Adaptive Geospatial Governance Model for Ethiopia

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ABSTRACT

Citizens use Geospatial information for many different purposes in their daily life, and it is vital for socio-economic planning and development in Ethiopia. As a result, the need for having efficient geospatial governance model, which enables proper management, control, and monitoring of geospatial policy implementation throughout the country is essential to make conscious decisions at the right time. This study paper therefore; examines the status of Geospatial governance practice in Ethiopia; the governance models available and analyze the pros and cons of each model; the recommended geospatial governance model for Ethiopia. This study discovered that there is no adequately defined governance model at federal as well as regional level. The existing structure is short-term oriented, uncontrolled and Ad hoc. This significantly hinders users in getting timely access to trustworthy geospatial data to do their necessary works.

Having appropriate geospatial governance nonetheless, will enhance the processes and actions that are required to manage the planning, design, implementation, and ongoing maintenance of geospatial technology. It also enables users to get timely access to reliable digital spatial data and offer uniform standard and workflow procedures. These are some of the benefits that can be derived from implementing Adaptive geospatial governance model in Ethiopia.

Keywords: Geospatial; Governance; Geospatial Governance; EGIA, NSDI, Adaptive geospatial governance model; Ethiopia

1. INTRODUCTION

All levels of government, non-government organizations and citizens require reliable, accurate, timely and trustworthy geospatial information as a whole. This is only possible through efficient geospatial governance. Geospatial technologies are considered as digital technologies that play a major role in influencing political and economic planning and implementation within nation states. The ability of digital data and information to transcend modern conceptions of time and space has considerable consequences for governance based upon the nation-state. Digital technology gives rise to new forms and expressions of governance: a paradigmatic change in the constellation of power relations between individuals, governments and social institutions [3]. Dialogue appears as an essential element of governance Jessop , theorised the understanding of governance as " thr reflexive self-organization of independent actors involved in complex relations of reciprocal interdependence". Such self-organization being based on continuing dialogue and resource-sharing to develop mutually beneficial joint projects, and to manage the contradictions and dilemmas inevitably involved in such situations[1].

The members of the governing body of a country or an organization define governance by the Business Dictionary as "establishment of policies, and continuous monitoring of their proper implementation" [16]. This implies that governance gives meaning if policies have been formulated, adopted and enforced. This shows geospatial governance is not a one-time exercise rather it requires strategic leadership and commitment to realize a better way of dealing with the management and control of spatial information.

Geospatial governance in its broadest sense is part of the overall technology governance of one country or an organization, but with a specific focus on improving the management and control of geospatial information and technology. Governance is not just data

management or just the process around capturing data or using it; rather it is a holistic capability that includes all the data management and control. Governance of geospatial data is beyond managing geospatial data; it is a matter of integrity and assuring trust in your spatial data. To be successful in our business, the most vital thing is to have reliable data. Geospatial governance spans the culture, organization, policy, and practices that provide for geospatial management and control of its performance, resource management, risk management, and its alignment with the overall business needs. Modern geospatial information techniques are becoming increasingly widely used in decision-making. Geospatial information-based decision-making has the advantage of being rational and evidence-based.

The main advantages of having a formalized geospatial governance model for Ethiopia are: It helps to translate the elements of national geospatial policy initiatives into practices; it defines the roles and responsibilities of stakeholder within the governance model; to effectively and efficiently realize geospatial initiatives in an integrated and synergistic way; it increases transparency and accountability among stakeholders and avoid massive disasters before they occur; it helps to realize national integration and interoperability among information technology systems, databases and software applications to communicate, exchange data accurately, effectively and consistently, and to use the information that has been exchanged.

The following definition of governance is used as a basis for this research paper, geospatial governance refers to all of the processes and actions that are required to manage the planning, design, implementation, and ongoing maintenance of geospatial technology based on national geospatial policy to achieve collective national goals. It is the management of an integrated solution that serves an entire nation by offering levels of geospatial functionality, uniform standards, databases, workflow procedures, capability building programs, and infrastructure backbone that enables smooth and efficient data flow.

The general objective of this study is to investigate the current geospatial governance in Ethiopia and develop a research-based governance model that enables to improve transparency and accountability in decision-making practices and enables an integrated approach to implement efficiently the national geospatial policy.

Under the umbrella of this overall objective, the following three specific objectives were attempted:

✓ Assess the current situation and characteristics of Geospatial governance in Ethiopia.

✓ Explore the available governance models and analyze their pros and cons of each.

✓ Develop appropriate geospatial governance model for Ethiopia.

The questionnaire is used to assess the current governance practice in Ethiopia. While reviewing of studies undertaken yet in governance in general and geospatial governance in specific are used to define appropriate governance model for Ethiopia. The major data collection methods and tools include document analysis and questionnaire. The questioner was distributed to selected four federal organizations that are mandated to manage, control, and use geospatial information at national level. These institutions are, Ethiopian Geospatial Information Agency (EGIA), Information Network Security Agency (INSA), Ethiopian Statistics Agency (ESA), and Ministry of Agriculture and Natural Resources (MANR).

2. GEOSPATIAL GOVERNANCE IN ETHIOPIA

Governance is considered as a central in contemporary developmental philosophies including in poverty alleviation programs, and environmental protection efforts or more generally in sustainable development agendas. Good governance and sound policies in geospatial information management are necessary to achieve sustainable development goals in Africa. Due to this geospatial information for sustainable development in Africa gives focus to the importance of having geospatial governance in its action plan from 2016 to 2030. According to United Nations Economic Commission for Africa, the challenges identified to enable sustainable development of geospatial information in Africa are: barriers to inadequate geodetic infrastructure; obsolete and non-digital information archives; insufficient capacity utilization and knowledge transfer; weak link or communication gap between policy level and geospatial expertise; fast evolution of technology; uncoordinated planning, design and implementation of development projects; inadequate infrastructure support; inadequate funding; institutional and legal challenges[15]. In addition to this, the governance structure in Ethiopia is uncontrolled, and Ad hoc lacks coordination between organizations, less powerful national agencies and poor data quality and compatibility. Similarly, institutional, legal,

policy, and technological issues are identified by Habtamu as the significant challenges for inter-organizational geospatial data sharing in Ethiopia[5].

On the other hand, the opportunities identified for geospatial governance in Ethiopia are the availability of open source software for metadata catalogue and clearinghouse implementation; availability of open and free global data; availability of international best practices; availability of international support and fund; and emerging technology advantages like using drones for aerial photography, cloud services like software as a service, infrastructure as a service, and platform as a service.

The geospatial information policy in Ethiopia facilitates necessary to access and makes the information available to the public, allowing government agencies such as INSA and EGA to share fundamental data sets with other public and private organizations and industries to enable innovative solutions by the private sector. National Spatial Data Infrastructure (NSDI) policy was devised under the supervision of INSA in 2014 to boost geospatial information effectiveness and efficiency in the overall national socioeconomic development. Proclamation No. 808/2013, Article 13, initiated NSDI in Ethiopia under the mandate of INSA to integrate spatial datasets and make them available through clearing house network. This collaborative geospatial data-sharing entity serves to develop sound geospatial data policy and legislation, prepare and impose standards, and assure the quality and compatibility of geospatial data.

To have a complete understanding of the national geospatial governance model in Ethiopia, and to assess the status of the existing governance practice the crucial following governance components were used as indicators. Respondents rate each component from 0% to 100% where 0% means that the component is not practiced yet, 100% means the component is fully practiced. Also, there was a detailed description expected for each component to describe the rating, and to explain more about the strengths, opportunities, challenges, and gaps in each component.

Table 1 illustrates the assessment result of the existing governance condition at organizational as well as national level. The average result is taken based on the assessment taken from the four government organizations. The results of the assessment shows that, the strategic plan shows 10% average value; there is no regular update on the strategic plan (0%); there is no national level vision and mission set for geospatial

instead there are only organizational level visions and missions (0%); there is no value given to the national geospatial governance model (0%); there are no geospatial governance principles set, there is no service level agreement, no culture of collaboration, and no critical performance indicators set at national level (0%) ; there are defined user groups at organizational level (50%); there is NSDI policy at national level (80%), and the roles of federal and regional authority is defined in their proclamation (60%).

Table 1. National governance assessment result

Governance components	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Strategic plan	▓	▓									
Regular update	▓										
Vision, Mission & Objective	▓										
Governance model	▓										
Enterprise Governance Principles	▓										
Defined user groups	▓	▓	▓	▓	▓						
Federal Vs Regional	▓	▓	▓	▓	▓	▓	▓				
Spatial policy	▓	▓	▓	▓	▓	▓	▓	▓	▓		
Key performance indicators	▓										
Service level Agreement	▓										
Culture of Collaboration	▓										

GIS Strategic Plan. Though there is no national geospatial strategic plan, one of the four federal organizations has organizational level geospatial technology strategic plan. Also, the defined strategic implementation plan is expected to successfully realize geospatial technologies objectives and goals set at the national level, but all of them do not have it. The strategic implementation plan was expected to detail

the tactics and strategies necessary for the deployment of geospatial information technologies.

Regular Update. The strategic plan should be updated annually or in a defined period not more than two years period. As the technology is changing fast the roles, vision and functions should continuously evolve. Therefore, the strategic plan needs to be updated to stay relevant to the national development vision and the practical aspects of every organization. Unfortunately, there is no update on the existing strategy and also no defined update time on the plan.

Vision Mission and Objective. The overall national geospatial vision must be broken down into concrete goals and objectives. So, does the available strategy show a clear linkage between vision, mission, objectives, and goals? However, as there is no clear national geospatial vision, the breakdown is not visible.

Governance Model. Governance model refers to the constellation of relationships among stakeholders and departments. A governance model lays out lines of responsibility and the hierarchy of decision-making power. It designated the tasks each stakeholder must accomplish. There should be a precise job classification among stakeholders in the formalized governance model. However, there is no formalized governance model available at national as well as organizational levels. As a result, the national coordinator is not defined, there is no layered functional group/stakeholder defined at steering committee, technical committee, sponsor group, functions group layers. The national Agencies are less robust to influence the regional authorities, and EGIA is expected to report to National Planning Commission in Ethiopia that limits its power and influence that the agency needs to have at national level.

Enterprise Principles. Principles are general rules and guidelines, intended to be enduring and seldom amended that inform and support the way in which an organization or a nation sets about fulfilling its mission. Enterprise principles provide a basis for decision-making throughout an enterprise and inform how the organization or the nation sets about fulfilling its mission. However, there are no principles of governance, applications, data, security, integration, and technology at organizational as well as national level.

Defined User Group. A geospatial user group is a cohort of stakeholders who share information and compare experiences with geospatial technology for the benefit of all members. Thus the user groups in all the organizations are defined clearly, but they do not have a coordinator and planned meetings frequently to share experiences among them.

Federal Versus Regional. The role of the federal government and regional government in realizing geospatial initiatives is aligned with the government structure in Ethiopia. Though there are still ambiguities in the roles of federal agencies as well as a regional organization working in geospatial, the overall structure is better defined. There is no formulized agreement between parties to cooperate sharing of data, resources, applications, training, and education to achieve their goals, but their role is defined in their proclamation, and they work according to the proclamation.

Spatial Policy. Policies refer to procedural codes of conduct that are ratified and enforced by stakeholders. The spatial policy that intended to guide data and resource sharing for the initiatives regarding personal and financial concerns at national level, and requirs geospatial technology initiatives. There is a national NSDI policy at a national level that helps stakeholders to work accordingly in realizing the required programs and initiatives set in the policy. The problem observed here is that there is no regular follow up and communication among stakeholders to check the status of its implementation.

Key Performance Measures. Key performance measures or KPIs have ratified metrics that gauge whether and how specific goals are met at the national level. These objectives, numeric representations of success or failure are crucial when competing for the costs and benefits of the geospatial initiatives. The assessment shows that there is no metrics at national as well as the organizational level to see the progress and measure where the nation, as well as the organization, is in realizing the mission.

Service Level Agreements. SLA is formal legally binding agreements that outline what stakeholders can expect from the enterprise. The parameters of an SLA are defined by the KPIs that are relevant to the technologies in question. The agreement clearly defined how stakeholders support each other. Surprisingly, there is no SLA practice available in the organizations assessed, though they have lots of geospatial technologies and tools bought from the international market.

Collaboration. Geospatial collaboration refers to the productive cooperation between individuals and

entities facilitated by the implementation of geospatial technology. A culture of collaboration refers to an attitude that is expressed by stakeholders in their relationships to one another. It is a positive inter-organizational interaction that facilitates creative problem solving and resource showing among stakeholders to achieve the common goal. This is lacking in almost all stakeholders, they don't cooperate rather they go on their way, and there is resource duplication, and the overall data is in chaos.

3. COMPARISON ON AVAILABLE GOVERNANCE MODELS

Today, governance is a key concept in a variety of disciplines and professions. However, governance means different things to different audiences and its meaning, scope, tasks, and functions are dependent upon the context in which it is being used. However, governance is a central concern of geospatial as it provides an accountability framework that enables collaboration and the building of trust necessary for reuse of component system and national talent in the area. Geospatial initiatives tend to be implemented concurrently at multiple levels hierarchy in the government structure.

The reduced role of central governments in geospatial project implementation and focus on creating a framework within which a national infrastructure can operate has led to a bottom-up, sub-national approach to the geospatial building throughout the nation. This argument was supported by Masser in his SDI governance literature[11].

The geospatial governance model is an organizational or national structure and process that facilitates geospatial technology growth and use. Institutions, actors including organizations and the processes involved, underpin governance. One should note that when governance is good, it leads to achieving improved utilization or management of resources and vise-versa. Similarly, Lackwood reveal that applying governance principles to natural resource management supports better resource management[10]. Therefore an appropriate governance model is essential for effective technology and information diffusion and management. Rist argue on the need to move from management focused sustainable development to governance focused sustainable development[14].

It is also important to consider the new trend of cyber influence in geospatial governance as the technology is influencing and dynamically changing the spatial industry. Harvey and Raskin propose that SDI is moving into a new era through the development of spatial cyberinfrastructure[6]. Therefore, to define appropriate geospatial governance need to consider the influence of cyber in the overall governance structure.

Commonly there are three types of geospatial governance models called Centralized, Decentralized and Hybrid governance models.

3.1 Centralized Governance Model

If all geospatial tasks, except data viewing and analysis, are handled by a central geospatial organization at the national level it is called centralized governance model. That means in Ethiopian context if all tasks are handled by INSA or EGA, all geospatial staff will be located within these organizations, and the required data is created and maintained by these organizations. The geospatial organization employs a cadre of management, analysts, technicians, and programmers who are tasked with overseeing all the technologies operation and management as well as required capacity building activities.

All other participants are considered as end users, with only the capability to view, query, and analyze spatial data. In this type of model bureaucracy and duplication of effort are minimized since there are a central command and control and a single budget source. This model is considered as a top-down approach to the command in the military. As shown in figure 1 below, the end user relies on the central geospatial business unit to get reliable geospatial information. This model is considered as well structured, well defined, and highly efficient but is not recommended for a dynamic and complex environment. It is also not recommended to national governance models rather is recommended for small departments and organizations.

Some of the advantages of having centralized governance model are: overhead cost is shared; easy for standardization, and interoperability; is most effective as resources can be leveraged in a cost-effective manner across the nation and data duplication is minimum; is good to better utilization of talent and tools this enables to have effective operation and maintenance. If alignment across all organizations were important, a centralized model would seem the proper choice. By directing and managing the program within a central governance body, all organizations at the national level would be forced to abide by the same unified policy set[13].
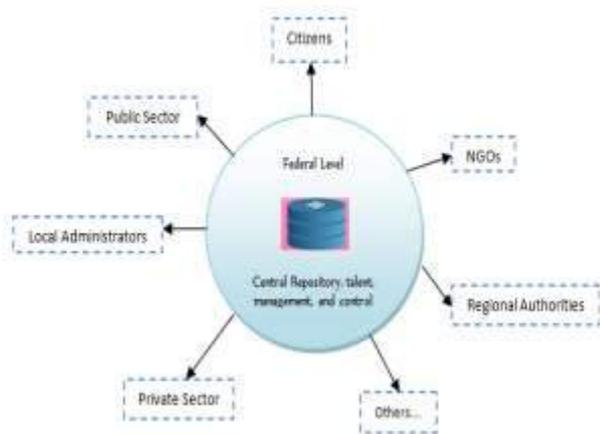
Fig 1. Centralized Governance Model

On the other hand, centralized governance model has the disadvantages of inflexible decision making; not user friendly as everything comes from top to bottom; difficult to technically communicate with organizations at different levels as all the experts are there at the center; challenge of getting enough budget and financing as everything is asked by one organization; single point of failure if something happens at the center it leads to undesired result.

Due to this gap, most governments and organizations do not implement a centralized geospatial governance model. Therefore, this is not also recommended for Ethiopian geospatial governance. This governance model gives exclusive power to the national government, as there is one place to go to access the posture of the organization that is not supported by the political structure in Ethiopia.

3.2 Decentralized Governance Model

Faguet in his study of decentralization and governance argues the importance of decentralization as, many decentralizations aim to reconstitute government-from a hierarchical, bureaucratic mechanism of top-down management, to a system of nested self-governments characterized by participation and cooperation, where transparency is high and accountability to the governed acts as a binding constraint on public servants' behavior[8].

In this type of model, geospatial data updating and maintenance responsibilities are assigned to individual geospatial participating organizations. All organizations are expected to have geospatial staff members. Therefore, all geospatial activities remain within each separate organization. Decentralized organizational structures may still have a geospatial

division, operating independently or under the supervision of another organization, but embrace and encourage the use and maintenance of geospatial throughout the organization.

During their courses of daily business, users update an enterprise database. As shown in figure 2 all users share responsibility for maintaining the geospatial system, and users within each organization maintain specific data according to their roles and responsibilities.
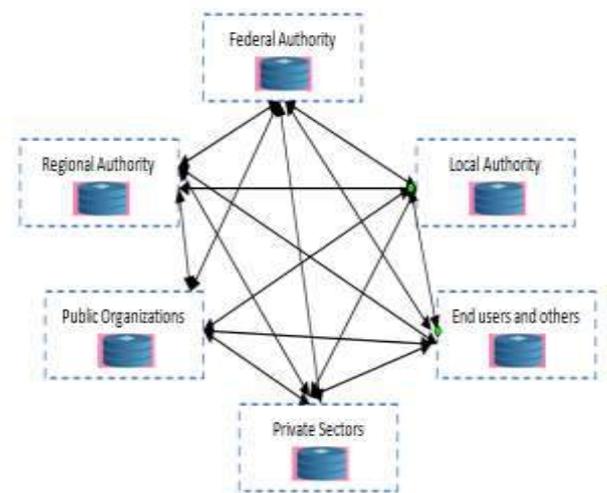

Fig. 2. Decentralized Governance Model

This type of governance model offers the following advantages: ability for organizations to guide geospatial activities independent from national structure that increase political competition by creating many smaller arenas that politicians vie to control; it allows bottom-up decision making and reduce abuses of power by transferring specific central government functions and resources to lower levels; organizations are sensitive to users requirement since they are in proximity to the developers; clear lines of responsibility within the organizations which improves accountability and responsiveness of institutions ; opportunity for multiple funding sources for large national initiatives[8].

The problems with decentralized geospatial governance model are: it has extreme stakeholder engagement that needs strong communications, paperwork, and bureaucracy to reach agreements between multiple organizations; redundant roles and responsibilities exist between organizations; multiple types of applications, software, and technologies which might create interoperability problem at national level;

higher overhead cost as there is no shared cost in multiple organizations; poor data sharing as there are lots of silos databases; poor organizational integration as organizations competing each other for funding or recognition. This

Due to this, these governments mostly practice decentralized governance model or organizations that are new to geospatial technology and if they are very small in size that has smaller or low volume of geospatial work. However, at the national level and regional level this model is not recommended, as there is a huge resource to mobilize, lots of stakeholders to involve, and difficult to manage and integrate required data and information at national level.

This model is not also recommended for Ethiopian geospatial governance model, because the model is not recommended for bigger countries like Ethiopia in which there is a requirement to mobilize huge resource, and need more integration between organizations.

3.3 Hybrid Governance Model

This model incorporates the benefits of each of the centralized and decentralized models. It uses dual accountability along functional lines.

When successfully implemented, this model can benefit organizations in the following aspects: improved efficiency; central data quality; shared the cost of database management and maintenance, as well as ICT infrastructures; integrated multi-organizational solutions can be implemented; the organizational ownership of relevant data sets is maintained.

If the Hybrid governance model is not implemented properly, the problems can be: roles are not clearly defined, making expectations unclear; unnecessary bureaucracy from too many standards or many agreements and negotiations; stakeholders end up setting their own priorities and looking out for their own needs.

The major advantage from the hybrid model comes from its flexibility. The geospatial central body is responsible for the overall professional direction, career development, geospatial system architecture, applications, license pools, and delegating project work. The intra-organizational stakeholder teams are responsible for data capture, data edits, quality control, and cartographic output. Redundancy is reduced since there is a central command structure that is made up of a geospatial coordinator see figure 3.
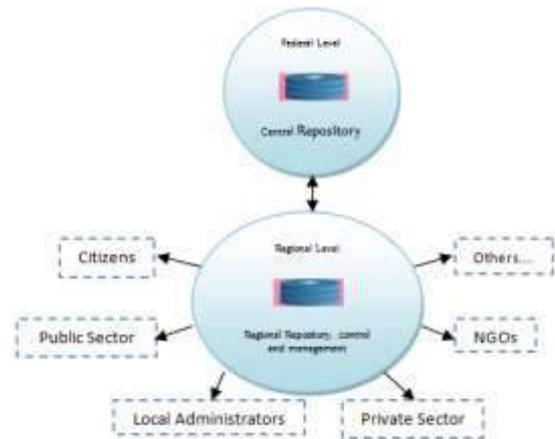

Fig. 3. Hybrid Governance Model

The risk associated with this model relates to the potential disagreements among participants with regards to roles and responsibilities. Strong communications, geospatial knowledge, and leadership are required for the hybrid model to run smoothly. This part is completely missing in case of Ethiopia, spatially the leadership and knowledge required in the area are not satisfactory to run hybrid governance model. In addition to this, the integration among stakeholders is weak, and they want to work independently without any central control and guidance. Kevin also support this, in discussing about mixed method approach for geospatial governance that partnership has emerged as an essential mechanism for establishing an environment conducive to data sharing and hence the facilitation of SDI development, however, unless the partnership arrangements are carefully designed and managed to meet the business objectives of each partner, it is unlikely that they will be successful or sustainable in the long term[9]. Therefore, this researcher does not recommend implementing a hybrid model for Ethiopia geospatial governance.

3.4 Recommended Governance Model for Ethiopia

The above three governance models are the models commonly used at an organizational as well as national level. However, the nature of the government in Ethiopia, as well as the current practice and readiness to realize the models are not recommended for the governance of geospatial at the national level.

Institutions and organizations found at different levels of a government structure in Ethiopia. The roles of each level in a federal government structure are defined based on the national government structure. This poses the challenge of determining how to deploy

effective geospatial governance among what are often disparate business units and entities. Therefore multi-level governance is recommended which fits the government structure as the most efficient way to govern geospatial at the national level.

The federal system exhibit varied, sophisticated and independent both regarding policy and legal frameworks and actors arrangement and participation[4,7]. Similarly, Bottazzi and Dao suggest a multi-level governance model for such complex system[2].

The geospatial requirements at lower layers of administration are greatly influenced by the local actors in the federal jurisdiction that is why multi-level governance model is recommended for the Ethiopian geospatial governance. According to the Proclamation no. 1/1995, the federal democratic republic comprises the federal government and the state members with legislative, executive and judicial powers. The federal government is responsible to establish and implement national standards and necessary policy criteria for science and technology, and enact laws for the utilization and conservation of land and other natural resources. States are also responsible for formulating and executing economic, social and development policies, strategies and plans of the state and administer land and other natural resources by federal laws.

The notion refers to the process of understanding the continuous and dynamic interrelationship that exists between different actors across national, regional and local levels during policy and law formulation and implementation[12].

In Ethiopia, the federal government structure allows the national government to formulate national geospatial policies and laws based on its political vision. The regional governments have the mandate to formulate region-specific regulations. Both the national laws and regional regulations are implemented to solve specific geospatial problems at the local levels. In Ethiopian federalism, regions have more power than the national government; they are entirely responsible for controlling and managing their resources.

The national agencies and institutions are there at the federal level to devise policies and define standards to realize interoperability among regions. The national institutions available in Ethiopia to set policies and standards at the national level are EGIA and INSA.

EMA is re-established as EGIA in January 2018 with the primary responsibility of compilation, preparation, analysis, production/ publication, administration and distribution of the fundamental geospatial information data sets in Ethiopia in addition to the regulatory power that the agency has in the areas of geospatial. Some of the fundamental datasets are geodetic control Networks Remote Sensed Imagery, Topographic Maps, Thematic Maps, Hypsography, Hydrograph, Administrative boundaries and Geographic Names. Furthermore, EGIA is the authorized Agency empowered to control and supervises the quality and standards of geospatial information products and producers in the country.

The mission statement of the agency is to produce and disseminate best quality and contemporaneous geospatial information products and services that fully satisfy the requirements of the customers and also to play a leading role in the field of geospatial information production and distribution in Ethiopia by regulating the quality and distribution of such products and thereby contribute to the sustainable development of the country.

The problem that the researcher observed in the structure that the agency has concerning the national mission gave is not aligned. The mission is a national mission not limited to specific authority like Ethiopian Planning Commission; instead, the agency is expected to mobilize almost all ministries, private sectors, NGOs and the whole society to realize the mission given by the agency. However, the actual structure shows that EGIA is organized under Ethiopian Planning Commission that is not aligned with the power given to the agency. Therefore in the adaptive governance model, EGIA is expected to have the leading role at the national level and need to report directly to the higher level of the government like other ministries and national authorities. This will help the agency to realize its vision of becoming a reliable and prime source of geospatial information products and services that can be cited as a role model in the field in Africa, by 2023 G.C.

INSA is also a government Agency with its mandate mainly focuses on cybersecurity-related works to ensure the security of information and computer-based key infrastructure at the national level. In its proclamation, No 808/2013 INSA gets an additional mandate to work in geospatial areas primarily to develop and administer National spatial data infrastructures. INSA taking the leading role has been working in developing National spatial data

infrastructure program starting from 2014. The program includes developing policy, institutional arrangement standards, technologies and metadata management and access to different governmental levels as well as private sector.

Though the national level agencies have power given in their proclamations, regional institutions plan and implement their geospatial programs without the consent of these agencies. This is commonly creating problems of resource duplication and standards in geospatial technology and data. This is happening because institutions at the regional level are responsible for collecting and managing geospatial data and information of their respective regions depending on the awareness level and leadership commitment to implement geospatial technology in their regions.

Therefore, the researcher recommends multi-layer geospatial governance model called "Adaptive Geospatial Governance Model." This model is defined based on the federal government structure, the level of geospatial understanding and practice in Ethiopia. It is based on shared services both at federal and regional institutions. The government organizations mainly focus in setting national geospatial policies, standards, defining the national geospatial architecture, managing and controlling national level geospatial data, building a centralized data warehouse to store and analyze data used for national planning and monitoring, and create international partnerships with countries on behalf of the federal government.

The regional authorities in the adaptive governance model are responsible for geospatial data collection, control and management; business and regional regulatory activities; design, implement, and manage geospatial infrastructure; provide geospatial service to the community; employ staff required to manage and control regional level geospatial information; create capacity building requirements, awareness to the community, and understanding among stakeholders in the area of geospatial information, technology and services. Therefore, this adaptive geospatial governance model supports the regionalization of geospatial and has hybrid geospatial governance model at the regional level. In this adaptive model, regional institutions will have the dual responsibility of satisfying geospatial goals at the regional level in addition to complying with the national policies and standards based on the roles defined above.

The advantages of having adaptive geospatial governance model are: it is aligned with the federal structure in Ethiopia; it simplifies communication and understanding among stakeholders; it improves efficiency as roles and responsibilities of institutions at national and regional level are clearly defined; improves end-user support and feedback as the regional institutions are near to their end users.

Still, there are some challenges of having an adaptive geospatial governance model in Ethiopia. These challenges are: getting multiple funding sources might be difficult; still regions might not comply with the standards at the national level and create interoperability problems at national level. The challenges are there due to the differences in understanding, priority given and commitment among the regional governments.
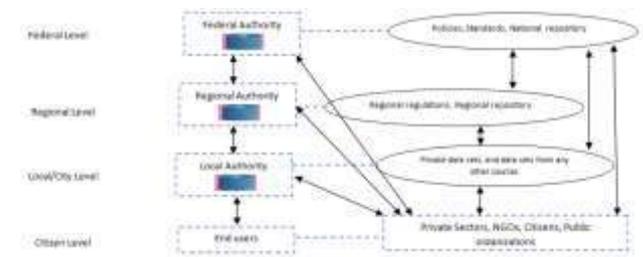

Figure 4. Schematic Representation of Adaptive Geospatial Governance for Ethiopia

In this model, at the national level, EGIA is responsible for developing national policy, meta-data standards and manages the national geospatial information at the national data warehouse and avail reliable and current data required by users. In addition to this EGIA is responsible for producing, compiling and disseminating reliable and authoritative geospatial information throughout the country. The agency is responsible for creating awareness in SDI, mobilizing and regulating all ministries and government organizations that have a direct connection with spatial data production or/and use.

Also at the federal level, INSA is responsible in designing and implementing efficient, effective, coherent and secure National Spatial Data Infrastructure at the national level based on the national NSDI policy together with national and regional authorities. Geospatial is considered as a critical data infrastructure in which Confidentiality, Integrity, and Availability need to be realized without affecting the efficiency of the data and information flow.

At the regional level, the regional authorities are also responsible for producing and disseminating quality

and timely geospatial information products and services of their regions that fully satisfy the requirements of regional and national customers. Also, the authorities need to comply with the national geospatial policies and standards; and regulate the process of data collection, analysis, and distribution.

Local authorities are primary users of spatial data and information from their regional and federal authorities. Also, they will have roles to collect and process spatial data required for land administration and land use at city or wereda levels through surveying and mapping based on the standards and templates set at the regional level. In Ethiopia, even though there are debates on the existence of different ownership and tenure regimes for land, the Ethiopian constitution asserts state ownership of land. As a result, the Government is not prepared at this time to legalize private property rights in land. This gives local authorities more power to manage and administer land effectively. So, in this model, they will have a role to collect land information and continuously update their data in their databases as well as at the regional data centers.

End users can be citizens, private sectors, NGOs, other government authorities, and institutions; these are users of geospatial data and information. Usually we can classify types of geospatial users that use variety of geospatial applications in to four layers of geospatial experts those users that can develop their applications on the top of available national geospatial platforms; analytical geospatial users are those users who can turn geospatial data into meaningful information; advanced users are those users that can generate software functionalities; and geospatial consumers are users that can get information from the available platform and applications in three step click using their terminals.

4. CONCLUSIONS AND RECOMMENDATIONS

This paper assesses the need for geospatial governance for Ethiopia. The existing governance problems in Ethiopia have been recognized at national and regional levels, and adaptive geospatial governance model is proposed as an appropriate governance model to solve them. As there is no formalized governance model in Ethiopia, there is a problem of clarity in transparency and accountabilities in the decision-making process that affects the overall performance of geospatial services throughout the country. In addition to this, every regional authority is working on its own without considering the alignment with the national geospatial policy and standards. On the other hand, there are

opportunities to develop a geospatial governance model for Ethiopia, as there is NSDI policy developed and enforced at the national level; there is international best experiences and technology new trends in the area which helps the country to get the latecomer advantages.

Based on the study the following recommendations for further research has been given. First, shortly, similar research works could be done to develop geospatial enterprise architecture for Ethiopia. Second, the more detailed geospatial architectural governance study can be done. Third, as the study only focuses on Ethiopian context, further study works can be done for other developing countries in Africa. Moreover, last but not least, further study could be done in the areas of geospatial business, and technology architecture for Ethiopia.

5. ACKNOWLEDGMENTS

6. REFERENCES
[1] Bob Jossop (2003). Governance and net governance: on reflexivity, requisite variety, and requisite irony, in Bang, H.p. (ed.), Governance as social and political communication, 101-116, Mancherster University press.

[2] Bottazzi, P. and Dao, H. (2013). On the road through the Bolivian Amazon: A multi-level land governance analysis of deforestation. Land Use Policy, 30(1), 137-146.

[3] Brain D. Leader (2005). The Governance of cyberspace: Politics, technology and global restructuring, London and New York.

[4] Gregersen, H., Contreras-Hermosilla, A. and White, A. P., L. (2004). Forest governance in federal systems: An overview of experiences and implications for decentralization. Interlaken Workshop on Decentralization in Forestry. Interlaken, Switzerland.

[5] Habtamu Sewnet Gelagay (2017). Geospatial data sharing barriers across organizations and the possible solution for Ethiopia, INSA, Addis Ababa, Ethiopia, IJSDIJournal.

[6] Harvey and Raskin (2011). Spatial cyberinfrastructure: Building new pathways for geospatial semantics on existing infrastructures.

[7] Howlett, M. and Newman, J. (2010). Policy analysis and policy work in federal systems: Policy advice and its contribution to evidence-based policy- making in multi-level governance systems. Policy and Society, 29, 123- 136.

[8]   Jean-Paul Faguet (2011). Decentralization and Governance: Economic Organization and Public Policy Working Paper, LSE Research Online,London, UK.

[9]   Kevin Mcdougall, Abbas Rajabifard,and Ian P. Williamson (2007). University of Southern Queensland, Toowoomba,1 and University of Melbourne, Victoria, Australia.

[10]   Lockwood, M., Davidson, J., Curtis, A., Stratford, E. and Griffith, R. (2010). Governance Principles for Natural Resource Management. Society & Natural Resources: An International Journal, 23(10), 986-1001.

[11]   Masser, I., A. Rajabifard and I. Williamson (2008). "Spatially Enabling Governments Through SDI implementation." International Journal of Geographical Information Science 22(1): 5-20.

[12]   Olowu, D. (2003). Challenge of multi-level governance in developing countries and possible GIS applications. Habitat International, 27(4), 501-522.

[13]   Pramod K. Singh (2009). Spatial data infrastructure in India: Status, Governance, Challenges, and Strategies for effective functioning, IJSDIR, Vol. 4, 359-388.

[14]   Rist, S., Chidambaranathan, M., Escobar, C., Wiesmann, U. and Zimmermann, A. (2007). Moving from sustainable management to sustainable governance of natural resources: The role of social learning processes in rural India, Bolivia, and Mali. Journal of Rural Studies, 23, 23-37.

[15]   United Nations Economic Commission of Africa (UNECA) (2017). Geospatial information for sustainable development in Africa: African action plan on global geospatial information management 2016-2030, Addis Ababa.

[16]   www.businessdictionary.com/definition/governance.html accessed on January 15, 2018.