



Responsible Land Governance: Towards an Evidence Based Approach

ANNUAL WORLD BANK CONFERENCE ON LAND AND POVERTY
WASHINGTON DC, MARCH 20-24, 2017



GEOSPATIAL INFORMATION DRIVES BENEFITS BEYOND LAND ADMINISTRATION – WHY AREN'T WE TAKING THEM?

JOHN KEDAR
Ordnance Survey
john.kedar@osi.os.uk

**Paper prepared for presentation at the
“2017 WORLD BANK CONFERENCE ON LAND AND POVERTY”
The World Bank - Washington DC, March 20-24, 2017**

Copyright 2017 by author(s). All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice appears on all such copies.



Responsible Land Governance: Towards an Evidence Based Approach

ANNUAL WORLD BANK CONFERENCE ON LAND AND POVERTY
WASHINGTON DC, MARCH 20-24, 2017



Abstract:

Low-income nations may in part still use mapping from the last century, perhaps 1:50,000 scale, but neither maintained nor digital. High-Income nations maintain large scale, attributed and accurate data from addressing to topography, imagery to networks. This geospatial data contributes towards GDP increase of between 0.2% and 0.6% and wide-ranging non-quantifiable benefits. Improved availability of this underpinning geospatial data, the digital version of the national infrastructure, leads to opportunities for better government, more transparency, effective urban planning, improved resilience, increased resource/asset and environmental management, and new business opportunities.

Low-income nations are often investing heavily into land administration supported by the global community. A sustainable land administration system can bring economic and social benefits. However, geospatial data collected to underpin land administration is not well used for wider benefit to the nation. Nor is the opportunity taken to collect other features concurrently to cost-effectively improve the national geospatial database and support wider socio-economic benefit.

Economic and societal benefits of geospatial enablement are well documented in high-income nations but not in low and middle-income nations. This paper will examine the benefits of geospatial enablement globally and conclude by offering thoughts on building geospatial capacity in nations.

Key Words:

Benefit, Geospatial, Land, Open, UK



GEOSPATIAL INFORMATION DRIVES BENEFITS BEYOND LAND ADMINISTRATION – WHY AREN'T WE TAKING THEM?

Geospatial Enablement

The Information Age is resulting in greater understanding, better decision making, improved economies and social benefits. Paradoxically it also brings knowledge of disparity, be it wealth and poverty or global opportunities and threats. The information age requires access to trusted data to bring value, and so we are seeing individual nations, indeed individual 'communities' within nations, benefit differently.

Mapping is a key component of the data that feeds this information age and its associated technological revolution. Many nations and cities maintain large scale, attributed and accurate data from addressing to topography, imagery to networks. It is the digital version of the physical infrastructure and forms the basis of the blueprint for effective planning, a means of monitoring change and an enabler for good administration and economic growth. In contrast some nations use analogue mapping from the last century, perhaps 1:50,000 scale at best, but neither maintained nor digital. Geospatial data is not the sole prerogative of national mapping agencies, but there will be many use-cases, from land administration to security where trusted 'whole-nation' data from governments is preferred over other sources.

For the purposes of this paper the term mapping refers to the visual portrayal 'on a map' of geospatial information (GI) and associated spatial information or location information. GI relates to the fundamental data, the underpinning framework, and spatial information refers to any data with associated position that can be viewed on a map or analyzed, individually or in combination with other spatial data.

There is no universal agreement on what the essential GI needs of a nation comprises. The United Nations Global Geospatial Information Management (UN GGIM) is conducting work on fundamental geospatial data themes that perhaps best illustrates the types of data considered here. In its progress update to the UN GGIM Committee of Experts Sixth session in 2016 it demonstrated that there is both commonality, and some difference, in thinking when considered on the World stage. Figure 1 demonstrates early views on these fundamental geospatial themes.



Responsible Land Governance: Towards an Evidence Based Approach

ANNUAL WORLD BANK CONFERENCE ON LAND AND POVERTY
WASHINGTON DC, MARCH 20-24, 2017



INSPIRE (Annex I & II)	Africa Reports	ANZLIC	UNGGIM NIA
	Geodetic control network	Positioning	
<i>Geographical names</i>	<i>Geographic names</i>	<i>Place names</i>	<i>Geographical names</i>
<i>Administrative units</i>	<i>Boundaries</i>	<i>Administrative boundaries</i>	<i>Administrative units</i>
Addresses		Geocoded addressing	
<i>Cadastral parcels</i>	<i>Land Tenure</i>	<i>Land parcel and property</i>	<i>Cadastral parcels</i>
<i>Transport networks</i>	<i>Transportation</i>	<i>Transport</i>	<i>Transport networks</i>
<i>Hydrography</i>	<i>Hydrography</i>	<i>Water</i>	<i>Hydrography</i>
Area Management	Land management units/areas		
<i>Orthoimagery</i>	<i>Imagery</i>	<i>Imagery</i>	<i>Imagery</i>
<i>Elevation</i>	<i>Hypsography</i>	<i>Elevation and depth</i>	<i>Elevation</i>
<i>Land cover</i>	<i>Natural environment</i>	<i>Land cover</i>	<i>Land Cover</i>
Land Use			
Buildings			Settlements
Statistical Units			
	Utilities and services		
	Drainage		

Figure 1: UN GGIM Fundamental Geospatial Themes at August 2016.

Source: UN Economic and Social Council Committee of Experts on Global Geospatial Information Management paper 'Determination of global fundamental geospatial data themes', E/C.20/2016/5/Add.1 dated 7 July 2016

The differences are not surprising; break needs down to country or city level and the picture will change again. But the similarities are obvious: geographical names, administrative boundaries, cadaster or boundaries to support land administration, transport and water networks, elevation models, orthorectified imagery, land cover. The differing views on the fundamental nature of Geocoded addressing may be explained by both addressing data ownership in a nation (it is not often the national mapping agency) and economic maturity – comprehensive national geocoded address databases are still being developed in many nations. Some other differences may be seen as semantic, rarely is drainage not seen as a key element of mapping or GI although more uncommon is its consideration as a 'network'.

European Directive DG XIII states that the ultimate aim of GI is to '*manage our natural environment more effectively and promote economic growth*'. It also highlights that that '*GI and GIS tools, working hand-in-hand, can improve the ability of many societal actors to make informed choices.*' The means to collect, maintain and provide this data in an accessible form is not considered in this paper. It may largely be from singular dedicated agencies such as Ordnance Survey in UK or a multitude of agencies thematically and/or split between nation/state/municipality. Geospatial enablement requires a nation to incorporate GI and spatial reasoning into its processes and decision making, so that it is second nature. This integration of GI and wider spatial information is key, and considered widely in spatial data



Responsible Land Governance: Towards an Evidence Based Approach

ANNUAL WORLD BANK CONFERENCE ON LAND AND POVERTY
WASHINGTON DC, MARCH 20-24, 2017



infrastructure (SDI) literature. SDIs require a mix of trusted data, technologies, leadership and governance, standards and policies, and education if geospatial enablement is to be achieved.

Geospatial enablement is more than GI or national SDIs. There is a global infrastructure that underpins this. In particular, the geodetic framework and precise positioning. The former is both important for accurate position but equally for precise measurement of the world and its changes. The latter is epitomized by Global Navigation Satellite System (GNSS) receivers, using the GPS, GLONASS, Galileo or Beidou system. Combined, the accuracy of absolute and relative position is playing a critical part in geospatial enablement.

The most important message to take from the UN GGIM fundamental data themes work is that these themes are unrelated to other classifications of government structures, sectors or themes. Figure 2 shows World Bank Sectors and Themes in a matrix combined with 4 fundamental geospatial data themes. A crude analysis demonstrates and illustrates that the need for GI is cross cutting across these World Bank sectors and themes. Note that these sectors and themes omit the all-important national security concern of all governments, a further driver for GI and sometimes the obstacle to its greater use in a nation.



Responsible Land Governance: Towards an Evidence Based Approach

ANNUAL WORLD BANK CONFERENCE ON LAND AND POVERTY
WASHINGTON DC, MARCH 20-24, 2017



Use by Theme/Sector	Example GI national data set			
	Infrastructure	Land Use	Land Tenure	Addressing
World Bank Theme				
Economic Management				
Environment and Natural Resources Management				
Financial and Private Sector Development				
Human Development				
Public Sector Governance				
Rule of Law				
Rural Development				
Social Development, Gender and Inclusion				
Trade and Integration				
Urban Development				
World Bank Sector				
Agriculture, Fishery and Forestry				
Education				
Energy and Mining				
Finance				
Health and other Social Services				
Industry and Trade				
Information and Communications				
Public Administration, law and justice				
Transportation				
Water, sanitation and Flood Protection				

Figure 2: World Bank Sectors and Themes combined with 4 fundamental geospatial data themes.

Source: The World Bank 2016 Annual Report and Ordnance Survey

The search for greater volumes of trusted, rich, accurate, current foundation geospatial data is driving new collection and management technologies. It is driving ministries, businesses and projects, including development banks and international aid funded projects, to create data for specific use-cases, ‘create once, use once’. This loses the efficiency and effectiveness of a national source of trusted and maintained data designed to underpin all use-cases, create once, use many’.

‘Create once, use many’ as a concept might reduce in importance in time given the increasing availability of data. For some use-cases this is undoubtedly true but for others not so. At least not yet and certainly not in low income nations where fundamental GI does not exist. There is undeniably a rapid increase in remote sensed data – be it space, ground or airborne. Equally the increasing use of smart devices allows rapid collection by the ‘crowd’. But as a government, business or citizen ask ‘what data do you trust for



Responsible Land Governance: Towards an Evidence Based Approach

ANNUAL WORLD BANK CONFERENCE ON LAND AND POVERTY
WASHINGTON DC, MARCH 20-24, 2017



the purpose you wish to apply the data?'. There are many applications that look good, indeed are good – they may give precise answers but are those answers accurate? Is it even the right application to answer the question?

Great innovation will keep moving us forward and will in time change the role of government national mapping agencies. But in the meantime, the need for trusted, and sometimes even authoritative, GI remains with us. That GI should be seen as a unifier, a means to spatially-connect government and enable business. Trusted data will be maintained, it will be complete, it will be accessible and it will be used.

Geospatially enabling a nation brings benefits across government, business and the citizen. There is much, albeit limited to high-income nations, international evidence that demonstrates the economic value of geospatial enablement, equally demonstrating that these benefits occur across a multitude of sectors. Likewise, some of the efficiency and effectiveness benefits to government are well understood, but wider societal benefits can be harder to gauge reliably or comprehensively.

Without decision makers understanding the wider benefits of GI, the predominant driver for geospatial data in low and middle income nations has often been land administration. Land administration projects are receiving significant interest and donor funds, DFID's Rwanda and Ethiopia programs being two UK funded examples. The same emphasis is not placed on the fundamental GI data that underpins a nation across a far wider range of sectors and themes, nor on building the capacity of nations to do this for themselves.

BENEFITS OF GEOSPATIAL ENABLEMENT

We live in a world of considerable change. Scientific and technological change is faster than at any time outside the two world wars of the last century. Manufactured goods, applications and data are merging to form smart networked devices and services – sometimes referred to as the 'internet of things'. Automated vehicles epitomize this development, simultaneously using data from the network and contributing to it. Dr Vanessa Lawrence used the phrase 'everything happens somewhere' to stress that a geospatial foundation becomes increasingly important in this machine age.

In some nations, the most trusted data about a nation's infrastructure is still the 1970's UK Directorate of Overseas Survey's 1:50,000 scale paper map, which may have subsequently been digitized. GI benefits



are not being realized and will, through differing needs and agendas, have different weighting to those recorded in high-income nations. But the basic benefits will largely be the same. This section looks across a range of benefits; it is not designed to be comprehensive but aims to make two points: benefits are cross-cutting and they require trusted GI.

Sectors

Figure 2 crudely illustrated the cross-sector nature of GI. Two recent studies in Ireland and Canada, each with a different analytical approach, add more detailed credence to this.

Hickling Arthurs Low, Canadian Geomatics Environmental Scan and Value Study, published 2015, includes an examination of the estimated increase in industry output because of GI. The detailed figures themselves are not important in the context of this paper, but the table is extracted at Figure 3.

Indecon International Economic Consultants carried out an Assessment of the Economic Value of the Geospatial Information Industry in Ireland for Ordnance Survey Ireland in 2014. It engaged with stakeholders across sectors to assess the ranking of significance of Government and Corporate users of GI, with the rating '*as significant or very significant user of GI*' ranging from 13% (Value-added service providers) to 84% (local government).



Responsible Land Governance: Towards an Evidence Based Approach

ANNUAL WORLD BANK CONFERENCE ON LAND AND POVERTY
WASHINGTON DC, MARCH 20-24, 2017



	Atlantic	Quebec	Ontario	Prairies	British Columbia	The North	Canada
	%	%	%	%	%	%	%
Agriculture, forestry, fishing and hunting	2.50	1.04	1.33	0.96	1.38	4.47	1.22
Mining, quarrying, and oil and gas extraction	3.32	4.44	4.67	4.55	5.12	4.32	4.54
Utilities	1.60	1.73	1.68	1.19	1.51	2.09	1.58
Construction	1.34	0.94	0.82	1.90	1.17	1.50	1.23
Manufacturing	0.16	0.57	0.30	-0.18	0.86	1.75	0.33
Wholesale trade	0.88	0.85	0.81	1.14	0.93	4.03	0.90
Retail trade	0.51	0.46	0.43	1.11	0.55	1.68	0.60
Transportation and warehousing	1.57	1.65	1.59	1.45	2.16	0.26	1.64
Information and cultural industries	0.47	0.32	0.43	1.01	0.45	1.14	0.51
Finance and insurance	0.74	0.66	0.80	0.97	0.59	2.52	0.78
Real estate and rental and leasing	0.55	0.45	0.49	1.47	0.63	1.65	0.72
Professional, scientific, and technical services	0.72	0.34	0.28	0.94	0.57	1.54	0.57
Management of companies and enterprises	1.06	0.82	0.84	1.75	0.93	2.52	1.08
Administrative and support, waste management, and remediation services	0.87	0.71	1.00	1.13	0.89	3.11	0.95
Educational services	0.28	0.35	0.35	0.66	0.35	0.98	0.40
Health care and social assistance	0.60	0.57	0.55	1.17	0.57	1.48	0.70
Arts, entertainment and recreation	0.40	0.39	0.37	0.72	0.42	0.77	0.45
Accommodation and food services	0.56	0.59	0.64	1.46	0.74	1.59	0.83
Other services (except public administration)	0.38	0.28	0.36	0.92	0.44	1.86	0.48
Public administration	1.59	1.36	1.43	2.03	1.15	1.89	1.51

Figure 3: Estimated percentage change in Canadian industry output as a result of geospatial information, 2013 (%). Contains information licensed under the Open Government Licence – Canada.

Source: Hickling Arthurs Low, Canadian Geomatics Environmental Scan and Value Study, published 2015.

The first conclusion from both reports is that GI underpins across a wide range of sectors. The second conclusion from Figure 3 is that, even in Canada, there are significant differences across provinces and territories due to differing needs and uptake. The use of GI, indeed different types of GI, therefore will vary across sectors and geographies. This has worldwide applicability and the detailed benefits to every nation will differ. National economic benefit and Return on Investment Studies are justified and will also help determine GI priorities.



Urbanization

Within nations urbanization continues to pose economic and social challenge. Rapid urbanization without sufficient regularized property or employment leads to immense social pressure through lack of infrastructure, informal developments and consequent potential unrest. Such urbanization must be planned and resourced; a well-planned city is a smart city in its own right. Development ‘blueprints’ have to be based on an accurate ‘model’ of the present, effectively ‘the map’ combined with administrative and statistical data.

Geospatial data is not just the back-drop, it is valuable data in its own right for national and urban spatial planning, especially when combined with multi-agency information under a SDI.

There are many benefits in using GIS in urban planning that include (UNHABITAT, 2008):

- greater efficiency in retrieving information;
- improved analysis;
- better communication to the public and staff; and
- improved quality of services, for example speedier access to information for planning application processing.

A mix of formal and informal settlement is common and can constrain development planning. Sustainable planning and management of population growth and urban expansion are achieved through continuous monitoring of an area (Chandon, M.C, *et al.* 2014). Mapping and analysing changes in urban neighbourhoods helps planners and decision makers; academics and planners can utilize remote sensing archives and other techniques to consider past growth of urban environments. GI provides spatial insights on basic infrastructure, other services and facilities, and the environmental condition of slums. This empowers local Government authorities in planning and executing slum improvement plans (Chopra, R, 2016).

The ‘smart city’ agenda is leading to significant investment in cities, particularly in sensor and transport technologies. Planning in cities is often undertaken by departments in isolation leading to anomalies and inefficiencies between health, housing and transportation plans. Location is neutral and transparent – it helps integrate planning whether through integrated planning applications or through simple ‘map-



Responsible Land Governance: Towards an Evidence Based Approach

ANNUAL WORLD BANK CONFERENCE ON LAND AND POVERTY
WASHINGTON DC, MARCH 20-24, 2017



overlays'. Most cities have GIS departments to enable this, although the supporting geospatial and statistical data can be poor or non-existent.

At the high end, the advent of 5G infrastructure and automation will see a need for increasingly rich, accurate and current data, including 3D. The 2015 TechUK study assumes that a GI pre-planning tool to estimate the likely coverage radius at a range of frequencies from a potential mast site could provide a near 'real world visualisation' before any expensive investments were made in site visits or installations of further digital infrastructure. Applied research into this field could, it is believed, save 20% of an operator's deployment costs (TechUK, 2015). This research is now happening, looking both at data and application. But in low and middle income cities the complaint by leaders is often 'I don't know what is there now so how can I plan the future?'

Environment

Managing the environment for reasons from biodiversity to agriculture requires data. Remote sensing plays an increasing part in this, especially as machine learning improves analytical techniques and knowledge of land use. Remote sensing on its own is powerful, but add GI and the power increases. Administrative boundaries, terrain data, infrastructure and even at local level roads and buildings contribute to, or help solve, environmental challenges.

India could become a water stress zone by the year 2025 and water scarce zone by 2050. Remote sensing, fundamental GI and GIS allows access, monitoring and conservation of groundwater resources (Ibrahim-Bathis, K., *et al.*, 2016). The estimated potential returns on the use of hydrogeological maps prepared from remotely sensed data for groundwater prospecting in India to be Rs 5,000-8,000 million (\$93-149 million) (Dasgupta, Prof. A, 2013). Terrain models and water networks from local drainage to national rivers will be an essential component of GI to help enable this.

Natural Resources

Natural resources remain in demand, despite reductions in price. Demands on water and agricultural land will require greater management; poor infrastructure leads to wastage – particularly in agriculture where this has both economic and food-security impact. Land tenure is seen to contribute to ensuring justice for rural communities when faced with demands of global extractive and agricultural companies, integrating



Responsible Land Governance: Towards an Evidence Based Approach

ANNUAL WORLD BANK CONFERENCE ON LAND AND POVERTY
WASHINGTON DC, MARCH 20-24, 2017



data from a multitude of sensors with geological data and fundamental GI enables comprehensive planning and management.

Take the example of crop insurance/compensation, which may be a State function in some nations. Remote sensing, cadaster, field boundaries, drainage and terrain all play a part in assessment of potential crop failure, subsequent compensation and reduction in fraud.

Business

Economies depend on successful businesses, large and small. Geospatial information is used across sectors, from marketing through logistics to insurance, utilities to telecoms. Banks can use it to help fraud detection, extractives and agriculture to get goods to market, telecoms and utilities to asset manage.

Businesses will buy trusted data and so meeting business needs is an important driver in determining fundamental GI requirements. Equally businesses want services, solutions and answers, providing greater opportunity for an adept national mapping agency or GI provider to generate revenue.

Social

Land registration brings three main benefits (Whitehead and William, 2013):

- Increased tenure security, which can incentivise investment in land improvements;
- Enhanced access to credit, thanks to the use of documented land as collateral; and
- Stimulate and facilitate functional land markets required to drive economic activity.

The underpinning land data, be it cadaster or boundaries, is often collected in isolation for registration purposes and yet some of the same data, such as land use or road edges, has wider benefits and the imagery collected for such programs should be of national use.

Results of GI use in the UK health sector are considered to include:

- Understanding the spatial-temporal nature of the national and local health picture;
- More effective scarce resource allocation; and
- Determining catchment areas for local services and planning the location of health facilities.



Responsible Land Governance: Towards an Evidence Based Approach

ANNUAL WORLD BANK CONFERENCE ON LAND AND POVERTY
WASHINGTON DC, MARCH 20-24, 2017



The use of Open Street Map by the Bill and Melinda Gates Foundation to help develop the underlying community population size for inoculation in Northern Nigeria demonstrates the benefit of crowd-sourcing where national data does not exist. In Denmark, this is taken a stage further with national geocoded address data enabling the Danish Centre of Disease Control to monitor infectious diseases and contributes to the analysis and detection of the transmission source of disease outbreaks.

Education and Gender Equality are partially linked. The use of GI and simple tools in education systems both helps generate better, more visual, learning and lifts the level of technical knowledge in students, ultimately contributing to better employment opportunities.

GI is one form of data necessary to plan, deliver and monitor social change. Wider statistical data is equally critical. The ability to combine the two to visualize and analyze statistics spatially is often overlooked. Equally the importance of GI, particularly geocoded addressing, to help collect statistics may reduce the cost, and ultimately potentially the need for, comprehensive national census. Combining GI and statistics is the most effective way to ensure effective and transparent resource allocation at all levels. At national level, it also enables the monitoring of sustainable development goals.

Resilience

Global warming and climate change are transforming national risk. National assets, infrastructure, health and populations will all be affected. Mass population displacement will create pressures on neighbors. Climate change coupled with urbanization will lead to more severe natural disasters, especially in coastal cities. Governments are expected to reduce disaster risk and to predict, warn, respond and rebuild. Geospatial data underpins this and provides the framework for decision making.

Disaster mitigation, prevention, and response are supported through geospatial technologies and GI. An example is Resilience Direct in UK, an open source mapping platform that enables all agencies at all levels to access and see the same picture of the truth, integrating data from across government with simple web-based open source GIS. During the 2015 flooding this included Copernicus remote sensing data. The ability to understand where and who will be impacted and the needs of those impacted is simplified; “how many people will have to be evacuated, when, for how long, what routes, where do the vulnerable live, what is the ethnic split to allow the right food to be provided, what else could happen to make the situation worse and how do we mitigate...?”. These are geospatial problems that are enabled by GI and



Responsible Land Governance: Towards an Evidence Based Approach

ANNUAL WORLD BANK CONFERENCE ON LAND AND POVERTY
WASHINGTON DC, MARCH 20-24, 2017



the sharing of data across government. Resilience Direct enables this understanding and thence timely decisions, although it is worth noting that institutional reluctance to share information was a far bigger hurdle for Cabinet Office and Ordnance Survey to overcome across government than the technological solutions.

Government Administration

Taxation and government revenue generation regimes differ. The use of GI to enable tax collection is only partially understood. However, property taxes benefit from maintained property databases (GI geocoded addressing data including unique identification numbers being a key element). Agricultural land taxation or subsidy requires understanding of field sizes and agricultural use. Congestion charging on route data and even business and income taxes non-payment can be reduced through geospatial analysis. To illustrate this, in 2009 UK local government revenue from taxation was over £44 million higher as a result of using GI; this figure was expected to increase to over £89 million by 2015.

Governments gain widespread benefits from geospatial enablement: GIS technology improves decision making and eGovernment services improve efficiency and citizen experiences. This applies across government priorities, including those related to crime prevention, emergency management, disaster recovery, social services, health care, transportation, urban planning, environmental initiatives, and facility planning and management (Grant, A *et al.* 2014).

International research estimated productivity savings in the public sector from the utilisation of geospatial information to range between 0.2 – 0.5%.

Economy

Economies depend on successful businesses, large and small. Geospatial information is used across sectors, from marketing through logistics to insurance, utilities to telecoms. Banks can use it to help fraud detection and governments to improve taxation. In a range of studies the economic value of geospatial enablement is concluded to be between 0.2% to 0.6%. These studies cannot be easily extrapolated to low and middle income nations, where businesses may have different needs – the benefit could be greater or lesser.



Responsible Land Governance: Towards an Evidence Based Approach

ANNUAL WORLD BANK CONFERENCE ON LAND AND POVERTY
WASHINGTON DC, MARCH 20-24, 2017



Several studies in recent years try to establish economic value, Figure 4 below provides a summary. These measure different outputs and so cannot be directly compared, and all are high-income nation focused. The sponsorship of a full and effective GI socio-economics benefits study across nations in other regions is long overdue.

Year	Study	Relates to:	Country	OS Assessed GDP impact
2008	ACIL Tasman	Impact of modern spatial information technologies	Australia	0.6-1.2%
2008	ACIL Tasman, SKM & Ecological Associates	GI contribution to productivity	New Zealand	0.6%
2010	ConsultingWhere	7 Public Sector Services Productivity Related benefits	UK Public Sector	0.23%
2011	ACIL Tasman, Lester Franks & ConsultingWhere	Total change in real Gross State Product (GSP) due to productivity increase due to spatial information.	Tasmania State, Australia	0.4%
2011	GeoBusiness Nederland (2011)	Government, private and research sectors using GI	Netherlands	0.25%
2012	Richard Zerbe and Associates	Net benefit of GIS alone	King County Washington	0.09%
2012	Boston Consulting Group	Geospatial Industry (including remote sensing satellites)	USA	0.5%
2013	Oxera	Geospatial Industry as % of GDP	Global	0.2%
2014	Indecon	GI Contribution to the economy	Ireland	0.33%
2015	Hickling Arthurs Low, Acil Allen Consulting, Fujitsu & ConsultingWhere	Contribution of geospatial industries and GI to GDP	Canada	1.1%

Figure 4: Summary of a range of reports examining the economic benefits of GI and geospatial enablement. It must be observed that these studies cannot be directly compared, as each measure different outputs.

Source: Ordnance Survey summary of the Study reports shown in the table.



Responsible Land Governance: Towards an Evidence Based Approach

ANNUAL WORLD BANK CONFERENCE ON LAND AND POVERTY
WASHINGTON DC, MARCH 20-24, 2017



EFFECTING CHANGE

When there is undoubted benefit across so many sectors, why is it that many nations do not invest in maintained fundamental GI?

In part that is not true. Land tenure reform through effective land administration is a key tenet of addressing poverty and inequality. Nations, supported by development banks and international aid, are investing heavily into land administration across the World. Not all projects are successful and are often small-scale; sustainability often being cited as a concern.

Investment is also being made into geodetic networks, although these networks tend to be minimalist in nature and the full benefits of Continuously Operating Reference Stations (CORS) not realized. CORS is another example of a cross-cutting project, supporting everything from understanding climate change through surveys to resilience and construction. It can also be a revenue earner.

Some investment is being made into national mapping agencies for specific purposes, for example digitization of paper maps. But despite the cross-cutting benefits the wholesale, modernization, or transformation of national mapping capability to provide trusted fundamental geospatial data to government and businesses does not appear to be high on the agenda.

Land Administration

Land administration programs collect some foundation geospatial data, albeit only certain features, and current imagery. This geospatial data must be maintained to enable sustainable land administration, particularly in rapidly developing urban and peri-urban zones. Land Administration programs can overlook the capacity building necessary to allow a nation to maintain this fundamental geospatial data – capacity building takes time, typically 10 to 15 years, and thus funders and governments need to look at how the sustainable solution can best be achieved as a 5-year fund project is only part of the solution.

Land administration is seen as a ‘single ministry’ challenge, and a route to sustainable self-funding, even revenue-surplus is clear. Funders and development banks recognize its importance and projects are relatively easy to define. However, much of the data collected in land administration has relevance to the wider nation and its creation and maintenance should not be considered in isolation.



Responsible Land Governance: Towards an Evidence Based Approach

ANNUAL WORLD BANK CONFERENCE ON LAND AND POVERTY
WASHINGTON DC, MARCH 20-24, 2017



Some of the data collected for land administration has wider benefits across governments and business. It is also likely that the collection of a wider range of features and attributes could add significantly more value than cost if done at the same time. Imagery provides an ‘underlay’ from which other features could be extracted, automatically and/or manually.

Funders and recipient governments could work together to look at how the GI data from funded projects can assist the wider good of the nation. This may just involve sharing (if an SDI exists) or ensuring that national mapping agencies receive the data in a timely fashion and have the capacity to manage, maintain and serve it.

Trusting GI

National mapping agencies often promote authoritative GI. This is only part of the story; what is required is trusted GI, trusted for the purpose for which it is to be used. Some of this should be authoritative, particularly where land tenure or national security are concerned. A national gazetteer, cadaster, geodetic data and addressing are examples. But ultimately even this is trust – a reliable single source of the truth. Trust tends to require accuracy, necessary content, open standards, currency and access. It does not imply that it comes from a government body but many governments will want a single source of trusted GI and thus a national mapping agency will almost certainly play a major part in the supply of trusted GI to a nation. As automation becomes increasingly the norm then that trust becomes imperative – indeed Land GI providers may become exposed to liability.

There is a view that that national mapping agencies are losing relevance as data becomes increasingly available from many sources. On the contrary they are becoming ever more important as the means to ensure trusted, fit for purpose, geospatial data is accessible to all, and that it is done so efficiently. Loss of relevance is due to an inability to fulfil this function, failure to invest over the decades. Now is the time to invest.

Open data has great benefits conceptually and ultimately, if the data is trusted, nationally. Open data is not free data, trusted data costs money and therefore must be financed by purchase or government. Crucially technologies continue to evolve and the cost of trusted data can reduce. In UK two models encourage the use of GI and its benefits. Firstly, the freemium data model, some data being free at the point of use and richer data being licensed at a fee ensures a financially stable model for Ordnance



Responsible Land Governance: Towards an Evidence Based Approach

ANNUAL WORLD BANK CONFERENCE ON LAND AND POVERTY
WASHINGTON DC, MARCH 20-24, 2017



Survey. Secondly a single contact with government, which now sees more than 4000 government organizations involved, provides all OS data to all these organizations with considerable latitude in use. It is wide and easy access to trusted GI, rather than it necessarily being ‘free’ that really helps drive the open agenda.

A second common issue relates to GI being regarded as a ‘national security’ asset and not for widespread use, indeed some nations have separate military and civilian agencies producing similar GI or have release constraints to the public. This is understandable but not cost effective. There are, of course, means to protect national security interests in GI, but the reality is that Google Maps and others provide imagery that is accessible to potential enemies and terrorists. Even during the Cold war the Soviet Union maps of UK included detail deliberately omitted from Ordnance Survey maps. An equally compelling argument for sharing GI is that national security is increasingly a pan-government role, from preventing radicalization during education through the local policeman to national food security.

The value of data is often not recognized by politicians – put simply more impact is perceived in building a new bridge than transforming the national mapping agency for better data. The prospects of revenue generation or blame may overcome this, but ultimately good ROI studies are imperative to win the necessary investment in a national mapping agency transformation program or national SDI.

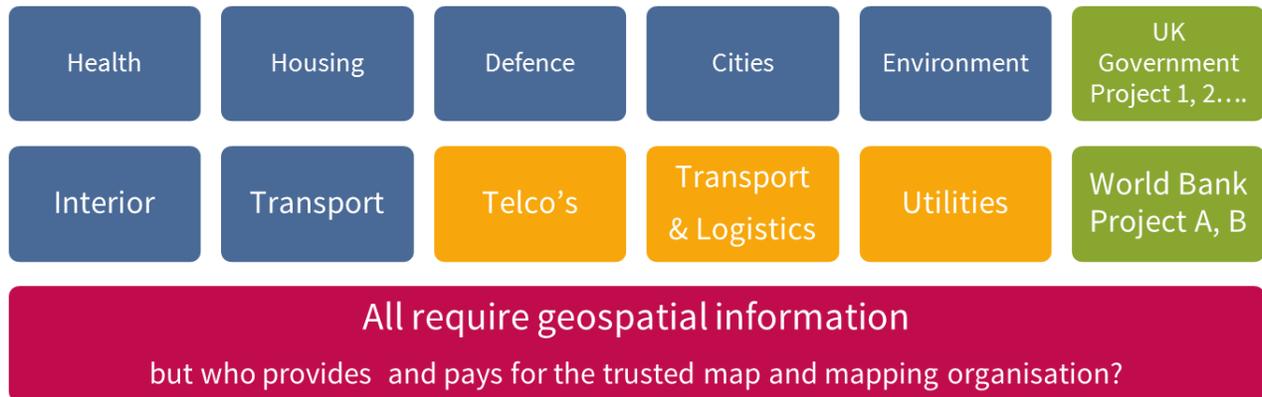
Project and Ministry Approach

The Land Administration example demonstrates the challenges of a project by project approach to data rather than a comprehensive approach that includes capacity building and ultimately the creation of national fundamental GI that is available to these funded projects too. Equally at national level, if GI supports so many then which department will ‘pay’ on behalf of all. Figure 5 illustrates this conundrum. Studies in UK illustrate how a single source of trusted GI to the government sector as far more cost-effective than individual organizations procuring individually.



Responsible Land Governance: Towards an Evidence Based Approach

ANNUAL WORLD BANK CONFERENCE ON LAND AND POVERTY
WASHINGTON DC, MARCH 20-24, 2017



*Figure 5: Ministries and their agencies, businesses and projects all require trusted GI. Providing this for the time being should remain the role of a national or city mapping agency and associated organizations.
Source: Ordnance Survey 2016.*

Transforming to Achieve the benefits of GI

It could be argued that the market will provide the trusted data. It is absolutely conceivable that this could happen in due course, but not yet, particularly as few mapping agencies are actually profitable and run as a business (Ordnance Survey is an exception). The market can absolutely provide contracted or managed services to deliver GI and services, and some nations are opting for this to remove risk and capital expenditure from government. But national mapping agencies and the national map are still seen as national assets, ones to be nurtured not off-shored, and with the opportunity to upskill local citizens. For the current generation, the national mapping agency (or indeed state or municipal depending upon national approach) has an essential role, and modernization or transformation is the probable route for GI data creation, management and services.

Such transformation takes time and cannot be seen as a project, rather a program with several components. A 5-year project could build the engage with stakeholders, build the infrastructure, create initial data, improve quality and currency, retrain a workforce and set up the right policies for a national approach. But capacity building for a sustainable organization will take far longer, as will enabling the benefits to be felt across the nation and potentially monetizing some data services and solutions. A long-term partnership with a 'transformed' national mapping agency is likely to be an important component in this, theoretical solutions are one thing, practical institutional experience another.

But transforming the national mapping agency is, in some senses, the easy part. Governments drawing the right models and policies is fundamental to enabling the benefits that GI can bring to the nation.



Responsible Land Governance: Towards an Evidence Based Approach

ANNUAL WORLD BANK CONFERENCE ON LAND AND POVERTY
WASHINGTON DC, MARCH 20-24, 2017



Policies that untangle unnecessary barriers to creating and serving national geospatial data. Policies that create open and accessible geospatial data that is available for business and citizen as much as government. Policies that determine how participatory mapping contributes to national fundamental GI and policies that change the approach to project by project collection of data.

Building Capacity

The embedding of ‘geospatial’ in education – the use of on-line GIS and good data to help students at all levels complete project work – as well as its on-line presence will help effect change. In UK, such use is part of the national curriculum. Equally supporting government agencies and businesses use geospatial techniques and technologies is essential. National agencies can play a part in supporting geospatial innovation, Ordnance Survey’s Geovation Hub being an example, and run masterclasses. Geospatial enablement also requires the education system to provide the surveyor, geospatial systems and GIS experts – a positive opportunity to upskill national workforces.



Responsible Land Governance: Towards an Evidence Based Approach

ANNUAL WORLD BANK CONFERENCE ON LAND AND POVERTY
WASHINGTON DC, MARCH 20-24, 2017



CONCLUSION

GI brings significant benefits to a nation across all sectors and to the economy. The level of economic benefit in low and middle income nations is little understood and resource should be expended gaining this understanding in order to help investment decision makers consider whether and how to invest in national GI and associated institutional capacity and capability..

National mapping agencies exist in low and middle-income nations. For geo-political reasons these are likely to remain the focus for trusted GI to a nation. But many need transformation from analogue to become suppliers of digital, maintained and trusted, GI. Transformation takes time and partnership with ‘transformed’ national mapping agencies can help with achieving sustainable solutions. The national mapping agencies may choose a managed services partner to help build initial GI data, so the nation benefits quickly whilst sustainable transformation is implemented.

Funding organizations should consider how sustainability can be better built into GI and land administration programs and how project collected GI can be utilized for wider national benefits, thereby creating more effect.

GI and associated services are one part of national geospatial enablement. The need for leadership, governance, policies, standards, technology, business innovation and education should be addressed in parallel.



REFERENCES

Chandan, M.C., et al. (2014). ‘Quantifying urbanisation using geospatial data and spatial metrics – A case study of Madras’, Paper for the *Conference on conservation and Sustainable Management of Wetland Ecosystems in Western Ghats*.

Chopra, R. (2016, June). ‘Urbanisation, Smart Cities, Slums and Geospatial Technology’, *LinkedIn*.

Dasgupta, Prof. A. (2013). ‘Economic Value of Geospatial Data: The great enabler’, *Geospatial World*.

Grant, A, et al., (2014). ‘Coordinates for Changes: How GIS technology and geospatial analytics can improve city services’ in *Innovation in Local Government – Open Data and Information Technology*, McKinsey and Company.

Hickling Arthurs Low, (2015) Canadian Geomatics Environmental Scan and Value Study.

Ibrahim-Bathis, K., et al., (2016). ‘Geospatial technology for delineating groundwater potential zones in Doddahalla watershed of Chitradurga district, India’, *The Egyptian Journal of Remote Sensing and Space Science*, Vol. 19, pp. 223-34.

Indecon International Economic (2014) Assessment of the Economic Value of the Geospatial Information Industry in Ireland

TechUK, (2015, August). *5G innovation opportunities- A discussion paper*.

UNHABITAT, (2008). *GIS as a Planning Support System for the Planning of Harmonious Cities*.

Whitehead, John and Marbell, William, (2013). ‘The economic benefits of geospatial technology’, *Position IT*.

TABLE OF FIGURES

Figure 1: UN GGIM Fundamental Geospatial Themes at August 2016..... 4

Figure 2: World Bank Sectors and Themes combined with 4 fundamental geospatial data themes. 6

Figure 3: Estimated percentage change in Canadian industry output as a result of geospatial information, 2013 (%). Contains information licensed under the Open Government Licence – Canada. 9

Figure 4: Summary of a range of reports examining the economic benefits of GI and geospatial enablement. It must be observed that these studies cannot be directly compared, as each measure different outputs..... 15

Figure 5: Ministries and their agencies, businesses and projects all require trusted GI. Providing this for the time being should remain the role of a national or city mapping agency and associated organizations. 19