Integrated management and sustainable development of coastal West Africa: the experience and the project of the UCAD Chair (Summary by *J. Quensière, A. Kane, A Fall Niang*).

Coastal areas and shorelines are sources of wealth coveted by a growing number of economic actors with diverging interests. The concentration of human populations in coastal areas is a global phenomenon and has now become a concern in Africa where 60% of the population lives within 10km of the shoreline (UNESCO, 2004).

The richness and diversity of natural resources play a key role in the concentration of human populations along the shorelines. In West Africa, major economic activities such as fishing and tourism are the fastest growing sectors of the national economy. They compete for natural shoreline and coastal resources with a growing number of activities such as agriculture, transport, livestock, forestry, industry, recreation, boating, various forms of aquaculture, salt mining, etc. Thus, it is clear that the use of coastal resources and coastal areas is a key driver of economic and social development in West Africa.

The increasing intensity of use of these resources obviously gives rise to many environmental problems. The rapid extension of human activities on this fragile and narrow fringe now poses a myriad of problems regarding sustainability. Violations of the environment primarily concern *alteration of ecosystems,* gradual *poisoning* of the environment and food chains and *overexploitation* of certain species.

Fishes are particularly overexploited. It is now widely considered that many West African stocks are fully exploited or overexploited. All recent indices indicate a significant decrease in demersal resources in West Africa with a particularly sharp decline of Senegal's grouper biomass (Epinephelus aenus) which has reduced by 90% (Gascuel et al. 2003).

Alteration of ecosystems takes various forms (GEO 2003), such as deforestation due to extension of agricultural lands or excessive exploitation of massive mangrove where climate change no longer allows for normal regeneration of mangroves (Andrieu, 2004). West Africa has therefore had the highest rate of deforestation with an annual loss of more than 1.5% of forest cover.

With the highest rate of urban growth in the world (5% according to the United Nations, 1995), growing real estate development is now a major source of deterioration of coastal ecosystems. This extension is going at a fast rhythm in some coastal regions such as the Petite Côte of Senegal (Diagne & Yamamura 2000; Baldé 2003, Ackermann et al. 2003).

This coastal real estate development does not only artificialise land, but also leads to increased coastal erosion, either by inappropriate buildings and facilities, or by increasing

extraction of sand for construction (Ouegnimaoua, 2003; Cesaraccio et al., 2004).

Effluents in West Africa are currently untreated. This results in significant pollution of industrial waste (colorants, ammonia ...), a significant organic burden and high concentrations of coliforms and faecal streptococci similar to those in Dakar in Hann Bay (Arfi and Bouvy, 2004), these pollutants make coastal waters unsuitable for bathing and marketing of marine products.

Over a third of African coastal ecosystems are now severely threatened by development related activities (FAO 1998). The intensification of human activities on the same spaces, and increasing use promotes the emergence of competition between different sectoral interests. The question is how to manage the multiplicity of activities for economic and social development, without destroying the natural resources needed for this development. The method advocated by the UNCED (1992) is to develop an integrated management of coastal areas to be considered as a socio-eco-system (UNESCO, 1997). The need to address the shoreline, its natural resources and their uses as a whole arises from two observations:

- The first concerns the nature of complex systems arising from the use of human resources and natural areas. Fisheries, agriculture, animal husbandry, tourism, urbanization, generate systems interfaces that make for interdependent natural and social dynamics. Natural resources cannot therefore only be managed on the basis of their bio-ecological characteristics. Their sustainable use requires a broad consideration of their social underpinnings (social, cultural, technical, regulatory,).

- The second finding is that these interface systems do not evolve independently of each other and interact through the social and natural environments they share. Sectoral needs for space, labor, and accessibility to resources (eg. water, soil, landscapes, markets, infrastructure ...) combine or clash and necessarily affect the dynamics of the use of each. These adjustments and co-evolution lead to the emergence of a global dynamic that no sector can be analysed in isolation from other relevant areas that constitute its environment.

The coast must be analysed at different levels of space and time, in terms of organization, internal structure and external disturbances. This approach therefore has important implications for scientific research and its objectives, and also on the economic and social dynamics of coastal areas through new forms of regulation and management.

Thus, scientifically speaking, one can no longer consider the preservation of resources solely in terms of biology, or even ecology. It is no longer living resources that need to be managed, but the use made of them by man, since no natural resources can now be

considered independently of the dynamics of the resources they exploit and alter their evolution.

Similarly, the externalities generated by an industry on other sectors must be taken into account. Inter-sartorial competition for space sector, freshwater resources, capital or available workforce make activities developed by man on the coastal fringes interdependent inter-dependent and lead to methods of regulation and management of the different sectoral approaches that exist today.

These scientific, administrative, legislative and regulatory changes need the support of a structured learning, if they must develop. It is here that the University is bound to play a leading role:

- ✓ As a promoter of new ideas rooted in our understanding of the natural economic and social dynamics;
- ✓ As the originator of research and innovative approaches for identifying and implementing new management practices and regulations;
- ✓ As a bearer of knowledge and training based on the spread of new paradigms suited to rational management and sustainable development, i.e. the construction and dissemination of knowledge and know how for the optimal use of national resources and the development of the country.

All these factors informed the creation of the UNESCO/UCAD Chair for the integrated management and sustainable development of the Coast over a decade ago. Based on teaching and research, this Chair is moving gradually towards introduction of a master's Programme of regional importance on the knowledge, monitoring and management of coastal systems.

Any intervention by the UNESCO Chair / UCAD integrated management and sustainable coastal development is based on the harmonious relationship of the three worlds of Research, Training and Development, which have for a long lived time skirted around issues concerning the coast, with little collaboration and without engaging each other.

Thus UNESCO / UCAD brings together:

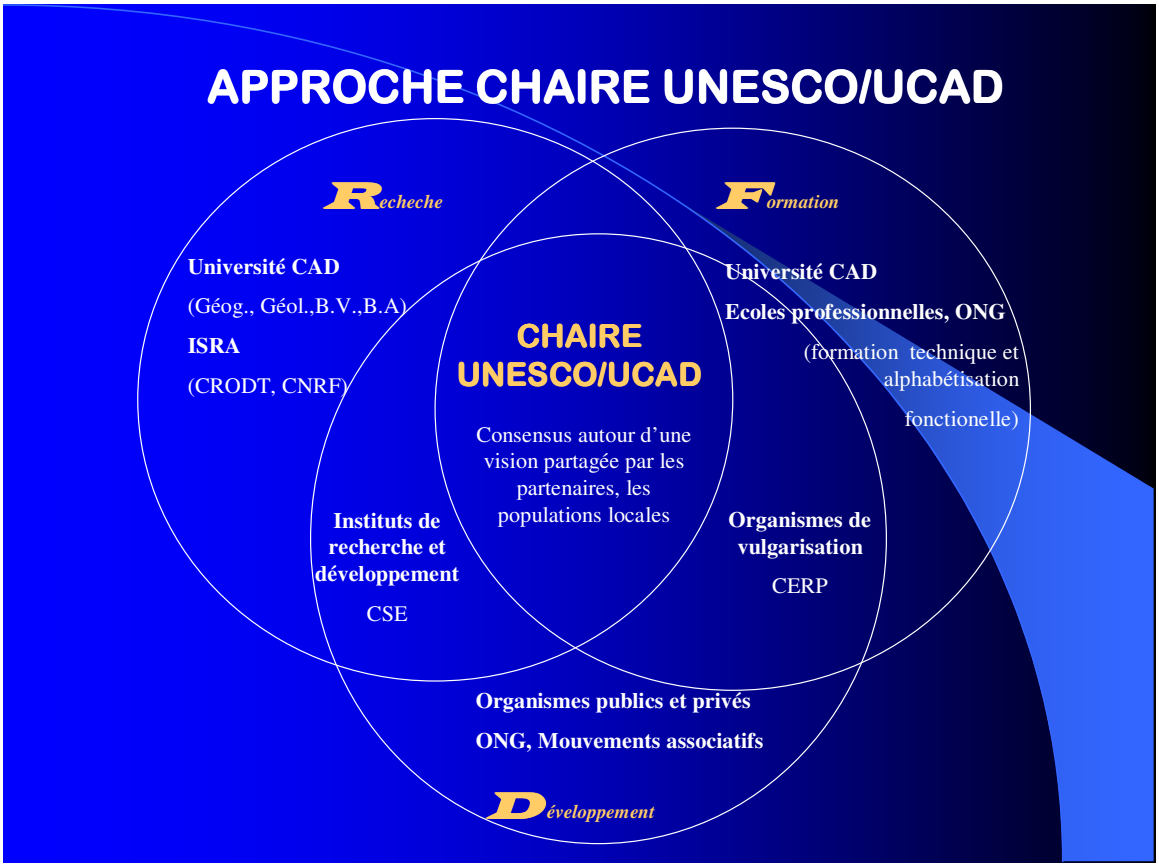
• Research institutions like the Cheikh Anta Diop University (through its geography, geology, animal and plant biology, law and sociology departments, among others); the Senegalese Institute of Agronomic Research (Centre for Oceanographic Research, Dakar

Thiaroye, and the National Forestry Research Centre), the Centre for Ecological Monitoring and the Institute for Development Research.

• training institutions such as the Universities of Dakar and Saint Louis.

• and development institutions such as NGOs, public and private entities and local community groups.

The following figure illustrates this framework for inter-agency cooperation.



This research environment, focused on thematic lessons, is essential and of great scientific and practical importance (production of extracts on the coast) for various development programs that are underway. The results could be part of the implementation of conservation strategies whose objectives are:

- Ensuring the optimal and sustainable use of natural resources in coastal areas to safeguard them for future generations,

- Identify new opportunities where resources are underutilised,

- To ensure and maintain biodiversity in the context of development priorities of our respective countries

- Ensuring the rational development of coastal resources

Space remote sensing is widely used in our studies on coastal and marine environments. The thematic priorities addressed through the use of this tool for the creation of a GIS database are:

- The search for indicators and control sectors to monitor the changing environment;
- The establishment of observatories of changing environments, dynamic characterisation;

- Reconstruction of the historical evolution of the coast of Senegal and by extension, West Africa (recent history of the coast or the shoreline by comparing multidated maps;

- Monitoring the morphological and sedimentological coastal sediment transport, sediment concentrations, bathymetry, bottom types;

- Hydrology: the study of hydrodynamic agents (waves, tides, drifts), floods, broken bars, color of water (productivity and proliferations);

- Pollution by hydrocarbons (eg. Hann Bay), industrial and urban pollution;

- Management and planning: land use, sensitive areas, the inventory of habitats and resources.

To manage, it is important to identify and monitor. Generally, many institutions are involved in this research, but their activities are not coordinated, resulting in the dispersion of efforts and lack of synthetic evaluation.

Remote sensing is also applied to living resources:

- Habitat for living resources: mangrove ecosystems

- Marine culture sites

- The maintenance of biodiversity

All this work leads to a mapping with an ecological goal, most often our maps are old, incomplete, not uniform or inexistent.

Socio-economic surveys are also conducted on:

- Sustainable tourism: it can take different aspects, cultural, ecological, hunting

- Population: several aspects are taken into account: demographics, burden of population, urban dynamics, anthropogenic pressure on ecological systems

- The economics of marine and coastal environments: the cost of natural resources and their degradation

The Chair has several major programs to its credit, and projects all along the coast of Senegal and has participated in sub-regional programmes.

Pilot projects have, thus, been developed on:

• Restoration of degraded ecosystems: Somoni and Saloum Mangroves, followed by the regrowth of the mangrove vegetation especially on the banks of Senegal in its estuary.

• Exploitation of fishery resources;

o a) monitoring of shellfish landings in Cape Verde (Bargny and Hann)

o b) the relationship between mangroves and the fish population

o c) impact of the Sangomar breach on fishery resources

o d) impact of the extension of the Langue de Barbarie and the development of the turbid plume off the mouth of the Senegal River (monitoring by remote sensing).

• Multidisciplinary approach to the coastal productive dynamics: the case of traditional methods of fishing on the Petite Côte of Senegal

• Biodiversity of coastal and marine zones

• Conservation and restoration of mangrove ecosystems in the Saloum Delta Biosphere Reserve

•Coastal erosion (Saloum and Yoff)

• Monitoring of water flows (estimated rate of flows at Diama, changes in fluvial dynamics, threats of flooding in the city of St .Louis), transport of solid matter and particles (measurement of Current and sediment sampling) in the estuary of the river Senegal

• Mapping (by topo-bathymetric measures) in bottom sediments of the river Senegal
• Study of the impact of tourism development (3 encampments established) on the development of the median sector of Langue de Barbarie

These themes have a common focus on integrated management of natural resources of coastal and marine areas. Combined field operations are conducted, with the view to

optimising the use of human, material and financial resources. Methodologies and all stations are commonly defined so that each researcher can take into account the concerns of others. This exercise offers everyone the opportunity to present the information at their convenience.

To strengthen its dynamism and adaptability to the conditions of a changing environment, the Chair has created more spaces for reflection and exchange on new directions.

Thus, a prospective first draft was completed during a preparatory meeting for the LMD reform organised under the auspices of UNESCO and the Rector in collaboration with the Université des Sciences et Techniques de Nouakchott, the CNRHB of Guinea, the UVSQ and IRD in 2004 specifically on the nature of the professions associated with emerging needs of the coastal area, on preparation for careers in coastal preservation. The objective is to develop a multidisciplinary Programme which does not lead to the exclusion of quality and excellence controlled knowledge of the discipline, but which allows for new opportunities at the interface of disciplines to new shared objectives, imposed by the complexity that are now the interactions between natural dynamics and the uses to which they are put by man.

The outcomes must meet the multiple needs of the integrated management of coastal zones: coastal landscape and coastal pollution control, waste, pollution, control of sampling and monitoring of sedimentary developments, monitoring of landscapes and fauna and flora resources, monitoring and management of AMP...

It is clear that mastery of these problems requires multiple and cross-cutting approaches: awareness creation and communication, implementation of standards and regulations, environmental diagnostics, chemical and bacteriological monitoring of environments, risk modeling, impact studies, rational socio-economic choices, development of indicators and monitoring procedures for control.

Three work orientations were confirmed:

(1) Deepening the multidisciplinary approach by identifying more clearly and operationally the interface objects between nature and society which constitute the shoreline and coastal systems;

(2) Call up the advances of science in the fields of geomatics and spatial analysis for more efficient research mechanism, and also for a more efficient mechanism for exchanges, consultation and training through new information and communication technologies tools;

(3) Federation of skills and experience to enable regional training more suited to the

needs of countries and foster the emergence of significant regional expertise on issues related to shorelines.

A second step was taken at the conference on "Integrated Management and Sustainable Coastal Development in Africa held in Dakar from 6 to 10 March 2006. The aim was to promote a reflection on the nature of sustainable development in coastal areas, the need for an integrated approach to coastal management and more fundamentally on the need for a Master's degree program to train managers capable of using an innovative approach to natural resource management.

Interventions and tests have focused primarily on the importance and complexity of coastal resources and coastal areas, as well as issues relating to the integrated management of these resources, then focus on the development of a Masters Programme, with the view to strengthening university education on issues relating to the region's coasts.

The momentum generated was based on the following: *the growing complexity of multiple interactions between natural constraints, economic and social issues of the shoreline lead to the development of new approaches and tools that higher education should contribute to awareness and use through teaching and research*. Nevertheless, lessons tailored to a better understanding and sustainable management of their resources have yet to develop.

The results of teaching ideas were presented and helped contribute to both:

1. developing a shared model of holistic representation of coastal areas and shorelines;
2. an understanding of the role that ICT tools can play to facilitate mediation of knowledge related to coastal zones and shorelines;
3. strengthening the complementary links between research and higher education.

The working sessions helped to address three critical aspects in preparation for a reflection on a Master's degree program.

The first aspect sought to clarify the nature of the complexity of eco-socio-coastal systems and the increasing role played by research and university training.

The second aspect focused on concepts of measurement and indicators in a context of sustainable development. Emphasis was placed on the operational aspects and on the role of indicators for monitoring the coastal system as well as a tool to support multilateral deliberations that characterise integrated management.

The third aspect involved the analysis of tools such as GIS and ICT, which were analysed in terms of their relevance in a context of integrated coastal zone management.

The findings can be summarized as follows:

- ✓ There is in West Africa an active practice of integrated management supporting the emergence of a first generation of practitioners willing to share their expertise and to enrich it with more formal training;
- ✓ There is also a series of participatory development initiatives involving various multilateral deliberation processes, so there exists in the sub-region specific expertise that can be applied to integrated coastal zone management;
- ✓ This expertise must find a mechanism to pool efforts and create a critical mass in favour of a university training;
- ✓ It is necessary to consider the contents of a masters programme in integrated management both in terms of interdisciplinarity, and in terms of expert contribution of the various disciplines, from the perspective of learning tools applied to cross-cutting issues relating to the coast.