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The National Resource Question and the Potentials of Cartography and Geographic Information Systems as Instruments of Spatial Engineering in a Developing Society

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THE NATIONAL RESOURCE QUESTION AND THE POTENTIALS OF CARTOGRAPHY AND GEOGRAPHIC INFORMATION SYSTEMS AS INSTRUMENTS OF SPATIAL ENGINEERING IN A DEVELOPING SOCIETY

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1. INTRODUCTION

Resources are fundamental and crucial to development. They serve as basic input necessary for attaining development. Nigeria can only attain development when available resources are effectively mobilized and harnessed towards attaining national goals and objectives as contained in the 1999 Constitution and other policy documents. For resources to be effectively used, there must be adequate information on their types, location, amount and distribution. Availability of this information will guide efforts at ensuring effective allocation and use of resources. Development programmes initiated at various levels of government in recent time have not achieved much due to the absence of the above information needed in fashioning an acceptable arrangement for ensuring effective allocation and use of available resources. Attempts at evolving acceptable and indeed a workable arrangement for resource allocation have thus remained fruitless. Most if not all of this information can be obtained through the application of cartography and GIS.

So far, Nigeria is still lagging behind in the adoption of modern mapping technology. This perhaps

explains why mapping is still at a poor state. This scenario not only portend a great danger to the country, but also limits the level of development in the country as there is no data base on which further planning and programme execution can be hinged. Resource mapping as an instrument of providing needed information and allocating available resources in a fair and equitable manner (spatial engineering) has thus suffered a lot of setbacks. This may largely be attributed to lack of commitment on the part of the government as shown by the absence of necessary impetus required to boost its activities. Up till now there exists no viable programme on resource mapping. This stems from the absence of a comprehensible policy and conducive environment for mapping in Nigeria. Past efforts on resource mapping has been largely ad-hoc, uncoordinated and short-sighted (Areola 1982, 1987, 1988 and 1991); Adeniyi(1979,1984,1985a&b, 1986 & 1989) and Balogun (1998). The result has been non-availability of current and reliable information on available resources in the country. Attempts at fashioning workable arrangements on resource allocation have been made difficult. The process of spatial engineering which is predicated on developing means of ensuring efficient distribution of resources among the geo-political units have remained ineffective and problematic. This trend must not be allowed to continue if Nigeria is to be self-reliant and purposeful in the effective management of available resources.

Viewed against this background, the paper makes a strong case for a national programme on resource mapping focused at utilizing the full-potentials of cartography and GIS as an instrument for ensuring effective spatial engineering in Nigeria. In achieving this objective, the paper specifically intends to:

- (a) Provide a framework for explaining and clarifying certain concepts relevant to the theme of this paper;
- (b) Explore the available tools necessary for spatial engineering as reposed in cartography and GIS;
- (c) Review the present state of resource mapping in Nigeria, the organizational framework, achievements and problems;

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(d) Identify fundamental issues and available options involved in the development and execution of a national programme on resource mapping.

a) Conceptual Framework

Concepts central to these of this paper shall be discussed in this section. These concepts seek to shed more light on the major theoretical strands embedded in the arguments developed in the present discourse. Furthermore, they highlight crucial issues as they relate to the place of cartography and GIS in resource development and the critical state it has assumed in the light of present experience in Nigeria.

b) Resources

This is a common term in every day usage. It connotes several meanings depending on the perspective from which it is viewed and the purpose for which it is used. Mitchell (1979); Adeniyi (1985 & 1989); Areola (1982 & 1992), Aweto (2001) have devoted substantial portion of their contributions to the issue of defining a resource. They identified certain issues involved in the evolution of resources and the socio-economic implications it holds for human development. Collectively, the inability to develop an adequate definition for resources may be attributed to following issues:

- i. the changing philosophy and nature of resources;
- ii. the uses and relevance of resources to human needs and goals;
- iii. the complex cultural and technical matters surrounding the concept of a resource.

For our purpose, we may define resources as entities or things that can be used in satisfying human need and additives (inputs) used in the production of good and services. Indeed the concept of resource is better understood if it is considered along side the idea of resistance. Resistance in this context refers to limitations or restrictions on the extent to which an entity can be adopted, identified and assigned to a specific use. Hence the concepts of resource and resistance cannot be separated from one another (Aweto 2001). In all resources could be NATURAL in which case they are found in the physical environment such as minerals, liquids, solid materials and physical substances or HUMAN when they are resident or innate in humankind in form of mental effort, initiative, skills, reasoning power, physical strength, intuition etc. In its strict sense, every development effort is centered primarily on how to adequately allocate and use resources efficiently for the benefits and well being of man.

In recent times, however, the domain of the concept of resources has widened to include the following attributes.

- a. A resource is only when it is considered capable of satisfying human wants and needs.
- b. Every resource has a specific use ascribed to it.

c. The development of a resource occurs in stages beginning from the perception of its existence. Next is the recognition of its ability to satisfy human needs and finally the development of a strategy devised towards ensuring its full utilization through exploration and eventual exploitation.

d. Resources are dynamic owing to the increasing effects of human knowledge, modern technology and changing societal objectives.

e. Resources are not equitably or uniformly spread over space. This probably explains why some places are more naturally endowed than others.

f. Resources are subjective in nature as they depend on 'individuals' perception and what they are eventually used for.

g. The adoption, use and development of a resource rest squarely on human decision. Man thus stands as the motivating force behind every search for a resource.

c) Resources Analysis and Evaluation

This is a recent field and discipline whose interest centers on determining the amount of available resources, the activities or uses to which they are appropriated and the generation of reliable information about such resources. The objective of the exercise is to determine where the resources are located and how they can be effectively allocated in such a way that they are better utilized. Resource analysis has in the last three decades emerged as a multi-disciplinary activity involving the collaborating efforts of specialists such as geographers, cartographers, economists, surveyors, engineers, and policy makers etc. all of whom provide necessary input into ensuring an equitable and fair allocation of available resources among the various segments of the society. In Nigeria, this field is confined strictly to the domain of certain policy sciences such as geography, economics, and policy administration. Its effective operation had been seriously hampered by the absence of reliable information on the location, stock and distribution of available resources.

d) Resource Management

This is a wider field of activity that is concerned with the process of making far-reaching decisions on principles guiding the identification, exploitation, allocation and eventual use of resources. It encompasses activities such as resource analysis, resource planning, resource survey, preparation and publication of resource inventories in the form of maps and tables etc. Often times it involves deciding on ways of preserving and prescribing means of ensuring the judicious use of resources in order to avoid wastes and inefficiency. Since, this is a wide field; the activities of several professionals are involved. However, these activities are often dominated by the contribution of several professionals particularly policy makers who are expected to advise and guide the use and allocation of resources.

e) *Resource Inventory*

This is a list or stock of available resources, their quantity, quality, location and distribution. It also provides information on abundant and depleting resources. Most inventories come in the form of maps, tables, and charts. Resource inventories stand as one of the by-products of resource surveys whether comprehensive or simply ad-hoc and it seeks to provide the basic data required in the various processes of resource analysis, planning and development.

f) *Spatial Engineering*

This is a relatively new concept in spatial and physical planning. It primarily centers on the ways of allocating resources as a means of tackling the problem of uneven development. The major thrust of this activity centers on how to ensure accessibility to available resources equitably over a given geographical area.

Spatial Engineering according to Okafor(2000) involves:

- i. the division of a geographical area into district units for the purpose of administration and development.
- ii. Creation of new spatial structures in the form of industrial estates, business zones, residential areas for the purpose of allocating available resources. This of course, constitutes the major task in physical planning.

In essence, spatial engineering stands as an instrument in planning used for ensuring fair and equitable allocation of available resources in order to ensure even development and socio-economic well being.

g) *Geographic Information System*

This is a recent technology used for collecting, storing, manipulating and analyzing spatial data in assisting certain cases that involves decision-making.

h) *Cartography*

This is a discipline that involves the collection, analysis and presentation of spatial or geographic data in the form of map and other related products as maps, globes, map models etc.

The Nigerian National Resource Question

This is a burning national issue that has over the years generated a lot of controversy particularly since independence. Contributors to this topical issue at different fora believe strongly that it has socio-economic, political and cultural dimensions. Toyo (1993), Kayode (1993), Mbanefo (1993), Dunmoye (2002) in their respective submissions, summarizes the Nigerian resource question as a collection of issues bordering on:

- (a) What resources are available in the country?
- (b) How should such resources be shared among the various geo-political units?
- (c) How gets what and in what proportion? This issue relates to the problem of fashioning out an

acceptable formula for resource allocation among the various tiers of government

- (d) Who controls the resources? This is a recent dimension in the resource debate. It had recently been resolved through the judicial process. In spite of this, it generated a lot of political tension and heat, which is beyond the scope of this paper.

All the above questions put together simply translates to the issues bordering on the amount of available resources and the formula to be adopted in allocating and using the resources such that it is well appropriated and every segment of the nation is adequately served. Of course, these issues if placed in their proper context reveal the spatial dimension they have since assumed. This implies that a search for an effective solution to this problem requires that the spatial context must not only be acknowledged but be adequately considered whenever attempts are made at fashioning effective arrangement at allocating such resources. This also demands that information be made available regularly as to the amount, location and distribution of these resources such that resources are allocated with due regards to the principles of fairness, equity and distributive justice.

Viewed against this background in the relevance of cartography and GIS as a reliable and effective instrument for providing the basic information required in arriving at an effective allocation formula. No doubt, a lot of principles and formula have been proposed and applied at various times yet the resource debate still abates. It is apparent that most revenue allocation commissions set up so far are yet to tackle the problem effectively. Perhaps, the persistence of this debate constitutes a reflection of the complexity of the resource question. Yet it can never be fully resolved until current and reliable information on resources are made available particularly as it pertains to the type, amount, location, and distribution of resources. It is thus obvious that planning will continue to be shortsighted and defective in the absence of such information. The inability to plan how to allocate and use resources effectively has been largely responsible for the present state of under-development in the country.

There is no gain saying the fact that for balance development to be realized, there is a dire need to seek ways by which the required baseline data on the type, amount distribution and location of resources can be obtained on a regular basis. In recent times, cartography and GIS have come to be recognized as one of the effective means of obtaining, analyzing and representing this information in such a way that they can be directly applied into every planning exercise. The remaining part of this paper addresses the state of resources mapping in Nigeria and the way forward in the development and execution of a national programme on resource mapping. This is seen as a fundamental step

Federal Department of Agricultural and Land Resources	Soil Maps, Land Use Maps	Exists at scales like 1:250,000 & 1:100,000
National Population Commission	Enumeration Area Maps, Township Maps, Population Maps	i. Mostly sketch maps ii. Not geo-referenced iii. Lacks modern cartographic standards.
Hydrographic Surveys (Nigerian Ports Authority)	National Charts	i. Exists at small and large scales. ii. Used for establishing water courses. iii. Strategic and defense purposes
Department of Civil Aviation (now Nigerian Airspace Management Authority MAMA)	Aeronautical Charts.	Shows the various air routes and extent of the Nigerian Airspace.
Nigerian Meteorological Department (Federal Ministry of Aviation)	Weather & Climatic Charts	Show weather and climatic zones
Federal Inland Waterways Department (Federal Ministry of Transport)	Drainage Map	i. Shows major Nigerian rivers. ii. Depict major drainage patterns and regions
Oil Companies (Shell BP, Total, chevron, NNPC)	Oil concession Maps	i. Shows major oil fields and other potential sources of petroleum resources
Private Mapping Companies (Cartography, Geographical Bureau, Nigerian Mapping Company)	Atlases, Wall Charts, Road Maps, Street Guides, Political Maps	i. A collection of small scale maps covering several themes. ii. Products meant specifically for educational purposes.
Publishing Houses (UPL. Longman, OUP etc)	Atlases, wall charts	Ditto
<i>Source : Balogun (1992), Dada (2001) and Field Survey (2002)</i>		

From the above tables, the following can be deduced:

- i. Most of the maps are grossly outdated as regular revisions are yet to be made;
- ii. Maps produced by private organizations and some official mapping agencies have restricted circulation due to either low production, limited distribution channels or based on security considerations.
- iii. Most agencies have not been involved in regular mapping activities in recent times. This is informed by the increasing mapping projects often contracted out by these agencies.

j) Benefits of Resource Mapping in Nigeria

In spite of the low state of resource mapping in Nigeria, there is no doubt that if pursued vigorously, it is capable of conferring substantial benefits on the country as a whole. Areola (1985 & 1986), Adeniyi(1985), Eden(1986) identified the following as the benefits accruable from a comprehensive programme on resource mapping:

1. It provides adequate and reliable information on the:
 - i. amount, types of available resources, their distribution over space, rate of usage and exploitation as shown by the present stock;
 - ii. capability and potential usage of untapped resources;
 - iii. identification of resources in terms of their location and composition;
 - iv. detection of changes in the volume of resources over a given period of time as a result of over-exploitation, deterioration or damage.

2. It facilitates the art of decision-making particularly as it has to do with the planning and control of resource use, its conservation and assessment of quality and quantity.
3. It provides solutions to problems of indiscriminate exploitations of resources owing to excessive usage and possible damage by providing information on alternative sources of resources, their location and stock.
4. It assists in the assessment of the condition of available resources especially on issues such as level of usage forms of degradation or damage and the effects of such on the stock of other resources and the environment in general.
5. It helps in the generation of reliable data, specifically official statistics which is useful in the execution of activities relating to resource, analysis and evaluation.

j) Problems of Resource Mapping

Attempts at enhancing effective resource mapping exercises in Nigeria has been bedevilled with certain problems which have limited the benefits that should normally accrue as a result of availability of reliable maps. Some of the problems include:

1. The absence of a comprehensive programme on resource mapping that would have ensured the effective execution of the various stages involved in resource mapping such as the conduct of systematic resource surveys, classification and inventory of resources as found within Nigeria's territorial space.

2. The death of reliable spatial data on Nigeria's environmental resources as shown by the lack of current maps showing the amount, types and distribution of resources. Available resource maps such as topographic maps, vegetation maps, soil maps etc are not only outdated but most are out of print. They require urgent revision if they are to be used for any meaningful planning exercise and public use. Apart from the huge costs that such a project will involve, the technical and manpower requirements for such exercises are too formidable for the official mapping agencies to afford and bear, at least within the limits of resources available at their disposal.
3. The dependency on foreign and private local consultancy firms to undertake resource mapping projects on behalf of official mapping agencies have made resource mapping to be ad-hoc and fragmented. It is no longer news that most mapping projects in Nigeria in the last four decades were undertaken by foreign consultancy firms and a few private Nigerian mapping companies. This can be attributed to some reasons. First, most official mapping organizations are not technically capable of undertaking large scale mapping projects due to the obsolete equipments they use in their various activities. Not only that, their personnel is not proficient enough in modern techniques of map production and may not be competent to undertake these projects in view of their complex technical nature. Hence, the projects are usually contracted out to the private mapping companies who are technically superior and better staffed to execute them. The present situation is certainly untenable since Nigeria by all standards and level of development is expected to be capable of executing such tasks without recourse to foreign involvement. Yet, the present situation contrasts sharply with this expectation. Hence, the scenario subsists while government continues to demand self-sustenance from her various mapping agencies.
4. Inadequate manpower and staffing within the mapping agencies have made the execution of these projects difficult if not, impossible. The available one are loaded with much duties such that they are unable to cope with the demands of their job. This problem had been further compounded with the inability of these agencies to recruit capable hands to help fill the gap. The result is a management structure that is filled with many officers at the top and few ones at the lower cadre. Balogun (1985b) in addressing the problem of manpower shortage in official mapping agencies had identified the following factors:
 - i. Constant review of remuneration packages in the public service. Indeed most of the reviews had recommended an upward adjustment of salaries and wages coupled with an attractive pension scheme. These reviews instead of retaining manpower in the public services had on the long run provided incentives for the few lower cadre officers to veer into private practice in view of the attractive remuneration packages. This had resulted in the mass retirement of available manpower to the lucrative private practice. What is more, the prevailing practice of awarding mapping contracts to the few available private mapping companies had further encouraged the early retirements of these officers as their involvement in such projects have kept them busy unlike when they were in public service.
 - ii. The increase in official mapping projects following the oil boom period and the prevailing culture of awarding the projects to private mapping outfits had encouraged the drifting of capable hands from official mapping agencies to the private organizations most of whom are better equipped and staffed to undertake such projects.
 - iii. Sustained political exercise involving the jurisdictional partitioning (division) of the Nigerian entity into states and local government since 1976. It is instructive to note that Nigeria had had not less than four exercises in state creation within a spade of twenty years. This situation had exacerbated the manpower situation as it created imbalance in staffing resulting in the eventual dispersal and fragmentation of available manpower as most of them had to move to their respective states of origin to start new mapping outfits there. It was not surprising therefore to note that most have remained idle since then, more so when the senior officers had to occupy the top posts with the middle and lower cadres being left vacant for several years.
 - iv. Legal enactments and regulation on labour and trade union matters which prohibited private practice while in public employment. This arrangement created certain incentives for those desiring private employment and, made many to opt out of public service earlier than they should.
 5. The ad-hoc nature of previous resource mapping projects without an in-built system for ensuring effective monitoring, evaluation and appraisal of executed projects. Experience has shown that as soon as most mapping projects have been completed then all other activities are wound up such that results of the executed projects are left unattended to by way of evaluation. This probably explains why monitoring and evaluation activities in the form of map revision exercise are never undertaken. Once a mapping project is completed, nothing is done by way of review and evaluation and by implication the end of such projects have come. In essence, opportunities for project appraisal as a way of fine-tuning gray areas are thus lost.

Developing a National Programme on Resource Mapping: The Way Out

There is no debate as to the need for a comprehensive programme on resource mapping at least as a step towards ensuring its gains and allowing for a conducive environment where maps are made available as and when required. In instituting such a programme, however, certain issues have to be addressed. The concern in this section is to briefly identify them and also proffer strategies for ensuring the eventual success of the programme whenever it is put in place. The issues include:

- (1) There is an urgent need for a policy on mapping and an official body (backed by law) to see to the implementation of the policy. Such a body should be given free hand to coordinate and administer the execution of mapping activities in the country including the adoption and implementation of digital mapping (especially GIS).
- (2) The adoption of modern mapping technology particularly GIS by the official mapping agencies as a basic step towards diversifying their activities, enhancing effective map production and much importantly meeting the mapping needs of the country. The implication of this arrangement may boil down to the discarding of obsolete equipment currently in use in these mapping agencies and the acquisition of modern mapping equipment such as computers, workstations, scanners, digitizers, plotters, mapping software etc.
- (3) The training of qualified manpower to run the affairs of the mapping agencies. This issue demands urgent and serious attention. Not only must the available manpower be trained regularly as a way of equipping them with latest mapping skills, they should be sent on regular refresher courses as a way of updating their knowledge on their respective beats. The effective training of mapping personnel will help reduce drastically the practice of contracting out important mapping projects. In addition they will be kept busy since they will be actively engaged in one mapping project or the other.
- (4) Regular and proper funding of mapping projects especially those initiated by the official mapping agencies. One of the problems affecting effective mapping operations is poor funding in spite of huge budgetary allocation devoted to mapping. The trend must be reversed if resource mapping is to yield the required dividends. Funding does not necessarily have to be solely dependent on the government. The mapping agencies must seek for viable means of generating revenue outside government subvention which unfortunately had been on the decline in recent years due to the prevailing economic crunch. A better way of generating revenue may be to devise better

marketing strategies for their various products. They may also need to convince government of the need to actively fund the mapping projects at least as a means of providing reliable and current data required for planning purposes.

- (5) Since resource mapping falls largely within the domain of thematic mapping it may be appropriate to consider the establishment of another mapping organization to handle the production of these maps. Currently, the Federal Surveys is saddled with the responsibility of producing the National Atlas, which was published last in 1981 in addition to other mapping functions. This arrangement has made it difficult for the organization to adequately cope with these functions in the face of dwindling financial and materials resources occasioned by the current economic recession. Not only will this arrangement help in relieving the FSD of much workload, it may on the long run help foster professionalism and specialization, which also will increase productivity and efficiency.
- (6) A conducive mapping environment is crucial to efficient map production. Hence it is necessary that such an environment be created whereby map users and producers will be afforded the opportunity of interacting regularly in exchanging ideas and also proffer ways by which mapping can be made more effective. Such a forum will equally assist in ensuring the realization of objectives of the various organizations involved in mapping. Needless to say that this proposed arrangement will be better guaranteed whenever the body earlier advocated for is established to coordinate mapping activities in the country.

II. CONCLUSION

This paper has shown that the current debate on the Nigerian resource question can be effectively resolved by tapping the potential of cartography and GIS as instrument of spatial engineering. The resultant effect will be a better resource mapping base on which future planning will be hinged. The way forward is to initiate positive measures aimed at enhancing the gains and benefits of resource mapping as currently reposed in cartography and GIS.

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