CREATING A SPATIAL DATA INFRASTRUCTURE DIAGNOSTIC TOOL

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Paper prepared for presentation at the
“2017 WORLD BANK CONFERENCE ON LAND AND POVERTY”

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Abstract:

The World Bank Group (WBG) land/geospatial team, working with the Food and Agriculture Organization of the United Nations (FAO) has created a Spatial Data Infrastructure (SDI) Diagnostic Tool package (hereafter referred to as SDI Diagnostic Tool) to facilitate a standard measure and approach to assessing a country’s SDI readiness and geo-maturity, initially at national level (i.e. the NSDI).

The SDI Diagnostic Tool has been designed for internal WBG use, allowing a relatively quick (4-5 days) assessment of a country’s NSDI to highlight potential components requiring support, and geospatial information (GI) that could be of use in WBG projects, or to support such activities. The SDI Diagnostic Tool measures the capacity and willingness of countries to develop and use NSDIs. It incorporates a range of factors, including policy, governance arrangements, legal, technical infrastructure, socio-economic impact, capacity development, applications & services and geospatial datasets.

The results, apart from the score, allow countries to identify missing or under performing elements of their NSDI and to prepare action plans with investment programs to maximize the benefits of this critical part of the information infrastructure. It also informs the WBG and country offices on potential improvements in the wider use of GI and related portfolio investments. As part of the SDI Diagnostic Tool package, a methodology for evaluating the socio-economic benefits of implementing and using a NSDI has been developed. This can provide countries with a business case for investing in NSDI and be effective in obtaining government budgets to accelerate NSDI implementation.

The SDI Diagnostic Tool was created after researching previous initiatives and discussing with industry experts. The draft SDI Diagnostic Tool was first tested in December 2016 and to date it has been used on a trial basis in nine countries – Albania, Croatia, Indonesia, Kosovo, Malaysia, Moldova, Scotland, Serbia and Zambia. The World Bank Land and Poverty Conference 2017 provides an opportunity to discuss the progress to date, to evaluate the initial results and to plan the next steps.

Key Words:

SDI Scorecard; SDI SDI Diagnostic Tool; NSDI SDI Diagnostic Tool; NSDI; Geospatial Maturity; Socio-economic Business Case.
I. WHAT ARE SDIs? WHY ARE THEY IMPORTANT?

Geospatial information (GI) has played an increasingly important role over the last two decades in supporting effective decision making to address social, environmental and economic issues. Location, is a critical piece of information because everything that takes place in the world happens at some location, however that is described – for example by an image, map co-ordinates, or an address. Location provides a common link to different activities and statistics relating to the same place, and allows different datasets to be combined, viewed, compared, and analyzed. Being able to access up to date, definitive and reliable GI allows decision makers to see where resources, infrastructure and people are located, and the environment they are in. This is essential information for evidence based decision-making; without it decisions can be at best ill informed, at worst counter productive and costly. Resources are scarce, environments are fragile, people are vulnerable – the decisions governments make to protect their people, conserve their environment, use their national resources wisely, to invest in their economies and manage their taxpayers money efficiently need to be supported by the best possible information available.

However, having access to such information and using it for evidence based decision making is by no means the norm; many countries lack the types or quality of GI needed, and even where it does exists, it can be difficult to find out what is available, whether it is fit-for-purpose, how to access it, who owns it, or how to use it. The problem is often most severe in developing countries, those with arguably the greatest need, as governments and citizens try to deal with poverty, insecurity of tenure, natural disasters, gender inequality and the affects of climate change. Even where it does exist, the availability of high quality GI is not necessarily enough; this has to be accompanied by a number of other factors before the benefits can be realized. Being able to find out what exists, having technologies that can bring different datasets together within a legal framework that allows it to be shared, and having an organizational structure and capacity to enable this are all factors. Facilitating such an environment often needs a degree of central or “top down” co-ordination, and the result is a Spatial Data Infrastructure (SDI), or where this is organized over a whole country, a National Spatial Data Infrastructure (NSDI).

This paper will look briefly at why a SDI is important – only briefly because the case is fairly well understood and most countries in the world are already at some stage of NSDI implementation. The paper will then describe why understanding a country’s level of NSDI maturity (the degree to which a country’s NSDI has been developed) is important to the World Bank Group (WBG), the Food and Agriculture Organization of the United Nations (FAO) and other support agencies. The paper finally describes i) a SDI Diagnostic Tool that has been recently jointly developed by the WBG and FAO, and ii) a socio-economic business case model for low and middle-income countries. At the time of the WB Land and Poverty Conference 2017, the SDI Diagnostic Tool has been tested in Albania, Croatia, Indonesia, Kosovo, Malaysia, Moldova, Scotland, Serbia and Zambia. The conference provides an opportunity to discuss these tools, to evaluate the results from the first test cases and to decide upon the next steps.
II. WHAT ARE SDIs? WHY ARE THEY IMPORTANT?

A SDI is a framework of policies, institutional arrangements, technologies, data and people that enables sharing and effective usage of geospatial information. When organized at the national level these are referred to as NSDIs.

Many definitions can be found, but the real significance is the ability to allow governments, and other sectors of society, to make the right decisions, based on the best available facts and evidence. Location is the hook that allows many different sets of data and statistics to be combined and that is a very powerful visualization and analytical tool. The main benefits of creating an effective NSDI include:

- Better planning, management and monitoring of activities by Government (at all levels) – by supporting decision making with a core set of interoperable GI that is up to date and fit for purpose. Being able to combine datasets makes it possible to observe patterns and allow analysis – for example to simulate a flood event and visualize the area affected, to estimate the effect on the transport infrastructure, utilities, buildings and people, so that prevention measures can be put in place and contingency plans formulated;
- Creating e-Government services for citizens – cost effective and efficient, with widespread access and transparency;
- Avoiding costly duplication by having single authoritative versions of each core dataset shared by all users;
- Providing datasets for all sectors to support their economic and social activities, and for the development of new services. GI used in an SDI plays an increasing role in private sector development, innovation and technological advancements.

The principles of creating a NSDI are relatively simple – fit for purpose GI is made available by mechanisms that allow datasets to be accessed, combined together, and shared. Software applications can embed the GI so that the user is only involved with the interface – for example typing in the names of locations for a shortest route calculation, providing an address to discover the nearest hospital, viewing an image to observe the locations of properties, or typing in a distance parameter to view the affects of noise pollution along a highway….the GI is not the prime consideration to the user, it is just facilitating the service. In reality the issues involved in establishing an effective NSDI can be complex however, involving inter-dependent legal, technical, organizational and governance issues that require a degree of centralized co-ordination.

**Essential national infrastructure** - Most countries in the world are in the process of developing NSDIs, which are now widely seen as a basic component of the national infrastructure, just as important as the road, rail or power networks. Recognition of the importance of GI is growing within initiatives such as e-Government, Smart Cities and Climate Resilience. It has an important role to play as the world becomes increasingly digital, as societies become more information dependent and we need to make sense of and exploit the vast volumes of “big data” being produced.

**Global recognition** - Recognizing the importance of GI, and how its use should be promoted internationally, the United Nations (UN) formed a committee of experts on Global Geospatial Information Management (UN-GGIM) in 2009 to ensure that Member States could work together, share knowledge
and support the development of strong GI bases. Their work has been based on “a common recognition of the value geospatial information can play in developing our economies, in providing critical services, in underpinning sustainable development and, in doing so, enhancing people’s lives the world over”. The work of this group brings GI together with statistics and both have a crucial role to play to support development.

**Sustainable Development Goals (SDGs)** - The effectiveness and efficiency of a country’s NSDI will have an impact on its social and economic growth, its resilience, and its ability to address its development needs. The importance of high quality, reliable and timely GI for addressing SDGs has been recognized by the UN (United Nations, 2015). Focusing on 17 SDGs, 169 targets and a global indicator framework, the document suggests how the world should be sustained through to 2030 and beyond, referring to the need to “exploit the contribution to be made by a wide range of data, including earth observations and geospatial information...”. Re-enforcing the need for data to be spatially referenced, UN Resolution 2016/1 (point 21) urges “national authorities to leverage new data sources, including Big Data, and technology to improve the efficiency of data collection, processing and dissemination, to institute geo-referencing as a standard practice...”

The current focus in the development community on the SDG indicators emphasizes the need for tools to plan, implement, monitor and evaluate activities. For example SDG 13 states ‘Take urgent action to combat climate change and its impacts’ The availability of GI in areas of meteorology, topography, coastal marine, socio-economic information of the local population and disaster emergency facilities can assist in modeling, forecasting and production of evacuation routes, flood inundation scenarios, flood hazard and risk maps. Governments around the world do not necessarily have a clear picture of their capacity to provide coordination across sectors, or have a sufficiently integrated approach to land administration (for example spatial planning, land use or property valuation/taxation) to optimize the activities required to achieve the SDGs.

### III. WORLD BANK USE OF GI

GI and NSDIs are key foundations to both guide a country’s strategic investments and to meet the WB’s objectives of eradicating extreme poverty and increasing shared prosperity. In a recent WBG review to consider data gaps, GI was identified as one of the fundamental data infrastructure components that needed to be strengthened to support the development process¹. This conclusion is further confirmed through the role of GI in achieving and monitoring the SDGs. However, many WB client countries are only at the very earliest stages of NSDI development.

The WB has recognized the significance of GI for i) its own internal use and ii) as a project component supporting client operations around the world.

Internally, a Geospatial Operational Support Team (GOST) has been set up with the vision “to bring geographic insight to every front in our fight to eradicate extreme poverty and boost shared prosperity, to be accomplished by ensuring that Bank staff and clients have access to the geospatial diagnostics,

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methods and tools that enhance project effectiveness, efficiency, and transparency”. The WBG has identified that there can be significant amounts of duplication in the capture of GI in projects, and overlapping GI service teams delivering similar products and services or developing systems and data that are not inter-operable. A coordinated approach to geospatial data in analytics should produce significant savings and efficiencies.

In external operations with country clients, support for NSDI is now a sub-component in most WBG land administration projects. The outputs can provide users with information relating to addresses, land use, valuation and ownership, for example. The WBG support to land administration around the world often takes the form of developing and strengthening a country’s cadastre and land register to secure land tenure rights and develop the land market. In order to support improved land administration, WBG financed projects often include investments in the geodetic infrastructure and creation of fundamental datasets, such as land parcels, buildings, orthoimagery and addresses. As client countries progress, a natural extension of work on land administration and management includes strengthening the NSDI so that a country is better positioned to make the decisions required, and put in place the actions needed, to maximize its social and economic development potential. A more mature NSDI will then be capable of supporting transport, health, water, environment, agriculture, and energy, for example. Hitherto it has not been easy to assess the level to which a country has developed its NSDI and approaches have been ad hoc. In order to improve how the WBG supports client operations and evaluate the effectiveness of the SDI, there is a need to quantify the degree of effectiveness to which a number of key GI components have been developed. Thus, the joint WBG-FAO team have developed the SDI Diagnostic Tool and scorecard described in this paper.

III. SDI DIAGNOSTIC TOOL

The design and evolution of the SDI Diagnostic Tool, begun in November 2016, is described in the following section. At the time of the WB Land and Poverty Conference 2017 the SDI Diagnostic Tool has been used in nine countries: Albania, Croatia, Indonesia, Kosovo, Malaysia, Moldova, Scotland, Serbia and Zambia.

Purpose – Although initially designed for internal WBG use, the SDI Diagnostic Tool also has an important role for the countries involved, and potentially for the wider GI and development community.

For the WBG: the SDI Diagnostic Tool is intended to help WBG staff and country offices to assess the geo-maturity of a country in order to identify any gaps and potential areas requiring investment. A secondary purpose is to identify key geospatial datasets and services that could be i) incorporated into WBG projects, and/or ii) used to support existing or future WBG projects in each country. For example land use, elevation and transport datasets would be valuable to support a forestry project.

For the country involved: by identifying elements that would benefit from further investment the SDI Diagnostic Tool can help to strengthen and increase the benefits of the existing SDI implementation in a country, perhaps re-prioritizing components, identifying elements that need to be added, or highlighting issues that need to be promoted more and brought to potential users attention. Identifying any gaps should ensure that future support to the land sector is provided in the context of the wider SDI, working in a “joined-up” way to ensure that data are collected and stored to common standards and made accessible.
through web services.

Why is this important? As already suggested the principle purpose of an NSDI should be to support evidence based decision making. Putting a number of the standard NSDI “building blocks” in place will not in itself facilitate this goal; it is important that the NSDI can be and is used. The “use of NSDI” for practical applications is one of the most important elements that the SDI Diagnostic Tool is designed to highlight. For example, creating high quality orthophotography of a country produces an immensely valuable dataset, but it would be wasted if potential users are not aware of it, cannot access it, or do not know how it can be used to help with important policy, planning and monitoring applications.

Description: The assessment of a country’s NSDI maturity using the SDI Diagnostic Tool results in a fairly detailed report (typically 10-11 pages) and is based upon desk research, interviews and a scorecard system. The interview takes the form of a series of questions relating to a set of indicators, and the scores for each indicator are designed to increase incrementally to reflect the degree of NSDI development. For example Indicator 3 in the Legal section of the SDI Diagnostic Tool scorecard refers to data sharing. A simple verbal or signed bilateral agreement would be a constructive first step towards sharing data, this could then become a more formal MoU type agreement, and eventually progress to a legal instrument that makes data sharing mandatory between data custodians. The score for this indicator increases progressively as data sharing becomes more formalized and established. After several iterations of designing the draft scorecard a series of 55 questions have been defined, grouped into 9 main categories:

- Policy and Strategy (5 questions);
- Governance arrangements (11 questions);
- Legal (6 questions);
- Accessibility and Technical Infrastructure (5 questions);
- Socio-economic impact (5 questions);
- Capacity Development (4 questions);
- Use of NSDI / Applications (4 questions);
- Core Datasets\(^2\) (the availability / status of 15 core datasets using the UN-GGIM core set of 13, plus Government Facilities, and Utilities);
- Thematic datasets: allow tailoring or targeting datasets that are linked to a country’s prioroties – this part of the scorecard is still under development.

The scores obtained from the interview are entered into a spreadsheet. For each question the score can range from 0-100, and for each of 8 categories (not including thematic datasets) an average score is derived, and these are then combined to produce an overall average score. A radar graph is automatically generated and this helps to visualize where the relative strengths and weaknesses appear.

Outputs - The final outputs from using the SDI Diagnostic Tool are:

\(^2\) Using the UN-GGIM definition (from UN-GGIM- Europe WGA Core_Data_Scope v1.2.pdf): “core data can be seen as the authoritative, harmonized and homogeneous framework data which both national and international users need to either fulfil their requirements or to geo-reference and locate their own thematic data”
1. A completed **questionnaire document**, which allows the interviewer to record scores, notes and interviewee feedback;

2. A **spreadsheet** showing scores for 8 categories and an overall score, out of 100;

3. A **report**, of typically 10-11 pages, compiled using the two outputs above, combined with the results of any additional desk research, interview feedback and other meetings and correspondence involved. The headings for the report include:
   - Key metadata – personnel interviewed, place, dates etc;
   - Overall Summary;
   - Country description, recent WB and proposed activity;
   - Background, NSDI background;
   - Scores, conclusions and comments on all 9 categories;
   - Feedback;
   - Conclusions, Scores, Identified Strengths and Weaknesses;
   - Recommendations;
   - Links, Statistics (e.g. mobile phone penetration, internet use etc), Glossary.

A significant indirect output / benefit from the SDI Diagnostic Tool is the skills transfer and capacity building that takes place during the interview and meetings process.

The SDI Scorecard questions are intended to provide a broad perspective. There will always be a wide range of views on how many indicators should be used, what elements should be included, and how, if at all, scores should be weighted. But there is general consensus on what constitutes the “foundation stones” of an NSDI, for example a set of core data (although the definition varies somewhat), a strategy and governance structure, funding, a means of identifying available data, an ICT infrastructure, a legal framework, sufficient capacity, standards, and the possibility of making the data available through sharing mechanisms. As described previously, the SDI Diagnostic Tool aims to identify how well developed each aspect is, while at the same time assessing the completeness of the list of components. It was also felt that
the indicators should be designed to reveal more than just a list of desirable components – importantly, they should indicate how the SDI is being used, for example how in practical terms it is supporting decisions that affect government policy or supporting the private sector or engaging with civil society.

Methodology – The design process involved an evaluation of existing work / studies, consultation with industry experts and then designing and incrementally improving a set of scorecard indicators and a report template.

Desk review of existing SDI Diagnostic Tools - There have been a number of initiatives in recent years, using a variety of methodologies, by organizations aiming to create a standardized assessment of NSDIs, including:

- The INSPIRE “State of Play” project by Leuven University, 2012, designed to assess the progress of SDI development within the European Union Member States;
- A “NSDI Index” discussion paper (Chandler, Mulyani, Schmitt and Jepson, May 2016) with a global perspective and aiming to identify an index that would support the realisation of the SDGs. This work has since been carried forward and supported by the Global Spatial Data Infrastructure Association (GSDI);
- A Global Geospatial Industry Outlook (Geospatial Media, 2017) described a “Geospatial Readiness Index” that ranked 50 countries according to scores for 4 main pillars of NSDI development – geospatial infrastructure and policy framework, institutional capacity, users adoption level and industry capacity.

Each of these approaches had their own specific focus whereas the WBG need was for a global perspective and a standardised methodology that could produce cost effective results i.e. using minimal input and a short timeframe to obtain a clear understanding of the geo-maturity of the country involved.

Consultations with various experts with international experience in SDI - SDI experts have been consulted to ascertain, for example, if similar tools already exist, the lessons that have already been learned, and the key issues that need to be addressed. Those contacted include:

a) EU INSPIRE State of Play project;
b) UN-GGIM;
c) Group on Earth Observations;
d) UN Statistics;
e) GSDI;
f) University of Leuven and KU Leuven Public Governance Institute;
g) GIS Capability and Maturity Model (URISA 2013);
h) Spatial Data Infrastructure Manual for the Americas (PC-IDEA 2013)

The UN-GGIM has been a key driver for SDI policy in recent years and the industry looks to their lead for a co-ordinated global approach. Their role is fundamental, and their outputs and representatives were consulted as part of the process of defining the approach to create the SDI Diagnostic Tool. Leveraging the resources at the disposal of the UN-GGIM, the list of core datasets used by the SDI Diagnostic Tool is the one defined by the relevant UN-GGIM committee (UN-GGIM Europe 2016). By consolidating the best aspects of previous NSDI assessment initiatives, consulting widely and looking at the specific needs
of the WBG, using a global perspective, it has been possible to create a SDI Diagnostic Tool, with appropriate indicators, that is relatively quick to complete, but which provides highly valuable and relevant information. A simple scorecard system using a standard table of indicators in several categories provides metrics for analysis, making comparisons and highlighting areas for potential investment.

The WBG Land and Geospatial Team – GI is a cross sector topic and does not align neatly to any of the existing WBG Global Practice divisions, which tend generally to be sector specific. The joint WBG and FAO Land and Geospatial team is familiar with taking a cross sector approach when dealing with land issues and have considerable experience, particularly in the Europe and Central Asia (ECA) region, with NSDI projects. A wide range of skills were brought together for the initial drafting of the SDI Diagnostic Tool in order to ensure a comprehensive set of components and questions that would cover all relevant issues. The team involved in the initial design of the SDI Diagnostic Tool included specialists in land law, land management policy/strategy, information technology, economics and land surveying. All team members have substantial experience in advising governments around the world in building their national SDI. Most have been involved in global and regional SDI initiatives. Representatives from the WBG Global Practices were also contacted to hear their requirements and to benefit from their input. The response to date has been enthusiastic and all have expressed great interest and willingness to contribute with specific areas of expertise and to use the tool in their work.

IV. SOCIO-ECONOMIC BUSINESS CASE DEVELOPMENT

Purpose - The SDI Diagnostic Tool provides a means of assessing a country’s geospatial maturity and highlights elements of an NSDI that could benefit from further investment. Such investment, as part of a critical infrastructure, is a relatively new concept for governments however and has to be carefully considered; investment in a NSDI comes at the expense of investment elsewhere of course and needs to be justified. Most of the existing information relating to NSDI cost/benefit comes from high-income countries: for example research on the value of GI has been done for Australia, New Zealand, Western Europe, USA, and Canada. However, even within those reports, the methodology used and types of benefits measured vary. There is almost no research or information for NSDI investment in low or middle-income countries, which are the WBG’s main clients. For this reason the WBG Land Team has investigated the socio-economic business case for NSDI investment, the results of which compliment the output from the SDI Diagnostic Tool.

Description – The socio-economic business case described in this paper has been developed as part of the support work to design an Integrated Land Management Program (ILMP) in Albania. It also co-incident and overlapped with the development of the SDI Diagnostic Tool. The objective was to investigate a limited number of use cases in Albania in order to derive evidence and metrics to develop a socio-economic business case for investment in NSDI within a WBG portfolio and project context. There is also a longer-term goal of developing a methodological tool, which can be enhanced and generalized to be applicable to many different projects and sectors, through a combination of the SDI Diagnostic Tool, available data, political and economic priorities. For each broad use case (such as landscape programs, forestry management or disaster risk management) the tool could be used to determine the best quantification approach.
The details of the socio-economic methodology and results are presented in the accompanying paper at the WB Land & Poverty Conference: “Economic and Financial Analysis of National Spatial Data Infrastructure: A Case Study” \(^3\) by A. Anand, A. Coote and K. Kelm.

\textbf{V. RESULTS – SDI DIAGNOSTIC TOOL}

At the time of writing the SDI Diagnostic Tool has been tested in nine countries. Candidate municipalities are also being considered to develop synergies with the work of the WBG’s Urban Global Practice Unit.

\textit{Conducting the SDI Diagnostic} - The time taken to complete the assessment in each country has averaged around 4-5 days, which matches initial expectations. This has generally followed a pattern of 1 day of desk research and preparation, half a day for the interview, another half to 1 day for follow up meetings / emails / teleconference meetings, and another 2-3 days for assimilating the data, completing the spreadsheet and the final report. Crucial to the efficient compilation of the reports has been i) meeting the right people in each country (those will the right combination of policy knowledge and technical expertise), and ii) having the right level of expertise for the interviewer. It was originally discussed whether the questionnaire could be worded so that someone without specific NSDI expertise could perform the interview - with sufficient guidance and explanatory text to accompany the questions. In practice it has been clear that this approach would not work effectively. The resulting Country Reports have been between 10-11 pages long and have been able to comprehensively describe the current status in each country, highlight areas of significant progress, but detailing areas in which further work and investment is required. It is the last point, a set of recommendations and actionable activities, which is the most beneficial to client countries, but which requires knowledge and expertise by the evaluation team.

\textit{Results} – For most of the nine countries in which the SDI Diagnostic Tool has been used, a fairly comprehensive 10-11 page Country Report has been produced. In each case the people interviewed, and in some cases others, were contacted to obtain their feedback and views on the results. The main NSDI requirements identified are listed in the table below, with comments, although it should be emphasized that this represents a very small snapshot of the overall findings.

\begin{table}[h]
\centering
\begin{tabular}{|l|l|l|}
\hline
\textbf{Country} & \textbf{Main NSDI Needs} & \textbf{Comments} \\
\hline
Albania & Standards \linebreak Capacity Development \linebreak User Group \linebreak New datasets & Strong policy and strategy scores, also legal, governance and infrastructure. Capacity development and use of NSDI needs strengthening. Some specific datasets identified as needed, as well as completion of standards. The results were seen as helpful to present to Government to support future NSDI investment requests \\
\hline
Croatia & Standards \linebreak Capacity Development & Significant progress in NSDI leadership and governance. Regular reporting on the progress to the EU and to the \\
\hline
\end{tabular}
\end{table}

\(^3\) Paper by A. Anand, A. Coote and K. Kelm
<table>
<thead>
<tr>
<th>Country</th>
<th>Engagement and Communication</th>
<th>Data Custodians</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia</td>
<td>Business case</td>
<td>Policy, regulations and IT infrastructure are in place. Geoportal is well-designed and active with most Ministries with geospatial data using it. However datasets are incomplete and inconsistent. Big push by Government to complete fundamental datasets. Interviews were well responded to.</td>
</tr>
<tr>
<td>Kosovo</td>
<td></td>
<td>The Law is for approval in the Parliament, the NSDI strategy is developed, including Business Model. Sufficient IT infrastructure is developed. The NSDI IT strategy under discussion and Capacity development and use of NSDI needs strengthening. The metadata catalogue to be added in Geoportal and some specific datasets identified as needed, as well as completion of standards. The results were seen as helpful to present to Government to support future NSDI investment requests.</td>
</tr>
<tr>
<td>Malaysia</td>
<td>Policy &amp;Strategy</td>
<td>The lack of a SDI strategy document has not prevented the sustainable development of SDI in Malaysia. The SDI operates well based on guidelines and circular letters. However, the Geo Master Plan (2017 – 2027) is under development. The score for Governance arrangements is quite strong, reflecting a NSDI well-functioning structure but it is limited to government agencies only (Government-to-Government). The Geoportal is in place, ICT infrastructure well established. Capacity building needs strengthening.</td>
</tr>
<tr>
<td>Moldova</td>
<td>Standards</td>
<td>Policy, strategy, IT infrastructure and legal all very well developed. Use of the NSDI for practical applications still low. The report was seen as valuable to inform (other) public administration bodies with NSDI responsibilities. The results contributed valuable information for WBG project preparation to identify sub-component activities</td>
</tr>
<tr>
<td>Scotland</td>
<td></td>
<td>Governance, ICT infrastructure and legal all well established. The report was seen as helpful to get Government support to elements that are still missing or which could be developed further, and to develop an Action Plan for the NSDI implementation</td>
</tr>
<tr>
<td>Serbia</td>
<td>Standards</td>
<td>Governance, ICT infrastructure and legal all well established. The report was seen as helpful to get Government support to elements that are still missing or which could be developed further, and to develop an Action Plan for the NSDI implementation</td>
</tr>
<tr>
<td>Zambia</td>
<td>Data – open data</td>
<td>NSDI Strategy in place but needs strengthening. Lack of dataset generally, and no use of Open Data concept</td>
</tr>
</tbody>
</table>

**Feedback** – All those interviewed as part of the SDI Diagnostic Tool testing so far have been positive about the process. In most cases it confirmed previous perceptions but added some substance by itemizing and highlighting issues and providing some metrics. In one case there was some initial skepticism about the process but by the end those concerned were very supportive, appreciated the value of the exercise.
and were thankful that the opportunity had arisen. Some common findings were that the NSDI policy / strategy was often well defined, with a good legal base, ICT infrastructure and governance structures. In some cases the responsibility for NSDI was in the hands of one agency, typically the National Mapping or Cadastre Agency, and there was limited involvement by other organizations. Capacity was always identified as an issue, both in numbers and skills, and as might be expected the use of NSDI was generally low – meaning that the benefits were not being fully realized.

How will the results be used by the counties involved?

- **Albania** – the results provide justification for government budget and donor financing;
- **Croatia** – A new checklist for an updated NSDI Strategy was created based on the SDI Scorecard report;
- **Serbia** – Results will be used to get Government support for elements still missing or which could be developed further, and to develop an Action Plan for the NSDI implementation;
- **Moldova** – used by WBG team to assist in the project preparation phase of new project – identifying activities for the NSDI sub-component;
- **Indonesia**: the SDI Scorecard is used as part of WBG project preparation for a large landscapes program that aims to develop One Map in an effort to establish a unified, agreed-upon base set of geospatial data for combatting forest fires, restoring peatlands and accelerating land registration.
- **Malaysia**: the SDI Scorecard was used to develop a Policy Note on public sector reforms and best practice case studies, which assesses various options for the government’s plan to develop a regional knowledge hub and contribute to a south-south exchange program.

**VI. RESULTS – SOCIO-ECONOMIC BUSINESS CASE**

A summary of the emerging picture of substantial benefits by use cases is presented below. It is a small snapshot of the overall report but it illustrates some of the benefits identified. This will form the economic analysis not only of the value of GI in Albania, but also what will be possible to achieve through the investment made under the proposed ILMP project. The use cases are:

- **Data sharing** – Currently many geospatial datasets are duplicated by different Ministries which results in inefficiencies, lack of inter-operability and confusion around which dataset is the definitive source of data;
- **Improved flood prediction** – more accurate flood prediction model to be produced using LiDAR derived 3D digital elevation models;
- **More Equitable Valuation** – orthoimagery can enable “footprints” of the 100k – 500k informal buildings to be captured for more objective valuations and enhance tax collection;
• **Tax Collection** – NSDI will facilitate the creation of a national addressing system. The benefits of such an initiative have already been observed in the municipality of Fier and could be applied nationally;

• **Coordinated Strategic Planning** – strategic planning by many Ministries is hampered by a lack of consistent, accurate and complete geospatial information. The availability of a single accurate national database showing cadastral parcels with ownership, buildings, roads, hydrology, geology etc. will facilitate better and more consistent evidence-based decision making between and within Ministries;

• **Infrastructure Design** – the selection of routes for new roads, optimum sites for airport and port development currently require aerial and land surveys to be commissioned for each project. Availability of data within the NSDI will reduce this data capture requirement;

• **Expropriation** – major projects such as the Trans-Adriatic Pipeline (TAP) have been hampered by the lack of certainty of land rights along the route of the pipeline. The SDI development and ILMP will enable such developments in future to have detailed information on land ownership and an accurate terrain model in advance of detailed design;

• **Stimulating Economic Development** – the very first questions that potential foreign investors ask of the Ministry relates to what land can be purchased or leased. Initially, they are looking for state land as the Government terms are very attractive. Unfortunately, the register of state land is very poor, with low percentages registered and much of it disputed. The NSDI and ILMP will produce certainty of title;

• **Promoting Tourism** – The NSDI will provide a consistent master source to support better investment decisions. Availability of good maps in hardcopy or as Smartphone apps also opens up eco-tourism opportunities.

• **Microfinance in Agriculture** – Banks have a generally negative view of loans for agricultural improvement, regarding them as being too high risk and too small in value. Improving the certainty of land title will enable loans to be more easily secured on immovable property;

• **Climate Change Adaptation** – The effect of sea level rise over time in coastal lagoons can be modeled with great accuracy, allowing alternative preventative measures to be assessed with greater certainty.

The economic benefits analysis in Albania has produced positive results to substantiate investments in Albania’s NSDI and ILMP. The methodology developed is relatively generic and can be applied in low and middle-income countries to produce NSDI investment justification as part of the SDI Diagnostic Tool package.
Feedback from those involved with the country assessments has been very favorable and the SDI Diagnostic Tool has raised considerable interest. In each country the reports have been put to good use and it can be assumed that any further implementation of the process will be beneficial to the countries involved. The next steps for development include:

**Enhancement of the SDI Diagnostic Tool for the WBG and client countries:**

- **Support for SCD/CPF process:** The WBG’s support to each country is guided by a Country Partnership Framework (CPF), which results from a Systematic Country Diagnosis (SCD). The SCD is a review exercise to identify key challenges and opportunities for a country to accelerate progress towards development objectives that are consistent with the WBG twin goals of ending absolute poverty and boosting shared prosperity in a sustainable manner. Many sectors within the WBG already have SDI Diagnostic Tools for the SCD process but recognition that NSDI is a critical infrastructure and a public good needs further strengthening. Thus, given NSDI’s positive potential impact on development, the SDI Diagnostic Tool could form part of the assessment process used to compile the SCD;

- **Enhance NSDI Business Line offering:** The SDI Scorecard is the first step in developing a more detailed program for a country to maximize the use of and investment in GI. The WBG aims to further enhance the range of technical and financial support packages for client countries. Together with the socio-economic business case, (an Action Plan or Road Map) the diagnostic package will both justify and prioritize investments in GI for maximum benefit;

- **Support Project Preparation:** Country reports could be, and indeed already are being, used to assist WBG project preparation (for example Moldova and Indonesia), especially for large multi-sector and landscapes project that require geospatial information and data sharing;

- **Improve WBG Portfolio Management:** The information from the reports could be used by WBG country office staff to help with portfolio management – ensuring there is no duplication of efforts (e.g. avoiding creating data and services that already exist or are being created in another project), and to identify existing datasets for improved project planning, management and monitoring/reporting. In addition, ensuring that all WBG investments compliment and support the creation of the NSDI by using the same standards, facilitating data sharing, capacity building etc. ;

- **Refine the SDI Scorecard for sub-national level**, for use by local/regional governments. A Municipal SDI (MSDI) would facilitate the creation of the vital link between information and services at the local level while ensuring interoperability and integration at the national level. The synergies will be further explored with the WBGs urban sector to coordinate and create a NSDI/MSDI toolkit for governments.

**Potential Use of the SDI Diagnostic Tool beyond the WBG:**
A Global indicator similar to the WBG’s “Ease of Doing Business” could be developed to assess and rank progress of countries in developing their NSDIs and using GI in an optimal way. Whether or not it is appropriate to compare and rank countries against each other will need to be explored.

The SDI Diagnostic Tool could be used, in its current form or modified if required, by other potential WBG partners e.g. UN-GGIM, FAO of the UN, GSDI, with information shared to benefit each partner and populate a global index/indicator;

VIII. CONCLUSIONS

The SDI Diagnostic Tool described in this paper has been tested in nine countries so far and provides a relatively quick (4-5) days assessment of a country’s NSDI, to highlight potential components requiring support, and GI that could be of use in WBG projects, or to support such activities. The feedback to date has been very positive and the Country Reports have already been used to positive effect by contributing to WBG project preparation, updating existing NSDI strategy documents and being used to justify future investment priorities.

The creation of a socio-economic business case provides a methodology to produce NSDI investment justification in low and middle-income countries. By providing hard evidence, aligned to a country’s policy priorities, the case for investing in GI and NSDI components can be seen to be cost effective, and to produce more widespread benefits to society as a whole.

Having tested the SDI Diagnostic Tool and produced the first version of the low and middle-income country socio-economic business case the task now is to evaluate the value of these initiatives, and to decide on the next steps. A strong case appears to be made for internal WBG use of these tools, and by presenting these initial findings externally, it will provide the opportunity for wider discussion in the GI community to decide if they could be used more widely, either in their current form or after further development.

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Acknowledgment:

The WBG would like to acknowledge the cooperation and support of all those who have been interviewed and helped to test the SDI Diagnostic Tool in the nine countries in which assessments have taken place to date. Their inputs have been very significant contributions to both testing and improving the SDI Diagnostic Tool.