GIS APPLICATION TO BOOST FISH PRODUCTION IN NIGERIA

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ABSRACT
The paper discusses the application of geographic information system (GIS) to fisheries enhancement, examining the capability of GIS, a computer – assisted analytical tool and spatial technology to offer the much needed operational strategies and techniques for acquiring, manipulating, storing, modeling and displaying multi–dimensional fisheries production data. Presentation is on the importance of the emerging technology of GIS and how it can be utilized to greatly speed up and make more efficient location optimizing processes and how the technology can allow for a through examination of the many spatially variable factors which might affect or control fish production both from aquaculture and inland fisheries in Nigeria.

INTRODUCTION.

Nigeria is a coastal state with a lot of fisheries resources, both in marine and in inland waters, the potentials for aquaculture is no doubt enormous with about 12.5 million hectares estimated to be suitable for aquaculture development in freshwater and marine environment (Gaffar, 1996).

Tobor (1993) estimated that Nigeria has aquatic potentials to produce up to 1.3 million metric tones of fish through aquaculture. The inland fisheries are estimated to be capable of producing over 1.5 million metric tones of fish annually with adequate management (Ita, 1993). The current overall fish production is estimated at 500,000 metric tones, whereas the requirement or demand for fish production is about 5 million metric tones (Dada 2004). This clearly shows that there exist a wide gap between fish production and demand for fish products.

It is ironical that Nigeria's 15 million hectares of inland water mass (Ita, 1993) and the 12.5 million hectare suitable for aquaculture land mass (Gaffar 1996) have not translated to abundance of fish for its citizen and economic growth.

It is evident that fish production in Nigeria has not witnessed any appreciable growth due severally to a number of environmental, socio-economic political and policy issues. The implication is that people have not been able to provide for themselves at the most basic level that is to provide a suitable means of producing sufficient food.

In response to this strategies aimed at ensuring food security is been adopted world wide, this is more so because the rapidly rising world population is causing pressure on both land and water space because of the need to greatly increase food output. F.A.O (1991) observed that a realistic and practicable way of supplying more food protein is to increase fish production through aquaculture and inland fisheries. Fish production can only be increased when the spatially variable production factors controlling aquaculture and inland fisheries are well understood and properly addressed.. One of the barriers both to increasing fisheries output and to enhancing the diffusion process concerning aquacultural techniques, has been the lack of data on , and method for optimising production location (FAO,1991).

To optimize production location, it is necessary that the great volumes and diversity of data required be captured efficiently and effectively so that the appropriate management decision can be made quickly and confidently .

The use of a computer – assisted analytical tools such as the geographic information systems (GIS) fill in this gap .spatial technology offers the much needed operational strategies and techniques for acquiring ,manipulating , storing ,analysing , modulating ,modelling and displaying geographically referred dada for solving complex human related problems. Combining Gis with remote sensing technology can greatly assist in the spatial decision making process.

Emphasizing the significance of this technology to enhance fish production in Nigeria is quite important at this time, considering the fact that GIS technology is relatively young in Nigeria.

This paper therefore discusses the importance of the emerging technology of GIS and how it can be utilized to greatly speed up and make more efficient location optimising processes and how the technology can allow for a thorough examination of the many spatially variable factors which might affect or control fish production both in aquaculture and the Inland waters of Nigeria.

FISH PRODUCTION: THE FUTURE OF FOOD SECURITY

Given the emerging scenario, the World population was estimated to be increasing at a rate approaching 100 million per annum (FAO, 1991). The Nigeria population figure for 2004 is 130 million. This implies that demands for food would increase.

Meanwhile, it has been noted that food production, which was increasing in the past, has cease to increase and had become inadequate to satisfy rising demands. The effect on people is under nourishment. (FAO, 1991) noted that grain production per person declined in 51 developing countries between 1981 and 1988, with the total number of malnourished increasing from 460 to 512 million. With the World population likely to quadruple between 1950 and 2025, and with potential agricultural land being already at a premium" then increasing food yields per hectare must be maintained. Meanwhile. Much of this increase must be in the form of protein.

At present the production of meat protein in most area is energy wasteful, this is partly because protein conversion ratio from feedstuff to meat is about 20% (Cox and Atkins, 1979).

This implies that conventionally produced meat will become an expensive luxury with alternative form of meat protein being increasingly pursued. Much of this will have to be supplied in the form of fish. Interestingly, it is widely acknowledged that feed conversion ratio FCR can be up to 67% for fish (Solomon et al, 1996) and that there are considerable evidence in the use of fish and fish product for solving health problems. (Abdulahi, 2001). The problem of protein – energy malnutrition (PEM) would be greatly solved by fish consumption.

The combination of fish yields from wild-catch and aquaculture will bring about increase output in fish food production granting that pragmatic management strategies that will boost fish productions are put in place.

SPATIALLY VARIABLE PRODUCTION FUNCTIONS CONTROLLING AQUACULTURE AND INLAND FISHERIES

Fish production is dependent on a number of factors; these factors have been termed production factors because fish yield/out put is a function of various combination of parameters or factors. The factors fall under environmental / physical, economic, and social factors and all these will show spatial variability within and between given areas or zones.

The rationale for most economic activities is profit maximization or cost reduction enterprises will seek to manipulate production functions in such a way as to best secure the maximum outlay of time capital or effort in seeking suitable location for aquaculture and capture fisheries, profit maximization is often the production rationale.

From the spatial perspective, it is quite possible to optimize production functions by taking the right decision based on available spatial data e.g. the best location for optimum fish production can be determined.

FAO (1991), observed that both aquaculture and inland fisheries are complex production activities, and that the range of controlling production functions will therefore vary greatly between and within different locations

Attempt is made here to identify some production functions controlling aquaculture and inland fisheries based on FAO (1991) are:

(a) Land availability
(b) Capital ownership
(c) Topography
(d) Climate
(e) Season and area
(f) Water availability
(g) Water quality
(h) Potential for competitive water use
(i) Soil properties
(j) Predators
(k) Adjacent land uses
(l) Proximity to supporting infrastructure
(m) Access roads
(n) Local political social & economic factors
(o) Environmental constraints
(p) Security
(q) Availability of skilled manpower
(r) Exploitation method
(s) Pollution
(t) Aquatic macrophytes
(u) Communication Etc

Attempt here is not to be exhaustive on production factors, it is to show their complexities and spatial variability, hence draw alternation to how GIS technology can be applied to capturing analysing and presenting those variables for effective decisions that are relevant for enhancement of fish production in Nigeria

GIS as tool for handling fish production functions In order to select a site or choose a general location from where a specific site may be selected for fisheries enhancement, then there must be information on the manner in which individual production function vary spatially and preferably how selected optimum combination of these functions vary in "space" making these information available can well be speeded up by the use of GIS For instance FAO (1991) observed that effective management of rare species will require detailed information on many environment variables, in order word, production variables covering a broad range of temporal and spatial scales.

In particular, environmental manager need to know where the biota of concern live, where threats to the biota may occur and the extent to which known threats will adversely affect the biota. Given this information, managers can develop cost-effective strategies to minimize further losses of biodiversity or to restore ecological systems, which are already degraded.

The great volumes and diversity of data required to manage biodiversity effectively necessitates the use of computer – assisted analytical tools such as GIS, so that appropriate management decisions can be made quickly and confidently.

Fabiyi (2002) stated that in recent years the development of GIS makes timely spatial information accessible, moreover, its capabilities of spatial analysis and presentation makes it useful tool for studying landscape and spatial structure, landscape changes analysis, land use and land cover analysis, land degradation, changes in natural resources and ecosystem e.g.

hydrological changes, vegetation socio – economic analysis of human activities within the environment etc.

Fabiyi (2002) captured the concept of GIS as a unique integration of computer hardware, software, peripherals procedural techniques and organizational structures, people and institution for capturing, manipulating, storing, analysing, modelling, modulating and displaying geographically referenced data for solving human related problem. Being that all objects, phenomenon, features and activities are geographic entities, the spatial relationship between geographic entities in relation to space can be captured, therefore all human activities and the natural environment where these activities take place can be captured as data, analysed and displayed with GIS for management decision.

Because geographic data can be assessed, transformed and manipulated interactively, they serve as test bed for studying environmental processes or for analysing the results of trend or anticipating the possible results of planning decisions (Burrough 1986) in principle, it is possible for planner and decision makers to explore a range of possible scenarios and to obtain an idea of the consequences of a course of actions.

It is important to state here that all the fish production geographic factors earlier mentioned have properties, it then means that GIS can be applied to them for investment and management decisions

Data on fish production functions can be categorized into spatial and attribute data as with all geographic data.

Spatial data are earth – related data about features on the earth surface. Depending on the mode of capture spatial data can further be divided into Raster and Vector data.

The raster data type records spatial information in a regular grid or matrix organized as a set of rows or column. Each cell within this grid or matrix contains a number representing a particular geographic feature such as soil types, elevation, hydrological changes, land use / land cover. topography etc. The satellite imagery obtained from remote sensing technology is a form of raster data. It is important to note that remote sensing provides 90 – 95% of GIS data.

Remote sensing refers to the group of techniques of collecting information about the earth object and its surrounding from a distance with the use of sensors without coming into physical contact with the object. The products are in form of images, which can be processed for further interpretation and application to solving earth related problems. Remote sensing and GIS are being integrated in analytical and application context.

Vector data records spatial information as X, Y coordinates or series of X, Y coordinate. Data can be captured as point line of polygon (area) in a two dimensional state.

Attribute data represents the characteristics or description of the geographic feature captured as numbers or characters typically stored in tabular format and linked to feature. E.g. the attribute of a river may include, name. length. width, depth, direction of flow etc. The attribute data is expected to give information on the geographic properties of the phenomenon being analysed

The spatial analysis capability of GIS makes it a unique technology GIS performs series of spatial analysis using the GIS software which include Arc view, Arc/INFO, ATLAS GIS, Map info. IDRISI etc.

Spatial analysis refers to series of iteration performed on spatial data to observe the relationship, scenario changes in even and area measurement.

The general GIS spatial analysis include:

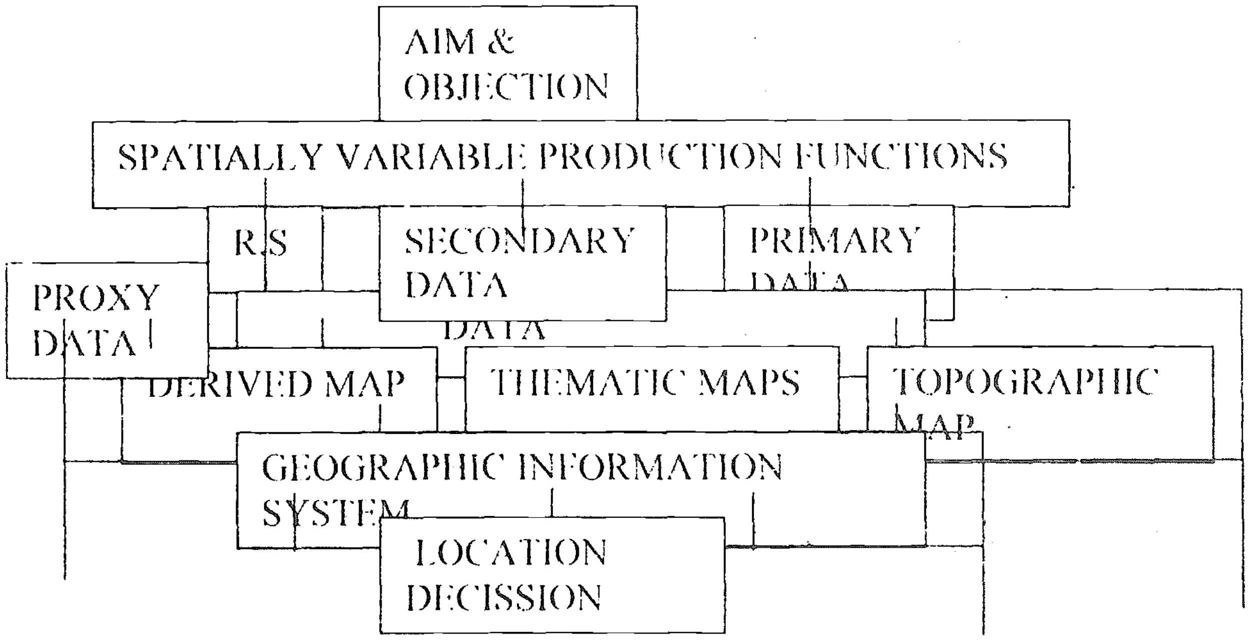
(a) Buffering
(b) Distance analysis
(c) Change detection analysis
(d) Area measurement
(e) Classification

(f) Networking
(g) Contiguity analysis
(h) Surface interpolation
(i) Digital elevation modelling (DEM)
(j) Spatial search. Etc.

The GIS software function in such a way that spatial data can be greatly manipulated.

Ultimately, GIS results are presented in maps, statistical table, charts and graphs and a vast amount of information can be accessed for effective decision in investment and management.

The schematic diagram below will assist in explaining the stages in spatial decision-making in GIS.



Source: FAO, 1999.

With the application of GIS to aquaculture and inland fisheries , relevant locational specific, precise, reliable and timely information can be obtained on
(a) soil suitability.
(b) water quantity and quality
(c) land use practices
(d) proximity to supporting infrastructure .
(e) pollution
(f) topography
(g) socio- economic variable s
(h)security
(i) impact of environmental change
(j) spatial inconsistencies in the demand /supply balance.
(k) the recognition of core areas were the diffusion of fisheries innovation may spread
(l) hydrological changes
(m) environmental impact assessment
(n) market analysis e.t.c .

The importance of GIS in fish food production can not be over-emphasized .F.A.O (1987, 1991 and 1997) have discussed these importance . Meanwhile, the application of GIS is at rudimentary stage in Nigeria . few publications are available on the subject of remote sensing and GIS in natural resources management (Adeniyi and Omojola , 1999, Abiodun 1999 , Olokor 2004 , Omojola 1997 , Adeniyi 1998 , Fabiyi 2002, Ayeni 2002).

The consensus among the practitioners of GIS is that it is a technology that will revolutionize the procedure of doing things in many disciplines because it greatly enhances the conventional way of conducting social and scientific research , and has the potentials to dissolve the rigid boundaries of many disciplinary .

As population increases , the challenge of achieving fish food security will also increase , as such there must be a quick response to solving the related problems , of famine , poverty, environmental degradation , inequality ,etc the application of GIS to aquaculture and inland fisheries can confidentially take us to the dream land of fish abundance.

RECOMMENDATION AND CONCLUSION

In witnessing a rapid growth in GIS application to inland fisheries and aquaculture , and thus increased fish production .the foregoing recommendation are considered necessary

(1) There should be capacity building so as to fill the existing vacuum created by dearth of GIS export .

(2) The government should make adequate provision for the mounting of GIS laboratories at designated fisheries institutions in the country .

(3) GIS should be introduced into the curriculum of fisheries sciences in institution of higher learning

Integrating GIS into inland fisheries and aquaculture will inevitably influence the nature , procedures and techniques of data capture , analysis and usage . This will no doubt enhance the process of making decision that will ultimately boost fish production in Nigeria .

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