

CROWDSOURCING-BASED GEOINFORMATION, DISADVANTAGED URBANISATION CHALLENGES, SUB- SAHARAN AFRICA: THEORETICAL PERSPECTIVES AND NOTES

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ABSTRACT: Scholars and practitioners concerned with geoinformation, cyber-cartography, development studies, and other subjects increasingly explore crowdsourcing and its huge advantages for development. Some have advocated it for adoption/promotion by government as a means of citizen engagement. The objective of this article is to increase the appreciation of the contribution that crowdsourcing can make towards resolving challenges associated with disadvantaged urbanisation in sub-Saharan Africa (SSA). We review urban challenges of SSA and three practices of crowdsourcing: volunteered geographic information (VGI), Citizen Science (CS), and Participatory Mapping (PM). Then we examine problems associated with the advocacy for government adoption of those practices in SSA. We argue that civil society collaboration with an international governmental organisation (IGO) instead of government promises a better way of adopting and promoting them. This suggestion is based on the fact that work related to this strategy is carried out by a global coalition of civil society, the UN-NGLS. This strategy promises a more rapid way of taking advantage of fast-tracking public engagement in the economic region, SSA.

KEY WORDS: SSA, crowdsourcing, volunteered geographic information, Citizen Science, Participatory Mapping, civil society, IGO, UN-NGLS

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Introduction

Within the past half-century or thereabout, the literature has tended to be suffused with some issues in the nexus of the Man versus Environment – including Society – interaction perspective of geography. Two of such issues deserve mention immediately. First is what we describe here as the processes of disadvantaged urbanisation in Africa, specifically its portion lying South of the

Maghreb Desert/Sahara. We use the phrase “disadvantaged urbanisation” to describe the manifold factors associated with a sort of urbanisation that presents residents of the affected urban areas with distress instead of prosperity. The latter point is explicated shortly. Second, pertains to products of scientific advancement used by people that we refer to as “advantaged technologies”. So far, we are yet to see evidences of a systematic agenda by academic researchers to lay these

phenomena as simultaneously as they present themselves in reality in the way they ought to be formulated such that one described as disadvantaged could be “redeemed” by its advantaged counterpart. Our purposes include attempting to formulate an intellectual framework or substrate, if you will, for developing such superstition of phenomena.

Objectives and organisation

The overall objective of this article is to contribute towards the debate on the creation and implementation of solutions based on information and communication technologies (ICTs) in the service of socio-economic environmental change/improvement in developing countries (DCs)/SSA. In the remainder of this paper, material relevant to the achievement of this objective will be presented in sections, as specified. In elucidating advantaged technologies, we appreciate the advocacy for government promotion of public engagement as recently championed by some (Estellés-Arolas, González-Ladrón-de-Guevara 2012). Here, we reflect on the way groups within society use the advantages of ICTs to achieve mutually beneficial goals through open calls, among other resources. To underline the foregoing, we show how Manuel Castell’s theory of network society illuminates the way ICTs revolutionise and advance human organisation, especially the promotion of interests of groups within urban societies.

Disadvantaged urbanisation in sub-Saharan Africa

The literature indicates a growing academic interest in many facets of societies, economies and environments, including the dynamics of population (growth, etc), urbanisation characteristics, and related aspects in Africa, especially sub-Saharan Africa (SSA). One of such recent studies (Ingwe 2012) involving a spatio-temporal analysis of applications for processing data representing various aspects characteristic of urbanisation in the economic region (by nation-state) found that considerable disadvantaged urbanisation had occurred over the past three decades.

That study concentrated on the rates of conversion of non-urban areas into urban ones (i.e. the urbanisation rate), computation of areas associated with the intensification of urbanisation factors producing disadvantages, such as inadequacy of urban services, e.g. drivable roads equipped with drainage channels for evacuating water and flood after rain, etc., specific sectors of the total urban area (slumisation), poverty, and safe water/improved sanitation. The findings included rapid rates of national population growth and urbanisation throughout SSA from 1980 to 2005, averaging 93.8% (range: 90.5% points), the lowest and the highest rates being 40% (Lesotho) and 130.5% (Niger), respectively; high national poverty rates, widespread in SSA: >50% in about seven countries (it might have been similar in more countries if a large number of SSA countries had reported their 1993 poverty rates); high urban/rural poverty ratios (1.05-1.79 points) between Nigeria and Benin Republics; a high average rate (73%) of slumisation in SSA in 2001 (range: 96%), the lowest and the highest rates recorded in Zimbabwe (3%) and Chad/Ethiopia (99%), respectively.

In the late 2000s, economic geographers or geographic economists reported that urbanisation and economic growth were all along involved in a symbiotic relationship whereby each revitalised as well as gained from the other. This implies that urbanisation catalyses and gains from economic growth and *vice versa* (World Bank 2009). That particular report did not acknowledge that the urbanisation outcome in Africa, especially in the



Fig. 1. Africa, with sub-Saharan Africa in lighter gray. Source: Maps.com, 2003.

large section lying south of the Maghreb (desert) – mostly described as sub-Saharan Africa – was diametrically opposite to the 2009 results; the literature had previously reported profuse images of adversities – economic, social, political, environmental – associated with the phenomenal urbanisation of this economic region. The latter is broadly known by the phrase ‘urbanisation of poverty’ (Ravallion et al. 2007; Ravallion 2001; Ravallion, Huppi 1991), or what we would refer to in this article as ‘urbanisation of adversities’ because it comprises scenarios that may not strictly fit into the term ‘poverty’ but reflect habits and scenarios that contribute towards the pauperisation of residents of urban and urbanising areas. The question that ought to have been asked and answered previously is about factors that make urbanisation in SSA different from elsewhere in the world where the symbiosis among the various aspects of urbanisation and economic growth strikes an equilibrium or other forms (degrees of) balance that create conducive urban environments for cities and economic growth to generate – rather than discourage – mutually beneficial inter-relationships capable of offering prosperity instead of misery in their local regions. How do we think about the challenges posed by disadvantaged urbanisation amid other phenomena? For example, how do we examine challenges associated with disadvantaged urbanisation in the context of opportunities offered by information and communication technologies (ICTs)?

Inadequate information/knowledge, rapid urbanisation in Nigeria: Challenges for urban management

The task of urban management include, among others, enhancement of operations or vital activities that facilitate various functions of a city/town, such as how to improve its attractiveness to investors, tourists, residents. Urban management asks and answers questions regarding the extent to which various communities within different sub-systems of the city achieve their myriad objectives. Urban management challenges have, more recently, increased in terms of demands on information and knowledge in the context of increased dynamism of urban-based and distant – but connected – phenomena,

a combination of new factors with existing problems, and so forth. This has been the case with the recent escalation of acts of new terrorism since 11th September 2001, or what has become popularly described – in simple US parlance – as 9/11 (McLean, McMillan 2003), affecting many cities with attendant out-migration of people from victimised ones, as has been occurring in cities in Nigeria, East Africa, Iraq, Syria, etc. Urban managers would wish to determine rates of in- and/or out-migration as a means of tackling problems being engendered. The resulting geo-information¹ could be superimposed on flows of raw materials for producing food. Despite the coincidence of disadvantaged urbanisation in the information age currently superseded by ICTs, urban management in developing countries/regions is yet to harness opportunities offered by ICTs for contributing geo-information solutions to resolve some of their urban challenges.

Advantaged networks and technologies

Here we refer to the body of literature concentrating on the development of information and communication technologies, describing revolutionary technologies that have emerged over the past three or four decades and that have created a multiplicity of advantages for human life. Although some of them have highlighted challenges and disadvantages, it is evident that their disadvantages, specifically the value they have added, have been distinctive. The same could be said of the emergence of networks created by people to muster power and resilience, mostly resident in cities. These ideas are elaborated below in the section concentrating on the theoretical framework.

¹ Geo-information describes information rendered in spatially coded ways (e.g. a map), mostly using computers, such that issues regarding where things are located, how much of them, and related questions could be more easily understood than when the same information is presented in conventional forms, i.e. as statistics, etc.

Information and communication technologies

Briefly on the origin of Information and communication technologies

ICTs started with the invention – many decades ago – of the electronic digital computer, followed by their pervasive application to data processing to produce information. This culminated in a revolutionary information technology about a century ago and was followed by the advent of the Internet and its use for military purposes, followed by its uses for civilian socio-economic purposes within the past three decades². The next stage was a merger of IT with the Internet and related communication technologies (such as video-conferencing and so forth), which led to what is now described as Information and Communication Technologies, or ICTs. These revolutions have culminated in the emergence of a new economy based on the pervasive production and application of information due to the proliferation of ICTs, i.e. the availability of high technologies for information production and their application in much easier ways than possible hitherto. It is suggested that the new economy does not necessarily connote fundamental changes in the principles of economics or business. Instead, it denotes a pervasive application of information, or increasing informatisation of traditional business methodology (Ingwe 2006).

Some general benefits of ICTs

They revolutionise many facets of modern living, socio-economic activities, and industries – including education. Not surprisingly, academic researchers and activists have been examining various phenomena engendered by the application of ICTs. For some of those reasons, the share of ICT-based facilities in secondary schools in Nigeria's 36 states and the federal capital territory (FCT) was analysed in the 2000s (Ingwe et al. 2008). More recently, the way in which

networking by academics as well as professionals concerned with a broad spectrum of energy (electricity, petroleum oil, natural gas, coal, etc.,) could be enhanced through cyber-spatial platforms was studied and reported (Ingwe 2014). With reference to challenges posed by rapid urbanisation in SSA in general and in Africa's and the Black world's most populous nation-state (Nigeria), in particular, it is necessary for us (and other scholars) to examine how ICTs could be employed to provide geo-information solutions capable of directly informing urban resident as well as strengthening policy-making in the country's multiplicity of urban centres. However, in this study, we examine a particular form of ICTs that constitutes what is described as a geographical version of crowdsourcing. The reason why we examine crowdsourcing instead of ICTs is because the latter provides a framework for operationalising or performing the former (see the section defining crowdsourcing later in this article).

Other ideas relevant to the topic

For some decades scholars have related the process of urbanisation and economic developments since the 1960s. For example, geographer Brian Berry concentrated on basic patterns created by those phenomena (Berry 1962). More recently, the 2000s saw policy-makers of developing countries with their enormous growth in human populations (including urban populations) urging population and development experts to study, employ and/or deploy scientific-technological and socio-cultural innovations that have accounted for the spectacular economic growth and created consumerist societies in global northern nations within the past one and half centuries (Demeny, McNicoll 2006).

Rather than going into an investigation of a possible and/or nearly exhaustive list of factors accounting for variations in urbanisation in SSA and its counterparts in the global North, we prefer to examine here particular challenges associated with the inadequacy of information pertaining to diverse characteristics/factors (spatial, temporal, structural, among others) in specific local-regional urbanisation contexts in SSA. We also examine the extent to which information and communication technologies offer solutions or could be harnessed to provide geo-information

² The Internet derives from networking, i.e. connecting digital computers at a global-scale within sophisticated technological frameworks or protocols (e.g. the World Wide Web) used for communicating the information produced in the IT sector.

solutions enabling the urban informal sector to mobilise towards achieving some socio-economic independence in urban SSA. We achieve those objectives by relying on multiple-source data as well as documented information and knowledge. While cartography generally and urban mapping in particular constitute one form of the creation and application of diverse information systems that have distinctively contributed to revolutionising economic activities and catalysed growth in the global North, the economic management paradigm applied in the developing world has, by and large, ignored the value of information systems generally, and urban information of the geographical kind in particular.

Mapping urban geographic complexities

Urban cartography, like all geographical information highlighting other distributions of phenomena, among other things in any place, be it rural or non-urban, has been acknowledged for clarifying manifold aspects, such as challenges concerning where, why, and how things are, interrelationships among them, and so forth. For example, with the recent realisation that urbanisation in Africa, like elsewhere in DCs, has been outpacing the capacity of city managers to provide required services, efforts have been made to ameliorate urban challenges in many facets. One of them has been in the area of mapping myriad aspects: flows of people, goods/services, challenges, opportunities, interests, and so on, within an urban system.

At this juncture, we point towards some questions waiting for answers. What ICT-based innovations have most recently been undertaken to reverse the gross inadequacy in geographic information in parts of the global South experiencing rapid urbanisation amid adversities in their socio-economic/environmental subsystems? How could such ICT-based innovations be rapidly replicated (with enhancements) in similar settings where such adversities tend to present nearly intractable dimensions?

Theoretical perspectives

To clarify this discourse, it is profitable to briefly examine some bodies of ideas capable of

elucidating phenomena related to this subject. Urban centres characteristically comprise networks of many categories: from networks of civil society to those of service providers, e.g. public transport services, to name but a few. We could not leave out possible networks capable of being set up by various institutions including those responsible for or involved in tertiary educational services, among other groups. To capture those networks, we consider it necessary to refer to Manuel Castells' theory of the network society.

The network society: a theoretical perspective

As recently reviewed and applied for advocating networks of academics and professionals in energy (electricity, renewable and non-renewable energy sources), some of central issues captured by the theory of the network society were highlighted. Considering that the review was recently undertaken comprehensively, constraints (of space, academic integrity, among others) do not bear repetition of a similar exhaustive review here. Therefore, only the key points will be mentioned here while referring readers to the existing literature. The theory recognises the role of globalisation and the way it drives transformation in terms of the society and culture.

The philosophical espousal of the theory started with an announcement of *The rise of the network society* (Castells 1996). This first volume of a trilogy highlighted the arrival of the information age and its impact on the economy, society and culture. Subsequently, the philosophy proceeded towards elucidating two other matters: the power of the organising identity of groups (Castells 1997), and explications of the *End of millennium* (Castells 1998). Related to the theory was the philosopher's further contribution, *Towards a sociology of the network society* (Castells 2000a).

Geo-information provision through crowdsourcing

This is not a popular topic in the literature on urban geography, regional and environmental management. However, recent contributions dealing with increasing vigour in the employment of social media for geo-information by researchers concerned with spatial data

infrastructure, e.g. Lauriault and Mooney (2014), elucidate the subject. Publicly financed, managed and 'authoritative' geo-information in developing countries has, by and large, been inadequate for facilitating and strengthening public policy. Crowdsourcing describes alternative models for generating and providing geo-information needed by the public. It is advocated as urgent and imperative in the context of the government failure to meet public geo-information needs as well as the dynamics of socio-technological characteristics of entities or constituents of nation-states, e.g. the devolution of 'authority' to produce facts for society (Lauriault, Mooney 2014).

Crowdsourcing: its meaning

This is a term regarded as still at its infancy and therefore variously defined, as indicated by the numerous references provided by two crowdsourcing advocates: Enrique Estellés-Arolas and Fernando González-Ladrón-de-Guevara (2012). Perhaps one of the most serious efforts to distil an integrated definition from profuse contributions of definitions of the concept available in the literature is a joint publication by academics in the field of management sciences: Enrique Estellés-Arolas and Fernando González-Ladrón-de-Guevara (2012: 197) assist us in elucidating various connotations of the concept³. They include: participatory work involving the cyber-spatial (online) platform; common association of such work with mutual benefits for all or most participants/partners involved in carrying out the task; heterogeneity of participants/partners –while some could be individuals, others might be institutions; the work so undertaken arises from an open call; the undertaking of such work as well as the invitation of partners to be involved happen in a flexible way.

³ Among the available contributions to defining crowdsourcing is one that could be called an outstanding commitment towards the advancement of its theory and practice due to the very rigorous and comprehensive approach to arriving at an integrated definition of the term. Therefore, readers are hereby referred to Enrique Estellés-Arolas and Fernando González-Ladrón-de-Guevara (2012), whose definition was adopted with adaptations in this article for clarification of the steps undertaken.

Crowdsourcing work/task is associated with variability regarding modularity, complexity, and the competence, experience, and potential of partners. Therefore, it is to be expected that the extent to which participating individuals and groups mobilise, deploy or contribute their resources (including money, time) for achieving mutually beneficial objectives and targets differs with each participant. The satisfaction of the user(s) also varies: while the invited participants could gain in terms of improvement in their self-esteem, skills, and/or economic or social acceptance, the initiator or crowdsourcer could benefit through access to (as well as use of) contributions of the user to the programme/project. The form of the latter depends on the type of programme/project undertaken. Since more elaborate discussions and definitions of this term –including a comprehensive review of its definition by numerous contributors – increasingly appear in the literature (e.g. Estellés-Arolas, González-Ladrón-de-Guevara 2012), the foregoing suffices for introducing the concept here as part of the examination of its applications in urban geo-information.

Owing to the constraints of space, time and focus, an exhaustive listing of the numerous benefits of crowdsourcing is beyond the scope of the present article. However, considering our concentration in this study on challenges associated with disadvantaged urbanisation, it is appropriate to acknowledge its contribution and potential in some aspects relevant to this subject. Among other efforts is Brabham's (2008, 2009, 2012) highlighting various uses of crowdsourcing as a model and/or a tool for leveraging manifold activities and processes, including problem-solving, public participation as well as online communities. In a similar vein, the literature is replete with reports about the value of crowdsourcing as a tool for innovation. A few of the many such innovations that deserve mention here include those in open source work (Buecheler et al. 2010) and commercial applications of products of crowdsourced but unpaid and/or underpaid work done by consumers (Kleeman et al. 2008).

Three broad categories of crowdsourcing

Volunteered geographic information, VGI

This refers to the art, science and technology of generating (and/or gathering), storage, processing or synthesis and management of geo-referenced facts representing the Earth's surface and near-surface features and phenomena by members of the public within suitable platforms, mostly websites. The specification of a geographic location (or coordinates) and a description of at least one – and if possible, more – of the characteristics of the contributed fact distinguish VGI from other types of crowdsourcing (Goodchild 2012). Its capability for being transmitted over social media has made it vigorously employable in volunteering GI, thereby increasing its value for leveraging collaboration among citizens volunteering it across the world. This accounts for its virtues that incline experts in GI to perceive crowdsourcing as a veritable means of rescuing governments that have failed to provide public GI needs to collaborate with 'citizens' sensors' to engage in partnerships capable of increasing GI databases. However, it is limited in two regards. First, VGI flourishes in urban areas while being scantily applied in rural ones. Secondly, concern has been expressed regarding data quality when applying VGI (Lauriault, Mooney 2014: 5).

Citizen science

This concept is used to denote many things. To some it refers to collaborative responses to challenges, e.g. environmental degradation, faced by the diverse constituencies of a community⁴. Some of the many activities involved in such programmes include monitoring the development of adverse phenomena and/or related ones, including the response undertaken, the tracking of dynamics. Others highlight the enlistment of members of the public in networks engaged in gathering data required to conduct scientific

research of multiple-regional scales that could cover economic regions and/or the global level (Bonney et al. 2009). Yet other workers present it as a community engagement strategy, a means of managing, including the monitoring of natural resources. Its emphasis has recently shifted from the traditional treatment of citizens as mere data gatherers to involving them in research programmes/projects as scientists. There are some notable examples of citizen science programmes. One of them, promoting wildlife conservation by concentrating on the exploration and documentation of species, is called *Project Noah. Marine Litter Watch* and focuses on litter quantification, while *Safecast* concentrates on mapping radiation levels in communities by compiling data/information gathered by citizens assisted with required tools for participating in monitoring local radiation.

Participatory mapping

This variety of crowdsourcing involves many more participants than its other counterparts. By the latter virtue, geo-information products resulting from its application are praised for their potential to enhance acceptable socio-economic human environments. Irrespective of its requirement for longer times for data gathering, the selection of matters of greater significance from the multiplicity of things existing in reality, and map compilation, it is still hailed for more important advantages. For example, by involving more participants it promotes two key conditions: local-regional governance because of the way the processes and strategies employed are appreciated for bringing about democracy (representative type) and a reduction of inequality in society; and greater transparency due to the ownership of and contribution to decision-making processes by more persons compared with its rivals. Moreover, it promotes a process whereby mass participation in mapping results in the portrayal of the 'cartographers' of the things they perceive more easily than in top-down produced maps. It is associated with complexities and complications, especially during the stages of resolution of issues resulting from group dynamics, intermediation involving advisors, participants, community groups, among others, and requires an expenditure of time and other resources (Estellés-Arolas, González-Ladrón-de-Guevara 2012).

⁴ Constituents of a community include concerned individuals/citizens, creative persons, civil society, e.g. advocacy groups, local institutions, graduates of tertiary institutions.

Discussion

Two major issues deserve a comment here: to what extent national governments in SSA can promote public engagement through outsourcing, and the role and potential of international governmental organisations, especially the United Nations and its agencies, in promoting public engagement – and by extension, crowdsourcing.

Would governments of sub-Saharan Africa be willing to promote public engagement through crowdsourcing? The advocacy that governments promote crowdsourcing to leverage public engagement is sound. What the advocacy has downplayed is the fact that nation-states are characterised by variegated socio-political, historical and economic landscapes whereby some accept Open Governance, others – even while pretending to allow freedom of information laws – maintain frameworks for resisting them. The prolonged and high incidence of poverty, inequality and unemployment in most parts of sub-Saharan Africa warrants a comment on the promises of participatory mapping in the region as a means of citizen engagement. However, this is where some advocates of this approach (e.g. Estellés-Arolas, González-Ladrón-de-Guevara 2012) must recognise the unwillingness of rulers, especially dictators transformed into election-based democratic heads in SSA. The indifference of governments to the plight of citizens has been one of the explanations for prolonged and serious poverty in SSA. Evidence should include intolerably high levels of poverty, such as in Africa's largest economy, Nigeria, where its post-independent rulers seem to have been preoccupied with looting public treasury to stash away in foreign banks, thereby subjecting to poverty as much as over 90% of the country's population estimated at 183 million (Population Reference Bureau 2013; Ingwe 2014). It might be more profitable for us to invite civil society to employ crowdsourcing for engaging governments of sub-Saharan Africa. Fortunately, civil society work of the type discussed has been going on in Africa. For example, environmental governance, promoted by The Access Initiative (TAI)⁵, whose work serves as a catalyst for mass

participation, legal redress, and capacity building. TAI associates with the Open Governance Initiative (World Resources Institute 2015). TAI works in Africa in many fields. It strives to expand awareness-raising programmes concentrating on environmental democracy and development principles that it calls Principle 10, and propagates environmental governance through the local media into African nations. It also works on the Open Governance in the Extractive Sector in Africa (OGESA) Initiative, securing land rights through community and corporate leadership (ILEG, n.d.). What we could not immediately confirm is the awareness and use of crowdsourcing in its campaigns.

Why public engagement through crowdsourcing could be better promoted by international governmental organisations (IGOs)

For many, if not most, developing countries where democratic government is yet to be further adequately institutionalised beyond the holding of national re-elections and where open governance is still a difficult option because of the bad influence of power elites, crowdsourcing could also be better promoted through programmes at the level of international governmental organisations (IGOs). A very good example is presented by the United Nations, one of the many agencies of which – the UN Non-Governmental Liaison Services (UN-NGLS) – assists and collaborates with civil society. “The United Nations Non-Governmental Liaison Service is an inter-agency programme of the United Nations mandated to promote and develop constructive relations between the UN and civil society organisations” (United Nations Non-Governmental Liaison Services 2014). Moreover, in specific sectors in which national governments have been known to purposefully stifle public engagement, the UN-NGLS promoted such matters using some of its agenda-setting instruments. Once more, we reckon that where there are high degrees of inequality in a society being mapped via participatory approaches, especially where those involved are treated as ‘experts’ contrasted to ‘feeders’ of data/information, on participatory mapping we certainly would get adequately represented features, phenomena, distributions in the finally

⁵ *The Access Initiative* is the largest network in the world dedicated to ensuring that citizens have the right and ability to influence decisions about natural resources.

compiled maps. Moreover, due to its global coverage, the UN-NGLS is more strategically positioned to take advantage of the applicability of crowdsourcing at the level of economic regions, e.g. sub-Saharan Africa.

Conclusions and policy implications

This article shows that while networks might have worked at achieving their set goals previously, the advent of ICTs has catalysed their unprecedented flourishing, especially in the area of mobilisation of their co-workers. Our literature review indicates that crowdsourcing has been making contributions to sustainable urban development, i.e. one that covers all sectors of the urban society, including social, economic and environmental systems/sectors in some countries. The new challenges arising from this study include the identification – or better mapping – of constituents of urban communities in sub-Saharan Africa as a means of raising their consciousness of achievements recorded by their counterparts in the economic region and elsewhere in the application of crowdsourcing for contributing solutions to urban problems, among other socio-economic and environmental ones. Although urban management in developing countries characterised by poor histories of geo-information production stands to gain considerably from those advanced technologies, the literature reports their application in economically advanced economies with commendably high records of geo-information production as well. That is, there is no need to restrict the benefits of crowdsourcing to developing countries beyond promoting their employment by networks or constituents of communities within their societies. We have been silent here about challenges associated with poor human-capital development in sub-Saharan Africa in general and in cartography and/or geo-information specifically. Suffice it to state that the use of crowdsourcing by university students for mapping informal public transport in Kenya's capital city, Nairobi, demonstrates one strategy of rapidly building human capital in cartography concentrating on a theme of enormous socio-economic-environmental value. Of course, this cyber-cartographic aspect could be replicated in a nearly inexhaustible list of issues and

challenges hampering sustainable development in the region.

The policy implications include creating and managing awareness-raising programmes on crowdsourcing at the UN-NGLS intended to produce a civil society that has the potential to take advantage of crowdsourcing for leveraging the achievement of their goals, promoting distinctive contributions as well as development at multiple scales: international or global, and regional or (sub)national, and that could put crowdsourcing on the agenda as a tool for promoting development within sectors (e.g. natural resource conservation) where its successful application has been reported.

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