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Enabling Sustainability: Hierarchical Need-Based Framework for Promoting Sustainable Data Infrastructure in Developing Countries

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Abstract: The paper presents thoughts on Sustainable Data Infrastructure (SDI) development, and its user requirements bases. It brings Maslow's motivational theory to the fore, and proposes it as a rationalization mechanism for entities (mostly governmental) that aim at realizing SDI. Maslow's theory, though well-known, is somewhat new in geospatial circles; this is where the novelty of the paper resides. SDI has been shown to enable and aid development in diverse ways. However, stimulating developing countries to appreciate the utility of SDI, implement, and use SDI in achieving sustainable development has proven to be an imposing challenge. One of the key reasons for this could be the absence of a widely accepted psychological theory to drive needs assessment and intervention design for the purpose of SDI development. As a result, it is reasonable to explore Maslow's theory of human motivation as a psychological theory for promoting SDI in developing countries. In this article, we review and adapt Maslow's hierarchy of needs as a framework for the assessment of the needs of developing nations. The paper concludes with the implications of this framework for policy with the view to stimulating the implementation of SDI in developing nations.

Keywords: spatial data infrastructure; Maslow's hierarchy of needs; motivation theory; sustainability; GIS; developing nations

1. Introduction

The greatest aspiration of every nation is to attain and maintain sustainable development for its citizens, to take its rightful place and play significant roles in global affairs. Today's digital, knowledge-based society is undoubtedly driven by information. It therefore comes as no surprise that this age is aptly referred to as the *information age*. Information is central to decision-making, policy formulation, and consequently sustainable development [1,2]. Nations make decisions and formulate policies with the view to ensuring efficiency and effectiveness in resource allocation and management in order to boost the welfare of its citizens. Spatial information forms the greatest component of the information resources used at all levels of decision-making [2]. It is therefore self-evident that, in the 21st century, a nation which is not spatially-enabled will find it quite difficult, to develop in a sustainable manner. However, history is full of examples of nations that developed their economies fully, without spatial enablement as mentioned here. One may argue that such development was not sustainable, but the fact still remains that they did develop. It is probably true that many developing nation governments care more about economic development than about sustainable development, but this also requires the rationalization and consistent pursuit of carefully formulated and highly prioritized development goals.

In pursuit of their socio-economic development aspirations, nations draw on datasets collected at different scales of jurisdiction and for different purposes to make decisions [2-6]. These datasets are often sparsely distributed and heterogeneous, making access extremely difficult, expensive and frustrating. Sometimes, doubling of effort occurs in the collection, processing and storage of data. Considering the scanty resources of developing countries in particular, and the prohibitive cost of collecting, processing, storing and maintaining spatial data, it is rational to create a framework that enhances easy discovery, evaluation and sharing or access to available spatial data. This has become even more urgent for developing countries as the development challenges of the 21st century continue to multiply and grow in scope and complexity on daily basis. The technical response to this desideratum is Spatial Data Infrastructure (SDI), which serves as the enabling platform for the timely and cost-effective distribution of spatial data or information for decision-making at different levels of jurisdiction and by different actors.

In recognition of its heuristic role in enabling socio-economic development, various countries have developed SDIs to support economic, environmental and social development decisions [5]. Viewing SDI from the same perspective of socio-economic development, some authors (e.g., [7,8]) argue that SDI should be considered as an integral component of infrastructural networks to enable sustainable development. This argument is particularly worthy of consideration since infrastructures are known to have "significant economies of scale and spillover effects on non-users, particularly as enablers of other forms of economic activity" [9]. Although the prospects of SDI are not in question, stimulating developing nations to appreciate the contemporary imperatives for establishing SDI has proved to be a daunting challenge. This challenge is partly attributable to insufficient understanding, expertise and resources, but largely to the inability of policy-makers and other development actors to properly situate SDI in the complex matrix of contemporary national needs and development aspirations [3,4]. To this end, it is imperative to propose a widely accepted psychological theory to drive needs assessment and intervention design that will lead to the development of SDI. It is in this context that we apply

Maslow's [10] theory of human motivation, specifically the hierarchy of needs, as a framework for viewing and unpacking the issues surrounding the development of SDI in developing countries for sustainable development. In this paper, we review and adapt Maslow's original hierarchy of needs to the nation-state with the view to promoting SDI development and discuss its policy implications particularly for developing countries.

2. Concepts of SDI

Geo-information tools such as Geographic Information Systems (GIS), remote sensing, and other allied technologies [11] have become premier tools for research, policy formulation, decision-making, and monitoring of sustainable development. Apart from its analytical power, geo-information tools also make possible cross-jurisdictional communication, decision-making, cooperation, and partnerships relevant for resource management [2-6,11,12]. These tools subsist on spatial data. Therefore, access to spatial data and/or information is central to decision-making and policy formulation regarding the allocation and management of resources for sustainable development. Collecting, processing and making spatial datasets available and accessible are expensive and extremely difficult tasks. Yet, both private and public institutions and organizations at different levels of jurisdiction collect huge amount of spatial data at different spatio-temporal resolutions and with different properties to support their activities. It is therefore imperative to adopt practical measures that preclude or minimize doubling of efforts, confusion and frustration in the quest for spatial data or information. Thus, SDI has a central role to play in the planning and management of natural resources and consequently sustainable development although building SDI systems is (just) a subfield of building information systems; and that field has a rather solid body of science and industrial experience of requirements engineering [4,11]. Grand scheme national or regional SDI have been the focus of attention and discussion in quite some circles worldwide, though relatively few systems have been realized [3,4,6]. The main reason appears to be that a healthy market of service consumers must be in place before an SDI can function. Those SDI systems that are in place seem to have come about because a real (specialized) market need was addressed. This appears to suggest that encompassing SDIs will need to grow slowly and organically, instead of being imposed by national or regional bodies. This evolutionary path to SDI maturity is very significant because it was motivated by a particular need. The general uptake of governments of geospatial tools to spatially-enable their policy formulation suffers from serious obstacles [2-4]. One important reason is that policy makers do not understand the methods and techniques applied to produce the "actionable maps," and this is further aggravated when they are exposed to multiple maps showing various scenarios.

Spatial Data Infrastructure (SDI) is simply a framework for sharing spatial data. As a framework or system, it comprises policies, standards and access networks that facilitate the collection, processing and sharing of spatial data within, between or among organizations, states or countries [7,13]. According to Scholten *et al.* [14], SDI provides access to collections of spatial data and services by interlinking data, metadata, access and use policies with standard internet technologies—at different institutions or organizations and at different administrative scales. The SDI Cookbook explains SDI to mean the relevant base collection of technologies, policies, and institutional arrangements that facilitate the

availability of, and access to spatial data [15]. Thus, SDI provides a basis for spatial data discovery, evaluation, and application for users and providers within all levels of government, business and industry, the non-profit sector, academia and even by citizens in general. SDI is based on a networked infrastructure that allows the integration of heterogeneous datasets from various sources based on a particular web ontology which makes access to data possible either directly or indirectly [16].

2.1. Components and Structural Requirements of SDI

National SDI has traditionally been conceived of as a vertical and/or horizontal network of other SDIs. From definitions, SDI is a framework of policies, laws, standards, and financing arrangement that links people and data [2-6,12]. Policies give direction to the evolution and development of SDI. Relevant in this context are the policies on information, which specify the conditions for access to what information; and the tools for manipulating, accessing or utilizing the information (e.g., information and communications technologies–ICTs). Pricing policies are also critical to facilitating access to spatial data or information, particularly with reference to public sector information. These policies are to be set by the national government and should provide a broader framework within which lower jurisdictions will formulate and operate their own policies. Laws are important in any self-governing society and in situations where diverse interests are to be confined to a sphere of competition. With regard to SDI, important laws or regulatory instruments needed are in the areas of copyright protection (intellectual property law), competition, privacy, and liability issues. Because a National SDI is a network of other SDIs, clearly stipulated standards are required to ensure harmonization and interoperability of spatial data [3,11,12]. These standards should be observed by all participants in the SDI. Groot and McLaughlin [17] identify three themes to reflect the value of well-chosen standards: portability, interoperability and information access, and maintainability.

Huge financial investment is required to create, operate and maintain SDI. Without sustained funding, SDIs will only last from a few months to years. The levels and model of funding for SDI, as well as the implications for participants should be clearly spelt out right at the onset of SDI development. It is in this arena that government participation becomes critical to ensure continuous and sustained funding for the SDI. Developing SDI in low income countries could therefore be seen as a disincentive if the benefits are not realized within a short time horizon. Also, SDI is about people. People work to create, operate, use and maintain SDI. Three key categories of people are distinguishable in SDI: suppliers (data, software, hardware and technical support), users of the items of the suppliers, and management staff. This indicates the need for a critical mass of professionals, and continuous development of human resource capacity for the success of SDI. Lastly, SDI provides a framework that connects people and data. Both spatial and non-spatial data can be incorporated in a national SDI; however, spatial data is largely emphasized. Here, Groot [12] adds application-specific data to the foundation and framework datasets set out by the Mapping Science Committee [18] of the US National Research Council. Some authors have extensively treated the components and structure of SDI [2-6,12,15,17,19,20].

2.2. Benefits of SDI

SDI is created to serve two key purposes: (a) to save money, effort, and time in accessing spatial data and using it responsibly (b) to avoid unnecessary duplication in the collection, harmonization and standardization of required datasets by promoting the sharing of available data [3,4,6,12]. Reports show that investments in SDI are yielding dividends such as development of spatial information marketplace, economic development, reduced resource disputes, social stability, improved environmental management, and improved land administration systems [3,4,21-24]. Thus, SDI saves nations scarce resources needed for other developmental purposes. By freeing resources such as time, effort and money for investment in other productive sectors of an economy, SDI contributes directly to economic development.

SDI also enables value addition and increases the utility of spatial data to both the public and private sectors [3]. This leads to improved profit and/or services to enterprises and citizens. For example, improved access to, and expanded use of public sector information can enable the emergence of new entrepreneurs, trigger innovation and improve social services. Information is a commodity or a product, and the creation of SDI also leads to the creation of well-established and functional information market. SDI is also at the heart of good governance as information empowers citizens and increases their participation in the democratic process [1,2]. For example, SDI can increase public participation in policy formulation, resource governance and ensure environmental justice. Authors such as [2-4,19,25,26] give various benefits that can be derived from SDI at different levels of jurisdiction and by different actors. In all, SDI allows data to be created once and used many times for many applications, it allows cooperative governance by integrating heterogeneous data providers and users, enhances effective localized management of resources, distributes the cost of creating and maintaining spatial databases, enables developing countries to participate in the global knowledge economy, and above all contributes to socio-economic development.

2.3. Global and Regional Efforts at SDI

U.S. President Bill Clinton and Vice-President Al Gore gave a seminal impetus to SDI through their respective executive orders and statements [26,27]. Following this pioneering effort, many nations have established SDIs at various levels of jurisdiction with verifiable success [3,6,12,17]. Beyond national SDIs, there are regional and global efforts to coordinate and integrate national SDIs into supranational SDI. On the global scale, there is the Global SDI (GSDI) initiative which is busily developing standards and creating a framework for sharing spatial data. Examples of regional effort at SDI are the Australia New Zealand Land Information Council (ANZLIC) and the European Geographic Information Infrastructure (EUROGII) by the European Council to coordinate and harmonize national SDIs of the EU member states through a common framework. As a practical sequel, the Infrastructure for Spatial Information in the European Union (INSPIRE) Directive came into force in 2007 to initiate the step-wise creation of SDI for the European Union member states, with full implementation expected in 2019. These efforts point to the critical role SDI can play in national-regional development and cooperation; and can serve as a useful model for other regions of the world.

However, it is admissible that every country is at a different point in the SDI development continuum, with developed nations at the front end and developing nations at the lower or rear end [3]. This notwithstanding, Williamson *et al.* [3] assert that even the poorest and least developed countries can still adopt SDI principles and initiate effort at SDI development to enhance socio-economic development. It is from this perspective that this paper derives its novelty through the application of Maslow's motivational theory to government action, with the view to encouraging SDI development particularly in developing countries.

3. Motivational Theory: Maslow's Hierarchy of Needs

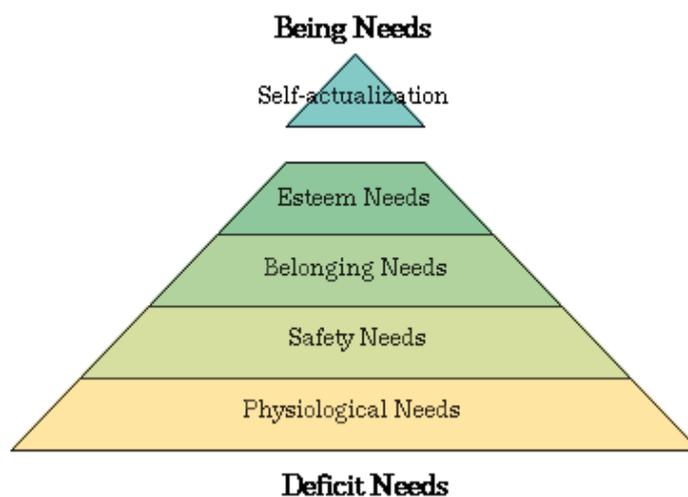
Three factors operate jointly to minimize the motivation to develop SDI. One, effective SDI development requires a participatory approach, which is often voluntary. Very few national SDIs have developed from a political mandate. Two, it requires a long-term vision as SDI may take a long time to mature and deliver dividends [3,17]. This is often at variance with the short time-horizon of politicians (often, not more than eight years) and anxious profit-seeking entrepreneurs. Three, it is cost-intensive. All these operate in a tension field of competing and differing interests and perspectives. Governments, however, are indispensable in the creation of a functioning national SDI, as they are required to make huge investments in it, facilitate the development of standards, and drive the SDI development through the instrumentation of information policy. Consequently, there is the need for a theory that can serve as the basis of psychological motivation and drive needs assessment for different participants and actors, particularly politicians, to collaborate and cooperate to build a national SDI. Here, Maslow's [10] theory of human motivation, particularly the hierarchy of needs, becomes applicable.

Why can a psychological theory of human motivation be applied to government motivations? The answer is not far-fetched. All governments, as organizational units, consist of humans and institutional structures. Therefore it is possible that (individual) human motivations, government policies and institutional structures interact and generate the decisions that governments take in their bid to meet development needs of the citizenry. It is important to state that humans do not always take decisions based purely on rational considerations. This is equally true for governments. The debate on rationality, choice and human behaviour will continue. However, we suggest that decision making whether at the individual level or national scale consist of both rational and irrational choices; and this does not invalidate the applicability of Maslow's theory to SDI. Certain characteristics of properly built national SDIs may actually be quite unwanted by the national government involved, but that government would normally be the entity to finance and sustain that system. It can also be argued that needs may not always and necessarily be hierarchical. However, the fact remains that individuals and governments make decisions based on choices and prioritization. This suggests an element of hierarchy of needs sometimes, if not always.

Maslow's theory of human motivation portrays the individual as an integrated and organic whole. Even though it has received moderate experimental support in predicting how individuals develop, evidence abound that the theory enjoys a wide acceptance [28]. The theory classifies all human endeavours as an attempt to fulfill one of five needs (see Figure 1): physiological, safety, belongingness and love, esteem, and self-actualization. However, the theory can best be viewed as a *framework* [29]

that facilitates understanding of human action, rather than a rigid prescription governing all human activities. The theory has found applications in diverse disciplinary fields, prominent among them being business/human resource management and medicine (e.g., see [30-32]; and [33] for some applications in hospice and palliative medicine). Rosenquist [34] used Maslow's hierarchy of needs as a framework for promoting ecological sanitation in different cultures. Few authors have attempted to apply the theory to nations as units of observation. For example, Sirgy [35] was the first to argue that the theory can also be applied in describing how nations develop and improve their quality of life. Hagerty [36] applied the theory to assess the development of quality of life of nations using time series analysis. Interestingly, China has held up the belief that the satisfaction of the *basic needs* of a nation is a prerequisite for the establishment of a successful democracy, a notion which appears to be in harmony with Maslow's motivational theory. To this end, we contend that Maslow's hierarchy of needs has a direct corollary in the development aspirations of nation-states, and is therefore applicable to the instrumental role of SDI in enabling sustainable development. We therefore propose Maslow's hierarchy of needs as a framework for the promotion of SDI in developing countries. Figure 1 shows the hierarchical order in which these needs are assembled and satisfied by the individual, followed by a brief discussion of the needs.

Figure 1. Maslow's hierarchy of needs.



a. Physiological Needs: this relates to need for food, water, shelter, clothing and others. They are the most fundamental need that intertwines with survival instincts to drive motivated behaviour in humans. This is because life itself is threatened when these needs are unsatisfied. To this end, humans will stretch every sinew to satisfy this fundamental need. It is noteworthy that it is rare for individuals who have not satisfied this need to mobilize their physical and/or mental resources for the satisfaction of other higher needs.

b. Safety Needs: safety needs relate to need for protection from harm. Safety needs are the next most obsessive needs of individuals when their physiological needs are partly or wholly satisfied. Safety needs emerge and become stronger because they are psychologically (not physiologically) perceived to threaten life and survival. Examples include shelter from the environment and intruders, law and order, and safe neighbourhoods.

c. Belongingness and Love Needs: this relates to the need for affection, i.e., to love and be loved. When individuals satisfy their physiological and safety needs, they move on to enter into deeper relationships such as friendships, romantic attachments and families to satisfy the need for companionship and care, as does involvement in social, community or religious groups.

d. Esteem Needs: there are two versions of this need. First is the need for self-respect characterized by feelings or desire for confidence, self-worth, competence, achievement, mastery, and independence. The second version is the need for respect from others characterized by the desire for social recognition of one's achievement, prestige, status, fame, and power.

e. Self-Actualization: this can be referred to as the *ne plus ultra*—the furthest attainable point—in human experience or life according to the hierarchy of needs. This need is characterized by the insatiable drive to realize one's full potential, the desire for self-fulfillment. Self-actualized individuals are both truly independent and effectively interdependent. It is a peak experience which Maslow refers to as transcendence. There is a high sense of appreciation of beauty, nature, and the circumstances of others. Also, Maslow refers to this need as the growth motivation or being-needs.

4. Application of the Motivational Theory to SDI

While Maslow's human motivation theory is goal-based, and captures the central role of conscious effort by the generality of humans (nations in this context) to attain desired goals or ends, SDI provides a means to these desired ends. SDI is therefore, in this context, only of an instrumental value. Therefore, SDI as an information infrastructure will be instrumental in aiding the process of decision-making, and consequently enhancing the capacity of nations to satisfy their needs. Norwood [37] proposes that Maslow's hierarchy can be used to describe the kinds of information that individuals seek to satisfy their needs at different levels. Obviously, different states or countries will develop SDI in response to felt-needs (which include perceived market) and in balance with available resources. Strain *et al.* [7] and Tuchyna [13] show the development trajectories of various SDIs at different administrative scales in response to different needs. We now proceed to discuss how Maslow's hierarchy of needs can be applied to unravel the needs of nations, and the utility of SDI in satisfying these needs.

At the lowest level, the physiology of a nation can be represented by the economy, which is the dynamic relationship between the production and consumption of goods and services. In this connection, the physiological needs of the nation can be represented by employment, food, health, energy, housing, water and sanitation. According to the hierarchy of needs, physiological needs can be understood as those needs that can threaten survival of nations if not satisfied. In other words, a nation incapable of satisfying these needs becomes dangerous to itself; and is bound to suffer from serious physiological disorders that can be manifested by widespread poverty, hunger and malnutrition, diseases, deprivation, and even political disturbances and instability. Such a nation will eventually lose its dignity and will be on its way to becoming a failed state. To exemplify this, Hagerty [36] represented the physiological need of a nation by its food production capacity (daily calories available per person). Daily calories is defined as the caloric equivalent of all food in the country over a year, after accounting for imports and exports, subtracting food used for seed or for animal feed [38]. A nation will spend all

or a huge part of its resources on satisfying these basic needs, much to the detriment of higher needs. According to [37], coping information will be most required to satisfy needs at this level; and information that is not directly connected to helping a nation meet its basic needs within a reasonable period of time is simply left unattended. To this end, there should be a substantial motivation for investing in the information infrastructure that will enhance the capacity of the nation to satisfy these basic needs. Geo-information tools (GIS, remote sensing) have been shown to improve significantly decision-making and management of the processes that lead to the satisfaction of the afore-named needs. Evidence of applications and utility of these premier tools in the effective and efficient allocation and management of resources related to agriculture, health, socio-economic analysis, water and sanitation, real estate and urban management, are unquestionable and replete in the literature.

Safety or security needs of nations can be seen in their desire for law and order, peace, and security in general (freedom or minimal effect from hunger, epidemics, disasters, and vulnerability to internal/external shocks such as climate change). Security of income and livelihoods can also be captured here. Generally, safety needs of nations can broadly be captured as need for economic, political and social security or stability. At the level of safety needs, nations need helping information [37]. They seek to be assisted in realizing how they can be safe and secure. Just like individuals, nations will devote much of their resources to building or strengthening the mechanisms that aid the security agencies to combat crime, ensure law and order, and maintain general tranquility for the citizenry, and show potency against external aggression. Citizens must also be assured of food and water security and safety from hunger. Nations also take steps to assure their citizens of their security or safety from the extreme effects of disease outbreaks and disasters. Prolonged or periodic shortage of food and/or water could have devastating effects on a nation and force it to return to lower needs. Improving living conditions implies improving national and individual incomes. Agriculture still contributes substantially to the GDP of most developing nations. To this end, it is rational for developing nations to strengthen their adaptive capacity to the anticipated devastating impacts of climate change. Here too, spatial information and geo-information tools are indispensable, making a rational case for investment in SDI. The utility of GIS and remote sensing applications in maintaining the dimensions of security discussed above is manifold.

Nations enter into various forms of relationships and alliances with other nations, and join regional or global organizations to enjoy comradeship, cooperation and mutual support. Belongingness needs (which we call inter-national needs) of nations can be viewed in the light of need for mutual support, cooperation, and cooperative or joint action on particular trans-boundary and international issues. Examples that readily come to mind are trans-boundary water resources management and large ecosystems (example, large marine ecosystem) management. Physiological and security needs can also drive nations to enter into similar relationships, even as a basis or prerequisite for satisfying lower needs. Belongingness need is the need for a nation to be accepted and supported by other nations, the need for acceptable participation in global or regional groupings as of right. Enlightening information [37] is sought by nations seeking to meet their belongingness needs. This is the kind of information that illuminates the understanding of one nation about another nation and consequently fosters cooperation in the spirit of mutual respect, understanding, and support. For example, in the event of a natural disaster in one nation, other loving nations quickly demonstrate their support and care

in various ways and forms. A functioning SDI, together with geo-information tools could play a pivotal role in facilitating the effectiveness and efficiency of such support gestures by the loving nations, and help maintain and strengthen these relations.

Nations strive to showcase self-confidence and to command the respect and recognition of other nations and supranational institutions or bodies. It is the drive to become a regional or global player (rather than a pawn) and/or model in specific areas of supranational affairs and endeavours. These attributes which relate to esteem needs derive from achievements especially in the level of general development which is assessed in terms of the degree of satisfaction of the lower needs, and improvement in democracy and responsive governance. Empowering information [37] is sought by nations to satisfy their esteem needs. This information empowers nations to develop their ego. The role of SDI and geo-information tools in satisfying the first three levels of need has already been emphasized and adds to the development of the ego of a nation. However, what needs to be added here is the heuristic role of SDI in improving and enhancing the process of democratization and responsive governance. To this end, the search light must be focused on how spatial information empowers citizens to participate in democratic processes such as decision-making, election of representatives, and policy formulation and implementation with regard to resource allocation and management. The participatory approaches to development decisions and actions enhance success of development projects and resource management through the agency of shared ownership and responsibility. This also increases the pride and patriotism citizens have for their nation, a situation that boost the ego of a nation. In this context, the relevance of SDI is self-evident as the principles and values of participation are immanent in the conception, the nature, and operation of SDI. The utility of spatial information and geo-information tools in participatory resource planning and management is amply demonstrated and abounds in the literature.

Finally, every nation strives to reach the level of self-actualization. Self-actualization comes when the lower needs (deficit needs) are largely or wholly satisfied. Here, need for self-actualization can be captured by the drive to achieve sustained growth, sustainable development, and maximum satisfaction of the other needs through the capacity to make the most efficient and effective use of all resources available to the nation. Even though this appears impractical (which is in agreement with Maslow's observation that very few individuals reach this level of experience), it is the ultimate dream of nations. For developing nations, this notion carries a lot of implications for their motivation and drive for development. As noted earlier, nations at this stage attain true independence and become effectively interdependent, and they tend to place much emphasis on the appreciation of beauty. In pursuit of self-actualization, nations seek edifying information [37], which enables them to connect to something beyond themselves or to help build other nations. In short, for a nation to become self-actualized, it needs to first and foremost satisfy all its deficit needs, take its rightful place, and responsibly play its rightful roles in the world. Obviously, this hinges on the satisfaction of lower needs in which SDI and geo-information tools have a central role to play.

4. Policy Implications for Developing Nations

Developing nations have a myriad of challenges to overcome. Unfortunately in the 21st century, these nations have to confront and overcome all their challenges at the same time. Development is a complex process which requires the mobilization of all available resources (including humans), the efficient and effective allocation and management of these resources, and through diverse strategies that do not escape the principles of common sense and sustainability. To this end, developing nations have to make strategic and operational decisions and policy choices that enhance productivity and speed up sustainable development. Policies are devised to address strategic and operational needs of nations. Policy formulation requires quality information, and spatial information is cardinal. Therefore, effort at developing SDI should run through the development policies of developing nations. We propose that developing nations consider the following issues for purposes of policy design:

- The need for psychologically motivated assessment and prioritization of national needs and identification of what tools and information will be required to address the identified needs over different time and spatial scales.
- The development of strong and far-sighted Information and Communications Technology (ICT) vision and policy that takes onboard the requirements of SDI (in terms of especially standards and funding) and allows both horizontal and vertical interactions particularly among public sector organizations at different levels of jurisdiction.
- The need to undertake a comprehensive assessment of the spatial data needs of the nation to identify what is available and its quality properties, and what should be collected by which organization.
- The overarching imperative to assess the human resource capacity and needs of the nation for the applications of geo-information tools, and to make plans for human resource development over a reasonable period of time.
- Lastly, the need to build critical partnerships and synergies early enough to drive a shared vision and responsibility, and to give direction to the development of SDI.

5. Conclusions

This paper has emphasized the centrality of SDI to the achievement of sustainable development, particularly by developing countries. The paper sets out a pioneering path in adapting Maslow's hierarchy of needs as a framework for promoting SDI in developing countries. It has been shown that developing countries in particular can use Maslow's theory as a framework to drive the assessment and prioritization of needs, and as a basis for undertaking motivated and deliberate action in developing SDI. If a nation is able to assess and order its needs as provided in the framework, that nation will be better positioned to make strategic and operational policy choices which should ultimately lead to sustainable development. Such a nation will be armed with the tools to effectively and efficiently allocate and manage resources to achieve desirable goals. And it should be a rational sequel to such an assessment that investment in SDI is both justifiable and profitable.

The paper identified the physiological needs of a nation to consist of employment, health, food, water, sanitation, housing and energy. These basic needs are viewed to be the bolts and nuts of an economy, and if they remain unsatisfied, the nation risks suffering from devastating physiological disorders. Safety needs were perceived to consist of need for law and order, tranquility, security of incomes and livelihoods of citizens, as well as protection of citizens from the extreme effect of disasters and epidemics. Feelings of insecurity could drive nations to focus on lower needs or rather be forced to enter into relationships with other nations or bodies for protection, a situation that compromises national sovereignty. Need for belongingness (which we refer to as *inter-national* needs) comprises the drive to enter into relationships with other nations or bodies on the basis of right to participation and mutual respect, trust, cooperation and support. The strength of this relationship and the depth of the care and love it delivers are seen especially in the event of dire need. Such event could be natural disasters, socio-economic disturbances or even political upheavals. Status or esteem needs are assessed in terms of the need for a nation to win the love, pride and respect of its citizens (which confers self-confidence on the nation), and to command the respect and recognition of other nations and supranational bodies. Status needs derive from the level of development in general, democracy and responsive governance. The satisfaction of all these needs (deficit needs) should lead to the satisfaction of the *ne plus ultra*—the furthest attainable point of self-actualization. This is the drive to realize sustained growth and development in consonance with the inherent capacity and endowments of a nation (sustainability). It has been pointed out in this paper that there is substantial evidence in literature and in practice that SDI, through the agency of geo-information tools, has a central role to play in the achievement of these needs. This consequently makes investment in SDI by developing nations a necessity. The paper therefore concludes with some thoughts on policy implications that are supposed to provide the fundamental forward thrust for policy design by developing countries in their bid to develop SDI.

Apparently, psychologists have yet to deeply investigate the utility of Maslow's hierarchy of needs to SDI in developing countries. In attempting to apply this theory, the difficulties and complexities inherent in it appear. We have attempted to stick to the original order of the hierarchy, with minimal adaptations. It is recommended that we search for other ways of adapting Maslow's hierarchy of needs to the assessment of *national needs* that will be widely accepted, and to the promotion of SDI in developing countries.

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