

# **BRIDGING KNOWLEDGE AND SCIENCE TO SUSTAINABLE DEVELOPMENT POLICY: THE ROLE OF GEOSPATIAL TECHNOLOGIES**

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**ABSTRACT:** The Global Environment Outlook Report of the UN Environment Programme (GEO-5) and several other authoritative scientific documents prepared in the context of the last United Nations Conference on Sustainable Development present undeniable evidence that humanity is currently living beyond the planet's means, consuming Earth's renewable resources as if we had one and a half planets to draw upon.

The emerging economies of Asia and the Pacific are exerting considerable pressures on biodiversity and ecosystems. The GEO-5 identified the main pressures on biodiversity include habitat loss and degradation, overexploitation, alien invasive species, climate change and pollution. The Region's ability to address climate change, rapid increase in consumption, natural resource availability and environmental sustainability calls for strengthening the link between scientific knowledge and policy making.

Asia Pacific can better address complex and demanding policy needed to reconcile the pathways between natural capital conservation and human wellbeing by narrowing the current science-policy gap. Information and knowledge exists, however it is fragmented, sometimes under-utilised, not properly documented, partly outdated, heterogeneous, not easily accessible and/or not always responding to policy-makers' needs. This paper summarises main issues for the production of national and regional State of the Environment (SoE) reports in Asia and The Pacific, and related needs for environmental data and information systems; and it analyses international best practice (based on 3 case studies) showing how geospatial technologies have assisted in providing relevant data and information for dynamic SoE reporting addressing science-policy gaps.

## **1. INTRODUCTION**

For evidence-based policy and planning to integrate sustainability approaches across all policy levels with the aim of overcoming current environmental challenges of the Region (e.g. rising greenhouse gas emissions, water scarcity, unsustainable consumption and production patterns and the management of chemicals and hazardous waste), improved monitoring and data collection is required, as it was recommended by the regional actors that prepared the GEO-5 report (UNEP, 2012). It also requires more dynamic environmental assessment and reporting tools and supporting data management capacities to present historic and near-real-time data and indicators on a number of environmental themes, to respond to urgent needs and emerging environmental situations of national and transboundary important.

Since 1972 countries and sub-regions of Asia and The Pacific have produced State of Environment reporting; however some governments and sub-regional bodies with environmental mandates manifest frequent inability of these reports to assist effective integration of environmental concerns into wider sectoral policies, for prioritization and planning, and monitoring and enforcement of legislation. This paper summarises main issues related to the production of national and regional State of the Environment (SoE) reports in Asia and The Pacific, related needs for environmental data and information systems; and it analyses international best practice (based on 3 case studies) showing how geospatial technologies have assisted in providing relevant data and information for dynamic SoE reporting addressing science-policy gaps.

To better understand country and regional needs, and how they could be addressed, the following section provides an overview of the status in the implementation of environmental data and information management systems in countries of Asia and The Pacific. This overview has been gathered through in-depth analysis of grey literature available over the World Wide Web and through stakeholder presentations and discussions at a UNEP meeting on "Bridging the knowledge and the science to policy gaps" held in Bangkok in November 2013 (UNEP, 2013).

### **1.1 Status of State of Environment Reporting**

National SoE reporting processes face a number of constraints, both in terms of preparing the reports and responding to their recommendations or findings. In countries of Asia and The Pacific, the integration of environmental concerns into wider sectoral policies is still incomplete. Both developing and developed countries of the Region experience financial constraints and technical weaknesses in their environmental information and reporting systems. A major

challenge to SOE reporting in the region is insufficient data for indicators that describe the state of environment due to limited existence of operational monitoring systems.

Furthermore, some environmental issues are trans-boundary (e.g Haze pollution in the Mekong Sub-region), ecosystem- and/or catchment-based, and therefore national SoE reporting and policy fall short to address the drivers of these environmental problems. For example, the carbon dynamics of countries and their capacity to produce food are part of much larger regional and global considerations. Thus, national information systems are increasingly challenged to be integrated with emerging sub-regional, regional and global information systems, to measure regional environmental trends and provide a basis for analysis and informed policymaking.

### 1.2 Environmental Data and Information Monitoring System: needs assessment

Current setup at national level varies among countries as shown in Figure 1. Operational national data management systems in some countries support only basic functions while other countries have more advanced systems capable of collating and aggregating data from local, to provincial to national level (e.g. China, and Thailand for pollution data), constituting a very strong data and information architecture to support informed decision-making.

The regional landscape of tools and information for reporting on the SoE is very heterogeneous; some countries count with well-structured Environmental Information Systems (e.g. China, India, Korea, Singapore, Japan), current and relevant information for assessment and reporting, near real time data and information, as well as ‘static’ databases for SoE reporting and monitoring, including strong human and IT capacities; at the other end of the spectrum are countries with very basic to non-existent data management systems and very limited human and IT capacity in terms of data collection, management and reporting. Countries like Bangladesh, Bhutan, Nepal, Pakistan have established the need for environment monitoring systems, although the systems are not fully operational (see Figure 1).

Data sharing mechanisms remain weak and information networking and coordination even amongst national agencies for effective data sharing is scarce or non-existent. For example, most environmental monitoring information of the Pacific Islands Countries and Territories (PICTs) is decentralized and segregated across governmental and non-governmental ministries and departments. Quality of data is also a concern as well as non-responsiveness of various organisations involved in environmental monitoring.

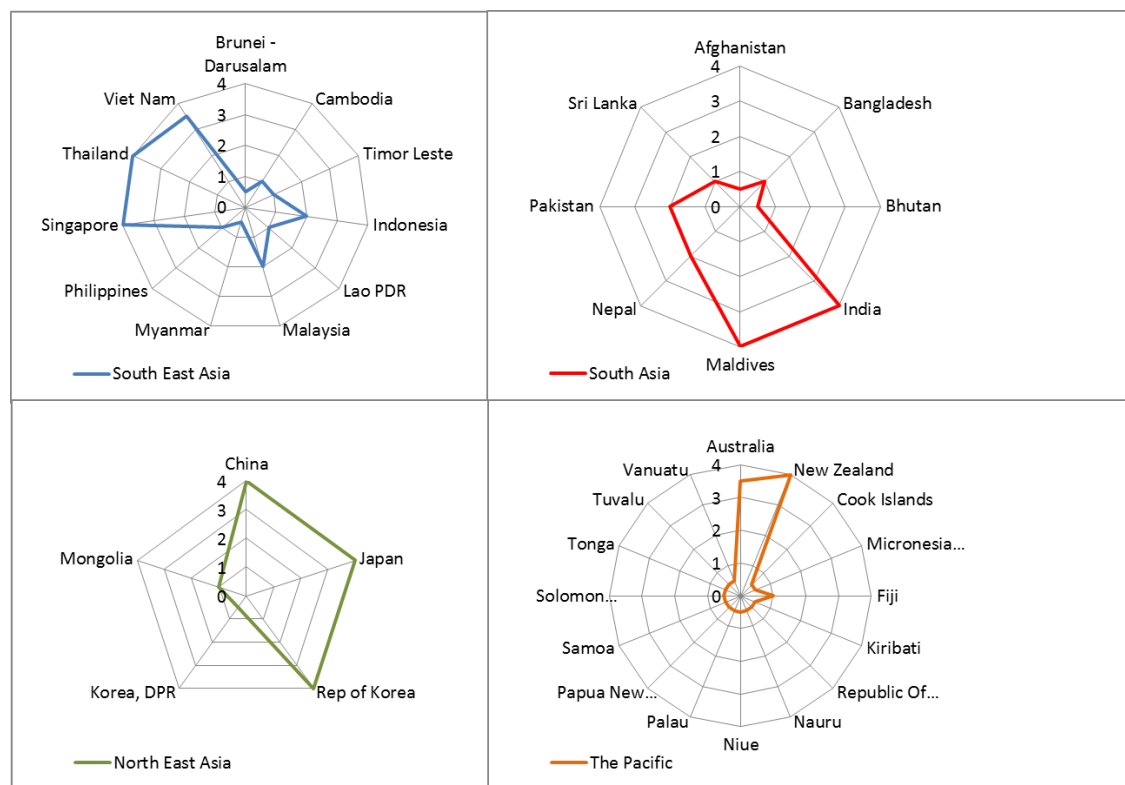


Figure 1: Radar diagram showing the level of development of National Environmental Information Systems in countries of Asia and The Pacific. 0.5=none to basic; 1: some (non-spatial) 2: average (some spatial); 4 : advanced to well established. Source: prepared by the Author with information gathered through analysis of documents accessed over the World Wide Web.

A needs assessment report of the South Asia Countries highlights lack of relevant data and gaps in the available datasets hamper sound policy decisions on natural resource management at the national as well as regional level (Development Alternative, 2008). Furthermore, sub-regional organizations experience difficulties in accessing data/information from national sources, hindering the understanding of regional trends, risks and progress towards the achievement of internationally agreed goals. The latter becomes relevant in light of the post-2015 UN agenda that will likely require a new set of indicators related to the implementation of Sustainable Development Goals (SDGs), wherein on-going negotiations confirm the need for integration of economic, social and environmental factors in setting targets.

## **2. BEST PRACTICE OF GEOSPATIAL TECHNOLOGIES FOR BRIDGING SCIENCE-POLICY GAPS**

This section reviews and analyses best practice on environmental monitoring and reporting of other regional organisations (i.e. The European Environmental Agency, the Abu Dhabi Global Environmental Data Initiative, the Latin American Development Bank), to identify conditions for robust data and information management for ongoing implementation of a dynamic state of the environment reporting at regional and national levels.

### **2.1 Eionet (European Environmental Information Observation Network)**

The European Environment Information and Observation NETwork (Eionet) is the main tool of the *European Environment Agency* EEA to collect data, information, and knowledge for the process of reporting on the state of environment. EIONET is both an organizational and a telematics network. EIONET increases interactions between various stakeholders and networks in partner countries. It also provides the stimulus and opportunity required to comprehensively identify the institutions generating environmental data in each country, undertake data inventories, explore new methodologies for data management and employ clearing house mechanisms.

The feat of this initiative lays in the successful creation and implementation of links between producers and users of information, including the decision-makers; an often overlooked, yet very important factor. The absence of such linkages creates an information vacuum where the users are unaware of the data available and producers churning out information that is never used. Adequate financing is crucial and required in order for the initiative to sustain itself, as well as dedication and commitment to maintain and organize all the stakeholders.

Coordination and collaboration are key conditional prerequisites and the success of the Eionet Data and information lays in the realization of the core principles of managing as close as possible to data source; collect rigorous data once and then share with others for many purposes; ensure data is readily available to public authorities and enable them to easily fulfil reporting obligations; ensure data is accessible to enable end-users to make comparisons at the appropriate geographic scale and to participate meaningfully in the development and implementation of environmental policy; and ensure data is available to the general public after due consideration of the appropriate level of aggregation, given possible confidentiality constraints (Stanner 2013).

Main lessons learned in the implementation of this initiative are: a strategic plan developed at the beginning of the project is useful to provide critical guidance throughout the implementation period. Reporting is most effective when done on an **outcome-output basis** with accurate reporting of results and scheduling. It is also important to ensure that all counterpart staff are available at all management and technical levels. It is necessary to factor in rapid changes in technology by creating flexibility in work plans – for instance short duration activities. Finally, it is always critical to ensure a participatory approach, at all levels, from the outset of programme design. Other specific lessons learned included the following.

1. The Eionet initiative revealed that gaps always exist –even if the institutional and technical resources of the countries selected for the first phase were quite good. These gaps cannot be filled in the course of a one, two or three-year initiative. It is a very long process that needs to be followed up by the countries themselves.
2. A key lesson learned was the need for sustainability. To ensure the long-term sustainability of projects, it is very important that their concepts and methodologies be integrated into sub-regional and government activities and budgets.
3. It is always important to start a network that is of a manageable size and made of committed partners (individuals and institutions). It demands a lot hard work to maintain and organize all stakeholders and the process should not be independent but complimentary to other on-going country environment initiatives. The work of coordination should be a regularized post.
4. Political support is very important when such initiatives are implemented at the national level. Politicians must be informed and they must be involved at the early stages of the process and awareness should be raised among national stakeholders regarding the need for involving the politicians. Regional and International organizations need to further encourage – and recognize - the political support of national level authorities.
5. Dependence on specific technologies must be minimized and any systems developed must be robust and should not be based on proprietary software. The cost associated with paying for software licenses could in the long term impede the development of national EIS's. Interoperable systems must be adopted at early stages of the project.

## **2.2. Abu Dhabi Global Environmental Data Initiative**

Under the guidance and patronage of His Highness Sheikh Khalifa bin Zayed Al Nahyan, President of the United Arab Emirates, the Abu Dhabi Global Environmental Data Initiative (AGEDI) was formed in 2002 to address the local, regional and global responses to the critical need for readily accessible, accurate environmental data and information for all those who need it. AGEDI also works to bridge the environmental data and information gap between developed and developing countries.<sup>i</sup>

AGEDI provides user-friendly access to high-quality environmental information, through a variety of information products. AGEDI produces the Abu Dhabi State of the Environment report, and it provides accessibility of data and information to all stakeholders, and enhances national and international mechanisms of information processing and exchange. It considers the whole chain of production of environmental assessments: Collect Data, Analysis, Visualization, Interpretation, Narrative, Publish, Share, Share again, Reuse and Link to. The success of this initiative has mainly been leveraging the links to different ‘chains of environmental information production’ (e.g. between countries, or between a country and a regional or global process).

Interestingly, political will –which takes its own time to develop- has shown more important than financial support in this Initiative, although retaining a predictable stream a core funding is essential. The initiative is not due to a legislative mandate but rather has taken off because of the demand for it from policy makers.

Standardization is important as ‘indicators’ translates data sets received from multiple sources into standard understandable units and language. This stems from the fact that it is commonplace for a lack of adoption of a standard approach to sharing environmental information across the web. For numerous reasons, the standards are weak in terms of their enforcement. There is no incentive to use them, and people have not truly bought into it. It places additional burdens, and the reason people think it's a burden is because there is no perceived value. AGEDI realized that they could not rely fully on standards. Hence the adaptation of “indicators”, as it also draws in data from Abu Dhabi, the World Bank, and other reliable open sources, and translates it into something that the National Reporting Tool (NRT)<sup>ii</sup> can use.

By adhering to the following recommended steps, as in the case of AGEDI, successful SoE implementation can be achieved. These are the following:

1. Monitor and enable environmental and societal data collection and assessment across worldwide networking movements.
2. Ensure capability and capacity building to support ‘best impact’ and application of data and information for local, national, regional, and global environmental decision-making.
3. Identify needs and work with theme experts to ensure sustainable development planning is based on timely, useable, and updated data and information of high quality.
4. Define and deliver projects that address specific data access, acquisition, and dissemination to boost the accessibility of data and information by all.
5. Enable and facilitate national and international information processing and exchange mechanisms.

Two of the key specific lessons learned from the AGEDI effort, which are the same as those experienced by the European Environmental Information Observation Network (Eionet) initiative, include the need for: a) sustainability (to ensure the long-term sustainability of projects, it is very important that their concepts and methodologies be integrated into sub-regional and government activities and budgets); and b) starting a network that is of a manageable size and made of committed partners. It demands a lot of hard work to maintain and organize all stakeholders, and the process should not be independent but complimentary to other on-going country environment initiatives.

## **2.3 Geosur - Serving Latin America And The Caribbean**

The GeoSUR Program is led by the Latin American Development Bank and the Pan American Institute of Geography and History. The Portal was developed with the technical support of the U.S. Geological Survey (USGS). The Spanish Geographic Institute (SGI), the Agustín Codazzi Geographic Institute (IGAC) of Colombia, National Geographic Institute of Ecuador (IGM) and the National Geographic Institute of Chile (IGM) are also key partners. GeoSUR develops geospatial services on the Web which enable users to locate, view, analyze, and obtain spatial information. Access to these services is open and free and no special software is required to use them. The Portal provides an entry point to spatial data published by Latin American and Caribbean agencies. The data may be consulted directly by means of partner map services, a regional map viewer contained in the portal or through various metadata services. Most of the spatial information available in this portal is available in map services operated by participating agencies in a decentralized fashion. These services are owned by spatial data producers from the region. These institutions register their various geo-services and their metadata with the portal in order to make them available to the public. No

special skills or special software is required to use the portal; it is free and open to the public. GeoSUR has four main components:

- 1) **Geoportal:** This is the first portal to offer access to spatial information for all the countries of the region in one place. Spatial data and metadata generated by participating agencies can be consulted in this website.
- 2) **Network of map services:** More than 90 agencies in Latin America and the Caribbean participate in GeoSUR by implementing map services and data catalogs that become part of the first regional spatial data infrastructure. It is a decentralized network and every participating agency is responsible for the development, operation, and maintenance of its geoservices.
- 3) **Regional topographic processing service:** The service allows modeling and generation of derived datasets such as slope, shaded-relief or elevation profiles from the 30-meter SRTM digital elevation model of the region. It is the first of its kind in the developing world due to its extensive geographic coverage and high resolution.
- 4) **Regional Map Service:** Regional maps of Latin America and the Caribbean are available for viewing and analysis through this service, on topics such as base maps, infrastructure, projects from the Development Bank of Latin America (CAF), land use and land cover, protected areas, aerial imagery, etc.

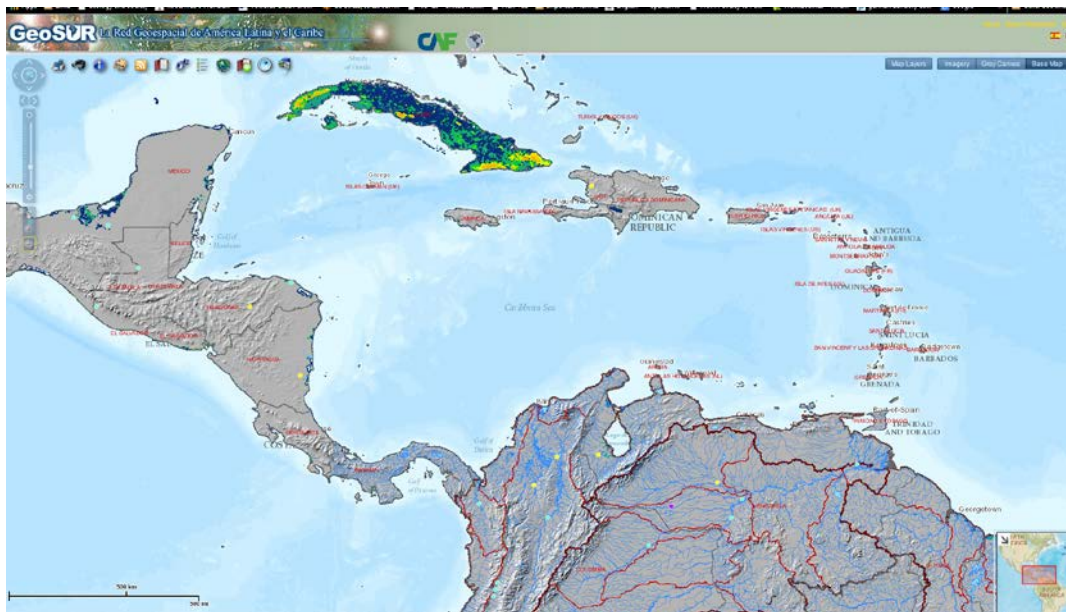


Figure 2: Visual display of the GeoSur platform for information at regional level.

GeoSUR also maintains a permanent capacity-building and technological assistance program to assist partner agencies in the development of map services and geospatial catalogs. The assistance is provided remotely and on-site if required. Once partner agencies develop their geo-services, these are linked to the GeoSUR Portal.

Key messages in terms of GeoSUR's success, include the following:

1. Be inclusive from the start, let potential participants know that they have to meet only a minimum set of conditions to join, and make participants understand that they join under their own terms.
2. Early establishment of simple and useful web services that help provide momentum for the initiative and that have practical and real uses for decision makers.
3. Define a clear long - term funding strategy (covering at least three to five years as a starting point). Key to success of GeoSUR has been the possibility to commit resources on a long term basis.
4. Streamline the process to join the initiative and encourage commitment by asking new participants to subscribe a letter of intent (required) and an institution-specific workplan (optional). This helps create a sense of ownership and commitment for participants and simplifies the paperwork required to join on both sides.
5. Design and implement a permanent capacity building program, making use of Webinars and other online collaborative tools to keep partners up-to-date on technological advances, and provide technical assistance whenever possible to keep costs down.
6. Promote horizontal cooperation: create a work environment that encourages innovation and collaboration and identify technical institutional strengths while asking key partners to assume leading roles in their specific area of expertise.
7. Define a clear strategy to deal with legal and organizational issues at both the regional and national level.
8. Establish clear and simple coordination mechanisms with related regional and national initiatives.
9. Establish a monitoring and reporting mechanism; follow up of commitments made by partners and other institutions.

10. Define and publish clear technical guidelines for the creation and publication of geo-services. Define mechanisms to periodically evaluate and update quality of services.

### 3 CONCLUDING REMARKS

Best practice gathered from the case studies analyzed in the previous section suggest that agreed, functional standards should be established at national and regional level to enable data from different projects and initiatives to be combined into 'de facto' long-term data sets, covering sub-regions; the synergy of geo-spatial technologies and field-based monitoring should be considered as the former is less costly.

Existing Environmental Information Systems for SoE reporting need to be responsive to unexpected short-term information demands, to meaningfully feed into environmental policy agendas, and be able to develop baseline capacity for future responses. Much of the former can be achieved if data is collected with a view to reuse, as demonstrated by the Eionet experience of the European Environmental Agency.

Legal arrangements for accessing environmental information can be significant barriers for information sharing between organisations with a mandate on SoE reporting and monitoring, and with the public. In this regard, licencing restrictions is a barrier identified at different levels (national, sub-national, regional, sub-regional). For instance, in Australia it has been identified that 'the most common barriers to implementing open access licensing for environmental information are communication and culture, with licencing being a manifestation of these barriers. (Tiney and Morton, 2012). An example of good practice to address open access to data and information are the Principles on Open Public Sector Information adopted by the Office of the Australian Information Commissioner (OAIC) in 2011. Uptake of these principles is occurring across government, albeit with challenges. Consistent with the Australian Government policy, in all possible cases licences purchased for data should be for whole-of-government and ongoing use, allowing release under Creative Commons Attribution licence (or Open Data Commons database licences where appropriate).

Countries of Asia-Pacific need dynamic platforms for environmental data, information and knowledge management and sharing that is responsive to policy through efficient and effective use of that information for improved environmental management and policy. This paper identifies challenges and constraints countries face, and it highlights opportunities and good practices that could help advancing the implementation of such platforms at regional and country levels. Real time data access of environmental information is accelerating dramatically and modelling of national, sub-regional and regional environments is becoming possible.

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<sup>i</sup> [http://bluecarbonportal.org/?dt\\_portfolio=abu-dhabi-global-environmental-data-initiative-agedi](http://bluecarbonportal.org/?dt_portfolio=abu-dhabi-global-environmental-data-initiative-agedi)

<sup>ii</sup> National Reporting Toolkit