

CARTOGRAPHY AND REMOTE SENSING EDUCATION IN AFRICA

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ABSTRACT :

The status of cartography and remote sensing education in Africa is discussed with emphasis on statistics related to existing training facilities at professional, technological, technician and sub-technician level. The problems facing manpower development in cartography and remote sensing are also discussed and some suggested solutions are prescribed. The paper concludes by emphasizing the importance of cartography and remote sensing as the bedrock for development and the need to develop a visionary educational programme for which Africa needs technical assistance from advanced countries.

SOMMAIRE :

Le document examine la situation de l'enseignement de la cartographie et de la télédétection en Afrique, en mettant l'accent sur les statistiques relatives aux facilités de formation existant aux niveau professionnel, technologue, technicien et opérateur. Les problèmes en matière de formation de main-d'oeuvre spécialisée en cartographie et télédétection sont également examinés, et certaines solutions sont proposées. La conclusion du rapport souligne l'importance de la cartographie et de la télédétection en tant que fondements du développement, et la nécessité d'élaborer un programme éducationnel avise et tourne vers l'avenir, pour la réalisation duquel l'Afrique a besoin du concours des pays développés.

1. INTRODUCTION

Cartography and remote sensing as defined by the United Nations covers the four major branches of the surveying and mapping sciences viz surveying, photogrammetry, classical or conventional cartography and remote sensing. This paper considers the status of education in these four branches and the problems militating against manpower development in cartography and remote sensing in Africa. Some prescribed solutions to these problems are also offered.

2. STATUS OF CARTOGRAPHY AND REMOTE SENSING EDUCATION IN AFRICA

2.1 Surveying :

At the beginning of the colonial era, surveying became very important as a result of the need for intensive mapping of the "Dark Continent" (Africa) so as to guarantee rapid physical development and expansion of new colonies. Since most manpower needs were met through foreign surveyors existing training facilities were only recently established compared to facilities in Europe and North America Fajemirokun (1982). Table I shows that surveying education is available at four levels in some African countries. The levels are identified as professional (University), technologist, technician and sub-technician (in-service training) levels. Only about 19 African countries offer surveying as part of University degree courses in other disciplines such as engineering and 10 countries out of these offer surveying as full University degree courses. Only 14 African countries

have surveying courses at the technologist level while 24 countries offer surveying courses at the technician level. Information about in-service training is scanty and the data in Table I concerning in-house training indicate that 16 countries have this level of training. Research facilities are available in only a few Universities as manifested in publications in Universities in Nigeria, South Africa, Egypt and Kenya. The research efforts in most cases are linked with thesis produced for higher degrees in these Universities (see Ayeni (1984), Adekoya (1985) and Fajemirokun (1982)).

2.2 Photogrammetry :

Photogrammetry education is traditionally an integral part of surveying education in Africa particularly at the professional level. This accounts for the fact that photogrammetry courses are offered as part of surveying degree courses in about 13 African countries (see Table I). There are higher degree courses such as M.Sc. or Ph.D. (Photogrammetry) in only 3 countries viz Kenya, Nigeria and South Africa. There are only two African countries where technologist courses in Photogrammetry are offered whilst technician courses are available in only three African countries. ~~In-service training in photogrammetry can be found in about 13 African countries.~~ More detailed information about photogrammetry courses offered by various African institutions can be found in Ayeni (1982) and (1984a).

The status of research in photogrammetry in Africa is the same as in the case of surveying. Research efforts in Universities in Nigeria, South Africa, Egypt and Kenya are associated with higher degrees.

2.3 Conventional Cartography :

By conventional cartography we mean the art and science of making maps. It is clear from Table I that few cartographic training facilities exist at all levels in Africa. Only 9 countries have Universities offering cartography as part of their degree courses. Technologist course in cartography is available in only one country while the technician for draughtsmen is the most popular cartographic training facility in Africa. Detailed information about cartographic courses offered in African institutions can be found in Ayeni (1984b).

Research in conventional cartography is almost nil in Africa. There is acute shortage of high level manpower and research equipment all over Africa.

2.4 Remote Sensing :

Remote sensing training is relatively new in Africa. Training facilities in this area are therefore very few. Although there are about 11 countries where Universities offer remote sensing courses as part of their degree programmes, these courses are usually very short and relatively few in number. Training does not exist at technologist level although the Regional Centre for Training in Aerospace Surveys (RECTAS) is planning a technologist programme in remote sensing which is scheduled to commence in 1990/91 session. The technician course is available in 2 African countries while 5 countries host institutions where short-term courses and in-service training courses in remote sensing applications are offered. These institutions are the Regional Centre for Training in Aerospace Surveys (RECTAS), Ile-Ife (Nigeria), the Remote Sensing Centre (CRTO) Ouagadougou (Burkina), the Regional Centre for Services in Surveying, Mapping and Remote Sensing (RCSSMRS) Nairobi (Kenya), the Remote Sensing Centre, Kinshasa (Zaire) and the Remote Sensing Centre, Cairo (Egypt). The remote sensing activities of these centres are reported in Olujohungbe (1986). Detailed information about remote sensing courses offered by some institutions in Africa can be found in Ayeni (1984a) and Adeniyi (1985).

Research efforts in remote sensing are few in Africa. Some modest research efforts are reported in Burkina, Kenya, Nigeria and South Africa and these are not linked with higher degrees as in the case of surveying and photogrammetry.

2.5 Comparative status of cartography and remote sensing :

Although training facilities are generally insufficient and inadequate in Cartography and remote sensing to meet mapping requirements in Africa, there are better training and research facilities in surveying than in the other three disciplines - photogrammetry, conventional cartography and remote sensing. For example whereas 10 countries offer full University degree programme in surveying, there are only 3 countries for photogrammetry and none in conventional cartography and remote sensing. Educational facilities at technologist and technician levels are grossly inadequate in cartography and remote sensing generally. Many African countries therefore have looked up to advanced countries such as The Netherlands, USSR, Britain, France, Germany, U.S.A. and Canada to mention a few for research and training in cartography and remote sensing.

The status of cartography and remote sensing education in Africa varies from country to country. For example, in Nigeria there are four Universities offering full degree courses in surveying, 10 Polytechnics offering surveying at technician level while two Universities award M.Sc. degree in photogrammetry and two institutions offer technologist programme in photogrammetry. Besides, about 10 Universities in Nigeria offer conventional cartography and remote sensing courses as part of their degree programme. By contrast, in some African countries only one University offers degree programme in surveying while other training facilities for surveying and cartography exist only at technician and sub-technician levels. The disparity existing amongst African countries with respect to their status of cartography and remote sensing education may be explained by their varying manpower needs, (see Bos (1982)), economic constraints and technological development. Some of the problems militating against cartography and remote sensing education and research in Africa will now be discussed.

3 PROBLEMS MILITATING AGAINST MANPOWER DEVELOPMENT IN AFRICA

3.1 Lack of recognition of the importance of cartography and remote sensing to development :

This is perhaps one of the greatest problems facing the profession of surveying and mapping today. It is true but sad to realize that many of our policy and decision-makers in Africa do not recognize the importance of cartography and remote sensing to development and therefore fail to rate them among their national priorities as stipulated in the Lagos Plan of Action (LPA) which was approved in 1980 by Heads of States and Governments in Africa and which is widely recognized in the international community as the blue print for Africa's development. Training research and manpower development aspects of cartography and remote sensing have therefore suffered over the years. Almost every other problem mentioned below derive from this fact.

3.2 Inadequate funding :

The second problem is a corollary of the first one. It is a common phenomena to find that cartographic institutions in Africa are plagued by inadequate fundings to carry out their noble objectives. This usually gives rise to inadequate physical facilities and therefore restricted admission policies. The window of opportunity is not therefore always open to those who may wish to pursue their careers in photogrammetry, remote sensing, map making and surveying.

More often than not such facilities for measurement or computing are non-existent or in short supply and practical or laboratory component of the training programme is not given adequate attention. Take the case of remote sensing as an example where due to constraints imposed by limited foreign exchange and capital the purchase of landsat and other satellite imageries by many countries is not often feasible. This limitation is complicated by the absence of a ground receiving and processing station in black Africa (Adeniyi 1985). Training and research efforts in remote sensing have therefore suffered a serious setback in Africa.

3.3 Suspicious attitude towards remote sensing and element of conservatism towards new techniques :

Remote sensing is still regarded in some developing countries as a surveillance or 'spy in the sky' tool by developed countries for gathering intelligence information about natural resources and military capabilities of poor countries. Some even frown at organizing remote sensing seminars in their countries. There are also some professionals in cartography who are so conservative that they receive new techniques and innovations with mixed feelings. This situation has not advanced the course of manpower and research development in Africa.

3.4 Dearth of qualified personnel for training and research :

Manpower complement in cartography and remote sensing or in any profession for the matter is composed of practitioners, teachers and researchers. The three components should co-exist in some kind of ideal ratio which should vary from country to country as well as with time. This depicts a horizontal structure, while the vertical structure of a profession is constituted by professionals, technologists, technicians and sub-technicians. These two should co-exist in some kind of ideal ratio. Studies conducted by Bos (1983) and this author show that the status of manpower development in Africa portrays a clear picture of inadequacy at both horizontal and vertical perspectives. Almost every notable institution offering surveying and mapping in Africa lacks adequate qualified teachers and researchers. The statistics compiled by these researchers bear eloquent testimony to this fact (see Bos 1983), and Ayeni (1984b), and Brandenberger (1983).

3.5 Lack of enough qualified candidates for manpower development, training and research programmes :

This problem is caused by three factors. The first is the requirement of high grades in maths and physics for admission for courses in cartography. The second is due to competition between cartography and other engineering courses with similar requirements for admission. The third which is of relative little importance is the confusion which potential candidates of surveying often face in distinguishing between land surveying and quantity surveying or estate surveying.

4 SUGGESTED SOLUTIONS

4.1 Proper recognition of surveying and mapping :

The first suggested solution is to get the powers-that-be to recognize the importance of national surveying and mapping institutions and in the words of Lagos Plan of Action (LPA) "to rate them high among their national priorities and to provide sufficient budget for them and also take steps to establish them where non-exist". O.A.U (1980) This can be achieved by national survey departments in collaboration with surveying professional associations and the training institutions formulating and executing a systematic and effective programme of public awareness on the role of surveying and mapping in practically every sphere of the economic and social life of the nation. This is an area where we have failed in the past. The opportunity of post celebration of 1986/87 as the "Year of Cartography" must not be allowed

to pass without mounting at national and local levels a programme of map education for the general public through the mass media particularly the print media, the radio and the television. The public must not be kept in the "dark" any more about the worth of surveying and mapping. An effective awareness programme should eliminate the fear of "spy in the sky" towards remote sensing and conservatism must be a thing of the past. We should borrow a leaf from United States of America where the President through an act of congress declared one week in 1983 as "The week of surveying and mapping" to be observed throughout the country and marked by activities at national, state and local levels.

A programme of public awareness of maps and their importance could start even at the primary and secondary levels, by displaying in the school premises a map, or enlarged aerial photographs or mosaic or annotated and enhanced satellite imagery of familiar areas and features with which students can identify. In this way surveying and mapping may be able to "catch them young" so that before students reach the tertiary level they have made up their minds to study cartography and remote sensing because they have been brought up in a map conscious society. One of the best and well known surveyor Africa has ever produced is a product of awareness of surveying in his early days ~~although this was not through a formal awareness programme.~~

4.2 Adequate budgeting for cartography and remote sensing :

Professionals in cartography and remote sensing must accept the challenge in this Year of Cartography in Africa to convince policy makers of the importance of allocating adequate resources and funds to surveying and mapping in general and to the training and research aspects in particular. It should not be assumed that once we have done our homework in the area of public awareness every other thing will follow automatically. The message should be driven home at the budgeting table by using all available resources such as the adopted resolutions at important forums like ECA Conference of Ministers, UN Cartographic Conference or by making relevant references to important documents such as Lagos Plan of Action (LPA) and the Final Act of Lagos (FAL), O.A.U (1980), African Priority Programme for Economic Recovery and Development (UN-PAAERD), UNO (1986) adopted by the UN General Assembly at its special session in 1986. Certain important national episode such as war, natural disasters like earthquakes, drought, flooding etc ... must be capitalized to get adequate budgeting for surveying and mapping. The Ministers in charge of cartography and remote sensing could be invited to participate in seminars or exhibition on the role of mapping before drafting the budget during an annual celebration of cartography and remote sensing.

4.3 Proper survey of status of cartography and remote sensing in all its ramifications :

The survey of status of cartography and remote sensing in Africa in all its ramifications at regional, sub-regional and national levels is a very vital exercise. The cartography and remote sensing community at these various levels does not have reliable data which can be used for effective planning purposes. The survey should therefore be done at these levels. It is most essential that there should be division of labour in conducting this survey. The national survey should be done by a national surveying and mapping agency or institution while the sub-regional and regional survey should be conducted by a sub-regional and regional surveying and mapping establishment. There should be a mutual exchange of data resulting from these surveys before and after the analyses stage.

The result of such surveys should give valuable information regarding the following :

- (i) the state of the art in cartography and remote sensing;
- (ii) the status of map coverage or photo and satellite imagery coverage;
- (iii) geodetic and gravimetric networks (including satellite campaign programmes);
- (iv) inventory of training facilities and programmes;
- (v) research needs in all branches of cartography and remote sensing;
- (vi) status of manpower structure and needs as it is related to professionals, technologists, technicians and sub-technicians, researchers, teachers and professionals. Apart from conducting relevant surveys at sub-regional and regional levels the results of national surveys should also be integrated at sub-regional and regional levels;
- (vii) statistics regarding budget allocations for mapping.

4.4 Evolving the correct educational system :

The result of such a comprehensive survey should assist in evolving a correct visionary type of educational system at the regional, sub-regional and national levels. The result of such a survey should also give an indication of the correct orientation of the educational system at secondary and tertiary levels. If there is dearth of professionals and teachers, the educational system (visionary) should correct such horizontal or vertical structural defects. Attempt should be made to house all disciplines of cartography and remote sensing in the same school or faculty in tertiary institutions. For example, faculty of cartography and remote sensing should be created in African Universities to cater for disciplines such as geodesy/geophysics, land surveying, photogrammetry, remote sensing, hydrographic surveying and conventional cartography, instead of housing these disciplines as departments of two or more faculties. This measure will take care of high level manpower which is in great need in Africa. Remedial courses should also be organised for students who are marginally qualified for cartography and remote sensing.

There should be an African-wide publication which will be responsible for the dissemination of research findings. Publication of text-books by University Lecturers should be encouraged. Libraries in the various institutions should be well equipped with modern text-books and current journals in cartography and remote sensing. Libraries constitute the back-bone for training and research.

4.5 Creation of a separate national agency for surveying and mapping :

In some African countries, cartography and remote sensing are housed in various government departments and ministries with resultant duplications in training and manpower development programmes. It is most desirable therefore to create a national cartography and remote sensing agency which inter alia will formulate policies and programmes regarding manpower development in cartography and remote sensing. Such an Agency will also determine the type of technical assistance needed from developed countries for the purpose of training e.g. intra-African, bilateral and multilateral cooperations. The Agency can also determine mapping requirements for the country, provide services and also coordinate cartography and remote sensing activities in other government departments.

4.6 The role of the Regional Centres :

Both the Lagos Plan of Action (LPA) and the African Priority Programme for Economic Recovery (APPER) envisage the strengthening of existing African multinational institutions dealing with natural resources apart from being the factory for producing necessary manpower in highly specialized disciplines to meet national needs and requirements at the professional, technologist and technician levels. They should also be very active in research efforts which are relevant to the national needs of its member States. The Regional Centres should also be a vehicle for the transfer of technology from developed countries to participating member States as well as a means of transmitting assistance from donor countries and agencies to member States.

They should also provide short-term solutions to the problems of shortage of manpower facing member States by means of a consultancy and advisory services as well as long-term solutions through prolonged training. The last and ultimate role of the Regional Centres is that they should replicate themselves where necessary at national levels and some of their present functions should gradually be taken over by corresponding government departments in member States in which case the Regional Centres will assume new roles.

In order that a Regional Centre should be able to fulfill these objectives it must conduct its own comprehensive and intensive surveys of the status of manpower structure and needs in their regional or sub-regional spheres of influence. It must also constantly assess the quality of its product in the market by periodic surveys.

The Regional Centres therefore constitute a vital part of the solution to the problems militating against manpower development in Africa. This is why the participating of member States of Economic Commission for Africa in these Centres is very vital so that national training and manpower development programmes can be harmonized with those at the Regional Centres.

5 CONCLUSION

Although Africa is generously endowed with natural resources, she is today experiencing an economic crisis. Africans may be described as a people suffering in the midst of plenty because they lack the necessary manpower to exploit their natural resources of which the good Lord has so graciously endowed them. It is through the vehicle of training and manpower development that Africa can acquire the necessary capabilities for exploring and exploiting her natural resources. This is very true of aspects of manpower development in cartography and remote sensing which are regarded as a sine qua non for resource development. The importance of natural resource development was emphasized in the the Lagos Plan of Action (LPA) and the Final Act of Lagos (FAL) which states "The major problems confronting Africa in the field of natural resource development include : lack of information on natural resource endowment of large and unexplored areas and lack of adequate capacity (capital, skills and technology) for the development of these resources", O.A.U. (1980).

It is indeed through manpower development that the nebulous concept of transfer of technology becomes a reality. One of the ways Africa can disengage herself from the present economic crisis is to pursue a visionary policy of manpower development in surveying and mapping as opposed to receiving aids and handouts. There is a wise saying which goes like this :

"Give a man a fish,
you have given him only a meal.
Teach a man how to fish,
you have given him several meals".

It is through manpower development that Africa can produce adequate number of professionals and teachers necessary for producing maps not only for natural resource development but also for other aspects of socio-economic development related to communication, tourism, security (military and police applications) early warning systems, administration etc...

It was time Africans developed a vision for cartography and remote sensing manpower development programme. A vision which can carry her through up till the year 2,000. Cartography and remote sensing the bedrock of all development and that this development can only be realized through a visionary programme for cartography and remote sensing education-a programme that will grant Africa scientific and technological emancipation. In order for this programme to succeed, Africa needs technical assistance from advanced countries.

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Table 1: Education and training in Surveying (S) Photogrammetry (Ph) Cartography (C) and Remote Sensing (RS) at various levels in Africa.

Country	University Level				Technologist Level				Technician Level				In-Service training			
	S	Ph	C	RS	S	Ph	C	RS	S	Ph	C	RS	S	Ph	C	RS
Algeria	Xf	Xp	Xp	-	X	-	-	-	X	-	X	-	-	-	-	-
Angola	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-
Botswana	-	-	-	Xp	-	-	-	-	-	-	-	-	-	-	X	-
Burkina	-	-	-	-	-	-	-	-	-	-	-	X	-	X	X	-
Burundi	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
Cameroon	-	-	-	-	-	-	-	-	Xt	-	-	-	-	-	-	-
Egypt	Xf	Xp	-	Xp	-	-	-	-	X	-	-	-	X	X	-	X
Ethiopia	Xp	-	-	-	-	-	-	-	X	-	-	-	X	X	X	X
Gabon	Xp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ghana	Xf	Xp	-	Xp	X	-	-	-	X	-	X	-	X	-	X	-
Ivory Coast	Xf	Xp	Xp	-	X	X	-	-	X	-	X	-	-	-	-	-
Kenya	Xf	Xp	-	Xp	-	-	-	-	X	-	X	-	X	X	X	X
Liberia	Xp	-	Xp	-	-	-	-	-	X	-	-	-	-	X	X	-
Lesotho	-	Xp	-	Xp	-	-	-	-	-	-	-	-	-	-	-	-
Madagascar	X	-	-	-	-	-	-	-	X	X	-	-	X	-	X	-
Malawi	-	-	-	Xp	X	-	-	-	X	-	X	-	-	-	X	-
Mali	Xp	Xp	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mauritius	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-
Morocco	Xp	-	-	-	Xt	-	-	-	X	-	-	-	-	X	X	-
Mozambique	Xf	-	Xp	-	-	-	-	-	X	X	X	-	X	X	X	-
Nigeria	Xf	Xf	Xp	Xp	X	X	X	*	X	X	X	X	X	X	X	X
Reunion	-	-	Xp	-	-	-	-	-	-	-	-	-	-	-	-	-
Rwanda	-	-	Xp	-	-	-	-	-	-	-	-	-	-	X	-	-
Senegal	-	-	-	-	Xt	-	-	-	-	-	-	-	Xt	-	-	-
Sierra-Leone	Xp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Somalia	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X	-
South Africa	Xf	Xf	Xp	Xp	X	-	-	-	X	-	-	-	-	-	-	-
Sudan	Xf	Xp	-	Xp	-	-	-	-	X	-	-	-	X	-	X	-
Tanzania	-	Xp	-	Xp	X	-	-	-	X	-	-	-	-	X	X	-
Togo	-	-	-	-	-	-	-	-	-	-	-	-	Xt	-	-	-
Tunisia	Xp	-	-	-	-	-	-	-	Xt	-	-	-	X	X	X	-
Uganda	-	-	-	-	-	-	-	-	X	-	X	-	X	X	-	-
Zaire	Xp	Xp	-	-	X	-	-	-	X	-	-	-	Xt	X	-	X
Zambia	Xp	Xp	Xp	Xp	X	-	-	-	X	-	-	-	X	X	X	X
Zimbabwe	-	-	-	Xp	X	-	-	-	X	-	X	-	X	-	X	-
Total	19	13	9	12	14	2	1	0	24	3	9	2	16	13	17	7
TOTAL	(10)	(3)	(0)	(0)												

X = available: f = full University programme: p = part of University programme: t = topography

Source: Surveys conducted by BOS (1982) Adeniyi (1985) and Ayeni (1986)

* Proposed Remote Sensing Course at the Regional Centre for Training in Aerospace Surveys (RECTAS) Ile-Ife, Nigeria.