The Air-Ténéré National Natural Reserve (RNNAT) Observatory: Territorial Intelligence for Sustainable Development

Yann Fléty, Franck Giazzi

"The Air-Ténéré National Natural Reserve (RNNAT) Observatory: Territorial Intelligence for Sustainable Development"

Yann FLETY, Franck GIAZZI

Yann FLETY
Geography Ph-D student
Laboratoire ThéMA (Théoriser, Modéliser pour Aménager)
UMR 6049 – CNRS
Université de Franche-Comté, 32 rue Mégevand
25030 Besançon Cedex FRANCE
flety.yann@free.fr

Franck GIAZZI
Geography lecturer
Laboratoire Territoires UMR 5194 UJF / UPMF / CNRS
Institut de Géographie Alpine, 14 bis, avenue Marie Reynoard
38100 Grenoble FRANCE
franck.giazzi@ujf-grenoble.fr

Abstract: The Aïr-Ténéré National Natural Reserve is a protected area in which conservation and development principles tempt to be combined (co-management). To follow-up environmental changes which determine people's life, and to support decisions to manage the Reserve, the first steps of a territorial observatory are introduced. Beyond the technical build up of the Geographical Information System (GIS), the prototype proposed here is a concrete expression of a part of a territorial intelligent tool. It embraces all territorial dimensions from spatial to actors ones, and try in the context of the reserve, to revisit the definition of local governance. This work is based on a master thesis (Flety 2006).

Keywords: "natural resources" management, territorial intelligence tool, GIS, governance, Aïr-Ténéré Niger.

1. INTRODUCTION

Territorial intelligence, beyond its impudent label, consists in a systemic approach of a territory to create an active cooperation towards sustainable development (Bertacchini, 2006). Its concrete application is a complete data collection, and the confrontation of stake holder's point of view, leading to coherent community actions. It specific aim is to create and produce information from the data collected. In this way, territorial observatories could be considered as one of the instrument of territorial intelligence. They are mainly web numeric applications with tables, maps and indicators, used to follow-up an evolution with prospective concerns. If the importance of partnerships and actors aspects is often emphasized, we propose here to focus chiefly on the territorial dimensions, so on actors and space. We introduce here a work dealing with the participative management of natural resources with development goals in the Air and Ténéré National Natural Reserve (RNNAT).

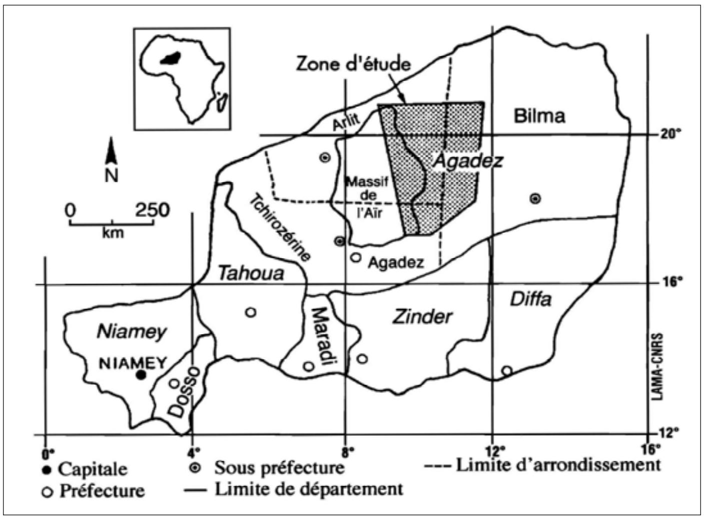
The RNNAT is a protected area in which conservation and development principles tempt to be combined (co-management). The way forward goes through resources management which deals with an evolution of ecological paradigms assuming the consideration of human factors (Rodary et al, 2003). Existing experiences have shown that exogenous conservation policy run up against local actors needs. Those policies lead to reconsider the traditional relation to resources which have shaped biodiversity, and so have negative consequences on the environment and the socio-economics population conditions. It seems relevant to consider local population as the first guarantors of conservation actions, the biodiversity managers and the beneficiary of its valorization. Territorial intelligence tools acquire a special importance in this co-management context of protected area. They tend to revisit local governance. The general context of territorial intelligence and observatory is the framework. Specifically, this paper aims at developing the integration of landscape evaluation and traditional ecological knowledge on a landscape unit basis. It illustrates the instrumentation method of a territorial analysis tool. In this sense, the protoype of a Geographical Information System (GIS) capable of integrating traditional ecological knowledge was build.

2. CONTEXT, PROBLEMATIC AND GOALS

2.1. Context: The RNNAT, between richness and fragility

The RNNAT covers some 77360 km² between the Ténéré desert and the Aïr Mountains. It boasts of an outstanding biodiversity. If rain volumes characterize the indigence of precipitations, norm in arid context, they do illustrate neither their random distribution nor the inter-annual fluctuations (Agadez 39mm in 1970, 4mm in 1984) (Giazzi, 1996). This spatio-temporal variability of rainfalls constitutes the limiting factor of the reserve system and should inspire flexible management methods. Vegetation is the renewable resource, conditioned by the rainfall, which represents the best indicator of the ecosystem evolution (Tucker 1991, Breman, 1991). Thus, it varies in extreme proportions from one year to the next, with obvious consequences on pastoral population recently settled. The assessed population may reach 5,500 shepherds and 3,500 visitors leading to consider this space as an agropastoral and touristic area. The addition of anthropogenic pressures linked to resources harvesting (overgrazing, fuel wood, water or poaching) are an issue. So it seems expedient to build management methods based on environmental diagnostics to take into account this new relation between man and its environment.

Figure 1: The Nigerian RNNAT (in Giazzi F. 1996)



2.2. The COGERAT program: Co-GEstion (co-management) Resource Aïr-Tenere

The main goal of this co-management program is sustainable development linked to participative principles. If the program is in keeping with environmental protection principles, the set of actions has to be made in a framework involving population as well as scientific, stakeholders and decision-makers. The specific goal of this program deals with the identification of intervention areas considering land degradations, and the proposition of technical solutions in a participative way. The action plan is build on “Pastoral run”, scale including valleys in the geomorphologic sense and landscape facet. The definition of “Pastoral runs” emanates from an anthropologic approach; they are spatial units restricted by a number of water wells and valleys which define pasture areas consumed by identified flocks. Those pastures are organized and used by producers namely identified who belong, according to them, to a specific tribe. As a consequence, the “Pastoral run” is a socio-spatial unit where production activities take place (Bourgeot, 1999). For each “Pastoral run”, a “Pastoral run” assembly, community structure composed of elected representatives, has a proposal capability related to resources management. Those management assemblies consider the “Pastoral run” as their spatial units of intervention. Moreover, an institutionalization process leading to the creation of commune based on those pastoral runs see the light.

2.3. Questions and goals: a perceptive variability?

Are planning and management possible without information on the area under study? If goals of co-management fixed go through mutation reports, environmental assessments are needed. Those assessments need geographical information through data collection and analysis. How to cope with the exceptional morphological variability of this environment and how to gain and to organize data to manage this reserve? Which tool can be enough reactive to deals with those changes? The main hypothesis is that the modeling of the system reserve through a GIS could contribute to the understanding of issues to manage natural resources. Resort to GIS is suitable as a synthetic, modular and scalable tool to monitor natural resources. The follow-up of landscape entities and their mapping, based on traditional ecological knowledge could lead to a sustainable management of the Reserve. Those assumptions imply that the reserve management is done not only for ecological purposes but also for development (tourism or pasture) ones.

The aim of this work is to approach the system reserve by structuring information about it in a framework able to integrate traditional ecological knowledge. The concrete declination of this goal consists in a tool allowing action by providing a representation of the environment, a prototype of GIS. If participative GIS are under increasing interest, the participative aspect of the tool proposed here is, for the time being, limited to data collection through environmental perceptions and evaluations. The question raised is the introduction of a quantitative occidental instrument to local Tamashek population. The traditional ecological knowledge and evaluations have to be calibrated for the equivalence with an occidental evaluation system. This paper aims at developing the participative integration of landscape evaluation and traditional ecological knowledge on a landscape unit basis to manage resources and to surround development processes. This work constitutes a methodological step needed to build up a prototype on a limited area (Theriault, 1995).

3. MATERIAL AND METHOD

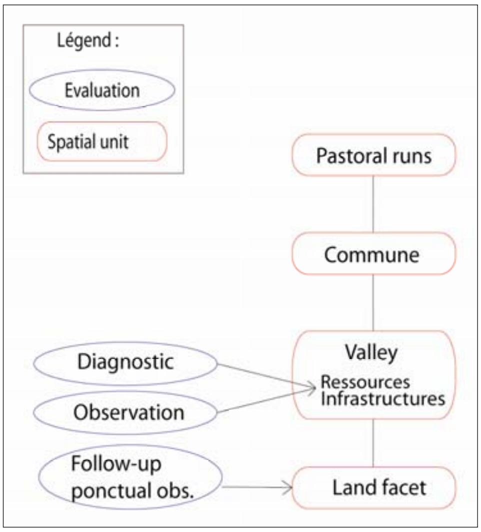
3.1. Landscape ecology as guideline, theoretical framework

In this protected area, different anthropogenic pressures were identified. The main one, the loss or fragmentation of habitats are well-know as a critical factors for biodiversity (BIOPRESS European Project, 2006). To deal with those pressures, there is a need of underlining the changes and to be based upon landscape ecology. This last associates two disciplines which are geography and ecology, trying to link spatial structures, and ecological processes. Different from the geographer landscape approach (Filleron, 2006) and if the ecology was "*without space and men"*, landscape ecology incorporate both (Burel and Baudry, 1999). The landscape is considered as a stack of ecosystems: it is constituted of spatial landscape units imbricated one in another. Although we mentioned landscape ecology principles, we do not use pattern or fragmentation of habitats for diagnostics. The resort to this hierarchical structure has consequences in the way we have organized data, and in the way the reserve is managed (grade participative decision process). The idea is to deal with units getting smaller and smaller. In this sense, the smallest unit of the environmental follow-up is the land facet.

Land facets (Bell and Clarke, 1985) are a spatial division based on an existing classification (Giazzi, 1996). They constitute the smallest area of the follow-up even if the limits of conclusions occurring at those big scales in arid conditions can be underlined (Niamir-Fuller, 2000). Indeed, spatio-temporal variations of rainfall lead to extraordinary fluctuations in vegetation structure. That the reason why the classification used considers the combination of two scales: the land region and the land facet and bring in land facet other biophysical characteristics as soil types, topography or microclimate. In term of landscape reading, land facets are identified as relatively homogeneous units during photo-interpretation. However, if land facets are the main units of monitoring for specific observations, due to the area of the reserve, most of the data would be gathered on a valley basis. The environmental follow up goes through data harvest as environmental diagnostics.

Environmental diagnostics need regular and participative evaluations. They are divided in three temporal components and are realized at different scales (Figure 2): punctual observations (landfacet scale), seasonal environmental diagnostics (twice a year, temporary view at valley scale), and phase diagnostics (every 5 years at valley scale). A set of indicators is specific for each type of diagnostics. Diagnostics elements based on traditional ecological knowledge and indigenous evaluations are geo-referenced to link natural processes and human practices.

Figure 2: Evaluation and spatial units.



3.2. Traditional ecological knowledge and indigenous evaluations

Traditional ecological knowledge deals with data, information or knowledge; they are an heirloom handed down from generation to generation about the relationship between human and their environment. Despite their arduous formalization, they are able to identified ecological changes (Berkes and Folkes, 1998). Several studies in the field of resources management used semi-directive interview based on maps to collect knowledge. The participative framework of the COGERAT gives a specific role to maps and mapping, they become the base of discussions. The gathering of that knowledge is considered as data collection.

3.3. The landscape maps as federative tool

If the RNNAT's biotope classification based on landscape typology appears as a preliminary step through environmental assessment, the landscape map should be able to realize environmental assets. Indeed, an inventory mapping carried out in a participative way would be able to interface local and scientific evaluations through traditional ecological knowledge (Giazzi, 2004 and 2005). Those assets have to be done by resources users. Thus, the map assumes a specific dimension in a participative framework. What are in this context the user's reference landscape units? Coming from anthropological approach, "Pastoral runs", valleys or facets, should be able to capture population relations to space and resources.

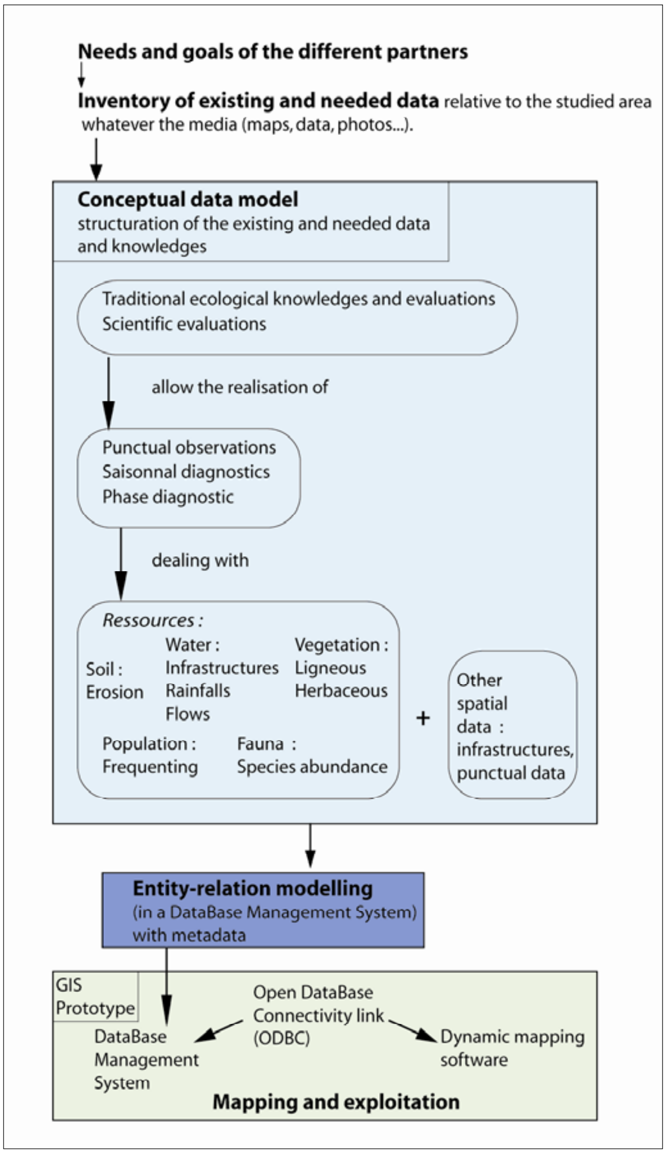
The map, as visual aid of data-reaping and analysis synthesis, would be able to be read by shepherds. Thus, integration of local knowledge and scientific ones, localized and confronted, would constitute a monitoring tool. However, considering the stretching of the Reserve and to answer the amount of spatial information and its heterogeneity, integration of landscape maps and local knowledge was done in a GIS. The last demonstrates up to date, spatial analysis and mapping capabilities, answering territorial management processes. In spite of its technical goals, the tool introduced here is a concrete expression of a territorial intelligent tool embracing all territorial dimensions, from spatial to actors ones, revisiting the definition of local governance. Indeed, as mentioned, the evaluations are made on socio-spatial scale becoming participative administration entities, pastoral runs.

3.4. Methodology

The increasing complexity of decision process leads to use analytical tools, in our case, the coupling of a database management system and mapping software. The resort to this GIS, considered as a toolbox, a geo-referenced database and a partnership organization structure (Burrough, 1998), has some consequences. Beyond their ability to manage data (acquisition, up to date) and more than their technicality, they used occidental scientific paradigms. Thus, the question of the insertion of a quantitative tool must be raise. The rationality in term of landscape spatial divisions is sensitive in respect to population's perception. They can be interpreted as a political injunction (Rodary 2003). However, in the participative framework of the Reserve, based on "true-life" socio-spatial entities, those remarks should not be retained.

To reach the build up of this prototype, the organization of information is made in several steps, get from MERISE method in its last development (Perceptory with UML, (Bedard, 2006) and becoming the geomatic approach (Figure 3).

Figure 3: Build-up methodology.

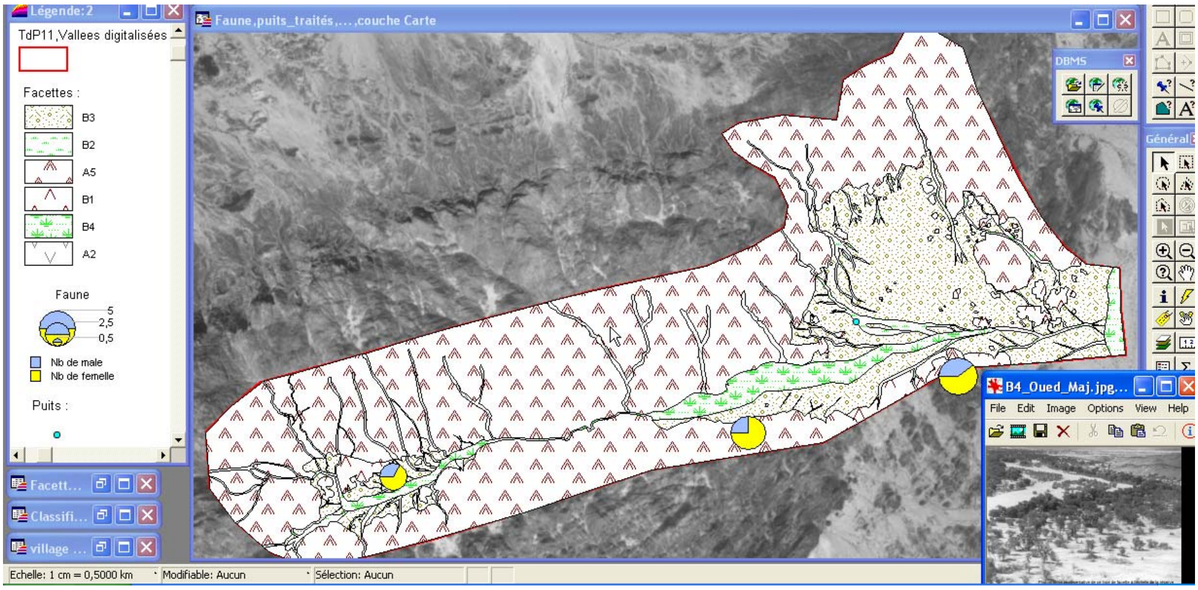


4. RESULTS

After having gathered the needs and goals of the different partners, comes a variety of models, from Conceptual Data Model (CDM) to entity-relation one, implemented in a database management system accompanied by metadata. This last is dynamically linked to mapping software.

After the identification of partners and future users and because of a participative context, we mentioned that the tool has to use indigenous evaluation for environmental diagnostics. One goal is to build a dual equivalence system, indigenous and scientific, requiring a calibration. What is the equivalence of 12mm fallen in June 2002 for the herdsmen? If an answer to the representation of quantitative data can be get round by codification, the one relative to calibration is empiric. The collect of the two values, indigenous and scientific, during a time has to be done to reach the calibration (started few years ago). At least, one condition of the participation is directly linked with the accessibility of the tool in term of language. Through technical aspects (Figure 4) which take a particular dimension in participative context, a double reading is possible. All toponyms, field entities or evaluations are in Tamashek, accompanied by an audible pronunciation. In the same way, distinctive photos can be displayed to identify and locate facet types, or other entities.

Figure 4: Mapping software snapshot.



5. CONCLUSION

In a participative conservation and development framework, and to cope with evolutions bearing upon a sensitive environment, a management program has been started. To reach this goal, one condition is to dispose of geographic information. Their gathering are based on ecological knowledge on a landscape basis and by this way, empirically, it promotes participatory and collective choices for actions, necessary but not sufficient conditions of "good governance". The tool is not considered as the heart of the decision process but as a pretext of questionning and a participation medium.

The proposed prototype gives a structure to data and integrates a dual equivalence system of evaluations, indigenous and scientific ones. GIS capabilities with the centralization and normalization of data are suitable in this context. GIS are considered as a toolbox, a geo-referenced database and a partnership organization structure; the link with territorial intelligence is then obvious: giving favour to actors or technical aspects, territorial intelligence or GIS come together in structures named observatories.

6. REFERENCES

Bedard (2006) Perceptory Project http://sirs.scg.ulaval.ca/perceptory/ consulted 03/05/06.

Bell and clarke J. F. (1999) Biodiversity and protected areas, Regional Report, http://www.mekonginfo.org/mrc_en/doclib.nsf/0/F745162DBAF349D4C72568330036F480/$FILE/FULLTEXT.html, consulted 3/05/06.

Berkes, F. et folke C. (1998) Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience, Cambridge University Press, New York.

Bertacchini Y., Girardot J.-J. (2006) De l'intelligence territoriale: théorie, posture, hypothèses, définition, in Ve colloque TIC & territoire: quels developpements? Université de Franche Comté, Besançon, 9-10 juin 2006, consulted 28/09/2007 http://isdm.univ-tln.fr/PDF/isdm26/3.YB-JJG-GG.pdf

BIOPRESS European Project (2006) - linking pan-European land cover changes to pressures on biodiversity http://www.creaf.uab.es/biopress/links.htm consulted 03/05/06.

Blanc-pamard C. (2003) Les temps de l'environnement. D'un sauvetage technique à une gestion locale en Afrique et à Madagascar, avec J.B. Boutrais, Historiens et Géographes, Regards sur l'Afrique n° 379 pp 249-262.

Bourgeot A. (1999) Anthropologie, environnement et développement durable, rapport de mission DDC Berne Suisse 70 p.

Breman H. and De Ridder N. (1991) Manuel sur les pâturages des pays sahéliens Ed. ACCT, CTA Karthala,, 485 p.

Burel F. and Baudry J. (1999) Écologie du paysage. Concepts, méthodes et applications Paris, TEC & DOC, 362 p.

Burrough P.A., MCDonnell R.A. (1998) Principles of geographical information systems Oxford, Oxford University press, 333 p.

Filleron J.-C. (2006) Le paysage, cela existe, même lorsque je ne le regarde pas ou quelques réflexions sur les pratiques paysagères des géographes, http://perso.wanadoo.fr/paysage/jcf2.htm, consulted 3/05/06.

Flety Y. (2006) La Réserve Nationale Naturelle de l'Aïr-Ténéré (RNNAT), Vers un instrument spatialisé de gestion des ressources naturelles: approches et outil, Mémoire de Master 2 Recherche, UJF, Grenoble.

Giazzi F. (2005) Elaboration d'une stratégie de conservation des ressources naturelles de la RNNAT, Etudes n° 4, UICN PNUD FEM (non publiée) 78 p.

Giazzi F. (2004) La carte des paysages, un outil de suivi du milieu dans la Réserve Naturelle Nationale de l'Aïr et du Ténéré (Niger). La gestion du risque climatique en question", CNG, Comm. Géo. des Esp. Trop. et de leur Dev., Orléans 24-26 sept. 2003, «Espaces tropicaux et risques: du local au global», PUO/IRD, pp.419-430.

Giazzi F. (1996) La Réserve Naturelle Nationale de l'Aïr et du Ténéré (Niger): la connaissance des éléments du milieu naturel et humain dans le cadre d'orientations pour un aménagement et une conservation durables / UICN and WWF; MH/E 712 p.

Niamir-fuller M. (2000) Managing Mobility in African Rangelands the legitimization of transhumance, Intermediate Technology Development Group Publishing, 240 p.

Rodary E. (2003) Conservation de la nature et développement, l'intégration impossible? Ed Karthala 308 p.

Theriault M. (1995) LASIG. Système d'information géographiques: concepts fondamentaux, Notes et documents de cours, numéro 12, LATIG, Département de géographie, Université Laval, Sainte-Foy, Québec, G1K 7P4, http://www.unites.uqam.ca/dgeo/geo7511-2001/htm/guide.htm, le 3/05/06.

Tucker C. J., Dregne H. E., Newcomb W.W. (1991) Expansion and contraction of the Sahara Desert from 1980 to 1990 in Science 253: p 299-301.