Experimenting with the design of policies on sustainable resources management.

Phase 1 Final Report
January 2004 – January 2005

15 February 2005

Background

1. The Desert margins Program (DMP) [1].

- Regional project of six years in three phases of two years, coordinated by ICRISAT.
- US$16,335,000 from GEF, US$33,537,000 in co-funding.
- Study sites: Burkina Faso, Botswana, Kenya, Mali, Namibia, Niger, Senegal, South Africa, Zimbabwe.
- Phase 1 of US$15,219,133 (US$4,987,134 from GEF and US$10,231,999 in co-funding) approved for June 2002-June 2004 (extension until December 2004).

The overall objective of the DMP is to arrest land degradation in Africa's desert margins through demonstration and capacity building activities. The GEF increment to this project will enable the programme to address issues of global environmental importance, in addition to the issues of national economic and environmental importance, and in particular the loss of biological diversity, reduced sequestration of carbon, and increased soil erosion and sedimentation. Key sites harbouring globally significant ecosystems and threatened biodiversity have been selected in each of the nine countries to serve as field laboratories for demonstrations activities related to monitoring and assessment of biodiversity status, testing of most promising natural resource management options, developing sustainable alternative livelihoods and policy guidelines and replicating successful models. The project will make a significant contribution in reducing land degradation in the marginal areas and help conserve biodiversity. Guidelines, recommendations and supportive national policies that address biodiversity concerns are envisaged to be in place in the implementing countries.

The consortium of partners pools resources and expertise of nine NARS and NGOs, four sub-regional organizations (CORAF for western Africa, SADC/SACCAR for southern Africa, and ASARECA for eastern Africa), five IARCs (ICRAF, ICRISAT, IFDC, ILRI, and TSBF), and three ARIs (CEH, CIRAD and IRD, with the experience of UNEP and UNDP in the implementation of the CBD, UNFCCC and UNCCD).

Expected outputs.

The DMP aims at producing outputs related to 7 components (ARIs are expected to contribute to outputs 1 to 5) :

1. Ecological Monitoring and Assessment;
2. Biodiversity conservation and sustainable use;
3. Sub-regional, National and local capacity building;
4. Alternative Livelihoods;
5. Policy and legal framework ;
6. Extension of Sustainable Natural Resources Management;
7. Stakeholders participation;

Expected Role of ARIs and IARCs.

At the national level, IARCs and ARIs , will assist NARS through the Scientific and Technical Advisory Team (STAT) to develop a common framework for site stratification and to characterise specific bench mark sites. The STAT will also provide support to NARS for the development of standardised data collection methodologies, storage and management systems for an understanding of ecosystem status and dynamics with regards to the loss of biodiversity. IARCs and ARIs will also participate in the implementation of studies at the benchmark sites

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[1] Extracted from DMP project document (download) .

and assist with an overall syntheses at the sub-regional and regional level. In addition, IARCs and ARIs will promote capacity building in the NARS through training courses and collaborative studies at the field level. Through these collaborative studies, IARCs and ARIs will provide support to NARS for the development of natural resource management methods and technologies that include strategies for implementing and promoting conservation, restoration and sustainable use of degraded ecosystems.

At the sub-regional and regional level, IARCs and ARIs will assess the need for new scientific, technical and social science in order to implement and fulfill all the proposed DMP outputs, and then develop appropriate training packages that meet these needs. Such training may be provided by an array of different types of courses, or through scientific team exchange visits and information sharing between sub-regions and countries to facilitate technology transfer. Sub-regional and regional synthesis of results will be developed by IARCs and ARIs through upscaling methodologies for south-south trends and through the use of systems modeling, remote sensing and GIS tools for extrapolation strategies. Biophysical and socio-economic approaches to modeling will be integrated to allow the screening and identification of scenarios that will lead to best bet management practices and policies for rebuilding biodiversity and restoring degraded and collapsed ecosystems. Once appropriate technologies and land use practices have been identified, IARCs and ARIs will assist NARS scientists to assess the training needs of all levels of stakeholders and target populations across sub-regions and countries. They will then develop training packages and appropriate policy guidelines that meet these requirements. They will also generate and produce information / dissemination packages.

It is expected that ARIs and IARCs will provide strong complementary expertise in specific fields:
- ICRISAT in crop biodiversity and natural resource management
- ILRI in pasture lands restauration
- ICRAF in agroforestry systems
- TSBF for soil fertility management
- IFDC for integrated soil nutrient management
- ARIs in models development and upscaling
- Specialized NGOs in medicinal plants
- NARS in local expertise on above

AIARCs and ARIs are expected to contribute to outputs 1 to 5 of the DMP, by unfolding activities along the following lines[2]:

1. Development of common framework for site stratification and characterization of specific bench marks
2. Provide support to NARS for the development of standardized data collection methodologies, storage and management systems for an understanding of ecosystem status and dynamics with regards to the loss of biodiversity
3. Participate in the implementation of benchmark site characterizations and an overall synthesis
4. Generating and production of information dissemination packages for all levels of stakeholders across sub-regions and countries (cross referenced to activities in national log frames)
5. Provide support to NARS for the development of natural resource management methods and technologies that include strategies for implementing and promoting conservation, restoration and sustainable use of degraded ecosystems (cross referenced to activities in national log frames)
6. With assistance of all participating researchers assess the scientific, technical and social skills required to implement and fulfil all outputs capacity.
7. Develop packages that meet requirements identified in 6.

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[2] S. Koala, personal communication (March 2004).

8. Scientific team exchange visits and information sharing between sub-regions and countries to facilitate technology transfer
9. Develop an upscaling methodology to infer south-south trends at a regional level through the use of system modelling, remote sensing and GIS tools for extrapolation strategies
10. Integrate biophysical and socioeconomic approaches to modelling that allow the screening of scenarios that will lead to best bet management practices and policies
11. With assistance of all participating researchers assess the training needs all stakeholders and target populations implementation
12. Develop training packages and appropriate policy guidelines that meet requirements identified in 11.

The contributing ARIs are the French Agricultural Center for International Development (CIRAD), the Centre for Ecology and Hydrology (CEH - Edinburgh), and the Development Research Institute (IRD - UR083).

- CEH focuses on physical and chemical processes linked to carbon cycle ;
- IRD focalises on soils biology ;
- CIRAD focuses on environmental policy through an experimental approach involving upscaling, modelling, and training.

Development of CIRAD-DMP proposal

Since January 2003 CIRAD and the DMP coordination have discussed about how CIRAD can best contribute to the work of the DMP. During the brainstorming sessions that took place within CIRAD, several scientists showed a marked interest and were ready to invest heavily in the DMP. This led to a joint proposal coordinated by Dr Grégoire Leclerc, which involved scientists working in socio-economics research[3]. The draft was submitted in May 2003 to the DMP coordination, which responded positively.

In August 2003 a new version of the proposal was sent which was officially endorsed by CIRAD top management, and the next months were dedicated to polish the proposal to include suggestions from the DMP coordination in order to improve its linkages to the DMP logframe. In January 2004 we had the green light from the DMP coordination to submit a workplan and budget for period January to June 2004, which we prepared and sent for approval by CIRAD administrative bodies within two weeks. We also started the activities related to the DMP but funded by CIRAD counterpart. The approval process took several months, culminating in a full proposal signed by CIRAD and ICRISAT DG in May 2004.

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[3] Which we found was somewhat underrepresented in the current national DMP activities, suitable for transversal research, and necessary to improve impact.

2. CIRAD-DMP proposal summary

CIRAD proposal relates to socio-economics and NRM policy. ARI activities are unfolded along the framework on this proposal. We propose to set-up, starting in DMP phase 1, a learning process that is co-constructed between scientists, policy analysts, and decision-makers, where the principles learnt from the field are synthesized and shared in a way that maximizes impact. This is done not only through support to NARS but also through sub-regional case studies, in order to go towards more coherence in the approach of policy intervention for the 9 DMP countries.

In our proposal, public policy is approached as a social mediation process, where actors and sectors confront their representations, objectives, and constraints. We offer to set-up and test a platform for demonstration and capacity building with policy makers and representatives of local organizations, to help endogenize resource quality and availability in development policy design. The project contributes to build multi-institutional capacity for policy design related to Natural Resources Management (NRM). It integrates lessons learnt from local experiences, modelling and upscaling. It envisions a 5 years horizon but the strategy and work plan will be re-evaluated after 3 years.

With groups of scientists, policy makers, and local players we will test the process of policy design and negotiation, and the relevance of prevailing economic and ecologic approaches to resource diversity, quality and management. This is done by capitalizing and formalizing local experiences in NRM (e.g. DMP guidelines, appropriate technology, sustainable livelihoods) and translate in a policy making context of national and sub-regional scope. The experimental platform will support the co-construction of an approach that is both culturally relevant and scientifically sound. It is meant to be institutionally independent and neutral to allow the freedom of exploring of policy options and avoid the trap of politics. In that sense, it is a learning tool and not a problem-solving one.

In the first 3 years the project 'i.e. phase 1 and 2) focuses on the arid and semi arid agroecological zones of the DMP West Africa subregion (Senegal, Mali, Burkina Faso and Niger). We will go with national DMP research and extract policy recommendations that will feed in the platform. We will examine the way these countries implement the Convention for Biological Diversity and the Convention to Combat Desertification, particularly with respect to their relevance to climate change and the cross-cutting issue of land degradation. We will also realize transversal research on natural resources diversity, quality and management in a sub-regional/national policy context. The subsequent phases we will move towards sustainable livelihoods by providing capacity building on the methods, tools, and processes put in place in phase 1.

The project is done in close collaboration with the national DMP coordination bodies of the sub-region, and with the Pôle Pastoral Zones Sêches (PPZS), Agrhymet, IIED, IER (Mali), with ISRA, ENEA and UCAD (Senegal), as well as with CORAF and the IARCs and ARIs involved in the project.

Four outputs are expected to be produced by the project:

1) An assessment of the current policy framework and its instrumentation, and on the current implementation of environmental measures.

 2) An assessment of resilience of rural sub-Saharan agro-ecosystems, with an emphasis on pastoralism and mobility and on the role of biodiversity and land degradation.
- We will realize transversal studies to enable upscaling of local experiences in a policy context.

3) A series of case studies that provide
- Co-generated biodiversity, land and water use rules to help policy design.
- Resource use models (land degradation, resource quality, biodiversity) organized in a generic framework. This will be done in close collaboration with IRD and CEH.
- Policy recommendations (goals, instruments, and implementation).

4) A platform for information exchange, negotiation, and experimental development economics (EDE)
- EDE package, including documents, data, and models
- EDE network, workshops and action-research

CIRAD project, although built with a strong internal coherence (and therefore has its own set of outputs and activities), is tightly linked to the DMP outputs and to the role expected from ARIs. More details can be found in the approved project document and CIRAD-ICRISAT MOU.

While the framework for CIRAD intervention is defined for the duration of the DMP project, a detailed work plan and budget has to be approved for each DMP phase.

For Phase 1 the following milestones[4] have been set:

for DMP Output 1:
- 1.1 Support to partners for experimental design and data analysis (Mali)
- 1.2 Indicators of human pressure on the Bamba environment, in a territorial context. (Mali)
- 1.3 Assessment of DMP biodiversity inventories in Bamba (Mali)

for DMP Output 2:
- 2.1 MAS for common pool resources management, adapted for biodiversity and climate change. (Sénégal)
- 2.2 Elicit local knowledge on NRM, biodiversity and climate change adaptation for MAS model (Sénégal).

For DMP output 3:
- 3.1 Synthesis of Sahelian NRM networks.
- 3.2 Internet portal and mailing list of network members
- 3.3 Integration of French ARIs to the network
- 3.4 Focus group on data collection with Malian partners and NGOs of the Gao-Tombouctou sub-region, which will include a hands-on training session in statistics.

For DMP Output 5
- 5.1 Assessment of NRM policies in NEPAD
- 5.2 Pre-assessment of CDB legal and institutional framework in Senegal
- 5.3 An Interactive tool for national Food security assessment (West-Africa scope; case study in Burkina)

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[4] Some milestones have been merged for clarity in the PWB synthesis document.

- 5.4 Land use models at different scales (village, region, country for Burkina Faso) that take into account carbon abatement costs.
- 5.5 Training needs assessment and planning workshop on environmental policy formulation.

The total budget is $154,091 to which the DMP contributes $61,500 and CIRAD $92,591. We mobilize the expertise of several CIRAD scientists, in particular: Bruno Barbier (France, Burkina Faso), Geert Van Vliet (France); Denis Gautier, Nicolas Picard and Philippe Birnbaum (Mali); Grégoire Leclerc, Marcel Djama, and Ibra Toure (Senegal).

While in phase 1 CIRAD emphasizes on support to NARS for standardized data collection, modelling tools, and training, we have also worked on other fronts (see table below).

Table 1.1. Approved budget (unfolded on ARI activities)

PWB DMP GEF Phase 1 In USD		Budget Year 1		Budget Year 2		Total	
CIRAD		GEF	Co-funding	GEF	Co-funding	GEF	Co-funding
Activities	1.Characterisation of benchmarks	-	-	-	-	-	-
	2.Standardized data collection	-	-	6 138	15 958	6 138	15 958
	3.Overall synthesis	-	-	3 375	12 640	3 375	12 640
	4. information packages	-	-	-	-	-	-
	5. Conservation and restoration, and livelihood options	-	-	5 677	6 504	5 677	6 504
	6. Identify scientific, technical, and social skills	-	-	3 614	3 981	3 614	3 981
	7. Develop packages	-	-	-	-	-	-
	8. Scientific team exchanges	-	-	4 936	7 164	4 936	7 164
	9. Scaling methodology	-	-	2 214	3 611	2 214	3 611
	10. Modelling	-	-	13 313	14 868	13 313	14 868
	11. Assess training needs	-	-	12 984	14 599	12 984	14 599
	12. Training packages	-	-	9 250	13 267	9 250	13 267
	total	-	-	**61 500**	**92 591**	**61 500**	**92 591**

3. Synthesis report Phase 1

In this section we synthesize the results obtained on Phase 1 milestones by grouping them under corresponding DMP outputs. Output 4 (alternative livelihoods) will be addressed specifically during phases 2 and 3. Table 3.2 and 3.3 given in annex summarize the activities in terms of DMP and CIRAD project outputs, respectively, with references to ARI outputs and activities.

DMP Output 1: Improved understanding of ecosystem status and dynamics with regards to the loss of biodiversity

Partners: (Mali) Institut d'Economie Rurale (IER), CEH, ICRAF

Milestone 1.1: Support to partners for experimental design and data analysis (Mali)

During phase 1 CIRAD has assisted DMP Malian partner IER to improve the experimental design of biodiversity conservation and restoration in the Bamba site (Northern Mali). At the moment the experiment is designed by IER as follows: 2 ha natural vegetation (fenced with barbwire); 2 ha experiments of tree rows alternating with grass rows (fenced with barbwire); 2 ha of natural vegetation (non-fenced). The first purpose of this experimental design, in Malian researchers mind, is to demonstrate to local populations how important is human pressure and how biomass can regenerate either by itself or via tree plantations. However, there is no replicate to this experiment at this time, while three replicates at least are needed each landscape unit, in order to be "scientifically" relevant. IER is reluctant to change this experimental design because of the additional costs. As this type of experiments typically carried on by NARS has important consequences for the DMP, it would be a task for the STAT to suggest a strategy for moving from an experiment which is built with a demonstration purpose to one that can be extrapolated beyond the site.

Milestone 1.2: Indicators of human pressure on the Bamba environment, in a territorial context. (Mali)

Human pressure may be studied with two complementary methods: in the first case the entry point is the set of indicators of human pressures on natural resources such as presence/absence of indicator species, tree shape according to cutting or herding practises, etc.; in the second case the entry point is people's representations of the environment, of its dynamics in time and in space and of the contribution of human activities to this dynamics. We first focus on this second approach in order to link (during phase 2) with DMP studies on vegetation, ecology, and human processes.

In an environment subjected to desertification since three decades and to erosion and sedimentation in valleys, exploitation of vegetal resources becomes an exercise that is as risky as it is disorganized. However in the Bamba territory, which is located on the left bank of the Niger river between Gao and Tombouctou in Mali, land use practices seem to remain the same despite the fact that environmental awareness and perceptions of environmental degradation by local populations are evolving. While there are less of the large cattle herds of the past, extensive livestock farming is still very important, with large herds of small ruminants and a general tendency to settlement. Some herds still follow the seasonal spatial distribution of pasture and migrate south of the river towards the Gourma, while most herds are maintained near the three Bamba wells as well as on the banks of the Niger river. Pastoral pressure is large and is exacerbated by the disappearance of high quality forages species from the area. In addition exploitation of trees, which are located in inter-dune depressions, has developed near villages and river banks. Wood is used for self-consumption but also for sale in Bourhem and Gao. Thorny trees are also used as fences for livestock or in irrigated valleys.

Biodiversity appears to be threatened, while vegetal biomass is decreasing near human settlements (villages, camps, and wells). Bamba populations perceive this degradation and acknowledge the loss of biodiversity, but most put the blame on

climatic issues.   There is widespread belief that when climatic conditions improve, vegetation will come back as it was before. However loggers that sell their wood are the ones that are generally reproved by local populations. Otherwise, apart from scattered plantations of *Prosopis juliflora* for dunes stabilization near villages, there is no change in practices in response to the perception of negative evolution of the environment and the biodiversity.

Documents:

Denis GAUTIER et Kantougoudiou COULIBALY, 2004. Gestion de la biodiversité végétale par les populations de Bamba, Nord Mali : pratiques et perceptions. Working Paper DMP-CIRAD 04/7.(download)

Milestone 1.3: Assessment of DMP biodiversity in Bamba (Mali)

The vegetation of the area of Bamba corresponds to the transition from the Sahel to the Sahara. It is characterized by a woody layer mainly dominated by *Acacia tortilis subsp. raddiana* and an herbaceous layer where the graminaceous *Panicum turgidum* prevails. The shrub layer is generally missing.   Within this floristic structure, the specific diversity of the vegetation is driven by local variations of the edaphic conditions essentially.   The herbaceous strata dominate over the sandy grounds whereas more diverse woody vegetation is located in the clay-sandy sectors and more generally in areas where ground water is close to the surface.   In addition, the topographic variations and in particular the position of the vegetation with respect to the wind is determining the distribution of the biomass *sensu lato* (i.e. density, height and development of the vegetation). This graduation is the consequence of a rather lateral drainage in the tops of slopes and the rather hydromorphic grounds in the basins shaped between the dunes.

Thus the variability of the vegetation of Bamba, its structure and its composition, is mainly dictated by the accessibility of the plants to the water resources and therefore, the variable capacity of the ground to maintain a sufficient hydrometric level.   In addition, the dominant ligneous species, *A. tortilis* could play an additional role in this water availability since it is fitted with a physiological system equivalent to a hydraulic pump able to go up in-depth water to redistribute it partly under surface during the night. This physiological property, named 'hydraulic lift', has been studied in depth and it has been shown that the quantity of water available for the herbaceous carpet is statistically higher near an *A. tortilis*.   Thus the woody structure seems to be fundamental in maintaining simultaneously a high level of specific diversity and an optimal development of the overall biomass. Human pressure (particularly via livestock) interferes greatly with this natural system: in the zones intensely grazed and trampled, graminaceous and cyperaceous vegetation is replaced by annual grasses and weeds; in addition, the woody layer is pruned and grazed intensely, which results in trees that adopt a stunted architecture and never exceed 1 m in height. The ligneous strata is decomposed, which changes the functioning of natural inter-dune depressions; water is not collected by vegetation at the bottom of the depressions, which results in limited groundwater circulation.   When vegetation disappears, the deep vertical drainage is replaced by surface drainage which cannot stop the progression of the sand, resulting in the generation of a system of active dunes.   The landscape goes progressively from a cellular to a linear organization.

Vertical drainage seems to be fundamental in maintaining landscape structure. This circulation being maintained by the ligneous strata we suggest that the presence of trees, particularly Acacia Tortilis, is the main stability factor in the function of sahelo-saharian ecosystems. In addition the presence of this species improves the soil because it is a leguminous with active nodulation and a proven association with mycorhizes.

After this initial phase of scientific exchanges between IER and CIRAD, we aim to accompany our DMP colleagues in term of methodological development and statistical analysis, in the perspective of producing extrapolable results and joint publications.

Documents:

Ph. Birnbaum, F. Dembélé et Y. Maïga, 2004. Caractérisation de la végétation et de la biodiversité dans le secteur sahelo-saharien de Bamba, Mali. Working Paper DMP-CIRAD 04/6.(download)

DMP Output 2: Participatory natural resource management methods that include strategies for conservation, restoration and sustainable use of degraded ecosystems developed and implemented.

Partners: (Senegal) Institut Sénégalais de Recherches Agricoles (ISRA), Ecole Supérieure Polytechnique (ESP) de l' Université Cheikh Anta Diop (UCAD), Pôle Pastoral Zones Sèches (PPZS), International Center for Tropical Agriculture (CIAT), Institut de Recherches pour le Développement (IRD).

Milestone 2.1: MAS for common pool resources management, adapted for biodiversity and climate change. (Sénégal)

Multiple uses of space and resources are driving the function and dynamics of sahelian agro-sylvo-pastoral territories. It is therefore essential for multidisciplinary research and development teams that accompany local populations in achieving sustainable management of their environment to know the rules and practices that govern the territory. The Pôle pastoral Zones Sèches (PPZS) started a collaborative project in 2002 to do just this, with a grant from CORAF/WECARD. The project aimed at using participatory cartography and multi-agent simulation systems (MAS) for knowledge sharing, negotiation and diagnostics on resources and their management, between scientists and herders on one hand, and between scientists from many disciplines on the other hand. The project produced a shared representation tool for the pastoral unit of Thieul and its resources, with a cartography that link herders' and functional criteria to scientists' technical criteria. When linked to a MAS, the cartographic tool allows resources users to engage in a planning process for management of their territory.

In 2004 value-adding and scaling-up activities could be accomplished thanks to DMP funding. Several peer reviewed publications were prepared. Local decision makers asked that the map be extended beyond the pastoral unit to encompass the extent of Sénégal's smallest official administrative unit, i.e. the *communauté rurale*. In effect, the transfer of competencies to *communauté rurales* brings a new dimension to territorial management and stresses the need for local negotiation support tools. The results will be shared during a workshop to take place in the area during first quarter of 2005.

This experience shows that Agent based models are powerful when it comes to integrate local knowledge with expert knowledge on NRM, and to explore complex dynamic scenarios with local players. We believe that the results of DMP research, as well as the simulation of innovation diffusion, can be effectively shared through a companion modelling involving multiple agents evolving in a spatial environment. CIRAD has ample experience with its user-friendly platform CORMAS.

Therefore we used the spatialized multi-agent system developed for Thieul as a starting point for a generic framework that can be adapted to other DMP sites. Although the pastoral activities are more present in the Thieul site, it is in many ways similar to other Senegal DMP[5] sites and little change is needed to use the ABM for the latter. It includes an activity diagram for Herders, Agro-Herders, and Farmers; ponds and vegetation dynamics models for 5 landscapes; an interface to specify climate scenarios.

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[5] In fact Thieul is less than 50 km east of the Sadio rural community which is a DMP site in Senegal.

In addition to substantial literature review we did a short field trip precisely to explore how a biodiversity module could be implemented in the agent-based model. Biodiversity Day (see milestone 2.2) was also an instrument to help identify key elements to take into account. Basically we have considered two main classes: Actors, and Zones. The relationship between Actors and Zones determines management schemes.

1. Zones for managing/monitoring biodiversity:
- Hot spots for conservation/restoration of biodiversity (e.g. ponds which are a reservoir of biodiversity, protected area, ranch)
- Cultural unit
- Landscape units
- Soils units

Within these zones we have:

1.1 Plant collections, with individual plant attributes:
- Ligneous/forage
- Number of individuals (young, mature, dead)
- Rarity (scientific)
- Simple growth model (Annual or perennial, etc..)
- Function (e.g. hydraulic drift)

1.2 Soil biodiversity attributes
- To be determined with IRD scientists

1.3 Probes to compute diversity indices (e.g. Shannon-Weaver)

2. Actors that manage biodiversity

Within the Actors class we have:

2.1 Two main types of actors:
- Resident (lives in the site and follow community rules)
- "foreigner" (does not live in the site and sometimes does not follow community rules)

3. Actors-Zones relationships

Each actor (pastors, farmers, cattle) has activities related to these zones:
- type of use (extractive (destructive or not), managed (e.g. pruning))
- Utility (preferences scale).
- Role with respect to the zone

This is being organized in a generic conceptual model for biodiversity, framed in Unified Modelling Language, which can be used to describe and model any biodiversity management situation (e.g. biosphere reserves). Programming of the conceptual model into the ABM is being done in Cormas ((http://cormas.cirad.fr/indexeng.htm) by the complex systems modelling and simulation team of UCAD's Ecole Supérieure Polytechnique in Dakar.

Documents:

Ibra TOURE, 2004. Elaboration d'un outil de simulation multi-agents pour la gestion durable des ressources naturelles d'un espace partagé : L'exemple de l'Unité Pastorale (UP) de Thieul – Sénégal. Working Paper DMP-CIRAD 04/8.(download)

Alassane Bah, Ibra Touré, Alexandre Ickowicz, Christophe Le Page, and Amadou Tamsir Diop, 2005. An agent-based model to understand the multiple uses of land and resources around drillings in Sahel. Mathematical and Computer Modelling, Elsevier (in press).

Alassane Bah, Ibra Touré, Christophe Le Page, and Grégoire Leclerc, 2004. A multi agent system for collective action around a drilling site in Sub-Saharan Africa: scenarios for biodiversity and climate change. Presentation to the 8th biennial conference of the International Society for Ecological Economics (conference topic: Behavioural economics and game theory), Montreal July 11-14 2004.
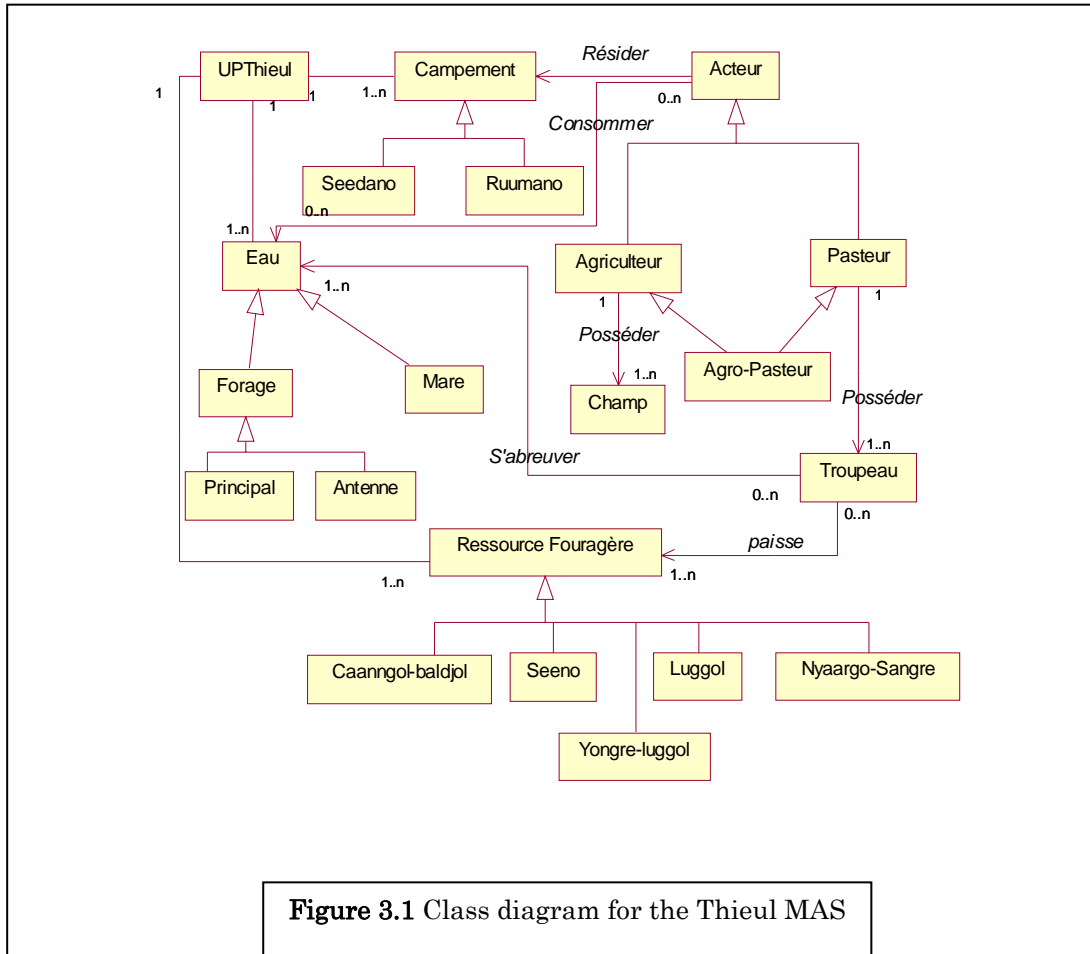
Figure 3.1 Class diagram for the Thieul MAS
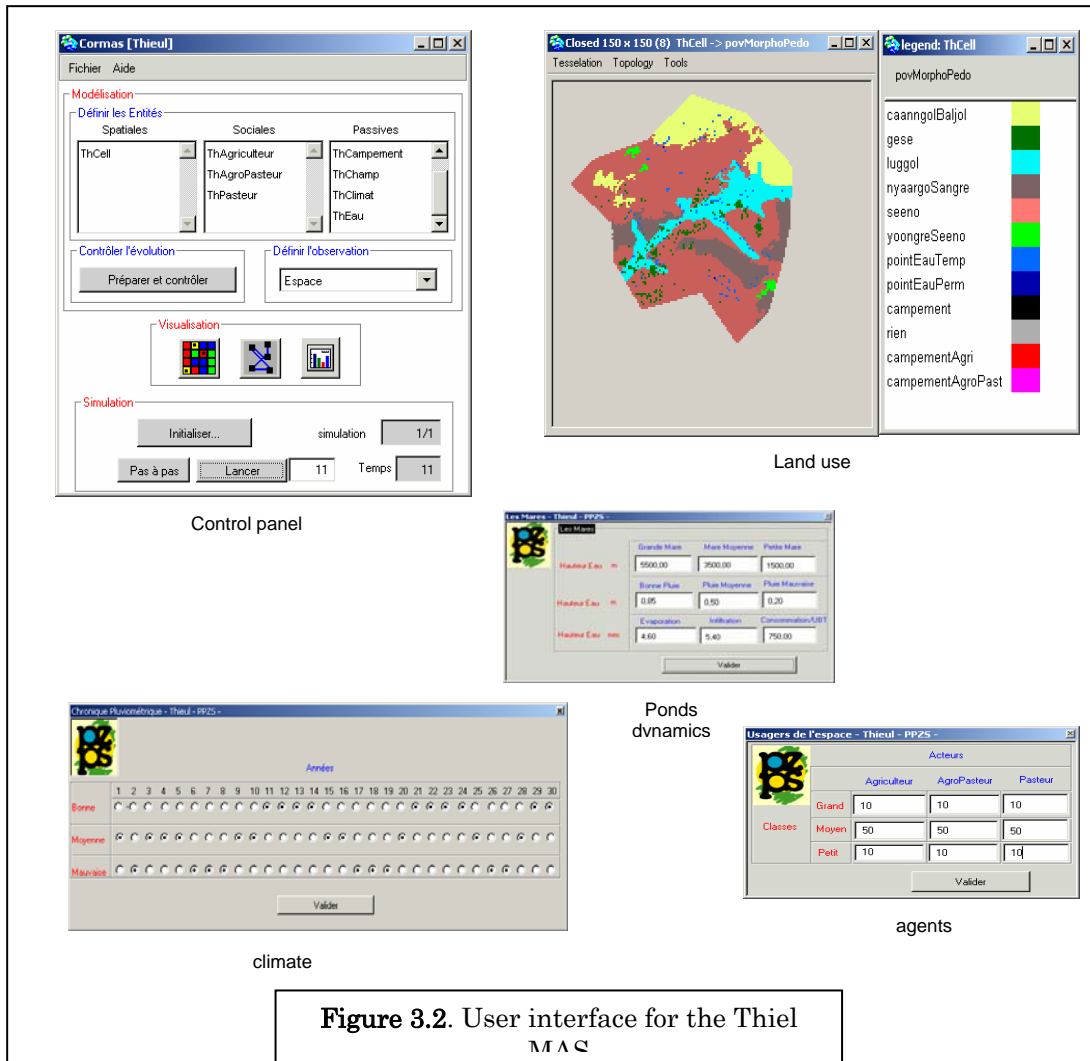
Figure 3.2. User interface for the Thiel MAS

Control panel

Land use

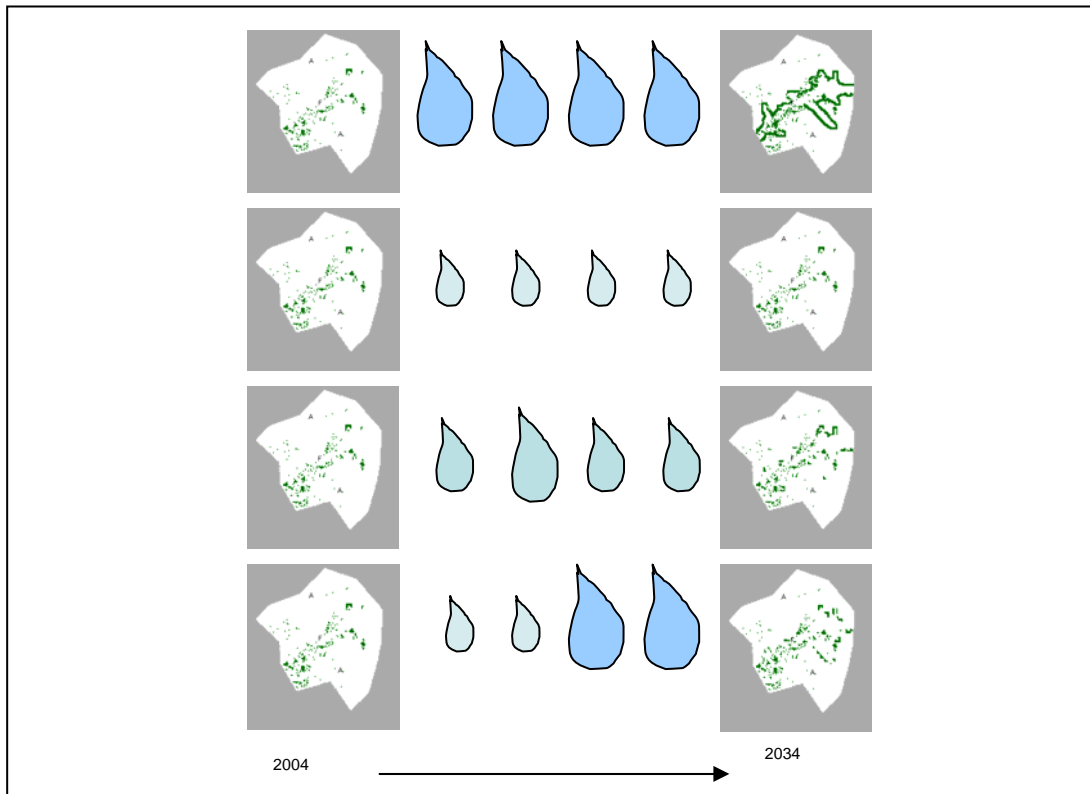Ponds dynamics

climate

agents

2004

2034

Figure 3.3. Effect of climate on agriculture extension 2004-2034 : from top to bottom : good/low/normal rainfall ; bottom: low rainfall (2004-2019) followed by good rainfall

Milestone 2.2: Elicit local knowledge on NRM, biodiversity and climate change adaptation for MAS model (Sénégal).

Initially we had planned to follow closely the methodology proposed by Ambrose-Oji et al (2002) in order to have local assessments that are useful for monitoring and evaluation of biodiversity.

However we realized that there was an urgent need for sharing the substantial body of knowledge and experience in biodiversity management in Senegal, and we decided to organize a knowledge sharing day on Biodiversity.

A first of its kind, the "Journée Biodiversité Sénégal 2005" took place on January 17th 2005 on the premises of the Institut de Recherche pour le Développement's (IRD) center in Hann, Dakar. It aimed at catalyzing exchanges between scientists, policy makers at the national level and local stakeholders directly concerned by this theme in Senegal. It was organized by CIRAD in the scope of its activities in the context of the Desert Margins Program (DMP), in collaboration with the International Center for Tropical Agriculture (CIAT), IRD and the Senegalese Institute for Agricultural Research (ISRA). It grouped approximately thirty participants actively involved in different aspects of the management or research about biodiversity.

Among the participating institutions were a large part of the DMP partners in Sénégal, including ISRA, the direction of Water, Forests, hunting and soil conservation (DEFCCS), the National Agency for Rural and Agricultural Extension (ANCAR), the Cheikh Anta Diop University (UCAD), the NGO Sahel 3000, CIAT, IRD, the common microbiology laboratory (LCM) of IRD, ISRA and UCAD, The association for promoting the Senegalese woman (APROFES), and three local elects of rural communities in the groundnut basin. Participants also included representatives of the National Parcs Direction (DPN), the superior polytechnic school (ESP), the pole of studies on pastoralism in drylands (PPZS), of the Girardel group at the Gaston Berger university, the groundnut basin program (PBA) of the German technical cooperation agency (GTZ), the International Development Research Centre (IDRC) and of the office to support Canadian cooperation (BACDI) and the French cooperation.

The day was launched by an opening ceremony with personalities of research and policy-making in Senegal, followed by a series of formal and informal presentations, a working groups session, a plenary session for the reporting of the latter, as well as an open synthesis discussion. Points of view were also exchanged during the breaks which were accompanied with "biodiverse" drinks and food. The day was closed with a theatrical dance presentation on soil biodiversity. Points of view have continued to be exchanged by e-mail after the event.

During the working groups session, participants joined one of three groups depending on their type of activity: policy-making, research, local development. Each group had the task of making a synthesis of its contributions to the conservation of biodiversity, which represented its offer. The following task was to formulate three questions addressed to each of the two other groups (representing a demand) and name a spokesperson for the group. The plenary reporting of the exercise, which aimed at presenting and matching offers and demands through exchanges between the spokespersons of each group, was a big success and was characterized by a great (and humoristic) performance by the spokespersons as well as a high interest and attention level of participants.

From this first Biodiversity day we can conclude that in Senegal there is a great range of political mechanisms and relevant research results but that their application in the

field remains a problem. If the problem of interaction between scientists and policymakers seems relatively easy to address, local stakeholders remain with very concrete and difficult problems to solve in the field. The management of the environment is a competency that is transferred from the State to rural communities in the scope of decentralization (except in National Parks) but the transfer of responsibility is not accompanied with a transfer in human and financial resources. The State remains with the task of handling the transfer of financial resources and knowledge necessary for the management of biodiversity.   A simple transfer is however not sufficient and it is also necessary to articulate the efforts of all to allow the results of research and the political mechanisms to be better adapted to local needs, and to allow these efforts to become synergetic. This could be done through a learning process in which policy makers, scientists and local stakeholders could work together along a well-defined framework. Positive contributions of the DMP could be to transfer to local stakeholders relevant knowledge and technologies made available by its partner institutions while giving support to the participatory elaboration, monitoring and evaluation of a land use scheme for the groundnut basin as well as in a few rural communities. Participants expressed the need to stimulate the exchange of knowledge and for a debate among diverse stakeholder groups, for collective learning about the management of biodiversity.

A report of the day's activities has been written which is accompanied by a CD-ROM containing the visual support material to the oral presentations, the photos and some short videos taken during the day as well as the press coverage, all accessible through hyper-links in the digital document.

Documents:

Nathalie Beaulieu, 2005. Rapport de la journée Biodiversité Sénégal 2005. Working Paper DMP-CIRAD 05/1. (download) (CD-ROM).

DMP Output 3: Capacity of stakeholders and target population enhanced through involvement/participation at all stages of the project cycle.

Partners: (Senegal) Université Cheikh Anta Diop (UCAD), Laboratoire d'Enseignement et de Recherches en Géomatique (LERG) ; (Mali)IER.

Milestone 3.1: Synthesis of Sahelian NRM networks.

Networking is now a priority and a necessity in research and development projects. The idea of a "network", however, spans a wide range of concepts and realities.

For some, networking means connecting professionals through diverse partnerships and coordination bodies. This is typical of NRM and development networks, including so-called "communities of practice". Although these types of networks are excellent for learning within a given discipline, in some cases they can give unexpected results: for example if society at large is invited to join or use one of such network everything is going to be viewed through the lens of the "expert", with a possible drift towards the "total institution".

An extreme conception of a network is to consider it as the sole property of the user. The network is therefore the set of non-professional relays mobilized by a user to go where he wants to go. This is typical to open systems, and there will be as many networks as there are personal situations.

A third version of the network, related to the "sociology of translation" is emerging as a powerful catalyst for action and innovation. Innovation sociologists Michel Callon and Bruno Latour have formalized a framework to analyse such networks. It has been applied to understand the emergence of technical innovations and scientific findings, the construction of norms and agreements between players with diverse interests (for example new fishing habits to avoid wiping some fish species). We are implementing such a network for our action research on public policy formulation, in which contribution of the DMP science will be key (see milestones 3.2 and 5.5).

The present milestone is essentially an inventory of institutional network initiatives in the Sahel, with an emphasis on development networks. Well organized, active networks are identified by their web presence and structure. Selected networks are listed in an analysis template that contains information on the type of network, its structure, mission, functionalities, impact, and the linkages with other organizations. This allows obtaining a synoptic view of each network, which is useful to build partnerships. We emphasized institutional networks but have also considered networks from civil society (diaspora, etc..). Among the 60 networks listed most are for communication and information purposes, or are scientific/technical. Economic ands social development or health network are also well developed. Critical aspects of development such as democratic development, human and women's rights, or education are more scarcely covered. The inventory of members will allow mapping these networks and identify critical points as well as leverage points in terms of partnerships. The DMP would benefit from contributing to some of these networks to improve its chances of achieving impact during the lifetime of the project and beyond.

Documents:

Aminata Gueye, 2004. Etude des réseaux sahéliens de développement. Working Paper DMP-CIRAD 04/5.(download)

Milestone 3.2: Internet portal and mailing list of network members

Development players are unanimous in recognizing that there is a need for better communication between disciplines and multi-stakeholders learning, multi-disciplinary, trans-disciplinary or involving civil society. Although participatory approaches have been relatively successful in reducing the communication gap between scientists and local players at community level for specific problems, much remains to be done to bring together decision/policy makers, the research community and society at large in a genuine multilateral learning process. This is essentially due to multiple scales, perspectives, and different timescales involved, but also to a resistance to test other forms of participation; particularly the ones that put the elite on the same level as common citizens, but also the ones addressing conflictive issues.

This milestone introduces the concepts of "hybrid forum" (or "socio-technical" forum) and how it is being implemented for the Desert Margins Program. The platform will eventually consist in three components.

- An interactive internet portal: http://sahel.info
- A monthly newsletter;
- Periodic socio-technical hybrid forums and training sessions

In this section we report the underlying philosophy and implementation, as well as the first results for the first component after its first year in operation. The second component is planned for phase 2. The third component has consisted in developing training modules on Environmental Policy negotiation, experimentation and evaluation (milestone 5.5) and in the *Biodiversity Day Sénégal 2005* held in Dakar on January 17 (milestone 2.2).

The site http://sahel.info is inspired by popular bulletin boards and is powered by the free content management system Coranto. In 2004 we have been posting 124 news related to Policy, Environment, Economics, Research/universities, and Rural Areas in the Sahel. The site has only been registered to the search engine Google and not publicized otherwise yet in 2004 it has been visited by more than 1000 different people who have looked at nearly 8500 pages (1000/month) and cast 1200 votes. Analysis of most/least viewed or best/worst ranked postings helps target topics should be addressed (or avoided) by research/development projects. Now that the prototyping phase is over we will publicize the site more broadly and attract new editors, particularly among DMP partners. The site http://dmp.sahel.info, which is based on the same technology as *Sahel Info*, allows sharing results and information specific to the DMP.

Documents:

Grégoire Leclerc, 2004. http://sahel.info: an online hybrid forum and a probe for public interests and opinions. Working Paper DMP-CIRAD 04/10. (download).

Milestone 3.3: Integration of French ARIs to the network

Progress on this milestone have taken place around the building of a network of experts for preparing the training modules on environmental policy negotiation, experimentation, and evaluation (see DMP output 5).
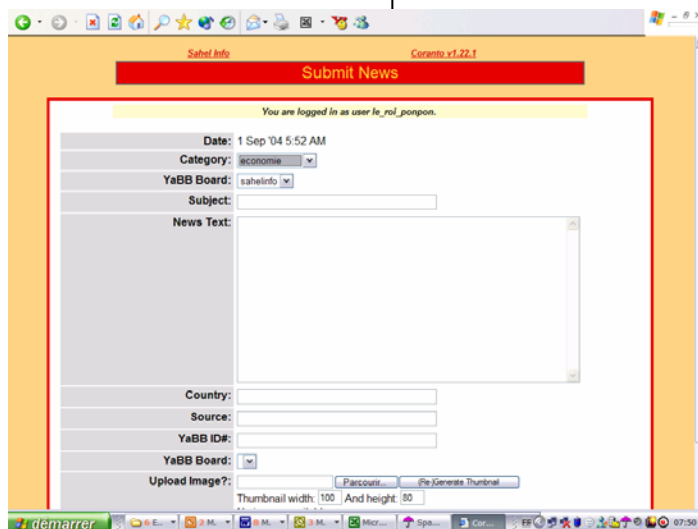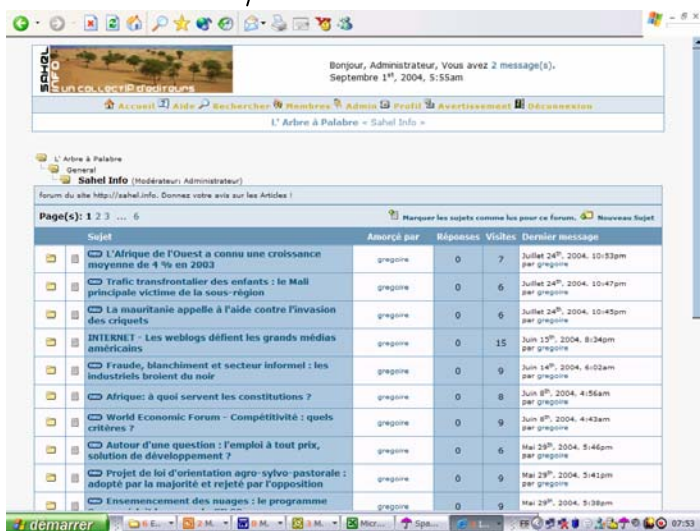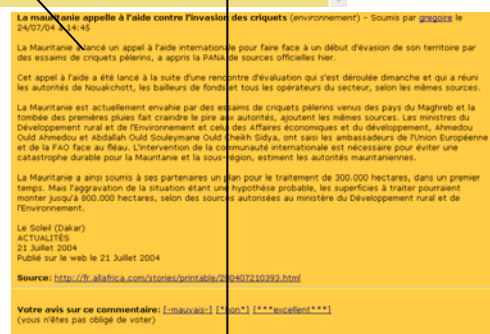
Figure 3.4. from top to bottom:
- *Sahel Info* main screen;
- Full posting and rating window pop-up;
- YaBB forum;
- *Submit News* pop-up window.

Milestone 3.4: Focus group on data collection with Malian partners and NGOs of the Gao-Tombouctou sub-region, which will include a hands-on training session in statistics.

A training course in statistics has been organized by CIRAD in IER CRRA of Gao (Mali) on July 3-11, 2004. 11 scientists from IER-Gao attended the course. The objective was that participants:
- Know what statistical analysis to do and what measurement protocol to set-up depending on a given scientific question;
- Be independent to run common data analysis tasks;
- To analyze their own data sets during the training session.

More specifically participants would be able to:
- plan data collection;
- structure their data;
- do one-factor analysis of variance;
- do a linear regression;
- know when to use a linear model: for what question and following what hypotheses;
- do a PCA or FCA;
- know when to use the main methods for multivariate analysis: non supervised classifications, cross-tabulation analyses;
- use the command line interface of the R software.

Each lecture is accompanied by application examples and is followed by hands-on exercises. The training material and organization of the course are given in the following document.

Documents:

Nicolas Picard, 2004.Analyse de données environnementales : méthodes de base en statistiques. Working Paper DMP-CIRAD 04/2.(download)

DMP Output 5: Appropriate policy guidelines and interventions for sustainable resources use formulated, promoted and adopted.

Partners: (Senegal) Institut des Scienses de l'Environnement (ISE - Université Cheikh Anta Diop UCAD). (Burkina Faso) Institut de l'Environnement et de Recherches Agricoles (INERA), Ministry of Agriculture (Secrétariat Permanent de Coordination des Politiques du Secteur Agricole), University of Ouagadougou.

Milestone 5.1: Assessment of NRM policies in NEPAD

We have completed a summary of the environmental policy framework of NEPAD, which allows us to better understand how environmental measures could be connected to this new economic policy aiming at the integration of African economies by 2025. The study presents the strategy proposed by the NEPAD for proper natural resources management in Africa. It is based on the analysis of documents of the environmental initiative of NEPAD.

NEPAD's environmental body has two main objectives: poverty reduction and contribution to socio-economic development. In effect in NEPAD perspective the "survival" of Africa depends on its "capacity to reverse natural resources degradation which constitutes the support to livelihood systems".

This degradation is closely linked to poverty and underdevelopment. This is why NEPAD environmental component includes sustainable NRM and environmental protection programs that are designed to be the foundation of an environment that will largely contribute to employment generation and consequently to poverty reduction.

On an operational basis NEPAD has developed an action plan for its environmental initiative. Approved in Maputo (Mozambique) in July 2003, the action plan has been elaborated following a consultative and participatory process under the umbrella of the African Ministerial Conference on the Environment (AMCEN), in collaboration with UNEP. It follows the lines of the UN Millennium declaration and the results of the World Summit in Johannesburg. The action plan does not aim at giving an answer to country-level problems but to the African continent as a whole.   The objectives of the plan are to "complement relevant African processes, including renewed AMCEN work plans, to improve environmental conditions in Africa.

To coordinate these actions Senegal (who is in charge of NEPAD environmental component) proposed the creation of en Interim Secretariat (SINEPAD). At this stage activities of the environmental component (79 project proposals at the beginning of 2005) have little visibility and are facing funding difficulties. NEPAD suggests an investment of the private sector but this has not happened to date.

Documents:

Yakhya Aicha DIAGNE, 2004. La place de l'Environnement dans le NEPAD, Working paper DMP-CIRAD-04/9. (download) .

Milestone 5.2: Pre-assessment of CDB legal and institutional framework in Senegal

We have completed an assessment of the implementation of the Convention for Biological Diversity (CBD) in Senegal. The objective of this milestone is to identify institutional and juridical constraints in implementing the CBD in Senegal, based on an analysis of Senegal's natural resources management policy. Field work in DMP sites, which was planned for June and early July 2004, had to be cancelled due to the repatriation of CIRAD's PI in Montpellier.

Conservation and balanced NRM have always been a major concern of Senegal establishment. Before independence the colonial power had initiated a resource conservation policy for more or less ecological reasons. It resulted in classifying forests and the creation of natural parks and reserves. This option has been maintained after independence was over.

Signed in 1992 and ratified 2 years later by Senegal the CBD is now part of Senegal's juridical corpus. Therefore the dispositions that it contains have to be applied like any other juridical norm.

After 10 years of implementing the national biodiversity conservation strategy in Senegal, the results are quite contrasted. Conservation efforts have resulted in a increase of biological presence in recent years, for continental resources as well as marine and coastal resources. On the other hand it has exacerbated conflicts between the State environmental administration and some local populations. Despite an increased level of awareness, populations near protected areas still feel excluded and dispossessed from the resources that they exploited traditionally, and this is not balanced by other income generating activities. Therefore populations have not hesitated in over-exploiting the resources despite the strict jurisdictions in place.

It appears that existing juridical dispositions suffer from four main weaknesses linked to the following points:
- The top-down character of Senegal's regulation. The creation of protected areas has been done with little consideration for the community rights that inhabited them initially;
- The ambiguity of land tenure regulation. In effect the *Loi sur le Domaine National* is not well understood and local populations are still relying on traditional rights;
- A juridical vacuum around some activities such as private management and ecotourism;
- The absence of a real taxation code in favour of saving biodiversity.

In addition to, The Institut des Sciences de l'Environnement (ISE), CIRAD's main partner for this output, is leading the consultation process for developing a new national strategy for sustainable development, which embeds Senegal's strategy for implementing the CBD. The latter is coordinated by the Direction des Parcs Nationaux which took part of Biodiversity Day (Milestone 2.2). These partnerships are unique opportunities for DMP research to be taken into account in Senegal development and environmental policy. We are currently exploring ways to facilitate this dialogue and the co-construction of these strategies.

Documents:

Yakhya Aicha DIAGNE, 2004. Contraintes juridiques et institutionnelles de la mise en œuvre de la convention sur la diversité biologique au Sénégal. Working paper DMP-CIRAD-04/11. (download)

Milestone 5.3: An Interactive tool for national Food security assessment (West-Africa scope; case study in Burkina)

African agriculture is often thought to be little sustainable, largely because it is based on fallow to maintain soil fertility rather than on chemical fertilisers or rotation with soil improving crops. However, population growth in rural areas and reduced availability of bare fertile land is reducing considerably the use of fallow both in space and time. As a result, there is accelerated degradation of natural resources, which sets a limit to crop and livestock productivity gains.
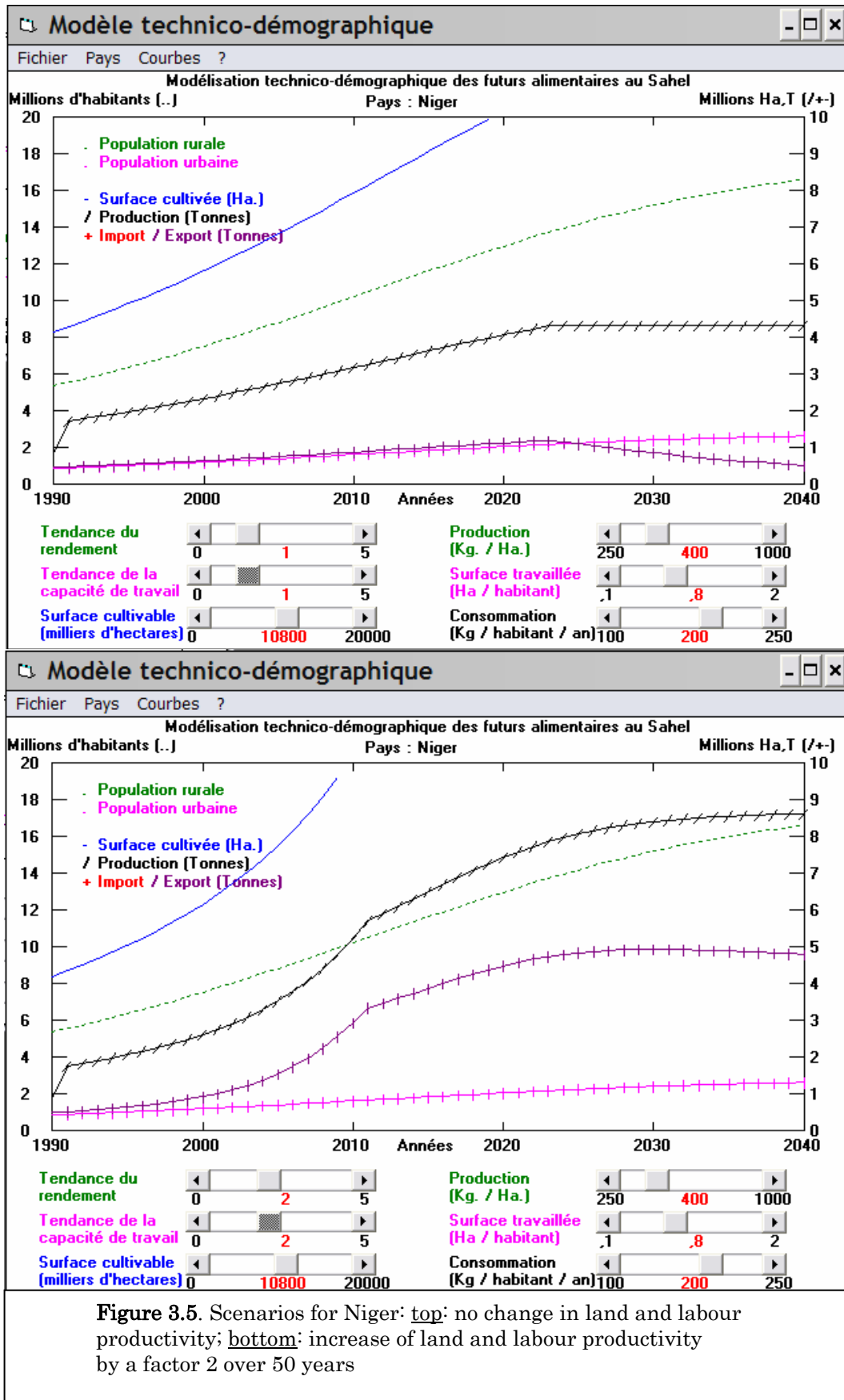
The interactive tool for Food Security analysis, programmed in Visual Basic, has been updated and used to prepare a paper on food security in Senegal and Burkina Faso for the Colloque Développement Durable in Ouagadougou on June 1-4, 2004 (http://www.francophonie-durable.org/). The tool combines a demographic transition component with a "technical transition" one which corresponds to diffusion of innovation. The effect of DMP-related innovation can be simulated by modifying land and labour productivity parameters (see figures below). The updated version of the tool has been made freely available on the Web by the authors (download).

We analysed the impact on food security of urban/rural demography and agricultural productivity in Senegal and Burkina Faso at the edge of year 2040. These simulations, which are interactive and easily interpretable, allow examining production and demand for agricultural goods under various hypotheses related to population growth, availability of arable land, and land/labour productivity. Results are contrasted for both countries and allow one to draft coherent country-specific strategies that favour more sustainable natural resources management as well as sound agricultural policy.

Documents:

Bruno Barbier, Grégoire Leclerc, Michel Benoit-Cattin, Jean François Ruas, 2004. La sécurité alimentaire au Burkina Faso et au Sénégal à l'horizon 2040 : Simulations technico-démographiques. Working Paper DMP-CIRAD 04/4.(download from Sahel Info) (Download from Conference website)

Michel Benoit-Cattin, Jean François Ruas, and Bruno Barbier, 2004. Updated version of VB tool for modelling technical and demographic transitions in the Sahel. (download).

Figure 3.5. Scenarios for Niger: <u>top</u>: no change in land and labour productivity; <u>bottom</u>: increase of land and labour productivity by a factor 2 over 50 years

Milestone 5.4: Land use models at different scales (village, region, country for Burkina Faso) that take into account carbon abatement costs.

Environmental measures such as DMP-promoted technologies have little chance of being adopted if they are not economically viable. CIRAD has explored ways to include environmental parameters into economic models, e.g.. through soil fertility which influences productivity, carbon abatement costs which influences the possibility to enter carbon markets, or other environment friendly incentives.

Model 1: Carbon sequestration : opportunity for developing countries ?
A simulation for Burkinabe agriculture

In the framework of the collaboration with SP/CPSA, Hamidou Seone, ex-employee of the ministry of agriculture of Burkina Faso, was sent to Montpellier to prepare a master degree in agricultural economics. His Master's thesis, supported by DMP funding, is about bioeconomic modelling of carbon sequestration in Burkina Faso to draw curbs of abatement costs. Bruno Barbier, his supervisor, has visited Burkina Faso's Ministry of agriculture in June 2004 to establish the basis of future partnerships. Dr Barbier is now outposted in Ouagadougou.

The thesis relates to economic aspects of an eventual environmental regulation aiming at reducing carbon emissions by agriculture in the cotton producing zone of Burkina Faso (i.e. the Western zone). Simulations with a regional mathematical programming model includes the possibility of adoption of new farming systems such as under story agriculture. We have tried to determine to what extent environmental regulation can lead to either a win-win or trade-off situation. Our hypothesis was that certain agricultural or conservation techniques can, in addition to their carbon balance, increase yields and income thanks to greater soil fertility and water retention capacity as well as reduced costs in chemical fertilisers. However, simulations have shown that environmental regulation would result in reduced farmer's income, and that subsidies would be needed to compensate for the loss. Such subsidies are possible through the clean development mechanism provided by the Kyoto protocol.

Documents:

Hamidou SEONE, 2004. Séquestration de carbone, opportunité pour les pays en développement ? Une simulation pour l'agriculture Burkinabé. Working Paper DMP-CIRAD 04/3.(download)

Model 2: Simulating cotton sector reform in Burkina Faso: Results of a recursive partial equilibrium model

A recursive partial equilibrium model was applied to the agricultural sector of Burkina Faso to explore the likely impact of policy reforms in the cotton sector. The supply side of the model simulates farmers' behavior through utility maximization and expected prices, under a "safety first" risk constraint. The model distinguishes between groups of farmers and herders within ecoregions and groups of consumers in the major cities. The model takes into account the lags between the decisions to plant and marketing time, allowing the production to differ from the initial expectation. After farmers' grain consumption is taken out the marketed surplus is confronted to a food demand function to produce equilibrium prices. These prices minus their transaction costs and the

marketed surplus determine the farmers' final net incomes. A fraction of this income becomes the initial value for a new model run. We repeat these runs over a 5-year period.

A two weeks workshop was conducted in May in Kaya SP/CPSA to calibrate the microsimulation model for the whole Burkina Faso (Mourad Ayouz from CIRAD). (it was paid by the SCAC).

The simulated policy reforms of the cotton sector include an increase in the cotton farm gate price, greater price variability, a phasing out of the "captive" credit system, a better distribution system of fertilizers and a removal of taxes and subsidies. The results of liberalization of the sector suggest a positive effect on the rest of the agricultural sector but this effect barely compensates for the loss of the credit system and the less efficient fertilizer distribution system. The results also confirm that a partial liberalization of the cotton sector is likely to encourage a more extensive farming system with less input, lower yields, a larger cropped area and a little more soil degradation, as it happened in countries that previously liberalized. One key factor is the system of fertilizers' distribution, which in Africa is usually weak and without public support (like most agricultural inputs). This plaids in favour of the site specific integrated soil fertility management promoted by the DMP, keeping in mind that grain yields would have to be at least the same as with chemical fertilisers.

Documents:

Daniel Deybe and Bruno Barbier , 2004. Simulating cotton sector reform in Burkina Faso: Results of a recursive partial equilibrium model. Working Paper DMP-CIRAD 04/1.(download)

Milestone 5.5: Training needs assessment and planning workshop on environmental policy formulation.

Environmental policies have evolved notably in recent years. Managed by the State and generally focused on preserving endangered species, now they have to be part of the decentralization process, contribute to sustainable development and to poverty reduction.

There are also great changes in the way public policies are being implemented: public participation is experimenting new decision-making models that are based on consultative and deliberative procedures. The underlying hypothesis is that public participation on sustainable management of renewable resources will be more efficient if they are co-constructed in partnership with multiple stakeholders of civil society. Policies are defined and governance instruments are being developed through "hybrid forums" that link public and private sector players and collectives (see milestones 3.1 and 3.2).

These changes in formulating public policy are largely unknown (or mystified) and uncared for by the majority of natural scientists. Most believe that their role is and should stay at the interface only, i.e. at the level of technical recommendations (actually this is the way the DMP has been designed). Few believe that they can actively contribute to the whole cycle of the policy process. CIRAD has plenty of experience in research and training on environment policy and collective action, yet we believe a more hand-on approach is needed for the DMP.

There is a clear demand for training on these new instruments of governance for natural resources management. In May 27-28 CIRAD scientists have met in Dakar with Senegal's key player on sustainable development strategy, Dr Henri Lo, to design a new crash course on policy training suitable for participants with diverse skills and viewpoints. We ended-up with two different proposals: the first is an innovative mix of approaches: situational strategic planning, hybrid forums, and hands-on experimentation and modelling for joint policy dialogue construction and learning. The second is more classic training on negotiated construction of environmental policy, balancing alternating lectures and role playing sessions. Budget estimates, awareness packages and training material will be developed during phase 2.

Training course 1: Experimentation and learning workshop on environmental policy design and evaluation.

The objective of the 5 days workshop is to assemble practitioners from different horizons to share experiences, experiment, and to collectively learn new approaches for evaluating environmental policies and building robust solutions to environmental problems.

Specifically participants will learn:
- What is the policy cycle in practice;
- How to evaluate a problem's complexity;
- How to chose methods and instruments best suited to the nature and complexity of a problem;
- How to develop self-learning capacity;
- How to pursue the learning process after the workshop.

The workshop is built on a series of learning principles:
- A dynamic process based on brainstorming and experimentation, not on lecturing;
- Participants are never bored or trapped in unwanted activity;
- The process builds on locally relevant case studies;
- Participants are exposed to a variety of tools and facilitation methods but are free to chose which one they want to learn;
- Fixed rules of the game but free choice of training trajectory.

The workshop targets a wide array of participants (minimum 25) from different disciplines and spheres of interest, with an emphasis on opinion makers. The idea is to help embed DMP scientists and partners into the wider multi-stakeholders group. The workshop has a national scope and will be tailor-made to suit country-specific issues, interests and competencies. It will be itinerant within DMP countries and a preparation phase will be needed in each country. In this preparation phase local instructors will be trained and key questions (hot, polemic or conflictive) will be selected as entry point to the learning phase. Participants will come from various horizons to ensure a heterogeneous set of viewpoints and experiences.

The workshop will start with a brief introduction on the genesis of public and private policies and the cycle of policy design. Each day will then start with a question (complexity of the question will increase from day to day). Work groups will discuss the question and a debate will be stimulated in plenary. Various mediation tools will be used to frame the debate. DMP scientists will therefore have the possibility to position their work in the larger, relevant, or hot debate. In the afternoon participants will move into a different learning environment, similar to a marketplace for tools and methods. The marketplace "stands" will cover a wide range of situations: some will address theoretical issues (for those who feel they need more theoretical background); others will provide hands-on training on specific tools (mediation tools, models, etc..); other may just provide counselling (e.g. participants may want to develop their own method,

browse the internet, or discuss with "experts"). DMP-promoted technologies or approaches, for instance, will be addressed in one (or more) of the stands depending on availability and area of expertise of national DMP scientists. A system for earning "learning points" will stimulate full involvement of participants.

Depending on availability of local or international expertise the following methods could be presented in the marketplace (*: methods that have been developed during CIRAD phase 1):

- Community-level bioeconomic models at that take into account DMP technologies*;
- country-level models to evaluate economic impact of technology (e.g. carbon abatement costs)*;
- agent-based models for to management of protected areas and biosphere reserves*;
- high-resolution remote sensing and landscape analysis for NRM*;
- evaluation of biodiversity function*;
- tools to assist new forms of socio-technical debate such as hybrid forums*;
- participatory land use mapping*;
- analysis of environmental data*;
- Situational strategic planning;
- Rapid Rural Appraisals;
- Pro-active conciliation tool (PACT);
- Fishbanks: a game to experiment with the tragedy of the commons;
- DMP-promoted technologies;
- International Environmental Conventions;
- Strategic environmental management;
- Theoretical lectures on selected themes;

At the end of the workshop participants will not only have learnt that the socio-technical debate is vital for collective learning and impact, but they will have gone through the whole cycle of policy design and improved their skills and self learning capacity to deal with it.

Figure 3.6. Experimenting with the policy cycle in a 5 days workshop
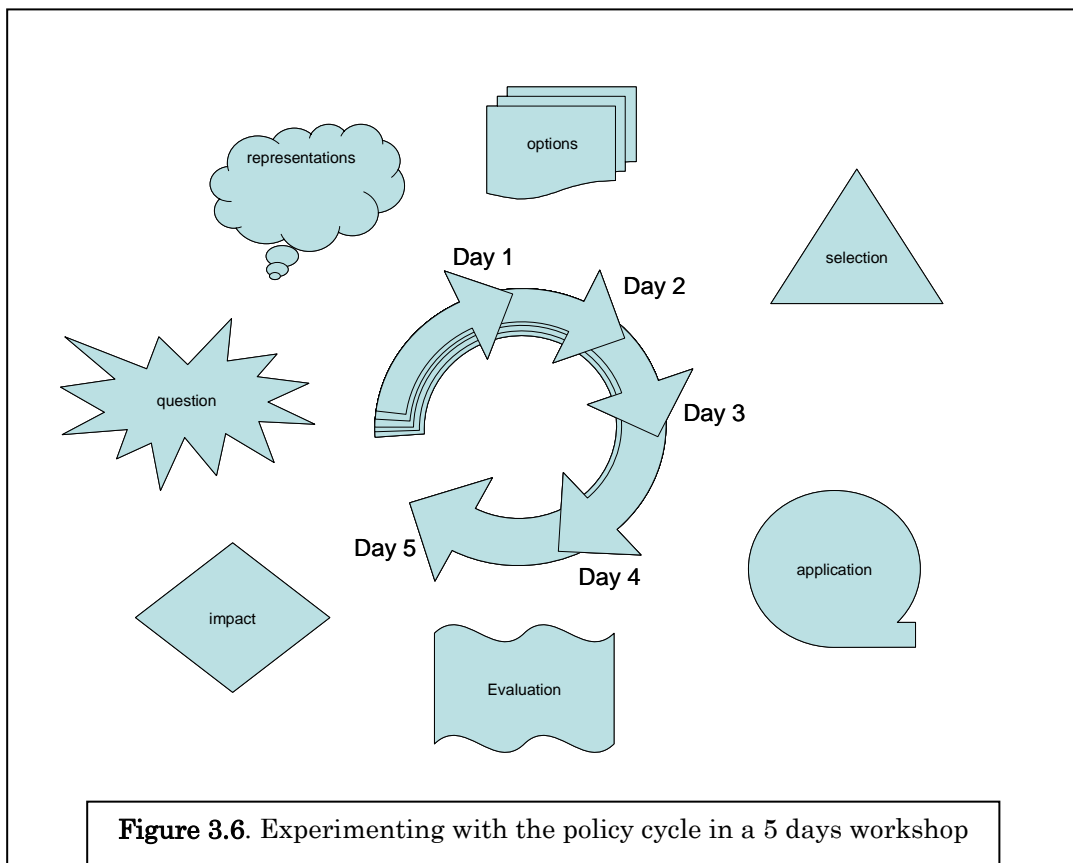
b) Training course 2: Negotiated construction of environmental policy.

This 5 day course aims at proposing approaches and tools for managing controversies between stakeholders involved in solving environmental conflict. It provides a way to define spaces for dialog by mobilizing these collective learning approaches and tools around a given environmental problem.

The proposed agenda for the course is given in Table 3.1. The course starts with an analysis of selected policies within the framework of the policy cycle. It corresponds to the baseline "state of the world", i.e. the set of options currently available for a given policy, which has been set by a panel of experts as intermediaries between policy makers and population. To help build this state of the world a policy evaluation tool, the strategic environmental management, will be presented. During the field visit to a protected area participants will realize what the problems are with the current policy implementation, and the need for a negotiated policy. Two types of negotiation approaches will then be presented. While one is based on building a shared vision and consensus ("patrimonial" approach), the other acknowledges conflicts and divergences ("hybrid forums"). Both aim at removing the layer of intermediaries (i.e. the experts) between population and policy makers by integrating them into the process. During the course participants will learn how to create a more complete and thorough state of the world and realize that submitting a policy to public debate produces new knowledge that can be fed back into the policy for greater relevance and impact.

Participants will come from various horizons:
- Civil servants of the agriculture and environmental sectors;
- Local government representatives;
- Representatives of farmer's organizations and other rural organizations;
- Representatives of nature NGOs (local, national, and international).

At the end of the course participants will have learnt:
- To share visions and issues related to application of international conventions in DMP countries;
- to use various instruments for analysis, proposition, and negotiation around environmental issues;

Table 3.1 : Proposed agenda for training course on the negotiated construction of environmental policy.

		Themes	Objectives	Activities
Day 1		AM : opening session	Round table to present participants. Description of training programme. Expression of demand by participants.	Introductory material. *Fishbanks*: A game to explore the tragedy of the commons.
		PM : introductory material	Presentation of main environmental issues and national programmes. Presentation of international conventions (history, evolution).	Discussion, experiences sharing with national players.
Day 2		AM : the policy cycle	Presentation on the policy cycle (public and private).	Lecture. Discussion and confrontation of viewpoints around case studies of environmental policy formulation.
		PM : instruments for concerted management (1)	Strategic environmental management	Lecture.
Day 3		Protected areas management	Confrontation of viewpoints between protected areas users and managers.	Field visit to a protected area.
Day 4		AM : instruments for concerted management (1)	The « patrimonial » approach. Management tools and role play.	Presentation of tool and group exercises. Lessons learnt.
		PM : instruments for concerted management (2)	Hybrid forums. Presentation of controversial issues. Group exercises and role play.	Lecture. Role play.
Day 5		Wrap-up sessions ; evaluation and closing sessions.	Synthesis of instruments for concerted management of NR. Discussion on their application to environmental policy.	Round table.

Project management and reporting.

Project management load has been large as expected for any new initiative, and exacerbated by the long delay in the signature of the MOU (on CIRAD side). A lot of the project management work has been dedicated to the preparation and revisions of the CIRAD proposal, budget revisions, and MOU which was signed in may 2004. Then we have set-up of a management and reporting system for CIRAD scientists based on the award winning Groove software (http://www.groove.net), have jump-started activities that needed DMP funding, and prepared a series of progress reports. Dialogue with CEH, IRD and with national coordinators and partners has been initiated, but there is an urgent need by the DMP management team to pull together the STAT which is, according to the DMP project document, the main communication body with national DMP teams. The STAT should also be the main instrument for coordinating ARI and IARC activities within the DMP.

Progress reports were produced in May and July 2004. 85% of the project was completed by June 30 and a 6 months budget-neutral extension was granted to complete phase 1. For the extension period the budget was slightly reorganized to reflect better the structure of expenses, according to UNEP budget categories. We had to postpone Biodiversity Day, which was planned to take place in December 2004, top January 2005 because of the limited availability of participants in the busy December period.

Working papers and tools.

Most project documents and tools can be downloaded from http://dmp.sahel.info.

Alassane Bah, Ibra Touré, Alexandre Ickowicz, Christophe Le Page, and Amadou Tamsir Diop, 2005. An agent-based model to understand the multiple uses of land and resources around drillings in Sahel. Mathematical and Computer Modelling, Elsevier (in press).

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Annex: Summary of Phase 1 activities

CIRAD activities during Phase 1 are summarized in Tables 3.2 (by DMP output) and 3.3 (according to CIRAD project document) given below.

Table 3.2: Summary of activities realized during Phase 1 and degree of completion of output (DMP outputs)

DMP Output	ARI activity (CIRAD Output)	Result/Activity	Milestone (% done)	Activities realized (January-July 2004)	Impact/Justification	Possible follow-up (PHASE 2)
DMP Output 1		**Ecological Monitoring and Assessment**				
1.5,1.13	A3, A9 (2.1)	Indicators of human pressure on the Bamba environment, in a territorial context. (Mali)	-Report	-field work for study on perception of environmental problems -explore options for high resolution imagery -purchase Quickbird image -edit report and translate summary	By identifying indicators of human pressure on natural resources allows to pinpoint important drivers of change and provide a way for monitoring and evaluation of resource quality.	Introduction of human pressure indicators into at territorial scale land use models during phase II. Replication of the study to other DMP sites. Essential input to STAT workshop of phase II.
1.8,1.9, 2.6	A2 (2.2)	Review experimental design for Bamba site (Mali)		-discuss with partners about experimental design; this led to training course in statistics (see output 3)	This is crucial to ensure that results from field experiments can be extrapolated.	Replication of design in all the DMP sites to allow regional extrapolation. Essential input to STAT workshop of phase II.
1.8, 1.9, 2.6	A2, A3 (2.3)	Assessment of DMP biodiversity in Bamba (Mali)	-Report	-realize study on the role of vegetal species on the function of agro-ecosystems. - review inventories -field work (surveys, data collection) -write report and translate summary	The role of specific species is particularly important in dry areas, yet this role is not well understood. This will also be important for monitoring and evaluation, and quantifying human pressure indicators.	A common framework for inventories and analysis which takes into account the specific role of species in native agro-ecosystems. Replication to other DMP sites. Essential input to STAT workshop of phase II.
DMP Output 2		**Biodiversity conservation and sustainable use**				
1.2, 1.5, 1.7, 2.5, 5.2	A2, A5 (3.1)	Elicit local knowledge on NRM, biodiversity and climate change adaptation for MAS model (Sénégal).	-Reports	-update of land use map for Thiel site and communauté rurale -literature review on participatory biodiversity assessment -TORs for student. -trip to Thiel to initiate dialogue on follow-up to participatory mapping and biodiversity	Demand from rural communities to map their territory. Need to share experiences and knowledge about biodiversity.	Exploring zoning scenarios with local players. Continue joint learning with key players in biodiversity management, via Biodiversity Day organized in other DMP countries.

				research, and to plan focus groups. -exchange about MAS model with communities. - conceptual model for biodiversity -identification of model parameters components for local biodiversity management -organize Biodiversity day -edit report and translate summary		
1.2, 1.5, 1.7, 1.13, 2.5, 5.2	*A2, A5, A10 (3.2)*	MAS for common pool resources management, adapted for biodiversity and climate change. (Sénégal)	-Report and papers -conceptual model -Operational CORMAS model (95% completed)	-update MAS for climate scenarios and ponds management -design conceptual model for biodiversity management -TORs for subcontract to ESP for programming biodiversity module -present paper at ISEE Montreal (11-14 July 2004)	The way biodiversity is perceived and taken into account by local populations is not well understood; an Agent based model allows to explore the impact of decision rules on biodiversity, according to various scenarios.	A companion modelling approach to policy design, to involve local players and local knowledge. Will be presented during the STAT workshop of phase II.
DMP Output 3		**Sub-regional, National and local capacity building**				
3.4, 7.2, 7.3	*A6 (4.1)*	Synthesis of Sahelian NRM networks.	-Report	- bibliography and methodology -TORs for consultant -hire consultant -research -edit report and translate summary	Many networks already exist for sub-Saharan Africa, which are often under-utilised. We want to complement existing networks instead of duplicating one of them.	Ensure the DMP is present and active in other networks.
2.5, 3.2, 3.3, 3.4, 3.6, 7.2, 7.3	*A6, A8 (4.2)*	Internet portal and mailing list of network members	-Report -Internet portal -tutorial (95% done)	-TORs of subcontract with LERG/ESP for technical support -set-up internet portal-purchase of low cost computer -write technical report and tutorial	Ensure an easy, democratic and lively sharing of information and knowledge .	More participation of civil society not directly linked to the project in the process of policy design.
3.4, 7.3	*A8 (4.3)*	Integration of French ARIs to the network	-Participation of ARIs in network	-email and meetings (environmental policy training)	There is a growing number of French economists exploring experimental and behavioural economics, which can help us	We expect increased participation of French economists in our network, particularly for phase II and III.

			animation		design rigorous methodologies.	
3.1, 3.5	A11 (4.7)	Focus group on data collection with Malian partners and NGOs of the Gao-Tombouctou sub-region, which will include a hands-on training session in statistics.	-Training material	-prepare training material on data analysis -organize and run training session	The focus group will allow identifying training needs on data collection and analysis methodologies.	Replication to other regions, and production of training material.
DMP Output 4		**Alternative Livelihoods**				
DMP Output 5		**Policy and legal framework**				
5.1	A12 (1.1)	Assessment of NRM policies in NEPAD	- Report	-literature review -hire 1 student for policy analysis -analysis of NEPAD NRM policies -complete report and translate summary	NEPAD is the vision for economic integration of Africa for 2025 and will shape development in the region; the way environment is taken into account by the economy is critical.	Possibility to influence or contribute to NEPAD environmental agenda. Essential input to STAT workshop of phase II.
5.1	A12 (1.2)	Pre-assessment of CDB legal and institutional framework in Senegal	- Report	- analysis of Senegal CDB situation -edit report and translate summary	Most national environmental policies originate on global environmental conventions. CDB has shapes biodiversity policies in Senegal.	Full assessment of CDB and CCD for DMP countries. Essential input to STAT workshop of phase II.
1.13, 3.7, 5.2	A5, A10, A11 (4.4)	An Interactive tool for national Food security assessment (West-Africa scope; case study in Burkina)	-publication -freely available tool	- update base data - Scenario runs with stakeholders -present paper to Colloque Développement Durable (Ouagadougou, July 2004) - translate summary	Mathematical models that integrate economic and biophysical factors allows to quickly explore the range of outcomes of policy scenarios.	Models will be updated with most recent data for the DMP countries; a regional sub-model will be added. Key input to STAT workshop of phase II, will help to grasp the importance of parameters.
1.13, 2.5, 3.7, 5.2	A5, A10, A11 (4.5)	Land use models at different scales (village, region, country for Burkina Faso) that take into account carbon abatement costs.	-Report (master thesis) -publication -Operational models	- Review on land degradation in West Africa -contract arrangement with students - model calibration and scenario runs with stakeholders - Restitution to Ministry of Agriculture in Ouagadougou - edit documents and translate summaries	Bioeconomic models implement linear programming to solve complex problems involving rational agents and constraints on the environment (as well as opportunities such as carbon incentives). They help provide good arguments to convince sectoral policy makers about the need for resource management to support a healthy economy	Models can be completed with most recent data from the DMP, including biodiversity. Essential input to STAT workshop of phase II, to ensure proper economic data is taken into account.

3.1, 3.5, 3.7, 5.2	A11, A12 (4.6)	Training needs assessment and planning workshop on environmental policy formulation	-Proposal for training packages (in phase 1 report)	-realisation of mini workshop for designing training in policy formulation -compilation of CIRAD training modules -Identification of site, participants, draft outline on approach and and strategy; -inform Senegal DMP coordination and ask for training needs -write proposal for training packages	Policy design is a negotiation process backed by technical arguments. This workshop explores with partners the way public policy is being shaped in West Africa. It will help all players understand their role, improve their self-learning capacity, and where they can make a difference.	Replication of the workshop to other regions and production of methodology guides. Essential input to STAT workshop of phase II, as well as for guiding socio-economic scenarios modelling for phases II and III
DMP Output 6		**Extension of Sustainable Natural Resources Management**				
DMP Output 7		**Stakeholder's participation**				

Table 3.3: Summary of activities realized during Phase 1 and degree of completion of output (CIRAD outputs)

CIRAD Output	DMP Activity (ARI Output/ activity)	Result/Activity	Milestone (% done)	Activities realized (January-July 2004)	Impact/Justification	Possible follow-up (PHASE 2)
CIRAD Output 1		Assessment of the current policy framework and its instrumentation, and on the current implementation of environmental measures				
1.1	5.1 (O5/A12)	Assessment of NRM policies in NEPAD	- Report	-literature review -hire 1 student for policy analysis -analysis of NEPAD NRM policies -complete report and translate summary	NEPAD is the vision for economic integration of Africa for 2025 and will shape development in the region; the way environment is taken into account by the economy is critical.	Possibility to influence or contribute to NEPAD environmental agenda. Essential input to STAT workshop of phase II.
1.2	5.1 (O5/A12)	Pre-assessment of CDB legal and institutional framework in Senegal	- Report	- analysis of Senegal CDB situation -edit report and translate summary	Most national environmental policies originate on global environmental conventions. CDB has shapes biodiversity policies in Senegal.	Full assessment of CDB and CCD for DMP countries. Essential input to STAT workshop of phase II.
CIRAD Output 2		An assessment of resilience of rural sub-Saharan agro-ecosystems. with an emphasis on pastoralism and mobility and on the role of biodiversity and land degradation				
2.1	1.5,1.13 (O1/A3, A9)	Indicators of human pressure on the Bamba environment, in a territorial context. (Mali)	-Report	-field work for study on perception of environmental problems -explore options for high resolution imagery -purchase Quickbird image -edit report and translate summary	By identifying indicators of human pressure on natural resources allows to pinpoint important drivers of change and provide a way for monitoring and evaluation of resource quality.	Introduction of human pressure indicators into at territorial scale land use models during phase II. Replication of the study to other DMP sites. Essential input to STAT workshop of phase II.
2.2	1.8,1.9,2.6 (O1, A2)	Review experimental design for Bamba site (Mali)		-discuss with partners about experimental design; this led to training course in statistics (see output 4)	This is crucial to ensure that results from field experiments can be extrapolated.	Replication of design in all the DMP sites to allow regional extrapolation. Essential input to STAT workshop of phase II.
2.3	1.8, 1.9, 2.6 (O1, A2, A3)	Assessment of DMP biodiversity in Bamba (Mali)	-Report	-realize study on the role of vegetal species on the function of	The role of specific species is particularly important in dry areas,	A common framework for inventories and analysis which

				agro-ecosystems. - review inventories -field work (surveys, data collection) -write report and translate summary	yet this role is not well understood. This will also be important for monitoring and evaluation, and quantifying human pressure indicators.	takes into account the specific role of species in native agro-ecosystems. Replication to other DMP sites. Essential input to STAT workshop of phase II.
CIRAD Output 3		**A series of well-documented case studies that provide co-generated biodiversity, land and water use rules, resource use models, policy recommendations.**				
3.1	*1.2, 1.5, 1.7 2.5, 5.2 (O2, A2, A5)*	Elicit local knowledge on NRM, biodiversity and climate change adaptation for MAS model (Sénégal).	-Reports	-update of land use map for Thiel site and communauté rurale -literature review on participatory biodiversity assessment -TORs for student. -trip to Thiel to initiate dialogue on follow-up to participatory mapping and biodiversity research, and to plan focus groups. -exchange about MAS model with communities. - conceptual model for biodiversity -identification of model parameters components for local biodiversity management -organize Biodiversity day -edit report and translate summary	Demand from rural communities to map their territory. Need to share experiences and knowledge about biodiversity.	Exploring zoning scenarios with local players. Continue joint learning with key players in biodiversity management, via Biodiversity Day organized in other DMP countries.
3.2	*1.2, 1.5, 1.7, 1.13 2.5, 5.2 (O2, A2, A5, A10)*	MAS for common pool resources management, adapted for biodiversity and climate change. (Sénégal)	-Report and papers -conceptual model -Operational CORMAS model (95% completed)	-update MAS for climate scenarios and ponds management -design conceptual model for biodiversity management -TORs for subcontract to ESP for programming biodiversity module -present paper at ISEE Montreal (11-14 July 2004)	The way biodiversity is perceived and taken into account by local populations is not well understood; an Agent based model allows to explore the impact of decision rules on biodiversity, according to various scenarios.	A companion modelling approach to policy design, to involve local players and local knowledge. Will be presented during the STAT workshop of phase II.
CIRAD Output 4		**A platform for information exchange, negotiation, and experimental**				

		economics, including EDE package, network, workshops, and action research.				
4.1	*3.4, 7.2, 7.3 (O3, A6)*	Synthesis of Sahelian NRM networks.	-Report	- bibliography and methodology -TORs for consultant -hire consultant -research -edit report and translate summary	Many networks already exist for sub-Saharan Africa, which are often under-utilised. We want to complement existing networks instead of duplicating one of them.	Ensure the DMP is present and active in other networks.
4.2	*2.5, 3.2, 3.3, 3.4, 3.6, 7.2, 7.3 (O3, A6, A8)*	Internet portal and mailing list of network members	-Report -Internet portal -tutorial (95% done)	-TORs of subcontract with LERG/ESP for technical support -set-up internet portal-purchase of low cost computer -write technical report and tutorial	Ensure an easy, democratic and lively sharing of information and knowledge .	More participation of civil society not directly linked to the project in the process of policy design.
4.3	*3.4, 7.3 (O3, A8)*	Integration of French ARIs to the network	- Participation of ARIs in network animation	-email and meetings (environmental policy training)	There is a growing number of French economists exploring experimental and behavioural economics, which can help us design rigorous methodologies.	We expect increased participation of French economists in our network, particularly for phase II and III.
4.4	*1.13, 3.7, 5.2 (O5, A5, A10, A11)*	An Interactive tool for national Food security assessment (West-Africa scope; case study in Burkina)	-publication -freely available tool	- update base data - Scenario runs with stakeholders -present paper to Colloque Développement Durable (Ouagadougou, July 2004) - translate summary	Mathematical models that integrate economic and biophysical factors allows to quickly explore the range of outcomes of policy scenarios.	Models will be updated with most recent data for the DMP countries; a regional sub-model will be added. Key input to STAT workshop of phase II, will help to grasp the importance of parameters.
4.5	*1.13, 3.7, 5.2 (O5, A5, A10, A11)*	Land use models at different scales (village, region, country for Burkina Faso) that take into account carbon abatement costs.	-Report (master thesis) -publication -Operational models	- Review on land degradation in West Africa -contract arrangement with students - model calibration and scenario runs with stakeholders - Restitution to Ministry of Agriculture in Ouagadougou - edit documents and translate summaries	Bioeconomic models implement linear programming to solve complex problems involving rational agents and constraints on the environment (as well as opportunities such as carbon incentives). They help provide good arguments to convince sectoral policy makers about the need for resource management to support a healthy economy	Models can be completed with most recent data from the DMP, including biodiversity. Essential input to STAT workshop of phase II, to ensure proper economic data is taken into account.

4.6	*3.1, 3.5, 3.7, 5.2 (O5, A11, A12)*	Training needs assessment and planning workshop on environmental policy formulation	-Proposal for training packages (in phase 1 report)	-realisation of mini workshop for designing training in policy formulation -compilation of CIRAD training modules -Identification of site, participants, draft outline on approach and and strategy; -inform Senegal DMP coordination and ask for training needs -write proposal for training packages	Policy design is a negotiation process backed by technical arguments. This workshop explores with partners the way public policy is being shaped in West Africa. It will help all players understand their role, improve their self-learning capacity, and where they can make a difference.	Replication of the workshop to other regions and production of methodology guides. Essential input to STAT workshop of phase II, as well as for guiding socio-economic scenarios modelling for phases II and III
4.7	*3.1, 3.5 (O3, A11)*	Focus group on data collection with Malian partners and NGOs of the Gao-Tombouctou sub-region, which will include a hands-on training session in statistics.	-Training material	-prepare training material on data analysis -organize and run training session	The focus group will allow identifying training needs on data collection and analysis methodologies.	Replication to other regions, and production of training material.