for other local health organizations (such as the health ministry or a local university with GIS resourses). When the time is appropriate, (we would also be willing to help project staff at the local levels exploit ESRI resources to help the national health ministry's get the highest and best use of their ESRI software investments.

Health Facility Inventories in Africa

Over the past several years, ESRI health and Human services Team has collaborated with the International Hospital federation to create an "open" hospital facility database. The efforts of this project have documented over 77,000 hospitals around the world. Many countries in Africa are represented and are being corrected for accuracy by local ESRI distributors. Since this is a global undertaking, Africa is one but of many challenges to build such an important, verifiable and accurate (geographically) database that all can gain access and use with a high degree of certainty of the geographical accuracy. ESRI would commit to helping the project contribute to this global database project as well as help the project gain access to it as it continues to evolve. The WHO has also expressed interest in collaborating on building such an important component of a global health spatial data infrastructure. The PHIT could make a significant contribution to this global effort during the course of its facility data collection activities.

OpenMRS and GIS

With the advent of greater utilization of OpenMRS within developing nations, and specifically the use of OpenMRS in a large scale implementation in the PHIT program, ESRI offers to leverage its relationship with the Reginstrief Institute, an long standing ESRI customer, to assist the transformation of ESRI tools and solutions into OpenMRS complying with open interoperability standards now present across the health industry. ESRI's will help to bring our extensive body of public health users in various health ministry programs (such as immunizations, material and child health, oral health, communicable diseases, population health, environmental health, epidemiology, and health promotion) into consultation is ways that help the PHIT expand the role of GIS within the context of improving human health and social conditions. Specific ideas would be to organize a global user's virtual network (or perhaps a wiki-like system) on the subject of "Vulnerability Impact Analysis"- for assessing access issues and outcomes of interventions. (We would expect it could attract 100's of users across the globe").

Summary of Possibilities

The role of geographically relevant health data within the framework of human health appears perhaps like an insignificant piece of administrative data among a much richer set of clinical information. In recent years, however, research from the Dartmouth's Clinical Evaluative research Center's Health care Atlas Project has accumulated significant evidence that geography is destiny – in fact medical destiny. We think this is no less the case in Africa. Where people live, work, and play have large and important roles in how healthy people will actually be and what risks to health they will face in the years ahead. Inaccessibility to needed health or human services maybe no less important that the availability of a vaccine during childhood. Making health interventions work in local communities is still a function of information transfer. Building sustainable informational "best practices" remain critical to the long-term processes of identifying undesirable change in conditions and measuring health and social outcomes.

ESRI, while a modest sized privately held GIS software develop, has a global footprint. Every day, ESRI people support over one million users of its software across 192 countries in the belief that by using its software the people of the world come to better understand their world (be it a Mogodugu, health district in Rwanda, or an entire nation. ESRI's vision of "healthy people everywhere" requires a mission that is strategically focused on equipping every health and human service organization; in every nation with information tools that help the health professional assess needs, evaluate risks, and implement interventions –and hopefully using GIS "best practices". In attempting to deliver on this mission, ESRI has daily contact with public health professionals across the globe – people striving to solve enormous challenges and to drive better outcomes into every coner of the world. Helping bring greater levels of spatial awareness, thinking, and literacy to the global health community for the benefit of improving the human condition to everyone, everywhere – is what drives our actions and affirms our commitments.

For more Information Contact:
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Global Manager
Health and Humans Services
ESRI
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IV. Select GISc Resources:

a). Version 1.0 - Matrix comparing software tools and their capabilities from both OSGeo and COTS world (last and definitive version as GoogleDoc online – contact Tom McConnell (gisprof@gmail.com) for access/permission:

SAMPLE of part of the MATRIX:

	Product	QuantumGIS/Grass	GRASS	gvSIG
	Website	www.qgis.org	grass.osgeo.org	www.gvsig.gva.e
	Type	Desktop	Desktop	Desktop
	Description			
	Overall Rating?	****		
Data Formats & Acquisition				
	Shapefile	Yes	Yes	
	File Geodatabase	No	No	
	Convert coordinates to points		Yes	
	Vector-Raster 2-way conversion		Yes	
	3D Volumes (voxels)	No	Yes	No
Editing & Conversion				
	Feature editing	Yes	Yes	
	Attribute editing	Yes	Yes	
	Geometric topologies	No	Yes	No
	Geocoding by street network	No	Yes	No
	Geocoding by direct address ma	No	No	No
	Change projection	Yes	Yes	Yes
	Projection on the fly			
Query				
	Simple identification (row displa	Yes	Yes	Yes
	Table export/display	Yes	Yes	Yes
	Selection by attribute (SQL)	Yes	Yes	Yes
	Selection by location	Yes	Yes	Yes

b) List of GIS-related Resources:

Some General FOSS-GIS and other GIS-related Resources:

- Africa OSSGEO network = http://wiki.osgeo.org/wiki/Africa
- AGIRN - http://www.aarse2008.org/
- Arc2Earth = http://www.arc2earth.com/
- Corona declassified imagery = http://www.geog.ucsb.edu/~kclarke/Corona/links.htm
- DaCorpsoft, LTD = http://www.dacorpsoft.com/ (small company that specializes in OSSGeo software for Latin America and elsewhere)…
- DNR Garmin = http://www.dnr.state.mn.us/mis/gis/tools/arcview/extensions/DNRGarmin/DNRGarmin.html
- EIS-Africa = http://www.eis-africa.org/EIS-Africa/
- FAO- GLTC (Global Land Cover Network - LCCS – Land Cover Classification System = http://www.glcn.org/index_en.jsp
- GDAL - Geospatial Data Abstraction Library = http://www.gdal.org/
- Geonetwork Opensource = http://geonetwork-opensource.org/
- Get from EarthExplorer (USGS) = http://edcsns17.cr.usgs.gov/EarthExplorer/
- GLCF = http://www.landcover.org/index.shtml
- Global map data = http://www.iscgm.org/cgi-bin/fswiki/wiki.cgi
- GRASS GIS = http://grass.itc.it/index.php
- gvSIG = http://www.gvsig.gva.es/
- IDEC-Geoportal = http://www.geoportal-idec.net/geoportal/
- ISO Metadata Editors reviewed including MetaD = http://www.fgdc.gov/metadata/iso-metadata-editor-review
- LCCS / GeoVIS and other software = http://www.glcn.org/sof_0_en.jsp
- MapServer = http://mapserver.org/index.html
- NASA World Wind = http://worldwind.arc.nasa.gov/
- NIH Image = http://rsb.info.nih.gov/nih-image/
- OGR Simple Feature Library = http://www.gdal.org/ogr/
- OSGeo = http://www.osgeo.org/
- QGIS = http://www.qgis.org/
- Robert Ford's LULC Module = http://resweb.llu.edu/rford/ESSE21/LUCCModule/
- Shp2Kml = http://www.zonums.com/shp2kml.html (Zonum solutions)
- TerraGO = http://www.terragotech.com/
- Terralook = http://terralook.cr.usgs.gov/
- What is OpenEV = http://openev.sourceforge.net/

List of DATA SOURCES:

- **Personal List of Resources created by the consultant—Robert E. Ford** http://resweb.llu.edu/rford/ESSE21/LUCCModule/imagery_sources.html

- **Biodiversity Informatics Facility – American Museum of Natural History** = http://biodiversityinformatics.amnh.org/ (see open source resources) = http://biodiversityinformatics.amnh.org/index.php?section_id=5

- **ESSE Design Guide – Many resources** = http://www.essedesignguide.org/

- **FAO Geonetwork** = http://www.fao.org/geonetwork/srv/en/main.search

- **Ford's list of Online Resources** = http://resweb.llu.edu/rford/courses/ESSC550/syllabus.html#ONLINE_RESOURCES
- **GBIF = Global Biodiversity Information Facility** = http://www.gbif.org/
- **Geobrain** = http://geobrain.laits.gmu.edu/index.html
- **Millennium Coral Reef Landsat Archive** = http://oceancolor.gsfc.nasa.gov/cgi/landsat.pl
- **Remote sensing from AMNH** = http://biodiversityinformatics.amnh.org/index.php?section_id=6
- **SERVIR – NASA** = http://servir.nasa.cathalac.org/

Some Health-related GIS resources:

a) **ESRI Healthy GIS** = http://www.esri.com/industries/health/index.html

b) **Framework for GIS in Public Health** = http://www.slideshare.net/wansooim/a-framework-for-geospatial-web-services-for-public-health-by-dr-leslie-lenert

c) **From IDRC – Dar es Salaam** = http://www.idrc.ca/en/ev-9357-201-1-DO_TOPIC.html

d) **Geospatial Application Papers > Health** = http://www.gisdevelopment.net/application/health/overview/index.htm

e) **GIS and Health** = http://www.spatialhydrology.com/health/health.htm

f) **GIS in Public Health** = GIS in Public Health Conference = http://www.urisa.org/conferences/health

g) **HL7** = http://www.hl7.org/about/index.cfm

h) **Spatial Epidemiology links - assorted**:

1. http://minority-health.pitt.edu/archive/00000417/01/Place,_Space,_and_Health-_GIS_and_Epidemiology.pdf
2. http://www.paho.org/english/sha/epibul_95-98/be961gis.htm
3. http://healthmap.wordpress.com/2008/03/27/gis-and-epidemiology/
4. http://scholar.google.com/scholar?hl=en&client=firefox-a&rls=org.mozilla:en-US:official&q=author:%22Jacquez%22+intitle:%22Spatial+analysis+in+epidemiology:+Nascent+science+or+a+...%22+&um=1&ie=UTF-8&oi=scholarr
5. http://geo.arc.nasa.gov/sge/health/landepi.html
6. http://dusk2.geo.orst.edu/gis/student_bibs/konnoffd.html
7. http://www.us.oup.com/us/catalog/general/subject/Medicine/Anatomy/?view=usa&ci=9780198509882
8. http://gisandscience.com/2009/07/13/spatial-analysis-in-epidemiology/

i) **UCSB - Health Data Model** = http://www.ncgia.ucsb.edu/projects/health/

j) **URISA GIS in Public Health** (http://www.urisa.org) What attendee said about the conference? Providence, RI Created by VERTICES GIS in Health Care http://www.vertices.com http://www.gisinpublichea...

k) **WHO Health and mapping** = http://www.who.int/health_mapping/en/

l) **YouTube – LLUSPH & Health Geoinformatics** = http://www.youtube.com/watch?v=4wWMP9bLpLk

x) **More to be added…**