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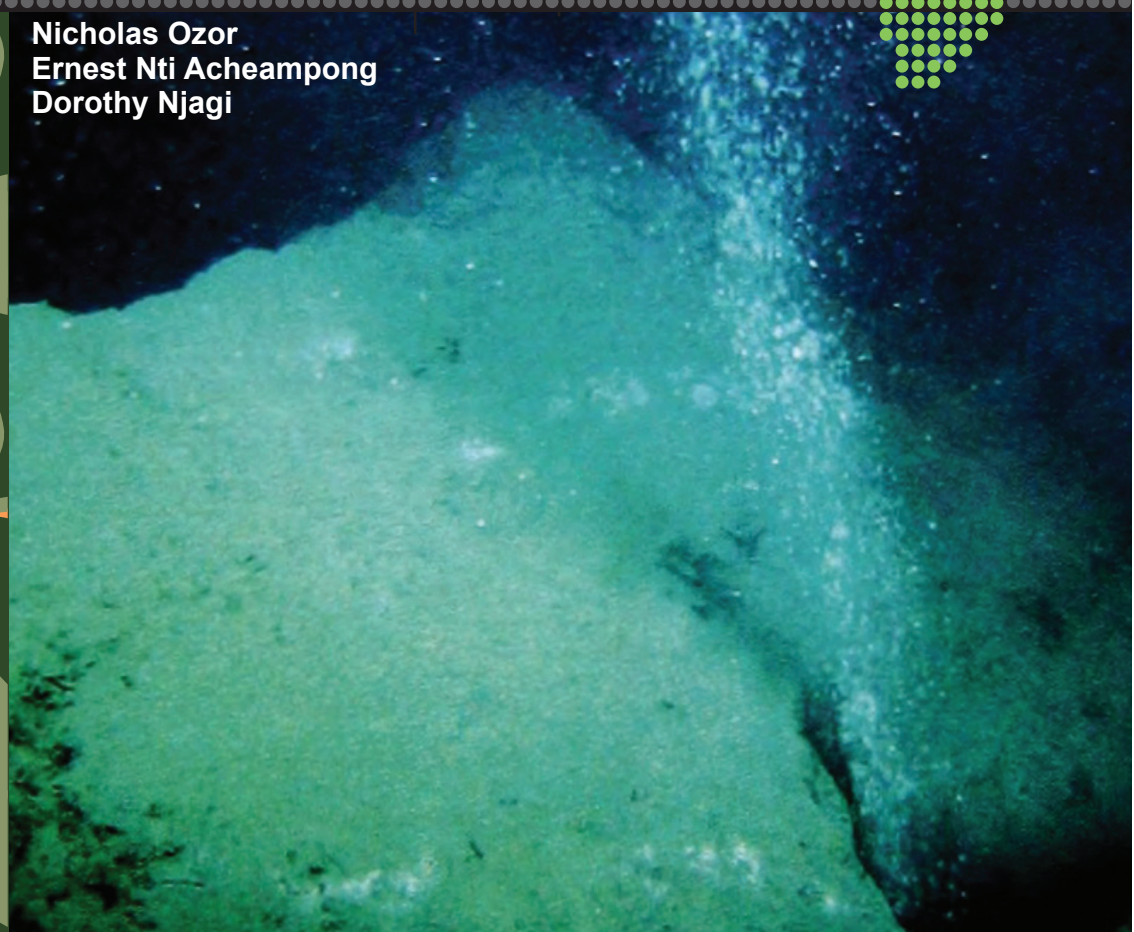

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African Technology Policy Studies Network (ATPS)

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About The African Technology Policy Studies Network (ATPS)

The African Technology Policy Studies Network (ATPS) is a trans-disciplinary network of researchers, policymakers, private sector actors and the civil society promoting the generation, dissemination, use and mastery of Science, Technology and Innovations (STI) for African development, environmental sustainability and global inclusion. ATPS has over 1,500 members and 3000 stakeholders in over 51 countries in 5 continents with institutional partnerships worldwide. We implement our programs through members in national chapters established in 30 countries (27 in Africa and 3 Diaspora chapters in the Australia, United States of America, and United Kingdom). In collaboration with like-minded institutions, ATPS provides platforms for regional and international research and knowledge sharing in order to build Africa's capabilities in STI policy research, policymaking and implementation for sustainable development.

About JRS Biodiversity Foundation

The JRS Biodiversity Foundation is an independent grant making foundation based in Seattle, Washington with assets of $42 million that awards grants to increase the access to and use of biodiversity information in sub-Saharan Africa. Our goal is to expand the tools and processes used to collect, manage, and disseminate biodiversity data and information ("biodiversity informatics") in sub-Saharan Africa and to connect this knowledge to the people — the policymakers, scientists, conservationists, economists, and the public — who make and influence decisions that are crucial to preserving biodiversity.

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1.0 Introduction

A major challenge for emerging field of biodiversity informatics is to develop infrastructure that allows the effective coordination of available data and information and knowledge on Earth's biological diversity to address issues relating to the natural environmental system upon which life depends. Biodiversity data, information and knowledge are critical to the scientific world and society for informed decision-making and formulation of national policies that facilitate sustainable management of natural ecosystem, sustenance of human health, maintenance of economic stability, and improvement of human life quality. The urgency for biodiversity information and knowledge deepens everyday as the transformation of natural systems to human-managed systems speeds up the decline and loss of biological diversity.

Researches and projects on the identification and characterization of biological species have yielded tons of species data globally. However, there are still immeasurable amount of species yet to be discovered and countered in certain parts of the world. With the current available scientists and levels of research activity, there is a growing likelihood that a vast majority of earth's species will go extinct without recognition[1]. The emerging field of biodiversity informatics is advancing efforts of the research community to systematically assemble information processing technologies such as information models, network communications, semantic frameworks, data integration engines, protocols, standards, software applications and web services, to enable an innovative way of analysis and synthesis of biological diversity research to address scientific conservation and sustainability issues. Biodiversity Informatics attempts to accurately acquire, integrate, analyze, interpret and apply information regarding biodiversity.

Biodiversity informatics can be modeled as a process of methods and events that begin with defining a scientific standard and method for data collection, and ending with application of information and knowledge generated for science and society. From the policy perspective, the commitment by the Parties to the Convention on Biological Diversity (CBD) to significantly reduce the current rate of biodiversity loss at global, regional and national level by 2010 has not been fulfilled in sub-Saharan African (SSA) countries. Efforts to implement these regulatory instruments, research projects and surveys have resulted in generating a wealth of primary biodiversity data, available to the biodiversity research community. In spite of the large deposit of biodiversity data, a large portion of it is still locked away, inaccessible and not digitized [2]. The lack of access to well-structured and processed biodiversity data and information leads to superfluous duplication of efforts that cannot form the basis for biodiversity decision-making as well as represents an obstacle to assessing the impact of biodiversity measures with valid indicators.

[1] Wheeler, Q. D., Raven, P. H., & Wilson, E. O. (2004). Taxonomy: impediment or expedient?.Science (New York, NY), 303(5656), 285.
[2] Global Biodiversity Informatics Outlook (GBIO) (2013) Delivering Biodiversity Knowledge in the Information Age. ISBN: 87-92020-52-6

As the field of biodiversity is broadening and becoming more data-driven, the nature of mobilizing and processing biodiversity data and information is also evolving to take advantage of the global advancement in the digital age. Technology such as the Internet, application software, virtual, and mobile platforms is set to revolutionize the way biodiversity data and information is captured, processed and used. Technologies are creating expectations for more efficient processes for data mobilization, analysis and access. The use of such tools has significantly improved the analysis, interpretation,integration, and visualization of biodiversity data and information.

2.0 Rationale

In sub-Saharan Africa, biodiversity provides a fundamental basis for economic livelihood and societal wellbeing. It is vital for the health of the earth's ecosystem that survives the current and future generation (African Biodiversity Collaborative Group (ABCG), 2008). Given the crucial role of biodiversity in the development of Africa's economy and the importance of high quality data to inform effective decision-making, it has become necessary to identify innovative best practices and policies, that are essential for facilitating the mobilization, processing and digitization of biodiversity data and information that would inform the management and achievement of biodiversity conservation targets in sub-Saharan African countries. This policy brief presents purpose-driven innovative best practices and policies that can contribute towards the facilitation of biodiversity informatics in SSA. Making processed data more widely accessible to potential users, and interpreting them to bring out meaningful information and knowledge and gaining insights from species occurrence and distribution data provides a vital asset for the development of well-informed policy and conservation strategies for biodiversity.

3.0 Innovative Best Practices and Policies for the generation, maintenance and access to biodiversity information in SSA

Capturing and managing biodiversity data and information will vary according to the purpose, priorities and development levels of countries. In SSA countries, research institutions and state agencies starve, without access to sufficient biodiversity data and information to develop accurate and reliable models and

to make recommendations on which policy makers can act and develop new policies. A rational approach for stakeholders is to establish a structure that will facilitate the generation, processing and access to biodiversity information and to provide reliable data for assessments and development of predictive models for decision-making on biodiversity conservation.

Countries in SSA do not have to re-invent the wheel judging from the fact that there are innovative practices and policies that are contributing to effective capture and use of biodiversity information and data elsewhere. Based on rigorous assessment of available literature and e-forum discussions, this brief offers a range of innovative practices and policy recommendations for biodiversity stakeholders to select suitable options required for their specific contexts to promote the generations, maintenance and accessibility of biodiversity information for diverse purposes including academics, research, decision-making, and planning. These measures are not in systematic or hierarchical order.

3.1 Development of basic biological inventory and systematic research

While this may sound like a common practice in most developed countries, many countries in SSA lack nationally centralized inventory of biological species. In most cases, the lack of adequate number of scientist and technique to carry out baseline surveys and inventories leave many species unexplored and unidentified. SSA countries must establish national inventories by documenting species and patterns of biologically diverse systems as pressure continues to mount on the conservation and resource management due to the rapid decline of biological diversity. Baseline data on species identity, distribution, patterns and hotspots of biodiversity remaining unexplored wild areas will become critical for analysis and predictive models about the value, relevance, and sustainability conservation decisions.

3.2 Development and application of Web-based and Internet-based biodiversity informatics infrastructure

The emerging field of biodiversity informatics continues to see significant development of innovative biodiversity software tools and applications, and network protocols at the national and regional levels in the developed region. At the global level, the Global Biodiversity Information Facility (GBIF)[3] supported by governments and many institutions worldwide focus on the development of tools and standards that establish a worldwide biodiversity infrastructure for making scientific information and data on biodiversity available and accessible through the internet using web services. By making data accessible and searchable via a single portal, the GBIF has extended the technology innovations, providing a one-stop shop for data, and strengthening protocols, models and web portals for biodiversity information.

[3] *www.gbif.org*

At the regional level, the Inter-American Biodiversity Information Network (IABIN)[4], mandated by the Organization of American States is supporting a decentralized, Internet-based, western hemisphere network that makes available and accessible biodiversity information resources, including software tools, training, and other services. At the national level, the Instituto Nacional de Biodiversidad (INBIO)[5] in Costa Rica is actively involved in the development of innovative biodiversity software tools and services. These are good illustrations of innovative practices that can facilitate biodiversity informatics in sub-Saharan Africa. At the regional level, Biodiversity Information Networks in the SSA must take advantage of the Internet age to develop a consolidated network of information systems soliciting for the commitment and contributions of all SSA countries, while tapping into the experience of global networks such as the GBIF.

3.3 Web -based biodiversity decision support sysstem for Biodiversity Informatics

Decision support systems (DSS) represent a terminal link of the biodiversity informatics value chain, as automated analysis techniques to facilitate analysis, interpretation and decision-making for policy makers and planners. Several practitioners, NGOs and research groups have recognized the significant potential of Decision Support Systems (DSS) to facilitate biodiversity informatics, given their ability to model complex processes and integrate knowledge across disciplines. Their potential utility has led to a number of interest groups developing DSS to support biodiversity informatics. For example, Natureserve[6] has recently developed one DSS system "Vista" to add value to its information resources for its clients. Collaborative development of an information infrastructure that would support and open, international architecture for decision support systems would do much to ensure a strong impact of biodiversity research.

3.4 Development and application of Biodiversity Informatics Potential (BIP) Index

The BIP Index seeks to fulfill a prioritization role, by integrating a number of parameters that might be related to the state of biodiversity informatics in individual countries[7]. The BIP Index has the potential to assist in (a) identifying countries or economies most likely to be able to contribute to filling gaps in digitized data, as well as being most likely to absorb, implement and reliably build required informatics infrastructure and capacity in biodiversity informatics; (b) provide a prioritization mechanism, by integrating a number of parameters

[4] *www.iabin.net*
[5] *http://*www.inbio.ac.cr/en/default.html
[6] *http://www.natureserve.org/*
[7] Ariño, A. H., Chavan, V., & King, N. (2011). The biodiversity informatics potential index. Bmc Bioinformatics, 12(15), 1.

that might be related to the state of biodiversity informatics in individual countries: infrastructure capacity (financial, human, and technical resources), data accessibility, and fitness for use of accessible data; assist countries, especially those with the most need (for example mega-diverse countries, or those whose biodiversity is most endangered), to mobilize resources and collect data that could be used in decision-making; and (d) be used as an equalizing measure involved in any biodiversity informatics compensation mechanisms across countries.

For instance, the BIP Index may allow the identification of biodiversity informatics-resourced countries that could afford to assist countries lacking in biodiversity informatics capacity in an efficient way that would potentially produce useful, quality data. Assessment of BIP Index can be done taking into account three criteria: (a) the intrinsic biodiversity potential (the biological richness or ecological diversity) of a country; (b) the capacity of the country to generate biodiversity data records; and (c) the availability of technical infrastructure in a country for managing and publishing such records.

3.5 Harnessing the power of Internet to create Biodiversity Information System

As the field of biodiversity becomes increasingly data-driven, global interactions become more network-based. The Internet continues to create expectations for more effective access to research data sets, analysis tools, visualization applications, etc. and for more remote interaction among scientists around the globe[8]. Through the Internet, several biodiversity information systems and networks have been established that are advancing biodiversity informatics. The translation of global initiatives to the national level, particularly in developing countries remain difficult. However, SSA countries can learn good lessons from emerging initiatives particularly in SSA. For example, Rwanda has showed tremendous commitment towards the establishment of a National Biodiversity Information Network (NBIN) and a National Biodiversity Information Management System (BIMS) to facilitate the collection, sharing, analysis, distribution and management of data and information for the biodiversity conservation and sustainable use.

3.6 Exploring the Open Access Platform for Biodiversity Informatics

The Open Access for data and services is an innovative way of allowing users unrestricted access and unrestricted reuse. This is revolutionizing ways in which data and information is published or shared globally. For example, universities and other public institutions in developing countries that hitherto could not afford journal subscriptions are now exposed to free access to journal publications. These institutions can also pay for access to be made available to

[8] Hardisty, A., & Roberts, D. (2013). A decadal view of biodiversity informatics: challenges and priorities. BMC ecology, 13(1), 1.

their data and research output for a wider audience. Through the Open Access platform, research scientists in SSA can benefit immensely from biodiversity data and information sharing. At the sub-region, national institutions and university must strengthen collaborative networking and communication through the implementation of Open Access platform. While Open access to biodiversity data should normally be unrestricted as a general principle, it is essential to protect them when the need arises, for instance, location data for rare bird nesting sites.

3.7 The role of mobile technology

Development in mobile technologies for biodiversity informatics offers numerous opportunities for innovation. Smart phones and tablet PCs with on-board GPS location can be easily taken into the field, creating opportunities both for innovative data collection and user information services. Mobile apps for biodiversity informatics can be used to generate image-vouchered, location-tagged observations uploaded to central databases. While many biodiversity initiatives in SSA countries could benefit from mobile apps for biodiversity informatics, the development of such tools can be costly and time consuming. However, these constrains can be easily addressed by developing open-source and free mobile apps, keeping with the current trend of Open Access and Open Science in scientific research and publishing. Already, several free mobile apps and software tools for biodiversity are being developed and shared on mobile platforms such as android and apple operating system.

4.0 Policy Strategies

4.1 Comprehensive and Integrated Planning

Building an infrastructure of systematic biodiversity data and information needs strategic planning and integration of all biodiversity related strategies from local to national level. Countries should ensure that biodiversity data and information objectives are embraced within a broader national vision supported with appropriate policies and plans. The formulation of a national biodiversity plan presents a good opportunity for countries to implement strategies that focus on addressing biodiversity conservation issues. This also provides the avenue to build a network of biodiversity data and information from which indicators to monitor the progress of implementing the biodiversity plan would be attained.

4.2 Stakeholder Engagements and Partnership

Developing a comprehensive information base on biodiversity requires broad partnership buy-in. Onset and continuous involvement with key stakeholders is critical for creating consolidated partnership and a sense of ownership and relevance for building a digitized, structured biodiversity information system. In addition, the rationale is to bring together multi-disciplinary and cross-organizational teams that would enrich the program and improve the characterization of biodiversity values. By working together, stakeholders are in a position to leverage sustained funding by widening the investment portfolio from both public and private sources, mobilize and make openly accessible relevant biodiversity data to support education, research and decision-making and share expertise on good practices that can facilitate the acquisition, processing and dissemination of accurate biodiversity data and information.

4.3 Developing National Biodiversity Information Standardized Framework

Highly critical for biodiversity stakeholders is the need to collaborate in the development of a standardized framework to facilitate the generation, digitization and dissemination of biodiversity information. Historically, unsystematic approaches to biodiversity data collection have been inadequate in providing information on specific trends. This has presented difficulties in the gathering and analyses of biodiversity data required to produce accurate assessments and predictions. Countries in SSA must develop standardized frameworks that will guide the gathering, processing and utilization of biodiversity information in line with national priorities, objectives and circumstances.

4.4 Efficient governance structures for biodiversity

Governance encompasses policies, institutions, processes and power. The nature of governance is reliant on the institutional rules for decision-making and the capacity for effective stakeholders participation in decision-making processes. Co-operation at the various levels could spur coordinated action for building a consolidated biodiversity information network. Efficient governance systems can improve biodiversity information outcomes indirectly by enabling decision-making and management actions that support and are receptive to biodiversity issues. Better biodiversity information outcomes could offer recommendations for improving the extent of biodiversity values or reducing the threat to those values.

4.5 Capacity Building in Biodiversity Informatics

Building capacity across the biodiversity data and information value chain would empower stakeholders with requisite skills and knowledge to produce, process and make accessible accurate biodiversity information for conservation and socio-economic development. Building the capacity of African countries is highly essential for critical policy reasoning, research and development of

data and information systems, and to overcome the shortcomings that would undermine the relevance, credibility and legitimacy of biodiversity informatics towards strengthening the science-policy interface.

4.6 Facilitate release and access of public to biodiversity data

In 2004, at the 3rd IUCN World Conservation Congress, the Conservation Commons was established to address the dissemination and availability of this data. The basics to the conservation commons are three principles, which include (1) Open Access: promotes free and open access to data, information and knowledge for conservation purposes. (2) Mutual Benefit: welcomes and encourages participants both to use resources and to contribute data, information and knowledge. (3) Rights and Responsibilities: Contributors to have full right to attribution for any uses of their data, information, or knowledge, and the right to ensure that the original integrity of their contribution to the Commons is preserved. Users of the Conservation Commons are expected to comply, in good faith, with terms of uses specified by contributors and in accordance with these Principles.

4.7 Establishing biodiversity research centers in SSA countries

Research centers for biodiversity will play an important role in driving the field of biodiversity informatics into the mainstream through the development of standards and tools for generating and accessing valuable data and information on biodiversity in African countries. At the national level, very few countries have established research centers for biodiversity. One significant example is the South African Biodiversity Institute (SANBI), which is building a good reputation as a regional institution that is spearheading the field of biodiversity informatics in Africa. SANBI in partnership with Global Biodiversity Information Facility (GBIF) have been organizing capacity building workshops and conferences for African policymakers and biodiversity informaticians on mobilizing African biodiversity data as well as strengthening regional collaboration and capacity in biodiversity informatics.

5.0. Conclusion

Investing in the acquisition, processing and dissemination of biodiversity data and information is a costly affair, one that requires public-private collaboration, multi-level integration, physical and virtual infrastructure, among others. However, the benefits cannot be overlooked given that biodiversity information is fundamental to the development of good policy, and decision-making on biodiversity conservation and economic livelihoods in SSA countries. While tons of biodiversity data have been created in recent years in SSA countries through projects and research surveys, the nature of these initiatives has been mainly opportunistic, focusing on low-hanging fruits rather than data of strategic importance to research, policy and decision-making. Adopting innovative practices and policy-oriented strategies to facilitate digitization and dissemination of biodiversity data and information, making them freely accessible and easily useable will directly create a consolidated database from which countries can define targets and indicators as well as indirectly contribute immensely towards a more efficient and effective use of limited conservation resources. Technological advancement will continue to remain an important driver in the evolution of biodiversity research methods and protocols. Web technologies, Internet and network software will form critical foundations for collaborative interactions and research, open access to biodiversity data and information. These services, protocols, applications and standards will emerge and be supported in a global architecture for biodiversity informatics.

6.0 ATPS Technopolicy Brief Series[9]

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[9] http://www.atpsnet.org/publications/technopolicy_briefs/index.php

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