Geospatial Information, MDG's and Malawi

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The aim of my presentation today is to give firstly an understanding of the critical relationship between reliable geospatial information) GI) and the MDG's, and secondly how it is possible to collect such information rapidly. To achieve that I will start by describing GI to you, then assess the GI required to satisfy just one objective of one MDG, then to compare how GI is managed between here and in Malawi so you understand the benefits of properly managed GI. Then we'll have a look at one instant collection technology, Very High Resolution Satellite Imagery (VHRSI) before finally making a few concluding remarks.

Geospatial Information

So what is GI? It's basically anything that can be linked by location - directly or indirectly – on, under and above the ground.You will be familiar with map data at various scales, represented as points, lines and areas. This could be street furniture, fences, power lines, fields, buildings. Not so easily represented on a map is 3dimensional information – for instance geology, hydrology and topography. Google earth fly-through is an example of something that is created from 3 dimensional data. If we bring in time as well we can create networks that tell us how to get from a to b as quickly as possible, or where we are going to get electricity from at peak times, or how much water flows in different locations at different times of the year

Satellite imagery can be located because you can correlate imagery information to points on the ground. The same is true with types and spread of diseases like cholera and climatic factors like rainfall and temperature. Census data is related to a house so all the information related to that census can be indirectly located

Metadata is data about data. So as an example let us look at a water borehole. Its metadata could include: When it was built, by whom, for whom, maybe a picture, flow rate at different times of the year, maintenance history. Research has shown that as much as 80% of all information can be related spatially – so it could be argued that 80% of decisions have a spatial connection.

Geographic Information System

Because of the geographical linkage it is possible to combine all this seemingly disparate information into what is termed a Geographic information system or GIS. Its strength is in using their spatial relationships to create new information that would otherwise be missed. For example SEPA use it for flood monitoring so that people can be warned in advance of potential flooding to the houses and set in processes for evacuation; the police in Dumfries and Galloway use one to determine trends in burglaries. They can assess where the next burglary will likely take place and set police in place to arrest them. The Forestry Commission have factored in climate change predictions to assess the affect of existing forestry in Scotland - eg increased forest fires, drought stress, increased prevalence of pests and diseases, and have developed recommendations about species suitability and growth potential. All the major challenges faced in the world today like climate change have a critical geospatial properties.

Africa and MDG's

You will be familiar with the UN's 8 goals and 21 targets set to be met by 2015. Maybe not so familiar is the MDG Africa Steering Group, set up in 2007 which brings together leaders of multilateral development organizations to identify the practical steps needed to achieve the MDG's and other internationally agreed development goals in Africa, chaired by the UN Secretary-General. They tell us that achieving the MDG's in Africa will have an enormous impact in saving lives and empowering children. They have quite a task on their hands though since at the halfway point last August only 3 out of 53 African countries are on track to meet their 2015 commitments. We also learn from OXFAM only last month that urgent action is needed to prevent hundreds of millions more slipping into hunger.

Last August the group identified a list of priorities which they think will largely achieve the MDG's and other development goals if they are fully implemented. Let me focus on the first priority, that of Agricultural Productivity – and the first objective identified within that - doubling of food yields by 2012 - and assess some of the geospatial information needed to satisfy that one objective.

I would certainly need to know what crops are grown now; how they are managed; how their growth could be affected. Information like soil type, how steep the land is, temperature, possible diseases, nutritional value, pests, use of fertilizers. How are the crops watered – is it rain-fed or are there water points, what is the flow rate, on a seasonal basis, what is the water quality, how much is used, historical information like reliability /maintenance, who's responsible for it, is there an irrigation system or other water pipe network, how deep is the aquifer, rainfall pattern.

What other information do we need to know - latrines, animal grazing, district and regional boundaries, power and telecoms, susceptibility to natural disasters like flooding and earthquakes, ownership and legal boundary, contact information of the farmer and other stakeholders, route to market, rate of change of population, deforestation, climate change scenarios – is it going to get hotter, by how much, when - maybe less rainfall.

All this data can be linked into a GIS to tell us where we are now with crop production and prepare strategies to double the crop yields by 2012 – and of course the more reliable and up to date information we have, the more sustainable the strategy.

We could answer questions like: What sort of crops can I grow? Is there repeat harvest potential? Do I need fertilisers? Do I need water? What is the earnings potential? If we decide that we need water for instance, we can use the information to carry out a cost/benefit analysis on alternative water supply systems – should we consider a new water borehole for instance – knowing where the aquifer is we can assess the potential depth of boreholes at certain locations; factor in proximity to the crops and access limitations for the drilling machines to calculate the cost of drilling boreholes at different locations.

So for just one objective in the groups first priority a multitude of spatially related information is required to make the strategies developed sustainable. So, does Malawi have the information available to develop sustainable strategies for doubling crop growth, for instance? We'll look at that in a minute. First let's look at how we approach GI here in the UK as I think it's important to understand the difference.

GI in Malawi and the UK

Our National Mapping Organisation, the Ordnance Survey, has field surveyors continuously updating maps in urban and rural townships with infrastructure changes and new developments. Many of you will be familiar with the 1:50,000 maps but there are scales up to 1:1250. This larger scale is crucial to planning as it shows individual houses, utility points, access routes, boundaries, landscape features. They have also added value by including other information like residential/commercial property type, ownership, road names etc. Over the last 20 years the OS has digitised and integrated the map data into a seamless database allowing network analysis. I mentioned road networks earlier as an example.Whilst the hard copy mapping in GB was based on an old mathematical earth model the digital conversion has enabled all information to be aligned with the global positioning system, or GPS. The surveyors use GPS to collect new mapping data. The UK utility organisations and local authorities maintain their own infrastructure records but have agreements with the OS to receive automatic mapping updates on which to base them. So, while above and below ground information is not necessarily in one database, it is correlated through a common mapping background. Everyone is singing from the same hymn sheet and planning is based on current mapping information. The greatest significance is that, for the £100 million the OS gets to maintain the database each year £100 billion is generated by the private sector, or 1000 times return on investment, equivalent to 4% of GDP.

If we now turn to Malawi's maps, many are based on aerial photography taken in the sixties and seventies and there has been no detailed national update program since then. The 1:50,000 scale maps have been digitised but there is no metadata attached to the GIS The department received £229,000 last year and generated £10,000 in selling maps. With a 9 million population increase in the last 40 years the obvious question is 'where is everybody'? Regular census data has been collected but cross correlation is impossible because the maps are so out of date. Infrastructure changes, increased urbanisation and more densely populated rural areas present planners with an enormous amount of uncertainty.

Since the maps in Malawi are based on a 100 year old mathematical earth model, there are considerable differences with the modern GPS system, causing cross correlation errors between hand held GPS information and map position. The combination of out of date mapping and unreliable metadata has considerable strategic implications. At a national level for example the Malawi Government has a commitment to provide a water point within 500m for every 250 people. With GPS recorded points giving up to 300m positional difference from Malawi's existing mapping, together with demographic uncertainty it becomes an impossible strategy to realise. The same can be said with SWAP – a health sector monitoring and evaluation framework where the recipient country is supposed to tell potential donors the population % within 5km of a health centre in order to enable health sector strategies to be developed. Malawis Growth and Development Strategy has identified a 100% increase in small holder farmers owning at least 2 Ha of land by 2011. At a local level OXFAM in Mulanje were rehabilitating the gravity-fed pipes there a couple of years ago but they couldn't find the original plans to help locate the pipes, even if they had found them trying to correlate them with the out of date maps and the present infrastructure would have been very difficult.

GI in Africa

There are many independent initiatives trying to tackle the lack of GI in Africa. For instance the Gates Foundation has just funded a multi-million pound project to map soils for the whole of the continent. AfricaMap, developed by Harvard University is attempting to collate disparate historical datasets into one GIS. WaterAID have produced waterpoint mapping for a few Sub-Saharan African countries. These are known datasets. There are many unknown datasets around Africa and trying to find and access them is a huge practical obstacle, with questions about confidence in the data and cross-correlation into a common reference system remaining. There is no programmatic approach to collection and maintenance of national datasets. Even when NGO's and donor organisations collect geospatial information – the example I mentioned earlier with Oxfam for instance - there are no mechanisms for maintaining them or handing them over to a central information system.

Commercial organizations collect information for a specific project. If you take a look at Google Earth for instance you will notice patches of VHRS imagery in some areas of Malawi. It's been purchased by a commercial user for a specific project. The information is not shared. It doesn't help that Malawi's NMO is poorly resourced and receives little funding. Despite the power of geospatial information systems and technologies few African governments use them. I think it is important to change their minds though, and I believe new GI technologies, especially Very High Resolution Satellite Imagery offers a persuasive argument.

Very High Resolution Satellite Imagery

The first point is that there are no restrictions – no bureaucratic process required to get the imagery – the military cannot interfere with procurement. I remember a project my old company was involved with in Egypt where the military blacked out large areas of aerial photography where the military installations were based. It's cheap. Prices as little as $10 for archive imagery to $40 for new stereo imagery per sq km. New VHRSI imagery could be taken for Blantyre, for instance, for less than £5000. At 0.4m pixel resolution it could be used for large scale mapping and for engineering design – you can see individual buildings, water bore-holes, electric and telephone poles, fence lines etc. I also believe it's much easier for a layperson to understand imagery - instead of point and line symbols you can see actual details

The multi-spectral capability allows you to identify crop and tree types and diseases and soils. The stereo capability combined with soil, water and vegetative characteristics, many of which we can get from the mulit-spectral capability gives us the chance to create 3 dimensional models of geology, hydrology and topography. The topography could be used to determine new reservoir positions, for example, on the Mulanje Massif. Once you have the base imagery layer, because of its daily repeat coverage potential you have the option to get new imagery to identify changes in land use at whatever frequency you choose. The stereo ability allows us to create 3d visualisation and fly-throughs, as you see in Google Earth except much more detailed, for environmental impact assessment.

Conclusions

There is a crucial linkage between GI and achievement of the MDG's in Malawi. In order to meet the MDG's we need reliable and up to date geospatial information. But knowing what information exists and how to access it is a huge obstacle to using GI in Africa. There are commendable independent initiatives being developed but we really need everything to be collated into one national database. Mechanisms need to be established to encourage GI to be shared.

If Malawian engineers and planners had access to modern mapping, like we have in the UK, into which they could correlate other GI they would be best positioned to determine MDG strategies and hopefully rely less on external organisations. Unfortunately in Malawi maps are many years out of date making their jobs very difficult.

I believe we can produce large scale mapping in Malawi through use of the latest satellite sensors. Their information collection capabilities combined with modern processing softwares give us the potential to rapidly map the country cost effectively. This mapping will then create the basis for sharing GI through integration into a GIS. Having an easily accessible GI system throughout Malawi will encourage sharing of knowledge.

We know that in the UK each £1 invested in mapping generates a potential £1000 to the economy - I wonder how much money is wasted in Malawi by not having it! Throughout Africa the public service has frozen recruitment for existing mapping posts, nor does it create new posts because of budgetary constraints. There are few African countries that offer degree programmes in GI science. We need to convince Malawi's Government that investment in GI both at the National Mapping Organisation and at university should become a priority.

Malawi must relate its mapping to GPS - to facilitate that a modern GPS control network needs to be established and an accurate height model determined. This will enable GPS collected data to be properly correlated with map position.

Presently hundreds of millions of pounds worth of Information Technology related work is outsourced to India. Developing skills in Information technologies in Malawi would enable it to compete in this market, especially as Indian base prices have increased considerably over the last few years.

Each new VHR satellite that is launched presents greater opportunities for GI collection. Much of the information we identified earlier for doubling of crop production can be obtained from this imagery. It is important however that research is carried out into imagery processing techniques including automated information gathering and to reduce further the costs of map production.

Malawi has established a national geospatial data centre but is struggling to set in place mechanisms for collecting and standardising GI. A web based system needs to be established to facilitate knowledge transfer. This will require investment in broadband technology. Malawi's government needs to recognise that geospatial information is a national asset that underpins development, like we already do in the UK. There is a real urgency though. If Malawi is to develop adaptive strategies to the climate change scenarios that have been predicted, scenarios that will have a profound impact on the country's water and power supplies, then it needs to move quickly.

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