

REMOTE SENSING IN AFRICA: MAPPING APPROACH AND PERSPECTIVES

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ABSTRACT

Africa comes very late in the field of remote sensing and spatial data infrastructures because it has no accurate means of possessing and creating satellite observation tools.

In 1979, with United Nation Economic Commission for Africa (UNECA) help, five remote sensing training centres were launched in the whole continent. Today, some of the centres are no longer functioning and Africa is forced to adapt itself in the new Information and Communication Technologies (ICT) context.

However, the three main remaining international centres are struggling to bring all African nations to “eat” GIS and remote sensing. But there is an unbalance between Anglophone and francophone Africa either in membership numbers or in the centres themselves.

This mapping approach argues to necessity of equilibrating training in remote sensing and GIS in Africa. Mainly, it recommends the creation of remote sensing and GIS sub regional centres in each part of Africa.

Key Words: Africa, capacity building, GIS, ICT, UNECA, remote sensing.

1. INTRODUCTION

Remote sensing processes began in the earlier 19th century. It have been relieved in the 20th century by very sophisticated spatial data collecting methods linked to the opening of digital or numerical era in 1970-1980 through the CD and the computer. The creation of Global Positioning System (GPS) and its freeing in 1990 and the launching of Geographical Information System (GIS) enabled the development of very rapid and sophisticated communication systems that benefit from the constellation of satellites in the space. The context is that of geomatics and Information and Communication Technologies (ICT), those completely transformed the world in the last decades (1990-2000) and made remote sensing and mapping processes very successful. African continent that has been since very much marginalized by industrial and technological development is trying to benefit from this opportunity offered by the world history. But all African regions have not deeply involved and implemented this evolution at the same rhythm and level of interest. That is the main objective of this paper focussed on the location of main remote sensing centres in Africa since 1970s and the perspectives within African continent.

2. METHODOLOGY

We realise a virtual trip via Internet and web sites to collect useful data that have been transformed statistically using Excel software in order to produce final graphs of remote sensing distribution. We also use MAPINFO and ARCVIEW software to map out remote sensing centres in African countries and sub-regions.

3. CARTOGRAPHY OF REMOTE SENSING CENTRES IN AFRICA SINCE 1979

3.1 Overview of main Centres and their characteristics.

The first aerial surveys of Africa took place in 1913 in Benghazi (Libya). But it is after the Second World War that many aerial photographs were taken in Africa. Thus, According to Ribot F. (1989); African Continent since 1977 had 5 regional centres of remote sensing launched by United Nations Economic Commission of Africa (UNECA). Choice of the centres lays on geographical position and housing host facilities as well as contributions of members' states. Table 1 shows the five main centres and the number of those persons who have been trained during 1979 and 1987 period. One can observe that within the 5 centres, only three have effectively functioned.

Country	Centre Name	Creation date	Training Period	Training program and schedule	Training duration	Number of students
Burkina Faso	Centre Régional de Télédétection de Ouagadougou (CRTO) Remote sensing Regional Centre of Ouagadougou	1978	1978-1988	Professional and specialized training based on remote sensing, topography, hydrogeology and cartography as well as air photographs	6 to 9 months	268
Egypt	Remote Sensing Centre, Cairo	1978	National functioning, (no data available), training and involvement in remote sensing projects.			
Kenya	Regional Centre for Services in Surveying, Mapping and Remote Sensing (RCSSMRS) Nairobi	1978	1979-1989	Remote sensing, cartography, geodesy and photogrammetry.	1 to 3 weeks, 6 to 12 months	1000
Nigeria	Regional Centre for Training in Aerial Surveys (RECTAS) Ile Ife	1978		Sensitisation and Training in remote sensing and photogrammetry.	6 to 26 months	500
DRC (ex-Zaire)		1978	Have never functioned and no data available.			

Table I: Regional centres of remote sensing in Africa from 1978 to 1987

3.2 Ouagadougou centre.

Remote sensing Regional Centre of Ouagadougou (Centre Régional de Télédétection de Ouagadougou, CRTO) was created in 1978 with 15 member states namely: Algeria, Benin, Burkina Faso, Cameroon, Congo, Ghana, Guinea, Ivory Coast, Liberia, Mali, Mauritania, Niger, Senegal, Sierra Leone, Togo (fig.1) and has just trained 268 students less than RECTAS and RCSSMRS as shown by table I. This centre falls into lethargy.

3.3 Background of two remaining main centres RECTAS and RCSSMRS

3.3.1 Regional Centre for Training in Aerial Surveys (RECTAS) in Nigeria.

The need for a regional cartographic centre was first mooted at the first United Nations Cartographic Conference held in 1963 in Nairobi (Kenya). The 8th session of UNECA held in Addis Ababa in 1964 called for the creation of Regional centres for training in photogrammetry, photo interpretation and airborne geographical surveys. In 1971, four members' states (namely Benin, Ghana, Nigeria and Senegal) signed the principal agreement establishing RECTAS (fig.2). The centre officially opened on October 21st 1972 and four other members joined afterwards (Burkina Faso in 1981, Mali in 1982, Cameroon in 1983 and Niger in 1984). The Centre was known as Regional Centre for Training in Aerial Surveys until September 1987 when the name slightly changed and became Regional Centre for Training in Aerospace Surveys. Its scope covered photogrammetry, remote sensing applications, cartography and GIS. The consultancy service of RECTAS has emerged through its modern adaptation to technological evolution of the world that brings the Centre to carry many projects emphasizing on mapping, monitoring and management of natural resources and environment.

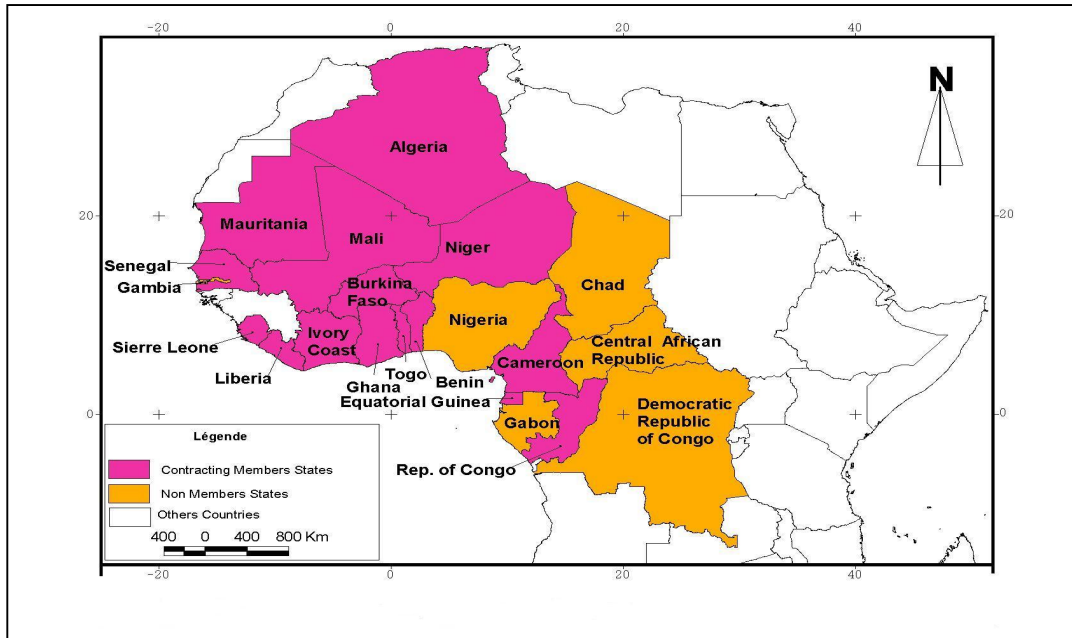


Fig.1- Remote sensing Regional Centre of Ouagadougou (CRTO), Burkina Faso

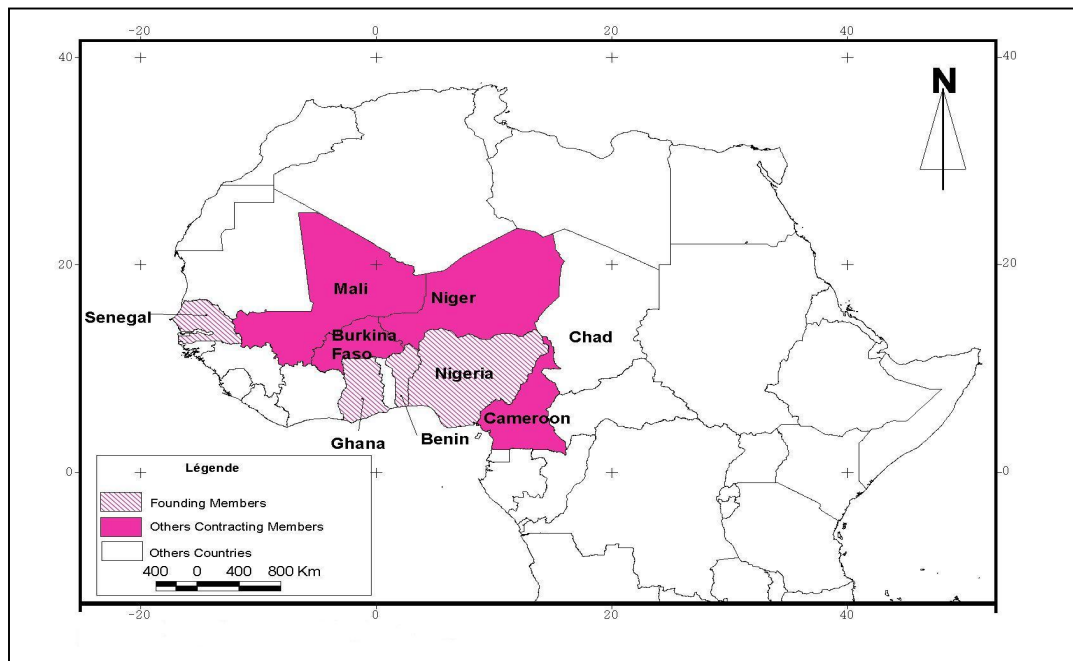


Fig.2 - Regional Centre for Training in Aerospace Surveys (RECTAS), Nigeria

3.3.2 Regional Centre for Services in Surveying, Mapping and Remote Sensing (RCSSMRS) in Kenya.

RCSSMRS was established in 1975 in Kenya under the auspices of UNECA and OAU founding members: Kenya, Uganda, Somalia, Tanzania, Malawi (figure 3). The Centre became in 1987 RCMRD (Regional Centre for Mapping and Resource from Development) with 14 contracting members states (Botswana, Comoros, Ethiopia, Kenya, Lesotho, Malawi, Mauritius, Namibia, Somalia, Sudan, Swaziland, Tanzania, Uganda, Seychelles and Zambia). The main objectives of the centre deals with: surveying and mapping (including aerial photographs, photogrammetry, photo-interpretation, geodesy, remote sensing, calibration and maintenance of surveying and mapping equipment). Its mission is extended to the promotion of development, application and dissemination of geo-information for sustainable development in Africa. This Centre whose mission has emerged and adapted to reach: resource mapping and environmental management, engineering services, human resources development and management is a great African centre involved in Africa Geodetic Reference Frame (AGREF) as forefront of its

implementation. It carries more than 18 projects in many domains (spatial data, GIS application, EIA etc.). The recent programs approved based on 2020 vision are being reformulated as follow: Resource Mapping, Remote Sensing and Environmental Management, Engineering Services, Human Resources Development and management.

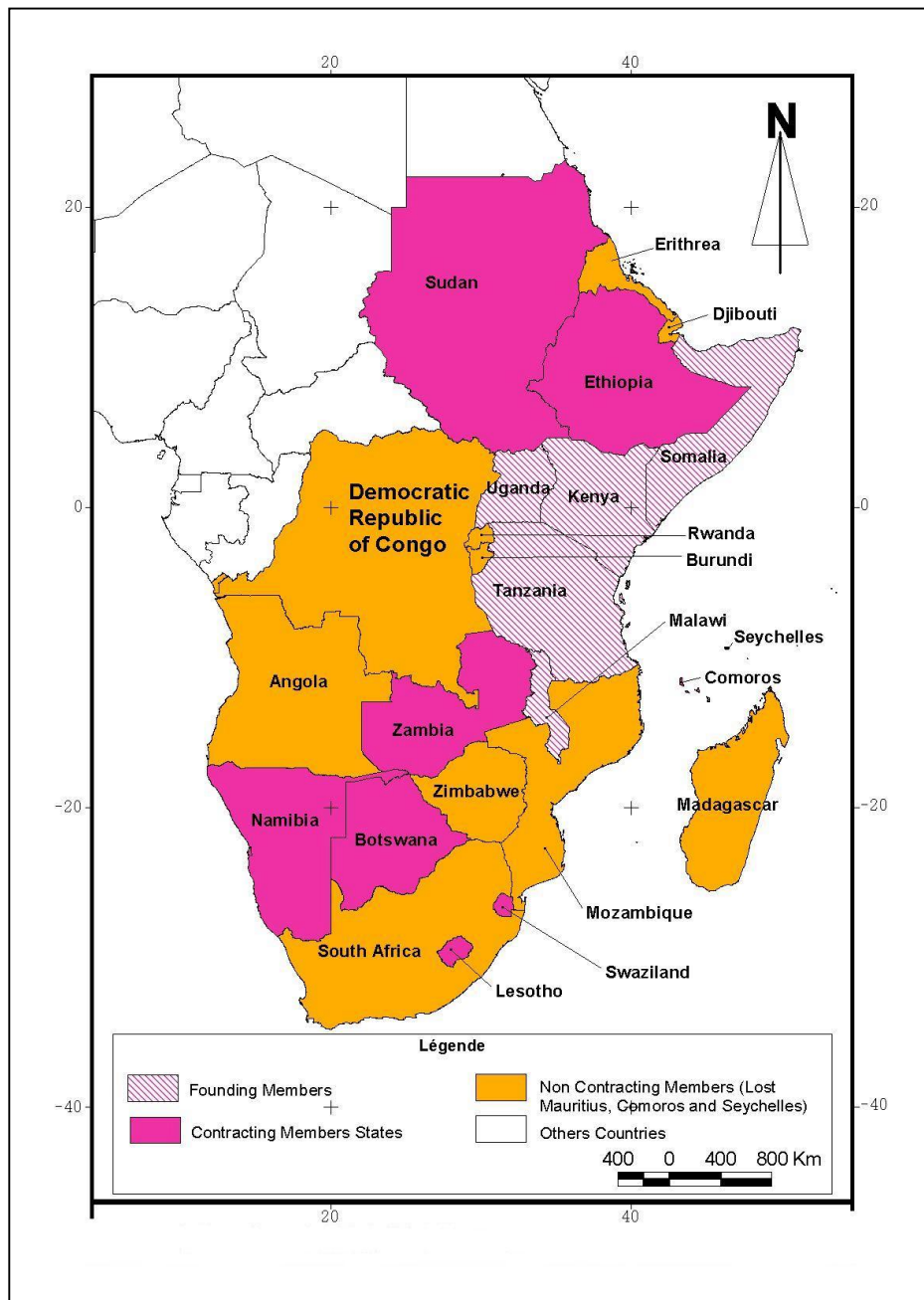


Fig.3 - Regional Centre for Mapping and Resource from Development (RCMRD), Kenya

3.4 Morocco recent centre

As remote sensing and spatial data is concern, the only forefront of Maghreb region is African Regional Centre for Spatial Sciences and Technologies (CRASTE: Centre Régional Africain des Sciences et Technologies de l'Espace). It carries within its member's only three Maghreb countries namely Algeria, Morocco and Tunisia. The others member states are from black tropical Africa: Cameroon, Cap Verde, Central Africa Republic, Democratic Republic of Congo, Gabon, Mauritania, Niger, Senegal and Togo (figure 4). The training duration is too long (2 years) and that is the main problem of this centre. Training emphasises in four main domains: Meteorology and Global Climate, satellite Communications, Space and atmospheric Sciences, Remote sensing and GIS. CRASTE is affiliated to United Nations Programs and carry seminars on Astrophysics for University Physics Courses and Humans in Space & Space Biology.

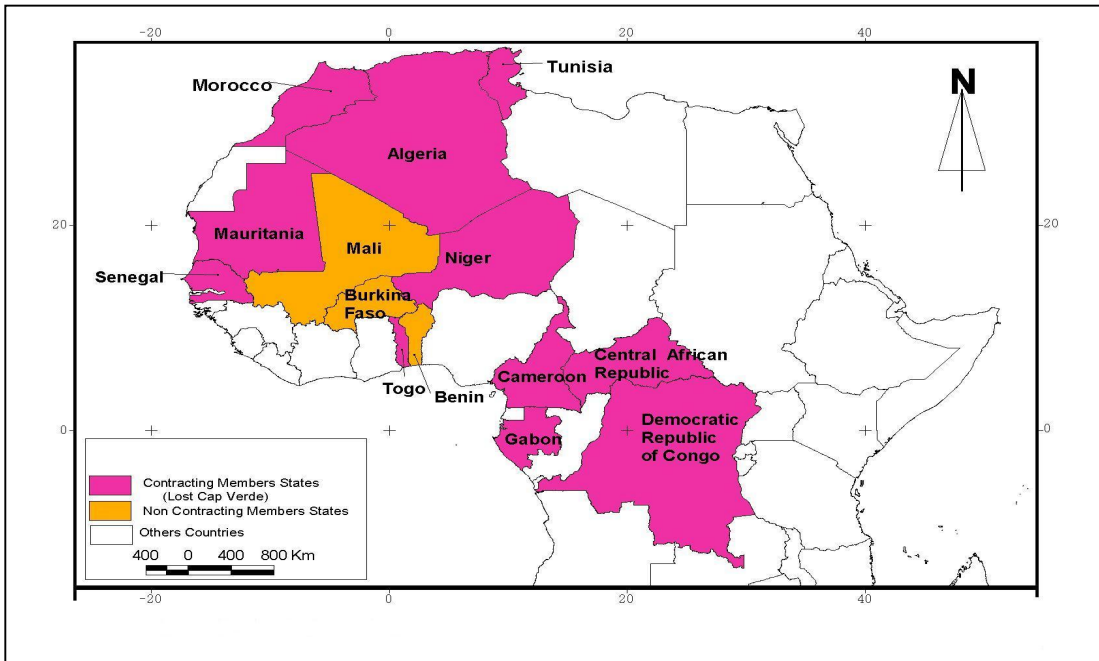


Fig.4 – African Regional Centre for Spatial Sciences and Technologies (CRASTE), Morocco.

CRASTE combined with RECTAS and RCMRD remained (fig.5) the main remote sensing Centres in Africa today. These centres are very instrumental in capacity building and they built partnership with many national, regional organizations and NGOs (table II).

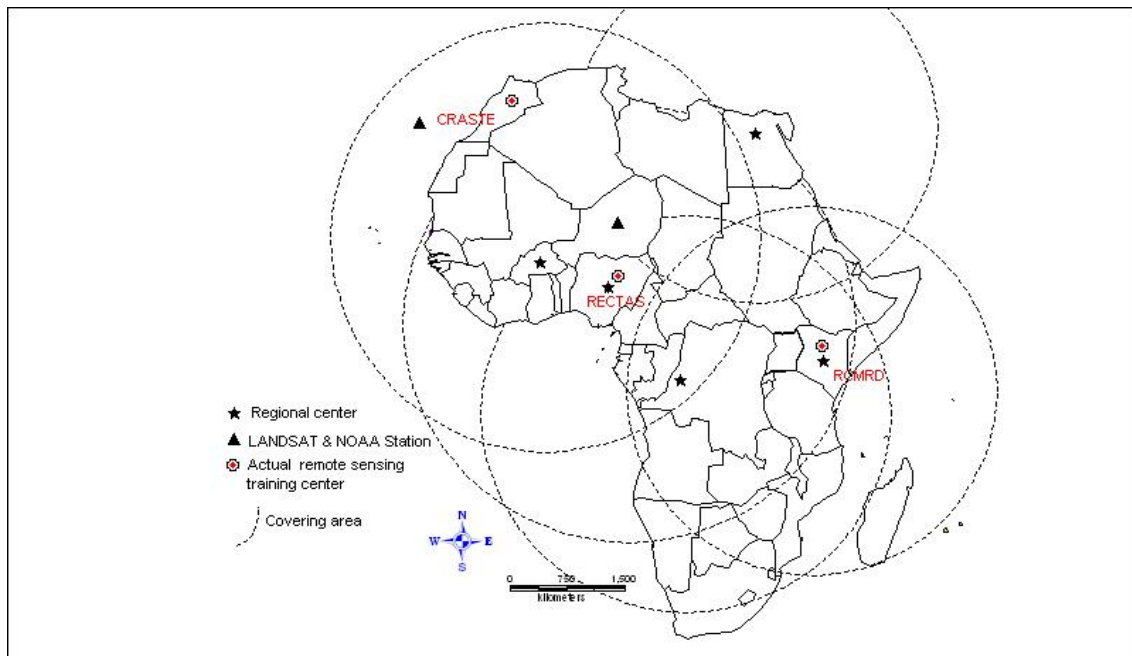


Figure 5 - Regional Centres of Remote sensing in Africa from 1979 to 2003.

Country	Centre Name	Contracting/associates members	Training program and schedule	Training duration and partnership	Number of students and observations
Kenya	Regional Centre for Mapping and Resource from Development (RCMRD) Nairobi launched in 1987	14/10	Remote sensing, cartography, geodesy, photogrammetry, resource mapping and environmental management, engineering services, human resources development and management; SDI, ITC	2 weeks to 3 months. Partners: Jomo Kenyatta University, IMIS, CISCO, Microsoft Comptia Vue .	2000 professional and technical officers (1000 between 2001/2003). English language
Morocco	(African Regional Centre for Spatial Sciences and Technologies) Centre Régional Africain des Sciences et Technologies de l'Espace (CRASTE)	12/3	Remote sensing, space sciences, meteorology, communications and 14 domains of thematic applications (forestry, ecology, cartography, geodesy, photogrammetry, DEM, GIS, geology, natural catastrophe and sustainable development).	2 years and 3 months in short term. Partners:	1000 French Language
Nigeria	Regional Centre for Training in Aerospace Surveys (RECTAS) Ile Ife launched in 1987	8/4	Remote sensing and photogrammetry, mapping, cartography and GIS, management of natural resources, consultancy.	12 to 18 months Partners: ITC, GDTA, CIRAD, AGRHYMET, ECOWAS	1200 public servants in regular training and 107 officers in short term. English and French language.

Table II: Regional centres of remote sensing in Africa since 1987

4. RELEVANT PROBLEMS AND PERSPECTIVES FOR AFRICAN CONTINENT

The tables had shown what happen in Africa since the remote sensing Era (more than a century today). Some regions have proudly taken the situation and the others seemed to sleep or fall into lethargy; it is the case of Central African region. The graphs realised from the statistics we computed are very expressive on that matter (fig. 6-7).

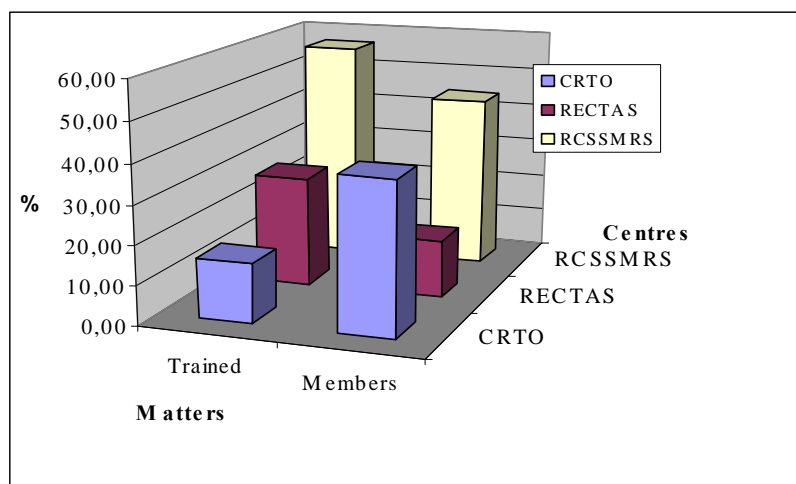


Fig.6a - Assessment of African remote sensing training (1978-1989)

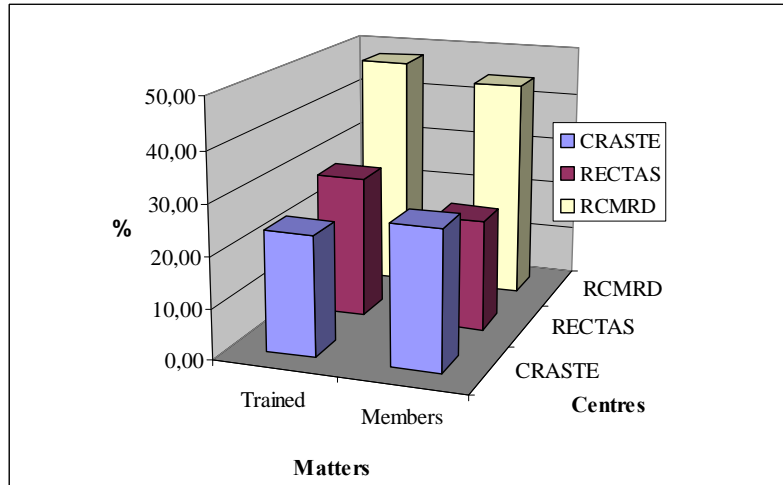


Fig. 6b- Assessment of African remote sensing training after 1990

If figure 6a shows a great disparity in the percentage of those who are trained and the states members, because CRTO have many members but trained a few candidates within the African continent; RECTAS in Nigeria has few members but have schedule its programs to numerous Africans. RCSSMRS in Kenya appears in the first period (1978-1989) as in the second one (after 1990) as a good training centre that adapt the tools to the world and African contexts (Fig 6a –b). There is a certain stability on the huge numbers of students that benefit from this centre as on the members states. This situation proved that Kenya is the good forefront in remote sensing in the black tropical Africa. But it is far from Central and Western Africa and so many countries of these sub regions could not benefit from the opportunity offered by Kenya centre. CRASTE centre in Morocco, because of language (French speaking), become the only forefront where countries from these subregions could relied on. This report is illustrated by figure 7 a-b on which one can see Central African countries and West African Countries as the last states in Africa in remote sensing matters while Eastern and Southern Africa (and Maghreb countries) improved continuously their skill in such scientific and technical domains. The situation could explain too the poor interest of this regions in the TIGER initiative proposal.

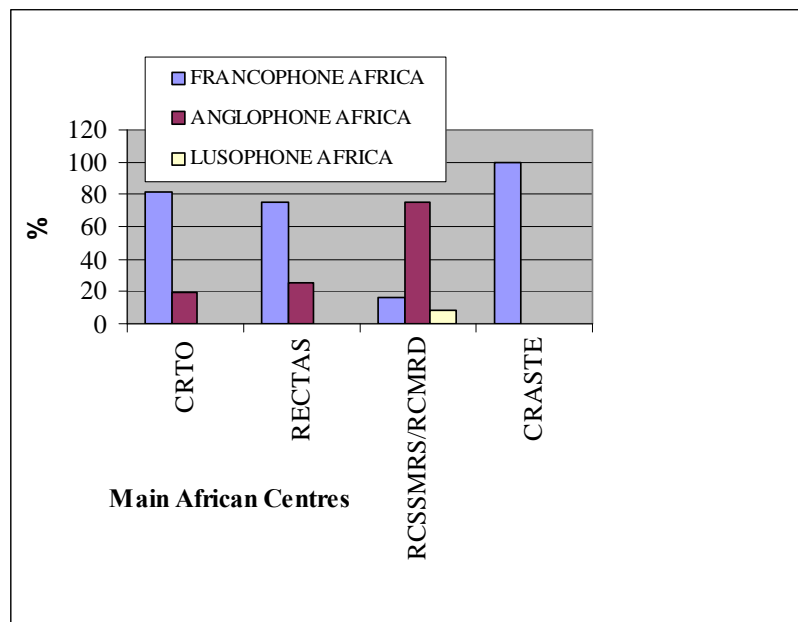


Fig.7a- Linguistic distribution of remote sensing training within Africa

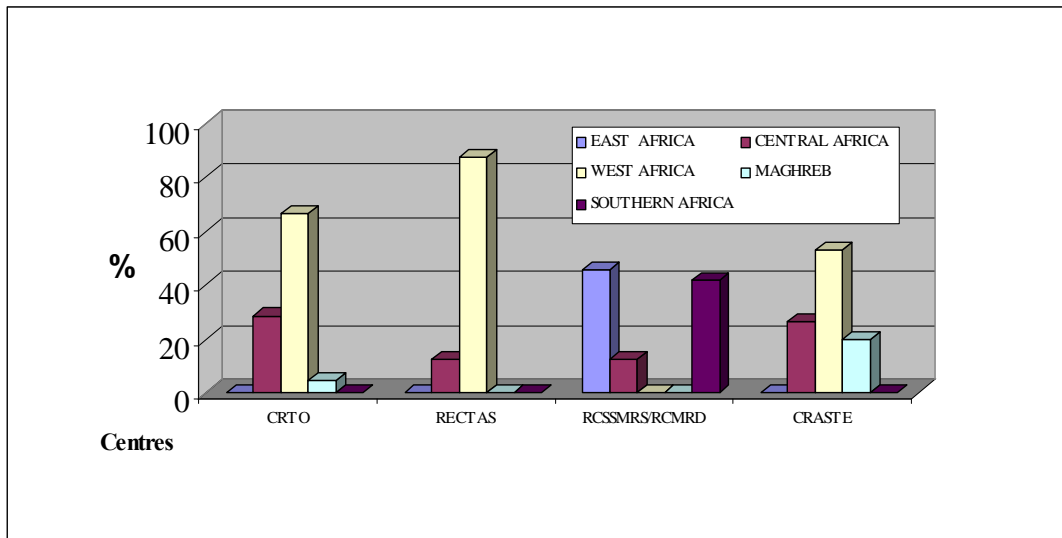


Fig.7b- Regional Distribution of Remote sensing Centres and members States within Africa

The perspectives could be that of implementing local training as it is the case in some countries like or UNECA should try to build up again Democratic republic of Congo centre for Francophone speaking countries or to implement a great centre in Cameroon or Central African Republic for these countries. For Cameroon appears like a good risk related to hosted facilities it can offer and also to its political stability. If this is not done the two regions should remain poor in remote sensing and GIS processes and should possess poor human skill in those technological aspects.

5. GENERAL CONCLUSION

With the multiplier effect of remote sensing data, one can say that there is a large number of Africans that have been significantly trained in remote sensing centres created in Africa since 1977. However, this appears insignificant if we look at the huge numbers of African population involved in public administration. Africa needs the spread popularisation and dissemination of spatial data as well as multiplication of spatial data infrastructures. In this aim, distance learning appears as a challenge to sensitise and realise effective training and also to overcome difficulties of spreading remote sensing methods and spatial data in Africa. Because accurate technological transfer need to be speed up in order to avoid another African delay in metadata, in ICT and geomatic. But, the strategies of implementing its tools need the financial and material support of States, institutions; private and NGOs even though if the cost is high; remote sensing and GIS brought profit in time, material, cost and human resources. But; as shown the graphs, the specific region of black francophone Africa (Central Africa and West Africa) need to be support in terms of training, implementation and reinforcement of capacity building in remote sensing. Yet, it is better to notice that United Nations Office for Outer Space Affairs (UN-OOSA) implement or is experiencing five great centres in developing countries (CRECTEALC in Mexico for Central America, CRECTEALC in Brazil for South America, CSSTE-AP In India for Asia, CRASTE-LF in Morocco and ARCESSTE-E in Nigeria for Africa). Finally, technologies transfers are very expensive and this exposed Africa to developed nations domination for many reasons:

- Restrict access to Internet in term of customers, Internet providers and speed. These factors are no longer appropriate to easier the downloading of spatial images
- The high cost of radar scene images (before actual TIGER initiative launched in 2003) that disabled Africa nations to get under control remote sensing procedures
- Poverty that reduced some African countries to begging. We add to this Environmental questions that enable Africa nations to think and organised as well as possible remote sensing training.
- The local perception problems and priorities: Europe considered water management as a priority today and Africa chooses food security. This brought perception conflicts relevant to aim, motivations and capacity building of remote sensing and GIS tools.

6 – REFERENCES

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BIOGRAPHY OF DR MESMIN TCHINDJANG

Dr Mesmin Tchindjang was born in Douala Cameroon on August 26, 1961.

Title: Holder of:

1- Ph.D thesis in Geomorphology in 1996 at University of Paris 7 in France entitled: The Central Bamileke Plateau and its surrounds: Regional morphology and slopes dynamic, Geomorphological study. The thesis dealt with Relief, Surface dynamic and Natural Risks.

2 – Master of Sciences in GIS (Methods and Techniques of Management of Environmental Information) at University Omar Bongo Ondimba of Libreville Gabon.

Function:

3 - Senior Lecturer in University of Yaounde I Cameroon, Department of Geography. My teaching domains in University of Yaounde concern: Geomorphology, Cartography and Remote Sensing, Environment, Tourism and Eco tourism.

4 – Associate Lecturer in Geomorphology and Remote Sensing at ENEF; Libreville Gabon.

Experiences:

- General Secretary of The National Geography Committee of Cameroon.
- Member of ICA working Group on Colonial Cartography
- Member of IGU working group on cultural geography
- Founding Member and coordinator of CARGIS; a Cameroonian association of cartographers, GIS and remote sensing
- Program Manager and Coordinator of Postgraduate Diploma and Master of Sciences in EIA in CRESA FORET-BOIS (University of Dschang) Cameroon.

Publications:

More than 15 scientific articles focussed on: The weathered pebble of the Bamileke plateau, The geological rock strata in Cameroon, Mining Sand exploitation on the Pan African granite rock of Batie Region, Central Bamileke maars, inundation risks in the Lake Nyos Valley, Erosion and Dissolution potholes on the Lake Nyos pyroclastic dam, tourism and ecotourism. Supervisor (students' research works) of almost 15 Master of Sciences thesis in Geomorphology, Management of Natural and touristic resources, Environment with tourism and Eco tourism, Farming transformation in West Cameroon, Sustainable Management of Fauna specimen (CITES Case) in Cameroon, Inundation and risks linked with shallows occupation in Yaounde town, Remote sensing and ecological prospect of biodiversity on Cameroon Mountains after 1999-2000 eruptions.