"CARTOGRAPHIC INFORMATION SYSTEMS AND EMPLOYMENT GENERATION IN RURAL AFRICA"

By

R. CHUKUDEBE BOB DURU Ph.D
Department of Geography
University of Nigeria, Nsukka

ABSTRACT

Even though there is increasing unemployment in Africa, there are various avenues for trained modern cartographers to become self employed. The prospective self employed graduate avails of periodic access to the urban based computerised work station operating a standard WILDMAP or similar equipment where he analyses the problem and data peculiar to his rural environment and task. The client could be the Federal, State or Local Government, private contracting, engineering, real estate, mineral prospecting organisations, institutions and private companies. A selected set of areas easily exposed and simplified for clients are presented. The need for international cooperation in this area of employment generation is stressed because of its novelty and technicality. The creation of International as well as National Institutes for Spatial Information Technology is also suggested.

---o---

Rising unemployment, age-selective rural exodus and explosive rates of urban population growth, which have beset African countries during the last decades, have also been accompanied by widespread famines (Onibode 1986). In Nigeria, the drop in mineral oil prices to ₦9 a barrel signalling an unanticipated disintegration of the protective shield of OPEC membership, has created a state of economic consternation characterised by uncontrollable inflation and high rates of unemployment among both the highly skilled and the uneducated (Ekugun 1986, Abiola, 1986, Muhammed 1986).

Dramatizing disappearance of jobs are government rationalisation of salaried positions, personnel retirement, cutback of import quotas for private industries needing imported raw materials thus creating underemployment, closure or merger of universities and university departments in Nigeria as well as widespread retrenchments and layoffs (Ekugun 1986). Crude activity rate (percentage of total African population in the labour force) has dropped from 42.8% in 1950 to around 37.5 per cent even though labour productivity (Agriculture) has remained at a low constant rate of 17 percent (UN, 1979). In Nigeria the average number of persons employed in manufacturing industries had dropped from 309,070 in 1978 to 293,290 in 1980 even before many factories then closed down due to lack of imported raw materials and spare parts (UN 1982 p 447). Crude oil prices which stood at $34 in 1981 have pulmetted to an unprecedented low value of $9 a barrel. During the period, significant increases in foreign exchange reserves were recorded among oil producing countries with the exception of Nigeria (TABLE 1, IMF 1982):

TABLE 1

CHANGES IN FOREIGN EXCHANGE RESERVES (BILLIONS)

Country	Change In Billion SDR	Comment
Saudi Arabia	3.0	Increase
United Arab Emirate	0.3	"
Indonesia	0.6	"
Kuwait	0.2	"
Nigeria	-1.1	Decrease

(1981 Figures)

The net increase in foreign exchange reserves for Africa as a whole during 1981 was 0.3 billion SDR which shows that Nigeria fell below the mean for the continent in spite of substantial oil exports (IMF 1982).

Age selective rural-urban migration is closely linked with the urban population explosion which persists in spite of urban unemployment (Table 2):

TABLE 2

AFRICA: Urban Population Change

Year	1950	1960	1970	1975	1980	1985
% Urban	14.8	18.4	22.9	25.6	28.7	32.1 %
Total Urban	33	51	82	n.a.	137	n.a millions

SOURCE: UN Department of International Economics & Social Affairs, Population Studies No 85, p 59

In spite of the increasing urbanisation, employment in the urban industrial and service sectors in Africa has been decreasing in several countries since 1960 (Frank 1967). This was spotted by Frank (1967) claiming that in spite of increasing urbanisation, employment in the urban industrial and service sectors in Africa has been decreasing since 1960. Barbison (1970), Callaway (1968), Lewis (1967) and Kilby (1969) have subsequently recognized the growing rural to urban migration in spite of urban unemployment caused in part by recent salary reviews. Harris and Todaro rightly conclude that attempts to increase urban employment without a concentrated effort to make rural life more attractive will only increase rural to urban migration by the increased probability of securing urban employment. (Harris and Todaro 1968, 1970, Duru 1974).

In Nigeria, unfortunately, this thesis has been understood too literally, particularly by economists and planners applying non-African classical labour surplus models which have but tangential bearings on the Nigerian situation (Williamson 1985, ILO 1984, ElGhomery 1984, Uphoff and Wignaraja 1984).

Universitites are the foremost producers of highly skilled labour (M'Bow 1979). This essay therefore makes an apriori assumption that university based departments will seek to establish a sufficiently precise relationship between course content and chances of post-graduation employment. Such parameters as technical content (T) studio and practical exercises (S), field task exposure (F), in-service or industrial attachment (I), relevance to income generation or financial risk minimisation (G), relevance to conservation and infrastructure protection (P), concentration on health (H) and concentration on law, order and social justice (J) may be considered as aids in assessing the potential employment generation function (Py) of any subject area. With these, a mathematical model can be formulated of the form

$$f(Py) \; \varphi(T,S,F,I,G,P,H,J) \; \ldots\ldots \; (1)$$

In the case of Cartography, there immediately arises the problem of definition. The International Cartographic Association Commission II deviated from its Education Commission's earlier, cautious and restrictive view of the discipline. (ICA 1968, ICA 1972). From a position of not wanting "to compete or interfere with the other established mapping sciences" it now proceeds to define cartography as "The art, science and technology of making maps together with their study as scientific documents and works of art (Keynen 1973). ICA Commission II further defined "maps" as including "all types of maps, plans, charts and sections, three dimensional models and globes representing the earth or any celestial body at any scale (Robinson 1978 p 5). This point of view, re-echoed by Piket who stresses "a new inventory of all aspects and components of our Earth" is described by Keates as "the concept of the general public" already adopted by the United Nations conferences and publications (Piket 1975, Keates 1985). These views clearly transcend Raisz's 1948 view that "The surveyor measures the land, the cartographer collects the measurements and renders them on a map and the geographer interpretes the facts thus displayed. (Raisz p. xi). Such neat and precise division, if it ever existed, has now been overridden by an avalanche of innovations in the fields of auto photo mapping, remote sensing and computer-assisted airbourne and space-bourne spatial data capture and handling systems.

In Nigeria, none of the 28 universities offers cartography as a seperate degree programme (Duru 1985). Nonetheless contents of cartography courses offered reflect the current ICA conception of the field of study as "the art and science of map making .... the totality of scientific, technical and artistic activities aiming at the production of maps and related presentations on the basis of data (field measurements, and aerial photographs, satellite imagery, statistical material, etc) collected by other disciplines" (ICA 1980 p. 4). To be fully relevant to the task of national development, the modern cartographer must be freed from the image of "someone who draws", Keates (1985, p 27). Cartography must also cease to be conceptualised as "the hand maiden of geography", surveying, or any other field since they all have their own central concerns which now differ from that of modern cartography (Thrower and Jensen 1976 p 34). The act of drafting a map is no more cartography than typing is authorship (Robinson, 1960, p.3). Modern cartography is the art, science and technology of spatial information capture, storage, and transfer using a wide variety of equipment, media, processes and

tools and following a standardized worldwide graphic or conventional symbolism. Taylor's awareness of this leads him to suggest "a new cartography".... "an emerging discipline" (Taylor 1985, p 3). Kadmon terms it "4m cartography" (Kadmon 1984, p 291). Automated or computer-assisted cartography refers to that aspect of modern cartography that embraces recent developments in computer technolocy and telecomunnications technology, especially in data acquisition, spatial data base and information system creation with or without inferface manipulations. So defined it can then be hypothesized that cartography's employment generation potential in rural Africa is significant.

The ILO's stated primary objective of "achievement of full employment (in member countries) by the year 2000" has run into such serious set-backs that the organisation may need to invest in accelerated research efforts in that direction to meet its deadline (ILO 1984). Other external bodies as well as donor nations and humanitarian organisations need to re-examine their assumptions about the major constraints on real development and employment generation in African countries. This may lead to policy modifications that will favour international collaboration in high technology projects and applied research especially in computer-assisted cartography.

In Nigeria such application of modern artographic information technology calls for integrated functioning of one or more data receiving and read out ground stations. The target groups are rural based teams of agents, self-employed field operators, namely graduates, whose university training in cartography has been enhanced to include modern cartographic skills such as

(i) Real time data acquisition and analysis,
(ii) Basic remote sensing,
(iii) Digital image processing and interactive editing,
(iv) Fortram, Basic and Assembly language programming
(v) Image quality evaluation, image reconstruction, restoration and enhancement,
(vi) Statistical analysis of spatial data,
(vii) Mathematical modelling of physical elements including isometric block diagram creation
(viii) Photo-interpretation and photogrammetry,
(ix) Electro-optical instrumentation, and
(x) Field survey princíples and instrumentation.

The objective is to adapt Spatial Information Technology "the eyes and ears of peace" through an appropriate organisational framework to generate self emploument for unemployed intermediate and high level manpower. Envisaged also are jobs in compugraphics instruction contracts.

The ground stations in each country should be capable of processing pre-recorded information and where possible be equipped with the facility to receive remote sensed data from some of the 150 (or more satellites in orbit (FAO 1981). The equipment could, for example receive imagery directly from environmental satellites especially the Nimbus series and also the U.S Heat Capacity Mapping Mission (HCMM) systems designed primarily for applications in rock, soil and vegetation studies among others (Barret 1981). Other environmental satellite systems which can serve as data sources include, Essa, Tiros-N, Cosmos, Nimbus, Noaa and Meteor series. For these and in the case

of all other satellite systems, access to tracks, coverage and dates of transit is a necessary pre-requisite.

Earth Resource satellite imagery should also be picked up by equipment at the data readout ground stations. HCMM which was launched in 1978 with a 16 day lag in coverage, a resolution of 500m in the visible spectrum (0.5 - 1.1μ) and thermal infra-red can indeed be considered also as an Earth Resource satellite. Similarly, Landsat-C (1978) and Landsat-D (1981) with a higher resolution of 30m in 7 multi-spectral sanning (MSS) bands as well as the later 1984 French SPOT polar orbiting satellite with a 20 meter resolution in 3 bands (0.5 - 0.6, 0.6 - 0.7, and 0.8 - 0.9μ) and transmitting both vertical and oblique imagery in a periodic cycle of 26 days should also be considered. Access to these either directly or through pre-recorded recent tapes and also the imagery processing and analysis equipment make ground stations quite expensive although costs can be cut by use of micro computers such as APPLE II. There must therefore be a committment on the part of national governments and large private prospecting and construction companies to use the station. An appropriate organisational framework should be devised to ensure that the field operators are not side-tracked by consulting or construction companies who should obtain comprehensive or selective data for the local regions through the field operating agents of the Ground Stations.

Costs may be minimised through the use of mini-computers such as the POPII/70 Digital Equipment with one megabyte of MOS memory. This is most efficiently integrated in the new WILDMAP interactive remote sensed data base and mapping system. The system builds up a data base for the digital production of maps and plans at medium and large scales. It effects a computer-assisted simultaneous restitution and digitizing using stereo-plotters and stores up geographic data and descrptive texts in the data base for a comprehensive land information system. It is thus able to build up cadastrial archives of properties, and public utilities of various types. It facilitates the management of such and other data needed for various land reforms, drainage and irrigation works among other uses. Its interactive capacity makes revision, updating and unification of spatial data from various sources easy. The aesthetic and fiducial quality of its automatic draughting of plans at any scale and its flexibility in acceptance of additional software qualify it for the title of "the best stereo photogrammetric interface and supporting software available at the time (Boase and McRitchie 1983). This system can support the interactive graphics work stations, two stereo-plotter work stations with automatic plotting tables, a flat-bed plotter, eight general purpose terminals and one Textronix 4010-1 graphics terminal. It can also support at least six CRT's. Its software consists of those of the famous INFORMAP system namely the MAP/IN, INFORM and C060/1 in addition to the CAP/IN a photogrametric input addition and theCIP which is basically contour interpolation programme. With these systems the employment generating agency can make available to its agents plans of public utilities, multipurpose cadastral plan, rating maps- land information systems; planning data for plant pipelines, conduits, and ducts; technical and scientific earth-space-related computations, commercial and transportation calculations as well as a wide range of statistical assessments and evaluations. It has been suggested that in view of the key role played by cost, a start should be made with a "system relying entirely on visual interpretation (Barret, 1981, p 9).

On the contrary, by using such newer modern digital equipment, colour controlled multi-spectral imagery analysis as well as geometrically rectified hard copy prints improved by contrast stretching and high contrast filtering can be achieved quite economically.

Information needed for regional development and resource exploration at relatively low costs must be accurate, comprehensive and timely. Such information needed in Nigeria includes major classes of land use major land capability classes, physical properties and characteristics of geological formations particularly for engineering sites such as major bridges, flyovers, cloverleafs and cause-ways; abutments, spillways, and outlet works, reservoir area delimitation and micro-contouring; road relocation and re-alignment designs, transmission line and major pipeline tract design and mapping.

Exact technical cartographic rendering will prove a big asset. Information is also often demanded by Ministries of Mines, Power and Transport on orientation, pattern and condition of faults, fractures, joints, bedding planes cleavages and schistocity, especially in foundation areas and tunnels and steeply inclined routeways and cause-ways. Distribution and areas of surface water, construction materials and rock outcrops are also required by various arms of government.

Also to be easily documented in Africa are stability of reservoir rocks siltation/sedimentation, valley side erosion, gullying and stream overloading, inundation, delineation and extent of areas likely to flood or actually flooded areas, flood monitoring, flood hazard assessment and flooding impact of new constructions. Others include vegetal cover, fire threats to plantations and forest reserves, squatter encroachment in forest and nature reserves, determination of new sites for forest and game reserves, conservation mapping, cropping patterns, water flow , water depth, location of new dam sites, wind speed, wind direction and estimation of precipitation. These and other related aspects of spatial information have been called for in recent times.

Examples include the 1978 Nigerian Government consultancy contract award (No, NIR/75/058) later updated with another related contract award (No. NIR/77/008). In spite of the pitiable spatial information situation at the time, the contracts sought exceedingly wide and ambitious targets. One target was "national policy on Watershed Management and Erosion Control including the institutional and legal framework necessary", while the other added "the Development of Forest Management Capability" (Onyagocha 1980). Terms of reference were:

1. "Assess the country's problem of erosion and watershed degradation and consequent problems of droughts and floods, silting and damage , or hazards to human settlements and the physical infrastructure;

2 Assess the country's present capability to solve problems of erosion and offer training in erosion control and watershed management.

3 Assess the country's need to rehabilitate land affected by strip mining and other development projects

4 Make recommendations concerning the role of the Federal Department of Forestry and the State Forest Services in erosion control and watershed management,

5 Prepare a proposal for an institution-building project in erosion control and watershed management at the Federal level. The programme of work .... should emphasize .... a multi-disciplinary approach.

6 Prepare a report summarizing the information collected under 1 - 4 above".

These prove existence of potential jobs.

International Partnerships In Spatial Information Technology

The disgust expressed early in March 1986 by the Nigerian Minister for Works and Housing that the Ministry's directors operate from offices in the capital city is perhaps misplaced since no field data collection centres are as yet in existence (NTA 1986). The minister should instead be oriented to receiving and paying for accurate field information from spatial information specialists (graduates) renting the computerised services of a Central Ground Station and awarding major contracts to such a station. This calls for a prior existence of a number of well equipped environmental and spatial information companies employing a few experts and operating as joint ventures between foreign partners and local experts. These will create jobs for many trained cartographers. To give to the trained cartographer wishing to be self-employed, the professional protection and prestige currently enjoyed by surveyors, architects, engineers and urban planners there is a need for creation of an International Institute of Spatial Information Technology which admits experts to its fellowship (FISIT). This will enhance the prospects of emergence of (NISIT's) National Institutes of Spatial Information Technology for cartographers in various countries including Nigeria.

CONCLUSION

The study has shown that even though there is increasing unemployment in Africa, there are various avenues for trained modern cartographers to become self employed. The prospective self employed graduate avails of periodic access to the urban based computerised work station operating a standard WILDMAP or similar equipment where he analyses the problem and data peculiar to his rural environment and task. The client could be the Federal, State or Local Government, private contracting, engineering, real estate, mineral prospecting organisations, instutitions and private companies. A selected set of areas easily exposed and simplified for clients are presented. The need for international cooperation in this area of employment generation is stressed because of its novelty and technicality. The creation of International as well as National institutes for Spatial Information Technology is also suggested. Graduate unemployment and potential presence of jobs, indeed justify a call on Electro-Optical Manufacturing companies encouraged by approriate UN agencies to invest in Spatial Information Technology and Management in partnerships with local experts.

REFERENCES

Barret, E. C. (1981) "Satellite Remote Sensing Systems for Water Resources Monitoring" in Travaglia C, Editor Report of the Fifth International Training Course in Remote Sensing Applications For Water Resources and Hydrology FAO, Rome pp 33 - 41

Boase, P.J. andMacRitchie, S.C (1983) From Pencils Through Pulses to Maps, Research Monograph McEllaney Surveying and Engineering Company Vancouver p.8

Callaway, A (1968) "Creating Employment for Nigeria's School Leavers" Administration - Quarterly Review Of The Institute of Administration University of Ife, October

Duru, R. C. Bob (1975) "An Approach to the study of Unbalanced Growth in African Cities" The Nigerian Journal Of Economic and Social Studies, Vol 17 March pp 65 - 84.

Duru, R. C. Bob (1985) "Status and Constraints of Automated Cartography Training in Africa: The Nigerian Example" in D. R. Fraser Taylor Education and Training in in Contemporary Cartography John Wiley & Sons New York pp 243 - 258.

ElGhomeny, M.R. (1984) "The Crisis of rural poverty: Can participation resolve it?" FAO Studies on Agrarian Reform and Rural Poverty pp. 1 - 18

Ekugun Mike (1986) "Sacked Pilots Await Benefits" Nigerian Sunday Times, January 12, p.1

Frank, C.R. (1967) "Industrialization and employment generation in Nigeria". The Nigerian Journal of Economic and Social Studies Vol xiix November pp 277 - 97

International Cartographic Association (1968), Catalogue of Institutions Providing Instruction in Cartography, Commission I

International Cartographic Association (1980) Proceedings of the 10th International Conference, Tokyo, p.5

International Monetary Fund (IMF) (1982), IMF Survey Vol. II Department of External Relation.

International Labour Organisation (1984) Social Development Newsletter No 20 January - June, P. 11

International Labour Organisation (1982) Social Development Newsletter NO. 16, January - June p 14.

Kadmon, N. (1984) "Automation, communication and education in cartography - preliminary results of an ICA survey" Technical Papers of the Austrà Carto One Seminar, Perth, Australia, pp 291-300

Keates, J.S. (1985) "Cartographic Education in the Mapping Science Field" in Taylor DRF (ed) Education and Training in Contemporary Cartography, New York, John Wiley & Sons p.27

Kilby, P (1969) "Industrial Relations and Wage Determination: Failure of the Anglo-Saxon Model" Journal of Developing Areas July, pp 495 - 519.

Lewis, W.A. (1967) Reflections on Nigeria's Economic Growth Paris OECD

M'Bow, M (1979) Technology for Africa UNESCO Bulletin Vol 14 p.2

Muhammed M (Ed) (1986) "Executive Thievery" Daily Times of Nigeria January 14, p3.

Nigeria Television Authority (NTA) (1986) News Feature March 3.

Onyeagocha S.C. (1980) "The Role of Forestry in Erosion Control and Watershed Management in Nigeria" UNDP/FAO Project Working Document No. 4 p. 2

Onibode, D (1986) "Press attacked over budget" Daily Times of Nigeria, January 14, p 2.

Raisz E (1948) General Cartography McGraw Hill, London

Taylor, D.R.F (1985) Educational Challenges of a New Cartography in Taylor D.R.F. (Editor) Education and Training in Contemporary Cartography, New York, John Wiley pp 3 - 25.

Todaro, M.P. (1970) "Labour Migration and Urban Unemployment: reply" The American Economic Review Vol LX March pp 187-88.

Todaro M.P. (1968) "An Analysis of industrialization employment and unemployment in less developed countries" Yale Economic Essays, Vol VIII.

Uphoff, N and Wignaraja P, (1984) "Rural development strategy: the central mode of local organization and changing "supply side bureaucracy" FAO Studies on Agrarian Reform and Rural Poverty pp 59 - 84.

United Nations (1979) World Population Trends and Policies 1977 Monitoring Report, New York p 132 - 167

United Nations (1982) Industrial Statistics Year Book, New York p. 447

Williamson J.G. (1985) "The Historical content of the Classical Labor surplus Model" Population and Development Review Vol II (2) June, p. 171 - 192.