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DEUTSCHE ZUSAMMENARBEIT

wps nexus

Frexus Project

Final Report on the co-development of analytical tools 2022

Implemented by
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Acronyms

ACLED	Armed Conflict Location & Event Data Project
ABM	Agent-Based Modelling
ABN	Autorité du Bassin du Niger / Niger Basin Authority
API	Application Programming Interface
BMZ	Ministry of Foreign Affairs – Germany
CLD	Causal Loop Diagram
COFOs	Land Commissions
CSO	Civil Society Organizations
DMN	National Meteorological Department of Niger
ECOWAS	Economic Community of West African States
EU	European Union
GIZ	Gesellschaft für internationale Zusammenarbeit
IWRM	Integrated Water Resources Management
IND	Inner Niger Delta
NGOs	Non-Governmental Organizations
PCA	Principal Component Analysis
PCCF	Potential Climatic Land Conflict
SPI	Standard Precipitation Index
ToR	Terms of Reference
UN	United Nations
WEF	Water Energy Food
WFP	World Food Programme
WISO	Wetlands International Sahelian Office
WPS	Water, Peace and Security Partnership
WRI	World Resources Institute

Contents

Introduction

The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and the Water, Peace and Security (WPS) partnership collaborate in the Frexus project in Mali, Chad and Niger. The aim of this project is to improve security and climate resilience in a fragile context through the Water-Energy-Food Security Nexus. This report gives an overview of WPS' activities in the Frexus project and identifies lessons learned, which can be of use in the further implementation of the project.

Overview

The vicious cycle of scarcity, competition, conflict and instability can be turned into a virtuous cycle of resilience, sustainable resources management, cooperation and security. The Frexus project, based in Mali, Chad and Niger aims to support the peaceful resolution of social tensions and conflicts between population groups that are caused or exacerbated by climate change in fragile areas. The project uses an integrated approach – Water-Energy-Food (WEF) security Nexus – to create and foster new opportunities ensuring long term sustainable development and peace. A Nexus approach entails considering the totality of the available sources for food, energy and water security and planning holistically how they can most efficiently together serve humans and conservation needs. Taking a Nexus approach to resource use and project planning in a basin allows to: 1) avoid undesired impacts on other sectors and conflicts between them, and 2) improve efficiency in use of natural resources for human livelihoods ensuring ecosystem conservation.

The involvement of the three sectors takes place on an equal footing and the intersectoral discussion of relevant issues and joint development of solutions leads to win-win solutions or, where this is not possible, at least to jointly accepted trade-offs.

Activities

Throughout the different phases of the project a number of key activities were/will be carried out. WPS specifically collaborated with GIZ on the activities of the action development phase. This document solely reports on WPS' contribution to- and lessons learned from these activities.

The **action plan development phase** aims to develop conflict-sensitive and climate-sensitive action plans via inclusive community workshops for the integrated management of land and natural resources considering the water-energy-food security nexus approach. In this phase, GIZ and WPS collaborate on:

- The extension of the Global hotspot identification and early warning tool with increased indicators to capture food and energy security dimensions. This enables the analysis of areas of potential conflicts over water, food and energy resources, as a starting point for developing climate sensitive and nexus-based responses to resources challenges, ultimately enabling sustainable and peaceful development under climate change conditions.
- The co-development of a local analytical tool, in a participatory manner with key local stakeholders, to assess the key drivers of conflict and assess local intervention options.

Global Early Warning Tool extension

Introduction

The Global Tool is an early warning and conflict identification tool that aims to identify areas that may suffer from natural resource conflicts in the future. The identification is based on the combination of several different indicators (based on open access data) which generally determine whether the challenges related to natural resources lead to conflicts. This allows early identification of potential conflicts (over a 12-month horizon) and therefore sufficient warning time for policy makers and other relevant actors to take action – ideally preventing or at least mitigating these conflicts. At the same time, it allows finer spatial resolution (at the second-order administrative level, i.e. sub-provincial or district level) and therefore a better understanding of local dynamics on natural resources.

Overall, the tool captures 86% of future conflicts, successfully predicting more than 9 out of 10 ongoing conflicts and 6 out of 10 emerging conflicts. The trade-off for this high recall is poor accuracy for emerging conflicts. About 80% of all emerging conflict predictions represent false positives, that is, cases where a conflict was predicted but did not occur.

With GIZ funding, we tested additional indicators capturing the food-energy-water nexus to understand if these indicators could improve the performance of the model. Though we did not see a change in the model's predictive power, we were able to use these additional indicators in causal model and on the tool for users to better understand the local context.

Global tool team members under GIZ: Charles Iceland, Samantha Kuzma, Liz Saccoccia, Alberto Pallecchi, Ninoslav Malekovic

Process

Data Preparation and Processing
Data preparation and processing is typically the most time-consuming part of any data project. This is especially true for the WPS quarterly conflict forecast since our data must be kept up to date. Every step of our data journey is written in Python code so that it can be replicated into the future. We also make these scripts publicly accessible, so we take time to write comments and make sure the code is legible.
The process included:

- Access the data
- Clean the data
- Create a timeseries of the data
- Create a data cube to access the data for the causal models
- Test data in the models
- Add relevant data to the website

Detailed steps on this process are described in the appendix.

Data Cube
We also embarked on a time intensive process to convert our data storage into data cubes. The data cubes are structured to accommodate very different types of modeling, in a way that the simpler table could not, and these allow for the multiple modeling tracks to proceed independently while always utilizing identical data.

Detailed steps on this process are described in the appendix.

Predictive Model

As new data became available, we retrained the Random Forest (RF) model to see if model performance improved, and to test if any new indicators proved to be important. Here, importance refers to how useful a given indicator was at helping the model make decisions. It's measured using the Recursive Feature Elimination (RFE) process, which identifies the variables most effective for predicting conflict. As stated in the technical note, RFE starts with the full set of features, and repeatedly retrains the model, in each iteration eliminating the least important feature (defined by a coefficient attribute of feature importance) until only one feature remains—in theory, the most important one.

We found no noticeable improvement in the conflict forecasts. Despite testing almost 100 new indicators in the model, performance stayed stagnate compared to the pilot. Our original plan was to upload the new model to the online tool if it surpassed the original. Instead, we've pivoted to focus on creating higher-performing models. We will train new types of algorithms using models that have better memory than the random forest approach. This means we can squeeze more information out of our existing data. For example, a deep learning model can remember and use a district's full history of conflict, rather than just the prior 12 months. We are using other streams of funding to pursue these types of models.

Although model performance did not improve, we did find several new food-related indicators ranked in the top in terms of feature importance. We can study the structure of these indicators to learn how we can engineer better-performing inputs for our new models.

Top ranked indicators added during GIZ work
Annual evapotranspiration anomaly (standard deviation)
Cropland (%)
Livestock density: chickens
Livestock density: pigs
Pastureland (%)
Surface water extent (area)
Water consumption segment for highest income households (% of all consumption)

Causal Model

The objective of the causal model was to identify and estimate causal effects of variables that pertain to water, food, and energy insecurity on conflict outcomes. This objective required from us to benchmark such estimates using different causal models. Starting with a static causal model that does not account for mediating effects, the benchmarking was intended to compare such estimates (a) in isolation against such estimates after considering (b) structure of mediators and (c) passage of time. Given the resolution of data, we developed two static causal models (i.e., a and b). These models enable us to benchmark static causal effects of water and food on conflict outcomes (i.e., conflict events and reported fatalities) under demographic and conflict-related mediators. The dynamic causal model (i.e., c) remains an issue for reason that are explained below.

As we developed the static causal models, the key challenge has been and remains data. Some statistical challenges that we faced had to do with the sample sizes. One of the models consumes many more observations. Hence, we had to focus on districts to secure sufficiently numerous observations. Moreover, some challenges couldn't have been overcome: Not all the variables, that were made available to us, are available across all the resolutions (i.e., countries, provinces, districts): Energy-related variables are not available for districts. Hence, we had to drop them from our consideration until they become available for districts.

As we delved into developing the dynamic causal models, absence of conflicts across time precluded extraction of time-series causal graphs. More than two thirds of analytical units have timeseries that follow this pattern. When it comes to the remaining analytical units where conflict outcomes vary across time, associations between time-series for different variables did not lend themselves to extraction of time-series causal graphs, despite several techniques that we applied to this end. Additional, social science and political variables should be made available to inform causal pathways behind conflict dynamics, as induced by water and food insecurity.

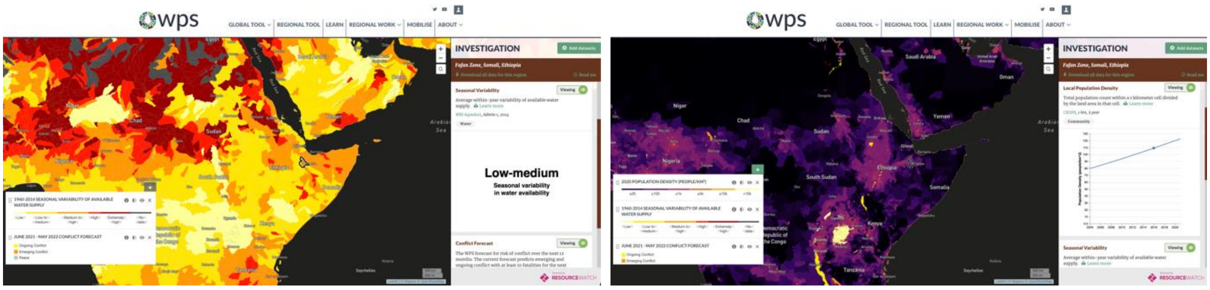
In line with earlier studies, we showed that water insecurity causes conflict outcomes. Like findings of the earlier studies, ours hold in terms of anomalous evapotranspiration. Unlike earlier studies, our findings also hold in terms of standard precipitation and actual evapotranspiration. Unlike earlier findings that relied on data sourced from natural experiments, our findings rest on observational data alone. Finally, via causal graphs, we could also specify, identify, and estimate mediating effects of food-related variables and demographics on conflict outcomes. In short, the proof of concept is such that causal modeling can be used for extracting, transferring, and consuming domain knowledge in water-induced conflict research. The causal model will be launched at our anniversary event in December 2022 in Washington, D.C.

Tool Updates

New Datasets
We worked with our partners to develop new datasets to assist users in understanding the on-the-ground information about certain regions. These datasets provide important contextual information about a location of interest including the status of local reservoirs and forecasted precipitation trends. We've added these datasets to the tool including energy-related indicators such as 'Power generation by Fuel Type' and food-related indicators such as 'Livestock Density' for a variety of animals. In addition, we've had to modify currently available datasets to fit new restrictions. Instead of showing the Armed Conflict Events and Locations Database raw values on the Water, Peace and Security tool, we've worked with the Resource Watch Data Team to aggregate the data to the number of events per type per district. See the appendix for the list of food and energy data sets.

Functionality
The global tool has a wealth of data to explore and understand, but we've come to learn that few users are comfortable enough with data to take advantage of these functionalities. Therefore, we released video lessons on interacting with the tool. In addition, we've incorporated data on the tool into our quarterly updates to demonstrate how to include it in analyses.

On the tool, it's possible to explore contextual information about a district of interest. By clicking on a district in the global tool, the side bar shows timeseries or descriptions of the conditions of that district (see below). We increased the number of datasets that show this information in the side bar if those datasets are relevant at the district level, including the new food and energy related datasets.



Results

Funding from GIZ allowed us to improve our data infrastructure, test additional indicators in the model, create a causal model, and improve the tool. Though the additional indicators did not improve our model's performance, adding them to the tool does allow users to better understand the food-energy-water-security nexus in a location of interest. In addition, we created causal models that gave us insights to the causal relationships between water and conflict. We found that anomalous evapotranspiration, standard precipitation, and actual evapotranspiration all have causal relations to conflict events.

This valuable information has extended knowledge on causal relationships of water, food, and energy to insecurity, and has informed our future research. We plan to create policy interventions built on the causal model, and are pivoting to a predictive model type that is stronger in time series analysis.

Local analytical tool

Approach and methodology

The Frexus project in Chad, Mali and Niger

The Frexus project in Chad, Mali and Niger, was designed to support the peaceful resolution of social tensions and conflicts between population groups that are exacerbated by climate change in fragile areas. The Sahelian region has experienced a convergence of different challenges in recent years and the security situation has deteriorated considerably. Community conflicts, for example between farmers and herders, have increased over time, and latent tensions have become open conflicts, even leading to the emergence of militias. In addition to this, the region is considered one of the most vulnerable to climate change globally and experiences a high fluctuation in rainfall leading to more unpredictable floods and droughts. As most livelihoods depend on the natural resources of these basins, scarcity and competition over these resources are increasing.

Three specific areas of intervention (see Figure 1) were identified by GIZ in close collaboration with the EU/BMZ, the main partners and stakeholders on the ground, following the desk study and various missions in the three countries. The project, divided into three phases, aims to develop and test an assessment tool and methods to examine the links between resource use, climate change and conflict risk, and subsequently identify and implement activities to address the challenges that arise within this nexus, particularly in fragile contexts. The development of the local tool constitutes the finalization of phase 1 (Understanding/Diagnostic) and should feed into phases 2 (Action plans) and 3 (Implementation).

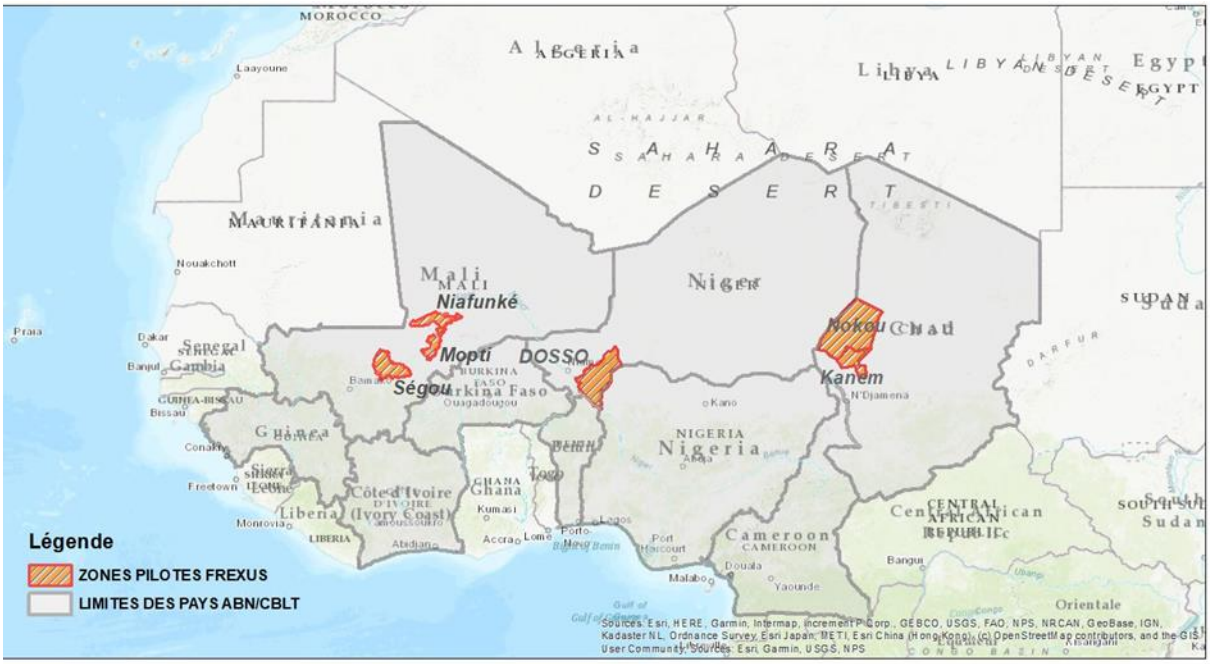


Figure 1 - Zone of intervention of the Frexus project in Mali, Niger and Chad (Source: Frexus, 2022b).

A local analytical tool

The Water, Peace & Security Partnership, via Deltares, has worked with the Frexus project to facilitate the development of a local analytical tool to examine the links between resource use, climate change and conflict and assess the water resources situation. The final objective was the co-development of a local analytical tool, in a participatory manner with key local stakeholders, to assess the key drivers of conflict and assess local intervention options. The development of the local tool is illustrated in Figure 2. It follows three phases which will be detailed below: 1. Understanding of the system through the Causal Loop Diagram; 2. Definition of the users' needs; 3. Data collection and integration into a policy dashboard. The dashboard as local analytical tool is an interactive platform for exploring and visualizing development and natural resource management scenarios and their potential impact on security and conflict risk. Eventually it should facilitate the dialogue and inform decisions on resource allocation and conflict prevention.

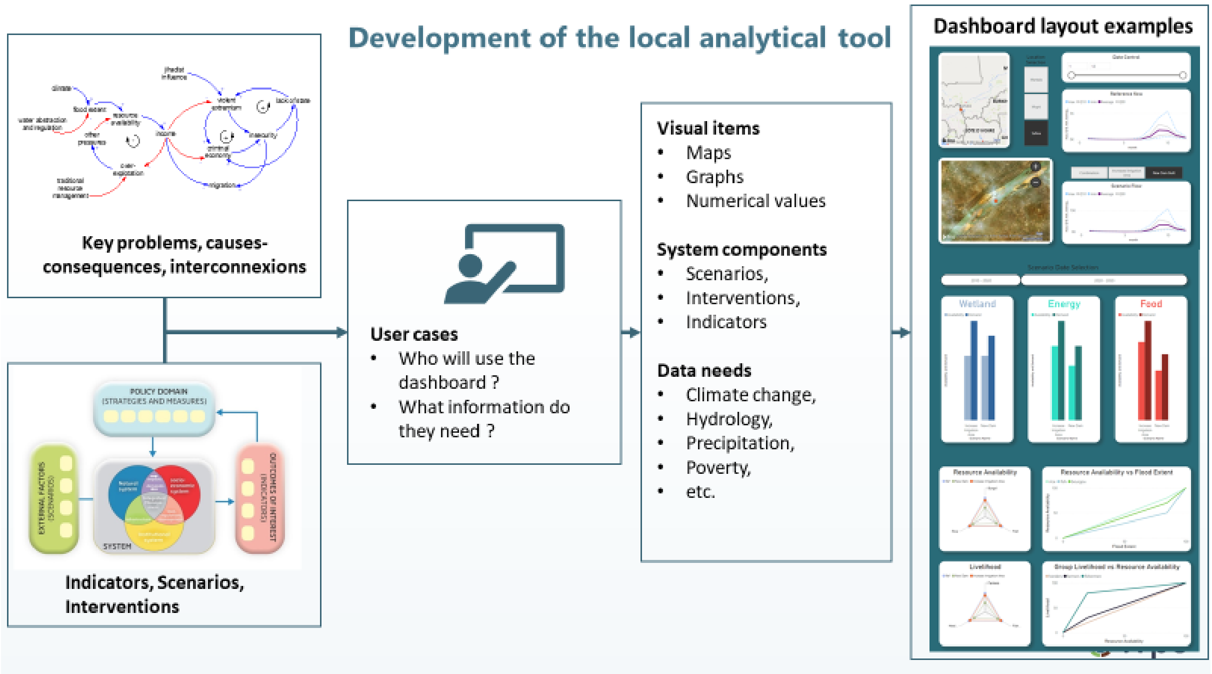


Figure 2 - Development phases of the local analytical tool

Throughout the process, Deltares is responsible for the development of the tool and methodologies. The development of a dashboard fitting the local needs is, however, not possible without a clear consultation with key local stakeholders. This last aspect is executed by the country teams of GIZ that were responsible for the stakeholder consultation process, the identification of the users of the dashboard and the facilitation of local data collection (complementing online sources or global datasets identified by Deltares).

Joint development and participative approach

The tool development process is based on the approach illustrated in Figure 3. An iterative process is set up jointly with the stakeholders: the 'co-developers', representatives of government authorities and civil society organizations at national and local level. It is coordinated locally by a team of 'co-moderators' trained in the preliminary phase of the project (described in section 3.2.), who ensure an ongoing discussion with stakeholders and future users. The process has feedback loops between the different steps. Data, both quantitative and qualitative, and information are identified, discussed and enriched during different consultations with the stakeholders, during workshops, trainings and bilateral or group discussions. In this sense, the policy dashboard development process is just as important as the tool in its final version. This participatory process supports the defining of a common understanding of the situation and the links between natural resources and security. It also aims to achieve the development of a tool for which the users feel ownership, namely a tool that meets their needs and that includes the interventions they want to visualize. In addition, by opening the dialogue amongst different groups of stakeholders, this process makes it possible to strengthen reflections on governance systems and possibly to (re)build trust between stakeholders.

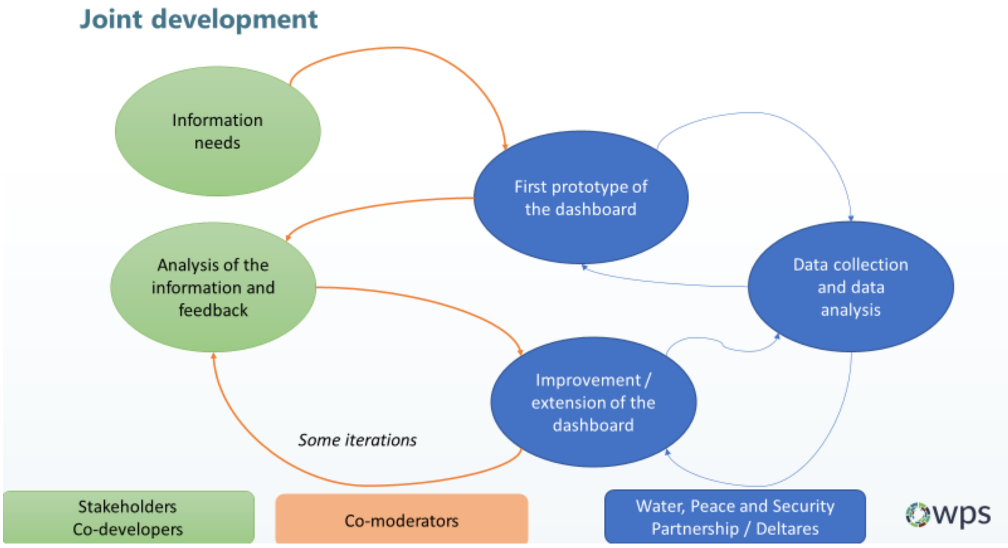


Figure 3 - Illustration of the process for the joint development of the local analytical tool

A common understanding of the links between natural resources and the risk of conflict

The first phase of the approach consists of understanding the system. When designing solutions in fragile contexts, it is important to take into consideration the interrelationships between different realities in order to avoid solutions that create new problems. The system analysis suggests adopting a global view of the system in which we want to intervene and to consider the interdependence of the different aspects of the system rather than addressing only one aspect of this system. It considers how changes in one factor in a system propagate throughout the system. For each of the three regions, the analysis focused on the links between climate change, natural resources and the impact on the risk of conflict. It aims to better understand how the resources linked to the Water-Energy and Food Security Nexus play a direct or indirect role in the emergence of conflict.

Group Model Building is a method in which a system is visually represented using System Dynamics to support a group in decision-making in complex problems. The aim is to structure a group process in which reaching consensus about and involvement in the decision is central. The model that is created is the means to achieve this goal (Vennix, 1996).

Using models – as representations of the reality – offers a communicable representation of the system complexity. In this case, “group model building” and more specifically the Causal Loop Diagram (CLD) is used as a methodology to jointly identify the interactions between the factors of the system. Group model building is an interesting methodology as it makes mental models (how we see the world) explicit and allows to discuss and understand how others perceive the world. Eventually, it aims at combining the understanding of the system of different actors into a ‘common understanding of the system’. A Causal Loop Diagram provides a visualization of the interconnections within the system. It is open to whatever is considered an important factor that influences the functioning of the system. In each of the three countries, a CLD is developed with the co-developers. Initially, the co-moderators conducted bilateral meetings which allowed the development of small diagrams, which were then integrated into a single diagram reviewed and discussed during a stakeholder workshop.

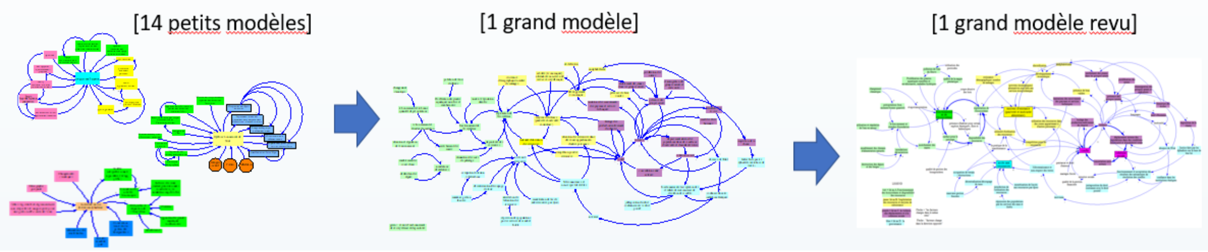


Figure 4 – The development of the Causal Loop Diagram for the case of Mali (Inner Niger Delta)

From understanding to visualizing scenarios

Joint analysis aims to create a common understanding not only of how the system works, but also of how to influence the system. The Causal Loop Diagram is therefore used to identify the main factors of interest for the different stakeholders, as well as the factors that could be modified most effectively to influence these factors of interest. Based on the diagram, the co-developers thus described the mechanisms of influence of the factors on each other. The factors considered most relevant were used for further discussion on the information that users would like to receive from- and visualize in a policy dashboard. Stakeholder dialogues and discussions can benefit from information and analysis, provided that this information is tailored to the information needs expressed by the stakeholders, or to the possible misunderstandings or disagreements on the functioning of the system identified during the first phase. In a second phase of the project, so-called *dashboard user cases* were collected. This means that the stakeholders have reflected on the users (who will use the policy dashboard?), the user needs (what information is useful?), and user objectives (why do they need this information?). These user cases (Who? What? Why?) allow us to tailor the dashboard to the local user needs. Tailoring in this case means the selection of indicators, the visualization elements, and adjusting the level of complexity. Since in most cases a large number of user cases have been collected, these were reviewed and grouped to reach the priority user cases.

Depending on the user needs for information, certain factors (elements of the Causal Loop Diagram) can then be quantified on the basis of (1) existing data (measured or modelled by external parties such as global data and projections), (2) through a local hydrological model, (3) using Agent Based Modelling (see section 0), or (4) using a semi-quantitative approach in which weights are given to factors of the Causal Loop Diagram by the local stakeholders (see section 0), in order to be able to visualize different scenarios in a dashboard.

The data collection process is different in each country because it depends primarily on the requests from the stakeholders, but also on the available data and available resources to collect and develop new data and simulate scenarios. The scope of the project differed between the three countries, as Mali benefited from other activities developed by the Water, Peace and Security Partnership. In the case of Mali, a hydrological model was available and an agent-based model (see section 3.3.4.) was already in development. These products have contributed to the data and scenarios integrated in the policy dashboard. On the other hand, for Niger and Chad there were no data production tools at our disposal. In Niger, local data gathering of drought indicators took place, conducted by local partners, parallel to the implementation of the semi-quantitative approach. Finally, in Chad the semi-quantitative approach was also adopted, and this was complemented by regional and global data accessible through open databases.

In parallel with the data collection, the development of the dashboard has followed an iterative process, using several prototypes as illustrated in figure 5. Such a process is implemented through several cycles in which stakeholders provide feedback on new versions of the dashboard leading to the final version, which is used for training. The result of local analytical tool development is a product, although the development process, that is the means towards this objective, is equally important. It contributes to a shared system understanding that may not have existed before and can support trust building amongst the stakeholders.

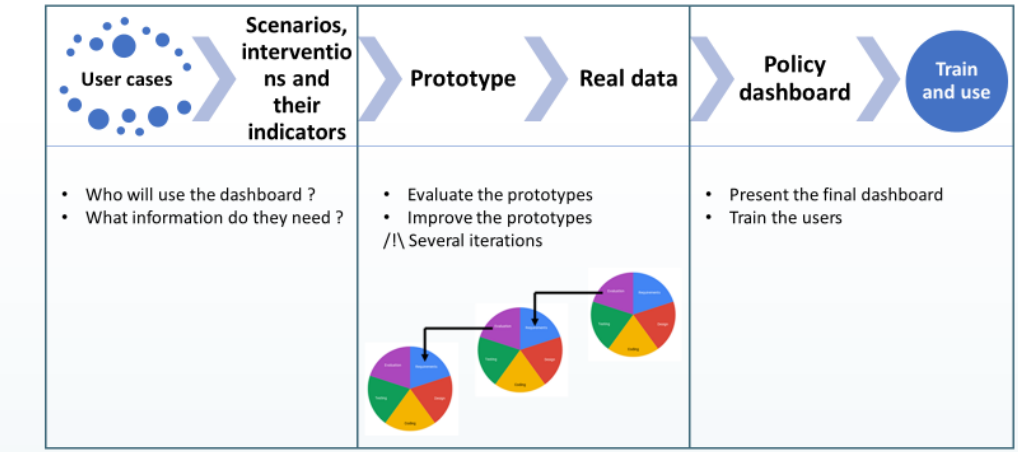


Figure 5 - The development of the policy dashboard is based on the user cases. Several prototypes are made and discussed with the stakeholders, in parallel to the data collection. In the final phase, the users are trained to enable them to use the dashboard for their own cases.

General features of the policy dashboard

Although each region followed its own process and development, some key features have been commonly agreed upon, in order to have consistency amongst the final products. This makes it also easier to use for those stakeholders who are active in the different countries.

- The dashboard is developed with Microsoft Power BI software (free license)
- The dashboard is developed offline, but it is published online. Users only need a web browser and an internet connection to use it. The data is protected, hence it cannot be downloaded from the publicly published web version.
- Users do not need advanced computer skills to use the dashboard.
- The dashboard is interactive
    - Clickable buttons allow you to change indicators / scenarios / interventions
    - Users can find additional information by clicking on the 'information' icons
- The language of the dashboards is French
- The style/layout of the dashboards is standardized

Preliminary training of the co-moderators

Introduction

For the development of strategies to address security challenges related to resources, it is important that all involved actors have a shared perspective regarding the link between resources and security. This understanding helps identifying the factors that can be acted upon to influence resources and conflicts links: a first step in making decisions and implementing solutions. Several workshops are needed to develop this understanding in a participatory manner, as well as an interactive tool through which information is summarized and visualized. To obtain the information to be incorporated into the tool and to get feedback from participants, a series of 3-5 interactive workshops is foreseen. These workshops will be facilitated by local staff of GIZ and/or affiliated organizations. To enable the staff in doing so, a Train-the-Trainers session for the moderators is organized.

Training objectives

The main objective of the Training is to train co-moderators in facilitating and moderating participatory analysis workshops using interactive information tools to support the process of co-development of the analytical tool.

The learning objectives assigned to this training workshop are:

1. Understand and apprehend the links between the Water-Energy and Food Security Nexus and security;
2. Be able to explain the concepts of system thinking and policy analysis, as well as the role of qualitative and quantitative methods in analyzing systems and the impacts of policy actions;
3. Be able to identify causal relationships between water and security in their countries;
4. Be able to explain the role of the tool to be developed
5. Be able to specify the use case and information needs as a basis for the development of the tool;
6. Be able to co-facilitate and moderate participatory sessions in which participants jointly analyze systems qualitatively and, based on this, identify key policy issues.
7. Optional: Become familiar with the use of the Vensim program and be able to train other users (depending on the time needed for other objectives);
8. Understand the objectives of the Frexus project, define the roles of moderators, co-developers (stakeholders), and the international team.

Overview of the training

Participants from Mali, Niger and Chad all travelled to Niamey, Niger where the training was delivered in a conference venue. The 20 participants of the three countries all came from different institutions. For three days, they were trained in the content and process they will facilitate in their own countries. The process and the role division were explained and discussed, and the participants also took part in group work and implemented exercises that they would later use in their workshops. Most of the exercises were done in groups per country. The program and results are summarized in the report of the workshop shared previously with Frexus ('FREXUS-participatory system analysis workshop_20211101").

With the skills and experiences developed through the training, the groups of co-moderators per country will be able to develop, together with GIZ and with feedback from Deltares, workshop programs and objectives for their respective countries. Through this process, they collect input for the development of an information tool and will later use the tool to support the discussion among the stakeholders.

The country groups working on the group exercises.

Key achievements

1. Generate ownership of the process

An additional purpose of the training was to generate ownership of the process amongst the co-moderators and allow them to understand, discuss and agree on their role. During the last day of the training, the roles were extensively discussed before being validated with all participants. This was a key step to create trust between the co-moderators and with the international team. The figure below summarizes the role division as agreed at the end of the training.

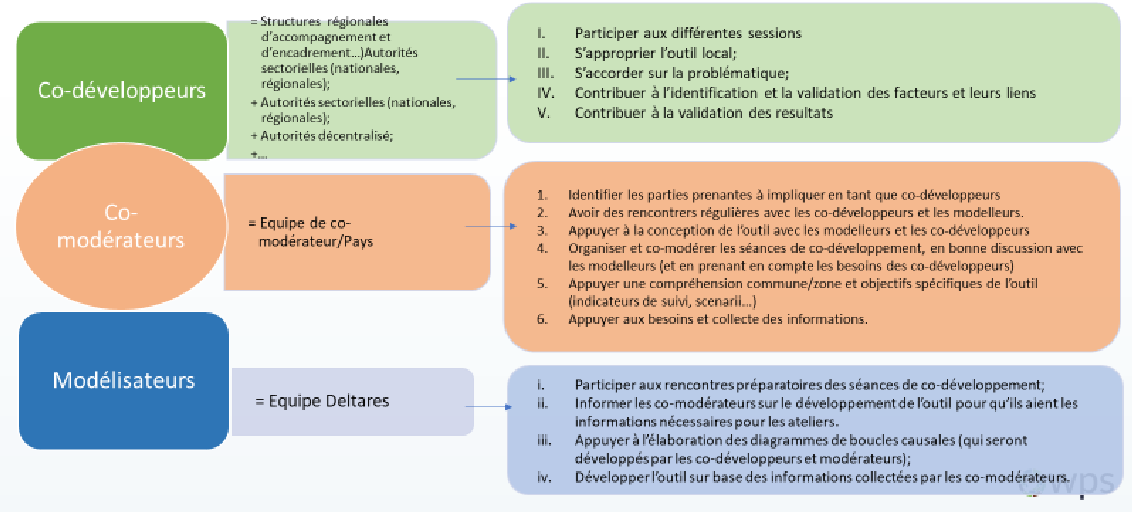


Figure 6 - Role division as agreed with the comoderators at the end of the Train-the-Trainer session

The final evaluation of the training highlighted that the roles and role division were understood and endorsed[1] by the co-moderators. They also indicated to be confident in using their skills and experience, in combination with their local knowledge, to contribute to a successful implementation of the process (see figure 6).

[1] To the question 'what role do you expect to have during the workshops ?', the participants answered with clear ideas that their role for the workshops will be co-moderator and facilitator of the process.

Figure 7 – Question 3 of the final evaluation of the Train-the-Trainers : Which personal skills do you bring into the training and moderation process ?

2. Capacity-building – knowledge and methods

The training is a crucial step in allowing the participants to become more familiar with the tools and methods suggested for the project. It is especially important not only that they become familiar with those methods, but also that they are able to use them in their own process. The training allowed to review some aspects of the methodology and adapt them to the needs and requirements of the local context. This has not only been done during the training but also throughout the process itself. From the evaluation of the training, it appeared that:

- The training was mainly perceived as interactive, effective and useful.

#	category	Detailed answers
6x	Interactive	Participative (2x), Interactive (2x), together with the others, common action
6x	Effective	Effective (2x), impactful, knowledge sharing, methodology
5x	Useful	Informative, relevant, useful, adapted

- All objectives, except the one on Vensim (see point 3), score between 3,6 and 4,0 on a 5 point scale, indicating that the respondents feel these objectives are sufficiently reached.
- The objectives with the highest achievement status are:
- f. [participants] will be able to better understand the objectives of the Frexus project, define the roles of moderators, co-developers (stakeholders), and the international EPS team;
- g. [participants will] be able to co-facilitate participatory sessions in which participants jointly analyze systems qualitatively and, based on this, identify key policy issues and related information needs.

Throughout the process of the development of the dashboard, the co-moderators were able to use and adapt the methods and tools which were presented during the training. Furthermore, some participants also indicate that those methods are relevant and useful in other contexts and show some willingness to replicate the process in other settings.

3. The use of the 'Vensim' software

The evaluation and comments at the end of the training indicated that some confusion remained on the difference between Vensim, as useful software for the design of causal loop diagrams, and the tool to be developed as outcome of the Frexus project. In order to ensure a clear process, the team of GIZ re-addressed this aspect when designing the program of the first workshop with the co-moderators. They clarified for each country the role of the tool and the difference with the Vensim software. Deltares also shared a document clarifying the use of Vensim. The confusion did not appear anymore in the next steps and development of the tool with the stakeholders.

It also appeared that some co-moderators quickly felt able to use Vensim and voluntarily decided to use it when developing the preliminary CLD as outcome of bilateral discussions. Not only has the tool facilitated the development of the causal loop diagram, but it also seemed to be a tool that the co-moderators can now successfully use, in a basic manner, for other projects.

Mali

Introduction

In central Mali lies the Inner Niger Delta (IND), a unique ecosystem that is the largest wetland in West Africa. Formed by the meeting of the Niger River with the sandy Sahelian plains, this wide network of channels, swamps and lakes mitigates an arid climate and constitutes the second largest inland delta in Africa. The Delta, a vast flood plain stretching along 300 km over an area of 41,195 km2 is an area of ecological interest classified as a Ramsar site[2]. From July, the river floods the region during an annual flood that can reach up to 6 meters. This flood allows the development of a rich ecosystem, which is an important water source for cattle, the reproduction of fish, and food cultivation. As a place conducive to rice growing, fishing and livestock farming, the delta is also of importance to the country's economy: it provides 15% of the country's cereals, represents 80% of the national fish trade, 30% of rice production, and 60% of the livestock stays there during the dry season. The ecosystem

[2] A Ramsar site is a wetland site designated to be of international importance under the Ramsar Convention, aiming at "the conservation and wise use of all wetlands through local and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world" (Ramsar.org)

value of the services provided by the Inner Niger Delta is estimated at US$500 million (Wetlands International, 2020).

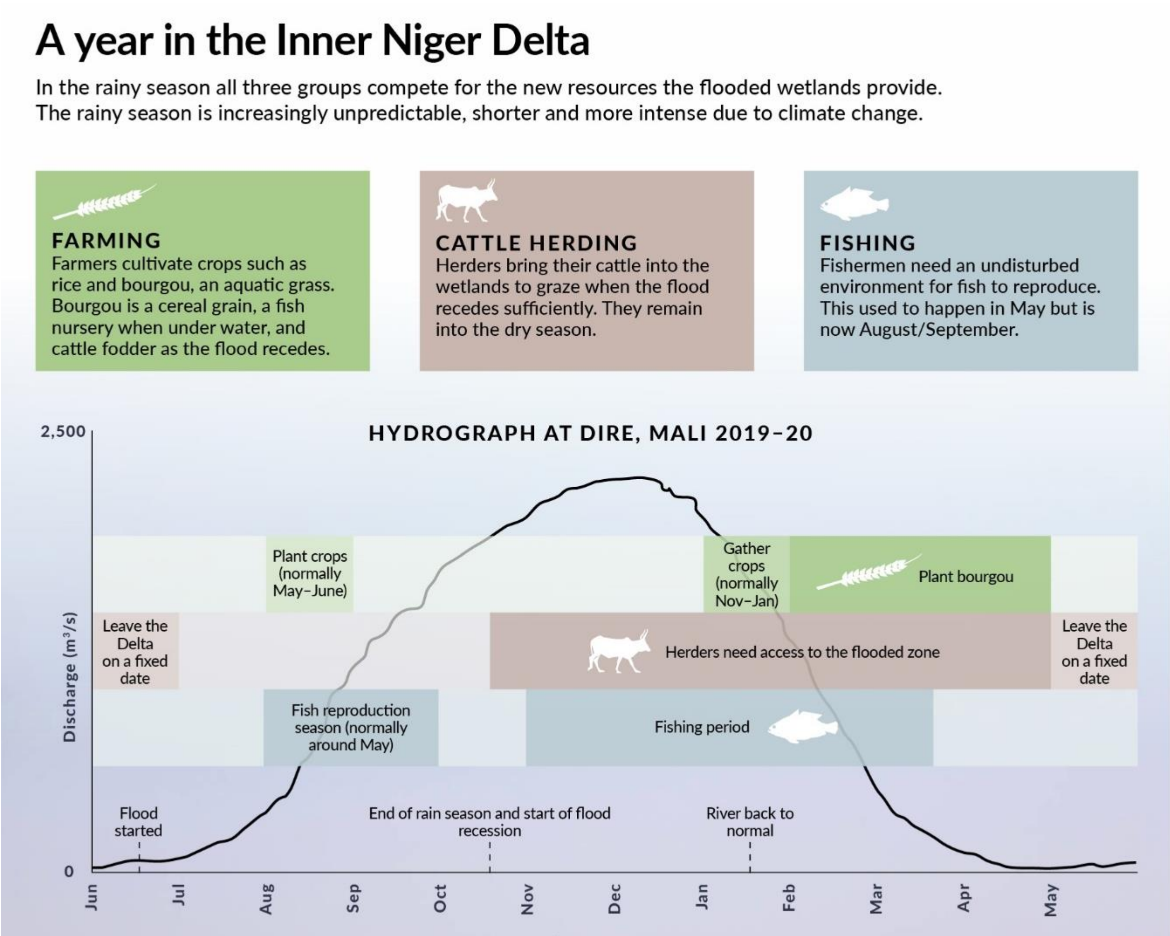


Figure 8 - A year in the Niger Delta (developed by International Alert. Source: Water, Peace and Security Partnership, 2022)

The diversity of uses of these same hydraulic spaces by communities throughout the year in a cyclical manner leads to conflicts related to the use of water resources. Moreover, the expansion of agriculture to meet the needs for food of a rapidly growing population contributes to heightening tensions between different population groups. According to Zwarts et al. (2009), the area of cultivated areas increased 2.3 times between 1975 and 2013, and irrigated areas almost quadrupled.

Research in the Inner Niger Delta has shown that a decline in flooding resulted in overfishing, overgrazing and reduced cooperation between different ethnic groups (Wetlands International, 2017). As an example, Morand (2016) indicated that conflicts can appear when water scarcity pushes farmers to crop fields in the lower flood plains, which are also used as grazing fields by herders. The pressure on this land can lead to conflicts between herders and farmers. In turn, these conflicts over land and scarcity of natural resources can be one of the reasons for rent-seeking by government officials, leading to an increase in anti-state and anti-elite sentiments among pastoralists (Benjaminsen & Boubacar, 2018). These sentiments can facilitate the support of jihadist groups in the region. The extent to which pressure on natural resources contributes to intra- and inter-community conflicts needs to be better understood to identify possible ways to reduce conflict risks over natural resources or prevent further escalation.

The Water, Peace and Security Partnership has been engaged since 2018 in the Inner Niger Delta in Mali, especially through local representations of Wetlands International Sahel Office (WISO) and International Alert. In 2021, it was decided to join forces with GIZ on the Frexus project. In Mali, the project focused on three communities spread around the Inner Niger Delta: Bellen (Segou), Konna (Mopti) and Soboumdou (Tombouctou).

Joint development process

The joint development process for the project in the Inner Niger Delta envisioned establishing vertical and horizontal links between government entities, researchers, academics, media, development NGOs and donors, integrating them in a close cooperation. The process, illustrated in figure 9) formally started in July 2021 and has taken place through five key activities which are briefly described here below.

1. **Bilateral meetings – July 2021**

The bilateral meetings were conducted by WISO and International Alert local teams with a group of 11 stakeholders. These meetings have been articulated around three key objectives: 1. (Further) introduce WPS activities in Mali; 2. Assess the perception of the stakeholders regarding main water-security issues in the Inner Niger Delta, and related information needs; 3. Assess the perception of the stakeholders on the causes, effects, policies and relevant actors related to their perceived main issues. The results have been translated in several individual causal loop diagrams. These individual diagrams have afterwards been integrated into a single model.

2. **First workshop – December 2021**

This workshop represented the start of the formal collaboration of the WPS and Frexus projects in Mali. To facilitate the integration of new participants from the Frexus project and ensure the same level of information for all at the start of the workshop, WISO has conducted six additional bilateral meetings with new participants.

During the workshop, participants from both projects joined in a merging of the projects. After introductory presentations, three participatory activities took place in which participants were asked to validate the results of the bilateral meetings and actively share their ideas and perceptions in a structured, moderated session. The first participatory activity concerned the identification of key issues and possible causes and impacts. Based on this analysis, the second participatory activity identified which of the issues, causes and impacts are considered major ‘outcomes of interests’ to different groups of stakeholders, which of these are external factors, i.e. beyond the sphere of influence of the participants and their organisations, and which of these could be considered within the sphere of influence and thus possible (connection points for) policy actions. These insights formed the basis for formulating information needs in the third participatory activity. Finally, in the session on ‘next steps’ the connection was made between the results of this workshop and the activities of the next workshop.

The outcome of the workshop was the validated Causal Loop Diagram based on the findings from the bilateral meetings. Furthermore, the user cases and key indicators to be integrated in the policy dashboard were formulated. Based on those outcomes, the WPS team started the development of a first version of the dashboard.

3. Second workshop – February 2022

From February 15-16, 2022, the WPS and Frexus projects held another workshop with the aim of allowing participants to discuss the first version of the local tool and to identify additional questions that the research team could examine. The implementation of the recommendations from the participants made it possible (1) to improve the dashboard of the tool through the adjustments proposed by the participants, (2) followed by the updating of the necessary data.

4. Bilateral meetings – May 2022

In May 2022, the WISO and International Alert teams in Mali organized bilateral meetings with potential users of the local tool. Organized in Bamako, Mopti and Ségou from May 11 to 20, 2022, these meetings made it possible to (1) further strengthen the knowledge of potential users of the local tool, (2) collect their observations/comments on the dashboard, and (3) obtain suggestions for possible improvement of the local tool. In addition, the WISO and International Alert teams had a meeting with the Niger Basin Authority (NBA) to present the local tool and collect opinions. This meeting resulted in recommendations on (1) the sharing of the terms of reference for the development of the tool, (2) the confrontation of the results of the tool with reality within the framework of its validation; (3) closely involve the NBA focal structure in the tool development process; and (4) the organizing of a workshop with NBA experts on the conceptual details of the tool and its operation.

5. Third workshop – June 2022

The 'final prototype' version of the policy dashboard was presented and discussed with local stakeholders during a workshop in June 2022. Following this workshop, some modifications (limited and final) were still made to the tool by the team of Deltares. This finalized the development phase of the tool, allowing the partners to begin the next phases of stakeholder engagement and dialogue at the local level.

Besides engagement activities with the stakeholders, the team of co-moderators has regularly gathered with Deltares to discuss progress and developments.

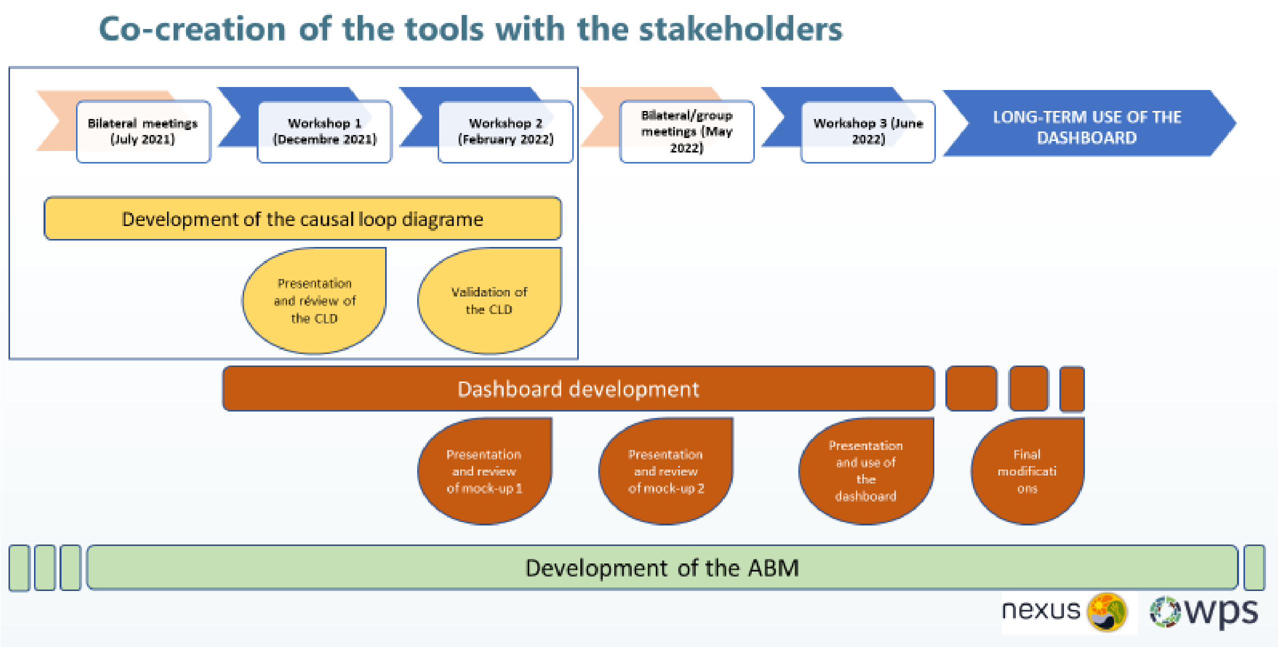


Figure 9 - The joint process development for the Mali case

Phase 1 - The Causal Loop Diagram

The Causal Loop Diagram (see figure 12) for Mali has been developed in three phases summarized in the figure 10.

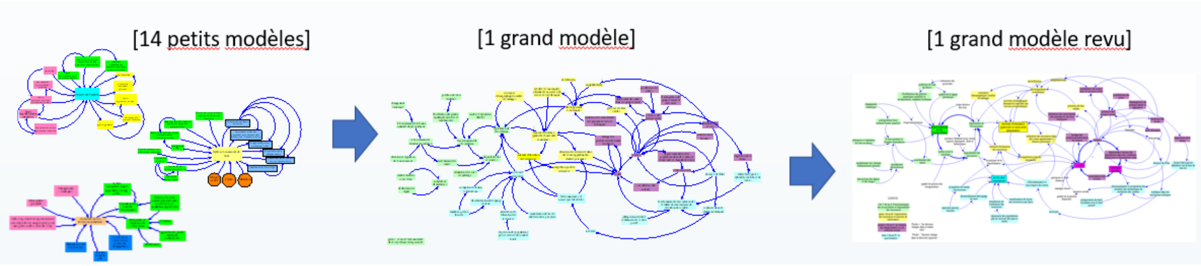


Figure 10 - Different phases in developing the Causal Loop Diagram (the processus started with small individual models developed during bilateral meetings; those models were integrated in one model which has been reviewed, discussed and validated with the stakeholders during the second workshop.

The final diagram reviewed and validated by all stakeholders reveals four different groupings of dynamics, which can be identified as follows:

A. Ecosystem functioning and resource availability
B. Resource exploitation and livelihoods
C. Competition, governance and conflicts
D. Violence, displacement and social cohesion

Each of these groupings is presented in more detail in a document (Annex 1) describing the factors and their interrelations in the local situation. This document is based on information received during stakeholder consultations. In this sense, the descriptions presented must be considered as a working basis and not as the only possible representation of reality.

Based on bilateral meetings and workshop discussions in December 2021, the following factors were identified as the key problems:

- Decrease in the ecosystem functioning (disappearance of water-related ecosystem services)
- Limited access to resources
- Conflict between users
- Disorganization of delta communities/ decrease in social cohesion
- Degradation of livelihoods in IND ("poverty" can be considered a consequence)
- Absence of the State

These have been included in a simplified version of the Causal Loop Diagram (see figure 11):

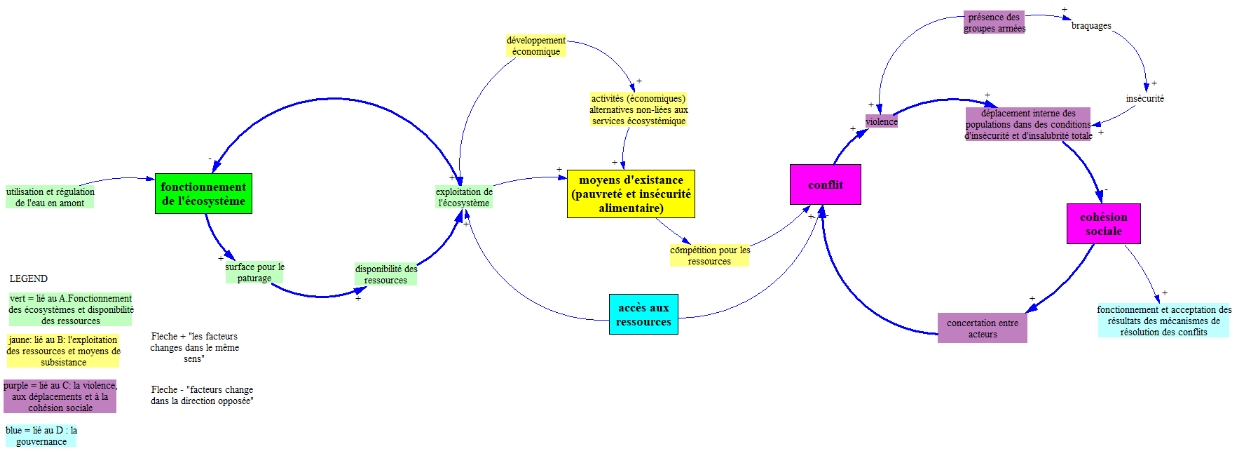


Figure 11- Simplified Causal Loop Diagram for the case of Mali

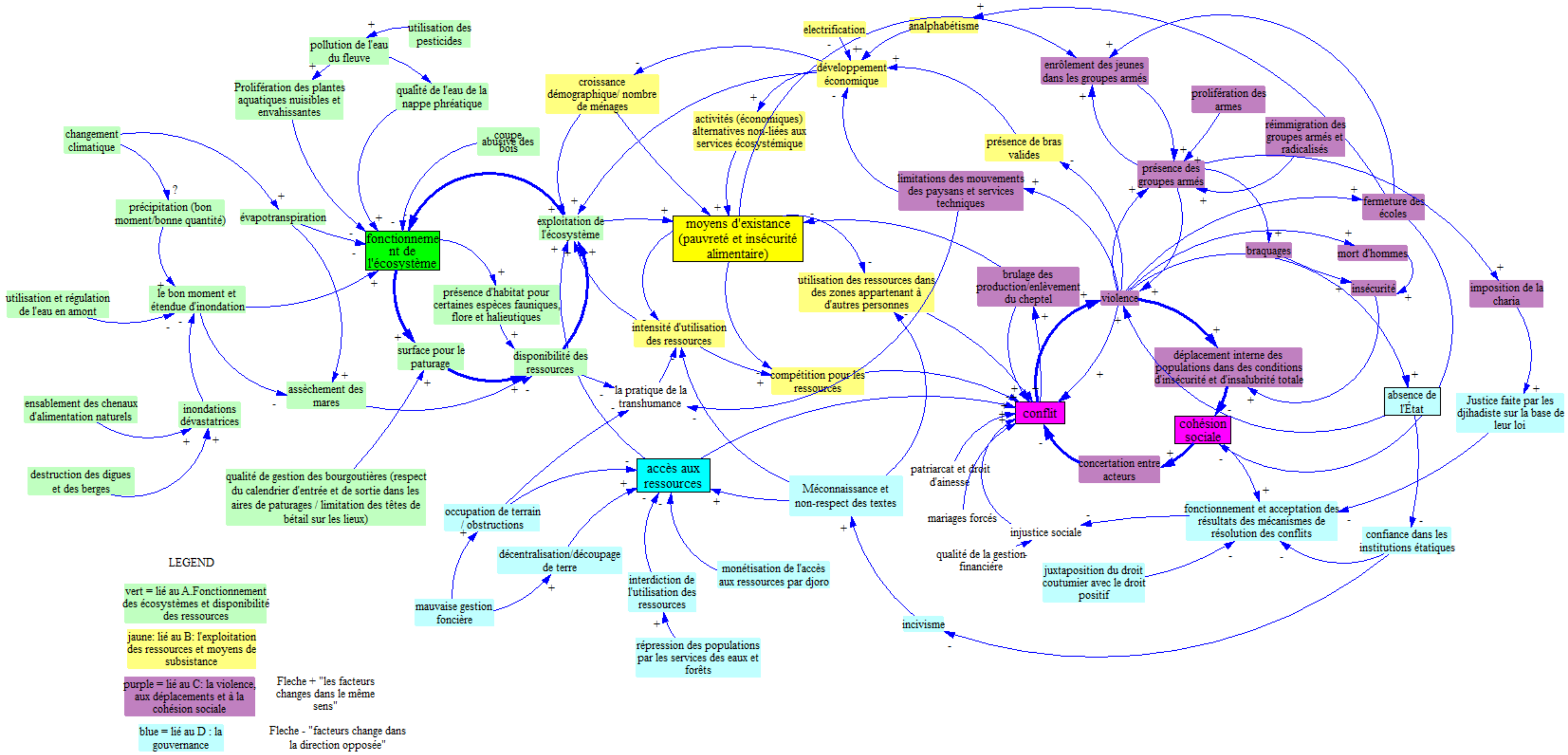


Figure 12 - Causal Loop Diagram for the case of Mali

Phase 2 - User needs and data collection

Using the Causal Loop Diagram as a basis, the user cases have been discussed to identify the related information needs. As a result of the workshop, fifteen user cases have been collected (see figure 13).

POURQUOI

1. résoudre le problème crutial d'insuffisance de bois de constructionet de chauffe dans la région.
2. D'améliorerer les aménagements des contre saisons en maitrise totale de l'Office Riz Mopti.
3. D'Installer des mini central hydrauélectrique
4. Solutions endogennes pérennes (long lasting solutions?)
5. Assurer la Sécurité Alimenaire
6. faire venir mes troupes
7. d'éviter les difficultés dans les pêcheries
8. mieux produire dans les baffons (bas-fonds?)
9. décider de la superficie en Ha à planter par espèce végétale
10. mettre en application les mesures d'aménagement et de gestion des pêchéries
11. pouvoir en application la convention communale de pêche
12. d'utiliser les variétés adaptées pour une bonne production et diversification alimentaire
13. prendre les disposition idoines en ressources humaines pour mener à bien les activités à la satisfaction des communautés
14. mener des recherches qui peuvent aboutir à faire des propositions concrètes
15. mieux planifier et conseiller les communautés

Availability of resources / ecosystems
Use of resources
Governance

nexus wps

Figure 13 - User cases identified during the second workshop

These cases cover a broad diversity of users and topics. Some of the most important information needs were the causes of inter-community conflicts, the evolution of flood levels, and the security status of pastures in conflict zones. Requested indicators of these information needs included flooded area and duration, water level, and discharge. Identified external influencing factors (scenarios, see figure 14) that impact the system are climate change and its impact on hydrology, as well as demographic growth. In addition, possible interventions were also proposed (see figure 15) and can be gathered in four categories: early warning systems, improved dam management, improved spatial planning, and improved legislation. Scenarios are considered as factors beyond the reach of decision-makers (e.g. climate change, drought, economic evolution), while the interventions are the factors on which political decision-makers or other actors can have a direct influence. For example, the construction of a well, improvement of governance, or the securing of pastoral areas.

Scénarios possibles (changements anticipés des facteurs pertinents)

Facteur(s) le(s) plus pertinent(s)	Changement dans le futur	Causes (externes) possibles du changement
Evapotranspiration	Va augmenter parce que le couvert végétable va diminuer, il y'aura une augmentation de la température et les vents chauds.	Sécheresse
Le bon moment et la bonne quantité de précipitation	Va diminuer parce que les précipitations sont liées à la disparitions du couvert végétal	Changement climatique
Le bon moment et l'étendu d'inondation	Va diminuer parcque les précipitations vont diminuer	Changement climatique
Utilisation et régulation de l'eau en amont	Va augmenter parce que les infrastructure hydro agricole et hydo electriques utilisent et contrôlent l'eau…	
Inondation dévastatrice	Vont augmentation parce que les communautés ne dispose pas de plan de contingence	Précipitation
Assèchement des mares	Va augmenter parce que les quantités d'eau de pluie vont diminuer	Précipitation
Ensablement des chenaux d'alimentation naturelle	Va augmenter parce que les mauvaises pratiques/drague/pêche/agriculture vont s'ampliphier à cause du mauvais comportement anthropique et le manque d'entretien…	Croissance démographique
«Bon moment et l'étendue d'innondation »	Intimmement lié aux changements climatiques dont les effets ne sont pas encore connu	Changements climatiques (possible forte innondation,possible fort ensoleillement, fort vent violent)
Disponibilité des ressources	Va diminuer avec la croissance démographique	Faiblesse des précipitations
Pratique de la transhumance	Va augmenter	Faiblesse des précipitations
Utilisation des ressources dans les zones appartenant à d'autres personnes	Va augmenter	Faiblesse des précipitations

Figure 14 - Scenarios identified by the stakeholders

Interventions possibles (influant sur les facteurs pertinents)

Facteur(s) le(s) plus pertinent(s)	Actions réelles/prévues/ possibles qui peuvent influencer les facteurs	Comment ces actions peuvent influencer ?	Autres facteurs qui peuvent être influencés par ces actions ?
Evapotranspiration	valoriser les stations météo	Mise à dispo de l'info à temps pour s'organiser	
Le bon moment et la bonne quantité de précipitation	valoriser les stations météo	Mise à dispo de l'info à temps pour s'organiser	
Le bon moment et l'étendu d'inondation	OPIDIN, Meteo	Mise à dispo de l'info à temps pour s'organiser	
Utilisation et régulation de l'eau en amont	valoriser les stations hydrologiques, **Comité de gestion des barrage**	Mise à dispo de l'info à temps pour s'organiser **Décider des quantité d'eau à lacher et le moment approprié**	
Bon moment et l'étendue d'innondation	- Améliorer les textes législatifs (politiques et stratégies) par l'intégration du lien entre l'eau et la sécurité. - Favoriser les stations hydrologiques; - Information et Sensibilisation des communautés locales dans la cohésion sociale	- Mieux cadrer les activités investissements et exploitation des ressources naturelles ; - Fournir des données quantitatives et qualitatives ; - CCC/IEC	- Conflits ; - Violence ; - Cohésion sociale - ......
Disponibilité des ressources	Aménagement des espaces ; Elaboration et la mise en œuvre des conventions	Améliorer la gestion	Les conflits ; violences
Pratique de la transhumance	Aménagement des espaces pastoraux ; Elaboration et la mise en œuvre des conventions	Améliorer la gestion des ressources naturelles	Les conflits ; violences
Utilisation des ressources dans les zones appartenant à d'autres personnes	Élaboration des schémats d'aménagement (délimitation des couloirs de transhumance);	Amélioration de la cohésion sociale	Les conflits ; violences

Figure 15 - Interventions identified and analyzed by the stakeholders

The data collection is based on the information needs expressed by the stakeholders and the data available, or possible to develop, as part of the project. All data are detailed in the user manual attached to the dashboard. A few key aspects are presented here below and illustrated in figure 16.

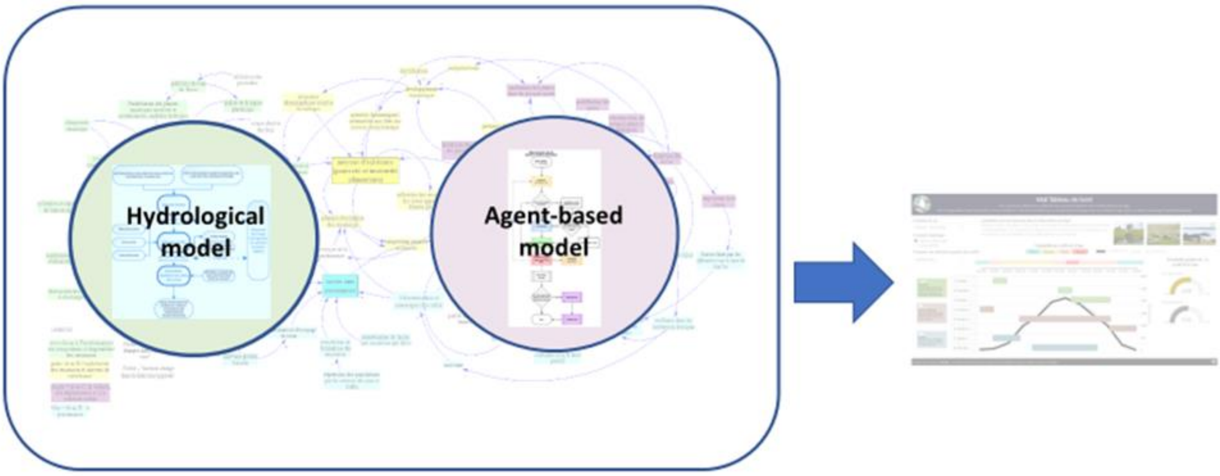


Figure 16 – The results from different tools and models are used to develop the dashboard

- In discussion with the partners and based on feedback from the bilateral meetings (July 2021), the period June 1984 - June 1985 has been taken as reference year (year of drought).
- The data integrated in the dashboard comes from numerical models (hydrological and climatic data) and from an agent-based model (human responses).
  - The hydrological model helps us to quantify the relationships between the different factors dealing with the water system. It includes aspects such as river flow simulation, water allocation, dam management, and also calculates the flooded area in the Inner Niger Delta. It is based on a previous study (Autorité du Bassin du Niger, 2019) conducted by Deltares and partners for the Niger Basin Agency. For the case of the Upper Niger Basin in Mali, we combined a hydrological model (wflow) with a water allocation model (Ribasim). The wflow model was developed from watershed maps

and precipitation and evaporation data, resulting in natural river flows. The water allocation model (Ribasim) uses these flows as input data and calculates the regulation of the river by dams and weirs and the allocation to various water users, based on information on the presence of infrastructure, population and irrigated areas. The combined model provides insight into how water is available to different water users in different parts of the basin, and can be used to assess how these are changing with possible future developments, such as climate change, population growth.

- The agent-based model, as a tool to simulate the (simplified) behavior of different agents in order to assess the impact of scenarios and interventions on conflict risk. Three agents are considered in the ABM for Mali: the farmers, the herders and the fishers.

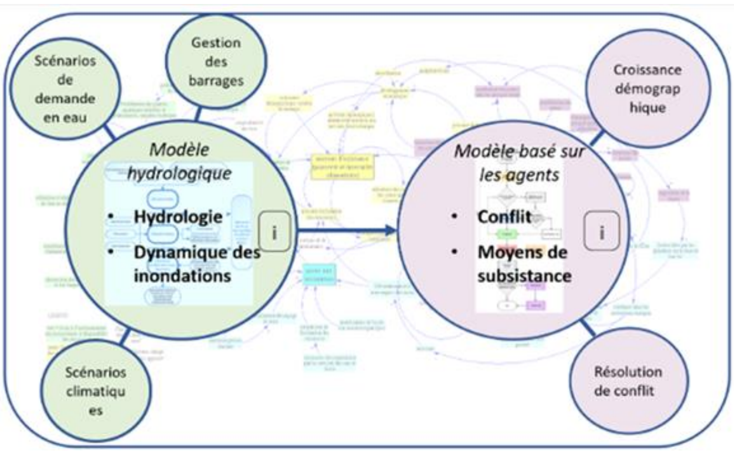


Figure 17 – The results for interventions and scenarios are calculated with a hydrological model and the agent-based model.

- Different scenarios and interventions have been simulated from both models (see figure 17) and the results are included in the policy dashboard to show how they influence the conflict risk over time. Three hydrologic, three demographic scenarios and a resource management system intervention were run and analyzed. Figure 18 summarizes the different scenarios and interventions. This provides a total of 18 scenarios included in the dashboard.

Hydrologic	Demographic	Accepted resource management system
S1: reference climate (1984)	Historic: reference population (1984)	No
S9: future climate (2050), dry	SSP5: increase of population	Yes
S6: future climate (2050), extra dry	Masterplan-IND: extreme increase of population	

Figure 18 - Scenarios and interventions

Using agent-based modelling, the results of the simulated scenarios have been assessed with three types of indicators related to conflict risk and resentment. “Conflict risk” in the ABM considers a broad definition of conflict, including non-violent and violent conflict. When households experience risk of conflict they have a heightened chance of being involved in a non-violent or violent conflict. “Resentment” in the ABM is considered as households feeling mistreated after the actions of others. The three indicators are:

- **Conflict risk**: the percentage of households that experience risk of conflict;
- **Resentment to** a certain socio-professional group [shown in the dashboard as annual maximum values]: the percentage of households that experience resentment towards a certain group (e.g. 20% of fishers and herders feel resentment towards farmers); and
- **Resentment from** a certain socio-professional group: the percentage of households that experience resentment towards any group (e.g. 20% of the farmers feel resentment towards fishers or herders).

Agent-Based Model (ABM)

Human behavior is an important component in the link between natural resources and security. The human behavior encompasses “the human responses to changes in their environments, to the actions of other actors, while considering institutional, political, historical and other factors”.

Agent-based modeling is a tool to simulate complex systems which are composed of different ‘agents’ in interaction. The agents adapt and evolve over time. The result of the agents’ behavior leads to interactions and certain trends might appear (e.g. migration from a certain area when the water availability decreases under a certain threshold). An ABM can simulate the (trends in the) responses of various actor groups to changes in their environment (physical, institutional, social). With this simulation, the agent-based model allows exploration of different scenarios and measures for situations which cannot be tested in reality.

Agent-based modeling is used as a research method to formalize, test and adapt our understanding of the behavior of actors in a specific region (e.g. the Inner Niger Delta), when they react to changes in resources availability, regulation (e.g. access to resources, conflict resolution mechanisms), demography, etc. Agent-based modelling helps to fill in the links toward the right-hand side of the causal loop diagram, related to livelihoods and conflicts.

It is important to notice that it is not possible to simulate human behavior as we can simulate hydrology, since human behavior does not follow strict laws, like the flow of water does. Therefore, the outcomes of the agent-based model should be interpreted with care. However, if the important linkages have been included correctly from the causal-loop diagram and if the quantification of the linkages shows sufficient relation with reality, it should be able to use the agent-based model to quantify the impact of scenarios and measures on water-related conflict likelihood, to identify the most probable areas of conflict in space in time and to describe the impact on intermediate variables such as resource availability and use and livelihoods.

Phase 3 - The policy dashboard

This section briefly presents the most updated version of the Mali policy dashboard, which integrates all comments of the stakeholders, as far as possible. A full description of the dashboard and data can be found in the manual attached to the policy dashboard.

Introduction page

The introductory page (figure 19) describes the purpose and background of the dashboard, including the problem definition, data, and models. It also includes a link towards a manual with a description of the dashboard and some exercises to guide users in their utilization of the tool.

Figure 19 - Introduction page of the Mali dashboard

Scenarios

The scenarios page (figure 20) is the main results interface. It is built around the activities of three groups (fishers, farmers and herders) in the delta and the seasonal flow of the Niger River. The page visualizes conflict risk and resentment, calculated based on hydrological, demographic and governance scenarios. The visualization of these links was inspired by an infographic produced by International Alert: Figure 2 of the report titled 'Water and conflict in the Inner Niger Delta: a governance challenge', 2022).

Figure 20 – Page 'Scenarios' of the Mali dashboard

<u>Forestry as a separate agent</u>

Three agents are considered in the ABM for Mali: the farmers, the herders and the fishers. Some stakeholders requested to add forestry as an agent. Forestry is currently taken into account in the agriculture activity. The inclusion of forestry as a new agent in the agent-based model has not been possible so far for the following reasons: (1) Previous research, including the WPS conflict analysis (Water, Peace and Security Partnership, 2022), considers three socio-economic groups (farmers, herders, fishermen) and the data collection for the dashboard followed this distribution. Therefore, the addition of forestry would require some adjustments in the previous analysis. (2) The dashboard is based on a detailed analysis of agent behavior of the three socio-economic groups. At this stage, specific behaviors for forestry have not been studied in previous reports, therefore no data is available to use in the agent-based model. While we acknowledge the relevance of the suggestion, we must conclude that forestry is taken into account in the results visible in the dashboard but not as a separate agent. This development can be considered for future developments of the ABM.

Comparison

The comparison page (figure 21) allows a detailed analysis of the different scenarios in the form of tables and diagrams (numerical and graphical visualization). In this way, the different scenarios can be better compared.

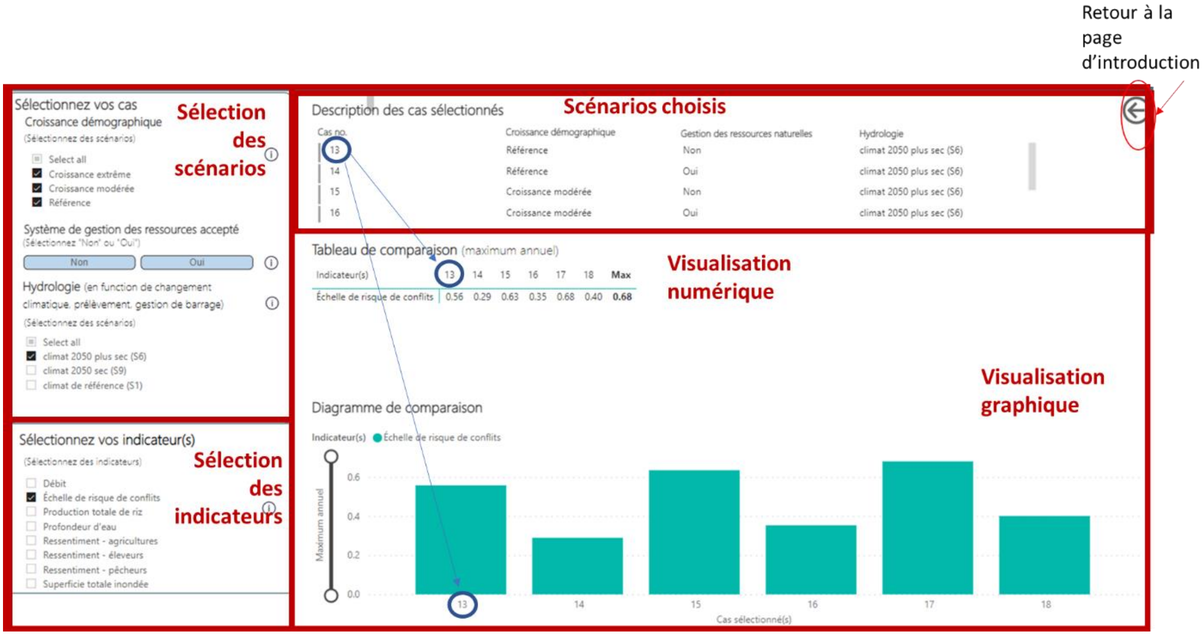


Figure 21 - Page 'Comparison' of the Mali dashboard

Inundation map

The inundation map page (figure 22) shows the maximum water depth, measured in meter over a year. Users can select a hydrologic scenario that changes the inundation map. Two indicators are displayed: the total flooded area and the average water depth. The map is interactive and allows users to zoom in and out.

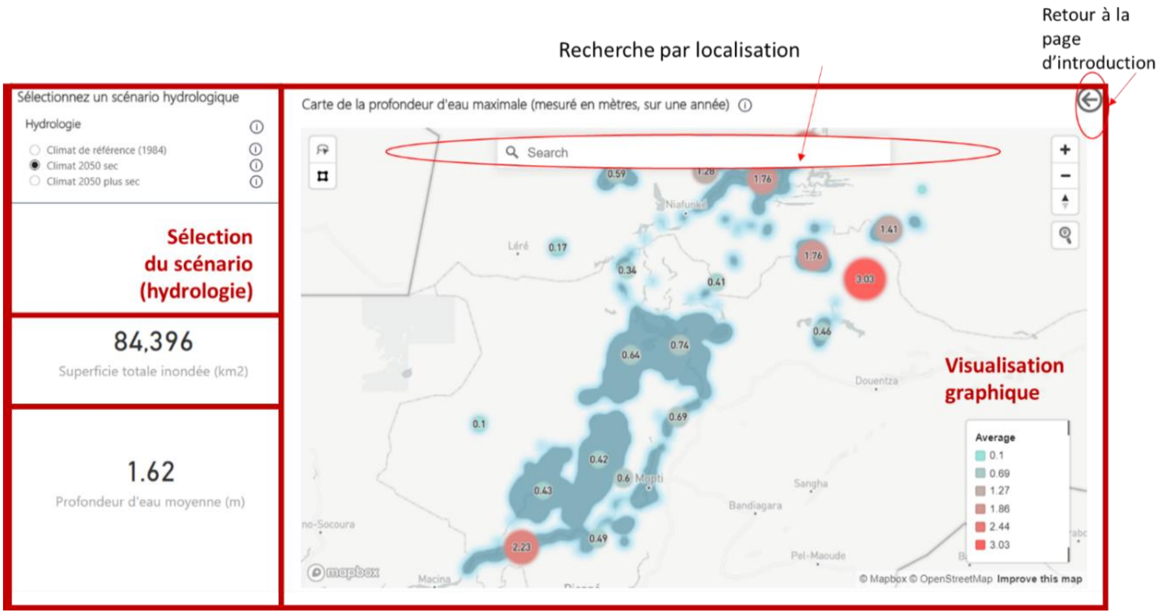


Figure 22 - Interactive inundation map included in the Mali dashboard

Results

1. On the joint development process

The joint development process seems to have led to positive results in the system understanding locally. The causal loop diagram has been used by the local partners in their local fora and they indicate that it has facilitated the dialogue around the numerous factors impacting the link between the natural resources and the conflicts.

The iterative process has also allowed to go step by step in the development of the Causal Loop Diagram and therefore to give stakeholders time to think about their own case and perceptions. There has been a noticeable evolution in the system understanding regarding the following aspects:

1. Taking distance from the problem itself: at the start of the process, it seemed difficult for the participants to take some distance from the problem itself and to zoom out on the system and its interactions. Using more neutral terminology in the formulation of the factors (disconnect it from the emotions and judgements to understand the mechanism) has been a challenging step but during the second workshop, we noticed an evolution as the discussion was much more on the system mechanisms than on the problems.
2. The causes and the consequences: the Causal Loop Diagram has illustrated the fact that a problem does not only have causes and consequences. Consequences become the causes of other factors and there are retroaction loops which can reinforce or attenuate each other. During the workshop, the variation between causes and consequences has been extensively discussed.
3. Deconstruction of the model: at the start of the process, many of the factors mentioned were still difficult to really grasp in their essence. Especially for the factors related to the governance, much of the terminology was relatively vague, e.g. 'Good governance', 'legislation', 'justice'. Much attention has been given to the understanding what those terms and how to deconstruct them. This step is important for the participants to realize that they do not necessarily give the same meaning to such terminologies. Numerous factors have been added in the diagram when deconstructing those factors. The table here below provides examples on how the factors have been deconstructed.

Governance	Trust in the state institutions Acceptation of the conflict resolution mechanisms
Legislation	Juxtaposition of the traditional and state law Ignorance and non-application of the legislative texts

4. Do not overlook the all system. Looking at the overall system can provide new entry points to solve the problems. It can help identifying interventions which are less directly related to the problem we encounter. Those possible interventions may be overlooked when we consider only one part of the system. During the workshop, some alternative interventions have been discussed and the participants have looked at their impact on the overall system. The exercise also helps participants to suggest actions which are more operational as they have to explain not only the intervention but also how it evolves throughout the system. It is here illustrated by two interventions discussed during the group works: capacity-building amongst young people (figure 23) and the improvement in the management of the bourgou fields (figure 24).

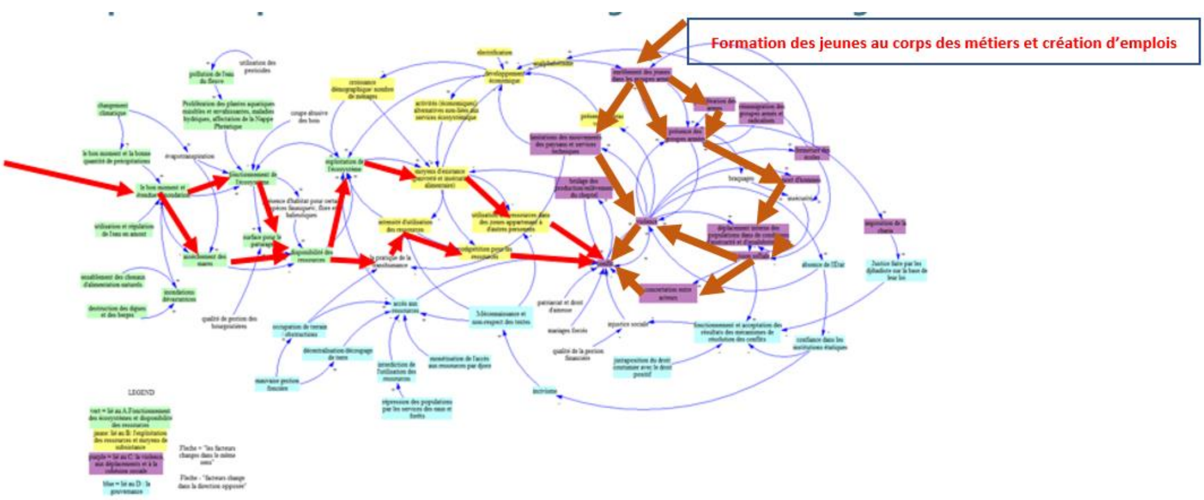


Figure 23 - Analysis of the intervention 'capacity-building amongst young people' and its impact on the conflict

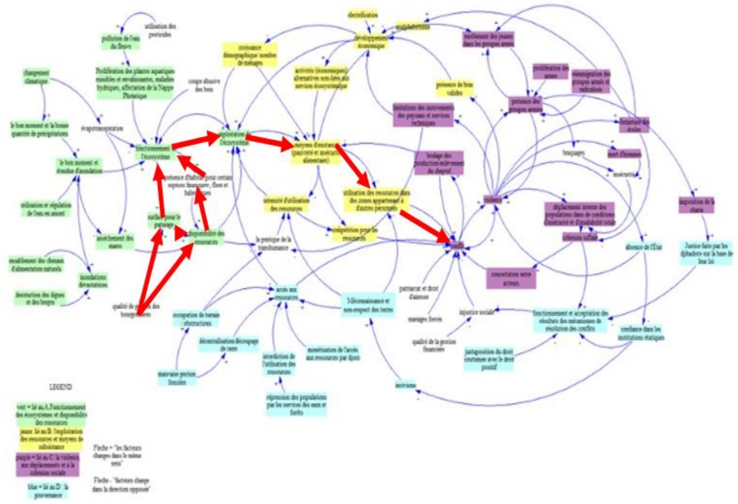


Figure 24- Analysis of the intervention 'Improvement in the management of the bourgou fields' and its impact on the conflict

2. On the users of the dashboard

The development of the dashboard has been hampered by the plain question: 'who will use it after it has been delivered'? Four groups of potential users were identified:

1. Policy makers and their senior policy development staff at the local and national level who 1) have become aware of the importance of conflict-sensitive water allocation decisions, 2) have the power to make those decisions and 3) are willing to make them. They will probably be able to use the results of the dashboard, but not able to operate the dashboard or to attend meetings in which the dashboard is operated. They will also probably need someone to present and explain the dashboard results.
2. Champions – this may be the most important target group. These are people from different levels and roles in society, ranging from informal community leaders to university professors who are able to influence local communities, the national public and/or local and national policy makers. They will also be able to use the results of the dashboard and in some cases be able to operate the dashboard and present and explain the results.

3. Local communities. It is unlikely that the local communities will use the dashboard – that is, without help. They might greatly benefit from using the dashboard in their dialogues and disputes, but will probably have to be assisted in using the dashboard by "champions".
4. WPS and GIZ project teams in Mali - they are able to operate the dashboard, understand the different components in the dashboard, and identify situations where the dashboard can be beneficial.

The participatory approach has been beneficial to develop a dashboard that can be used by a diversity of stakeholders, but it also presents the risk to tackle too many different user cases. When defining the user cases with the stakeholders it appeared that the stakeholders had different uses and different information needs. It is therefore recommended to further identify key users and to continue some trainings and presentations with them so that the policy dashboard can be owned by those organisations. If needed, the dashboard should be further adapted to their needs. During the final workshop, the participants and co-moderators have identified some actions in this sense:

- Set up a monitoring committee for the dashboard;
- Organize advocacy training for members of dialogue forums;
- Present and discuss the dashboard with key future users of the tool (ABN, National Directorate of Hydraulics and Universities);
- Present the approach to the Directorate General of Territorial Communities (which has a guide for the development of Communal Development Plans) and to national NGOs, especially those involved in the formation of development plans.

3. On the policy dashboard

Using the dashboard, complemented by the results of the ABM, some results can be presented. Those results have been verified with a team of local experts. However, it is strongly recommended that the co-moderators and the users of the dashboard can draw their own results and conclusions as they are more familiar with the local situation and as it would also guide them in their use of the dashboard. The results presented below provide some examples of what can be learned from the local tool.

Key findings

- Under the driest hydrological scenario, 1) the peak flow at Diré station is half of the reference hydrology, 2) the flooded area shrinks almost to its third and 3) the average water depth drops with almost 40%.

Tableau de comparaison (maximum annuel)

Indicateur(s)	1	13	**Max**
Débit	1,077.69	550.00	**1,077.69**
Profondeur d'eau	3.50	2.24	**3.50**
Superficie totale inondée	4,022.00	1,447.00	**4,022.00**

Figure 25. Table comparing peak flow, flooded area, and average water depth between case 1 (reference case) and case 13 (driest hydrological scenario)

- Considering a baseline climate, but an extreme population growth and a no commonly accepted resource management system, farmers will experience the greatest growth in resentment against them.

Figure 26. Resentment towards socio-economic groups under a baseline climate with extreme population growth and a no commonly accepted resource management system

- Without accepted resource management system and assuming a moderate demographic growth, a future dry climate doubles the number of months (from 4 to 8) with elevated conflict risk, while a very dry future climate triples it, making the entire year high conflict risk.

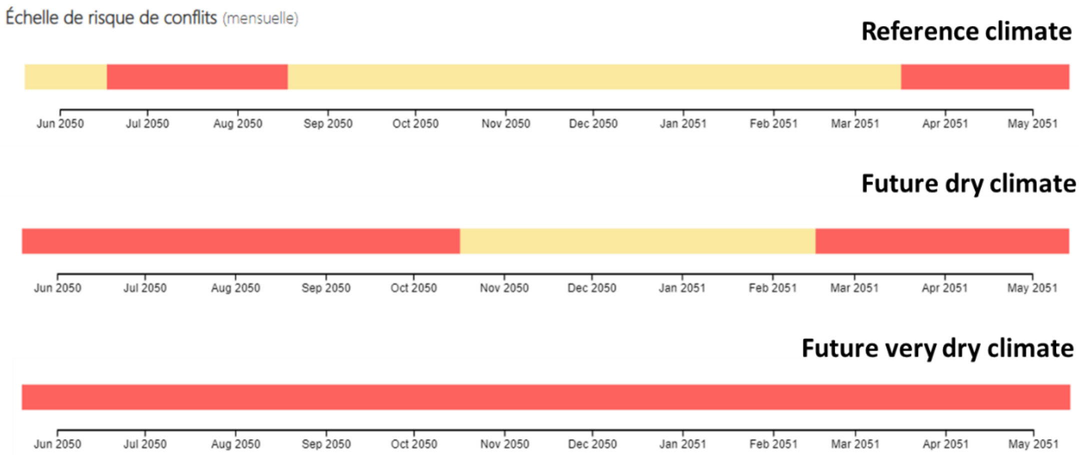


Figure 27. Conflict likelihood in a situation where there is no accepted resource management system and assuming a moderate demographic growth, under three hydrological conditions (reference, future dry, and future very dry)

- Considering the worst-case combination of driest climate and extreme population growth, adopting accepted resource management help mitigate the risk of conflict at or below the reference case level.

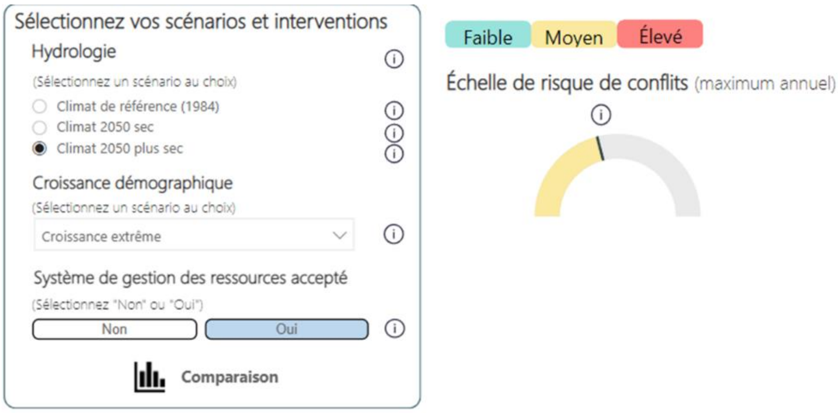


Figure 28. Conflict likelihood under a future very dry climate, extreme population growth, and with accepted resource management

- Fishermen benefit the most from adopting an accepted resource management system. This results in the largest decrease in resentment towards them.

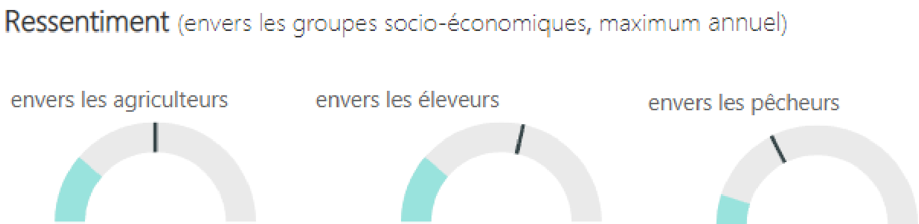


Figure 29. Resentment towards socio-economic groups under reference climate and population but with commonly accepted resource management system

- With drier inundation patterns, i.e. comparing the reference climate with a future dry or very dry climate, an overall higher risk of conflict is observed in the modelled results.

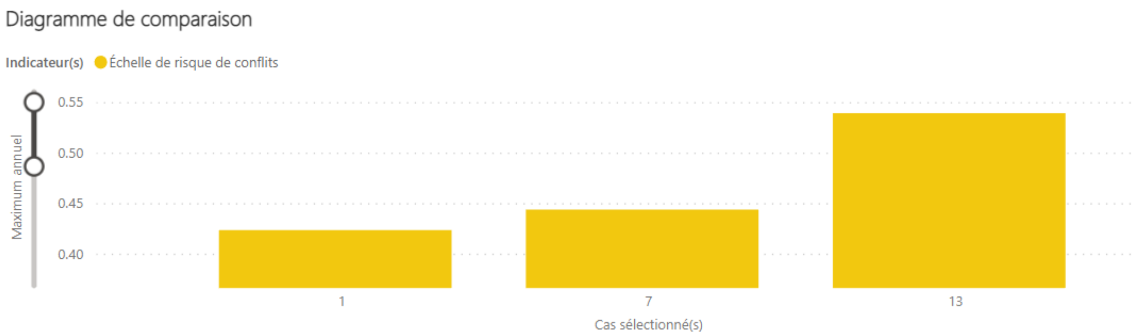


Figure 30. Diagram comparing conflict likelihood between case 1 (reference case), case 7 (future dry hydrological scenario) and case 13 (future very dry hydrological scenario)

- With both interventions and without intervention, the order of the conflict risk patterns over the climate and population scenarios is the same. From lowest to highest conflict risk, this is: (1) reference population and reference climate, (2) reference population and future dry climate, (3) moderate population increase and reference climate, (4) reference population and future very dry climate, (5) moderate population increase and future dry climate, (6) extreme population increase and reference climate, (7) extreme population increase and future dry climate, (8), moderate population increase and future very dry climate, and (9) extreme population increase and future very dry climate.

- The policy dashboard allows to draw two key messages regarding the natural resources management in Mali:

1. Although models exist regarding the impact of climate change on drought and flood risk in the region, the exact impact on the full water-energy-food security nexus is still uncertain. Climate change impacts require to be reflected in the governance system to keep the flexibility in the interventions in the future.
2. The accepted natural resource management and conflict resolution system has the largest influence, decreasing the conflict risk with 50% on average. The dashboard visualizes that governance seems to have more influence on the conflict risk than the climate.

<u>Illustration of the use of the dashboard</u>

The exercise below was given during the final workshop and it illustrates how the dashboard can be used to analyse and discuss future scenarios.

1) Base yourself on a starting 'scenario' (climate change), which you can explore.
The dashboard offers two future scenarios, to be compared to the situation in 1984. The scenario you start with is irrelevant for the exercise, you can explore the other scenario later. Your group will work on:
Select your scenario in the dashboard.

2) What happens if there is a demographic change? What is the impact on the risk of conflicts?
Using the dashboard, explore the changes that are taking place: - If you change the demographics (select from the dashboard):
o Which demographics most increase the risk of conflict? How to explain
o How does extreme population growth impact resentments towards different communities?

3) What if there is the introduction of a commonly accepted natural resource management system? What is the impact on conflict risks?
Using the dashboard, explore the changes that are taking place if you are introducing a commonly accepted natural resource management system (select from dashboard):
o What is the impact on the risk of conflict with a commonly accepted natural resource management system?


Figure 31 – Stakeholders using the dashboard during the workshop

Niger

Introduction

With an area of 31,000 km², the Dosso region is the smallest of the seven regions of Niger. Nevertheless, it is densely populated since it has more than 2.4 million inhabitants. The essential particularity of the region is that it is classified exclusively as an agricultural zone in due to heavy rainfall. It is not bordering the pastoral zone bounded to the north, yet due to its strategically important geographical location for transhumance from northern Niger to Benin and Burkina Faso to the south, Dosso is characterized by numerous transhumance corridors, numerous pastures and a pastoral infrastructure making it possible for pastoralists to travel with their herds.

Conflicts of interest are multiplying between pastoralists (mainly nomads) and farmers. Many projects, national and international, have made it their mission to find appropriate approaches and build long-lasting relationships that contribute to the transformation of resource-based conflicts between farmers and pastoralists, and that improve resource management in the face of general conditions conducive to aggravating these conflicts. Given the complexity of conflict dynamics in Niger, above all a global and systematic approach is necessary to break the lines of conflict and contribute to a positive spiral in favor of peace (Frexus, 2022). The GIZ-led conflict resolution process in Niger started in 2021 with three municipalities in the Dosso region: Farray, Falmaye and Sambera, with in total 51 villages surrounding the shared pastoral areas between the three municipalities.

Joint development process

The joint development process for the project in the region of Dosso envisioned establishing vertical and horizontal links between local and national government entities, researchers, academics, media, development NGOs and donors, integrating them in close cooperation. The process has formally started in January 2022 and has taken place around five key activities. Deltares has been supporting these activities in their preparation and in the processing of key results for the development of the tools. Because the local process has been led by a local team of co-moderators, this report will only present the key objectives of each activity.

- In January 2022, **bilateral meetings** were conducted by the co-moderators – under the lead of GIZ – with a group of 16 stakeholders. The bilateral meetings have been articulated around three key objectives: 1) (Further) introduce the Frexus project and approach; 2) Assess the perceptions of the stakeholders regarding main water-security issues in the region of Dosso, and related information needs; 3) Assess the perceptions of the stakeholders on the causes, effects, policies, and relevant actors related to their perceived main issues.
  The results of the bilateral meetings have been translated in 16 individual causal loop diagrams. With support of Deltares, these individual diagrams have afterwards been integrated in a single model.

- In February 2022, the first workshop has amended and validated the findings from the bilateral meetings with the larger group. This allows for better integration and builds on the work already done during the training, as well as in the workshops and other activities in the past years. Furthermore, the objectives and user cases of the dashboard and the key indicators to be integrated were formulated. Participants also indicated which factors they found important and for what kind of decisions they could use the Causal Loop Diagram and the subsequent dashboard.

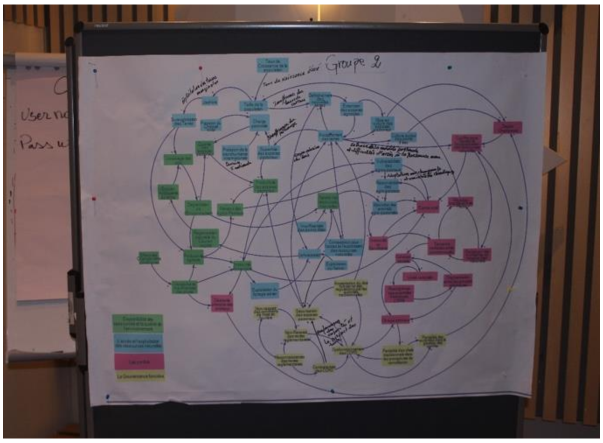


Figure 32 – During the workshop, the participants have discussed and improved the Causal Loop Diagram (here a picture for the group working on the 'governance'

Based on the questions and information needs identified during the first workshop, Deltares developed a first version of the dashboard.

- When developing the dashboard, **regular team meetings** took place between the team of co-moderators and Deltares/WPS Partnership. Those meetings especially focused on: 1) Developing a simplified Causal Loop Diagram to be used in the dashboard; 2) Defining the content of the dashboard, test and validate it for the data collection; 3) Developing a methodology to weigh factors from the Causal Loop Diagram (see section 3.3.10).
- In July 2022, the co-moderators conducted **bilateral meetings** in order to collect semi-quantitative data and define the weight of the factors of the Causal Loop Diagram (simplified). These meetings also allowed to already collect observations and comments on the dashboard, as well as suggestions for possible improvement of the local tool.
- In August 2022, the **second workshop** was organized, with the aim of enabling participants to discuss the prototype version of the local tool and to identify additional questions for the research team to examine. The dashboard was validated and, using the dashboard, participants identified actions to influence the relations between natural resources and

conflicts. Following the workshop, Deltares has further improved the dashboard by integrating the few recommendations and adjustments proposed by the participants.

These activities have taken place in parallel to the local dialogue process in the three pilot municipalities and have led to the official signing ceremony of the local convention on Nexus action plans for the positive transformation of conflicts and strengthening of social cohesion (September 2022).

Phase 1 – The Causal Loop Diagram

The Causal Loop Diagram (figure 28) for Niger has been developed in three phases summarized in figure 26.

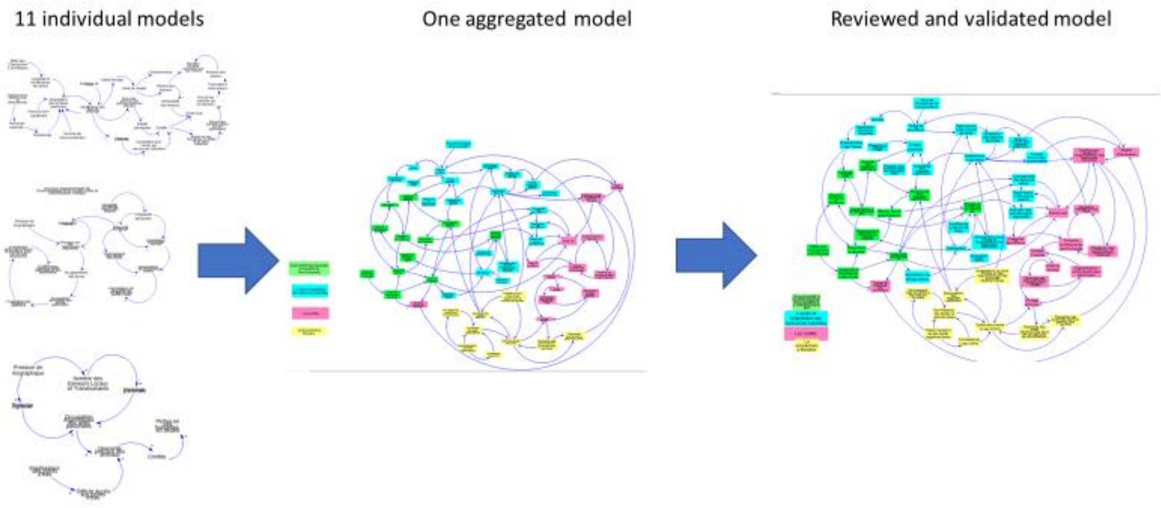


Figure 33 - Development phases of the Causal Loop Diagram

The final diagram was reviewed and validated by all stakeholders and reveals four different groupings of dynamics, which can be identified as follows:

A. Availability of resources and quality of the environment
B. Access to water and use of natural resources
C. Conflicts
D. Land Governance

Each of these groupings is presented in more detail in a separate document (Annex 2), by describing the aspects that have been drawn from the stakeholder consultation. This is based on the information received during stakeholder consultations. In this sense, the descriptions presented must be considered as a working basis and not as the only possible representation of reality.

Based on discussions in bilateral and group meetings, some factors were identified as the key problems. They have been included in a simplified version of the Causal Loop Diagram (figure 27):

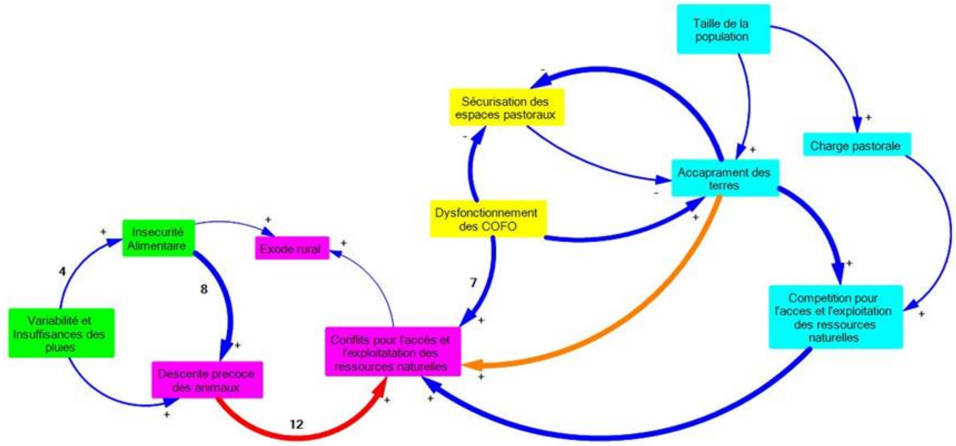


Figure 34- Simplified Causal Loop Diagram for the case of Niger

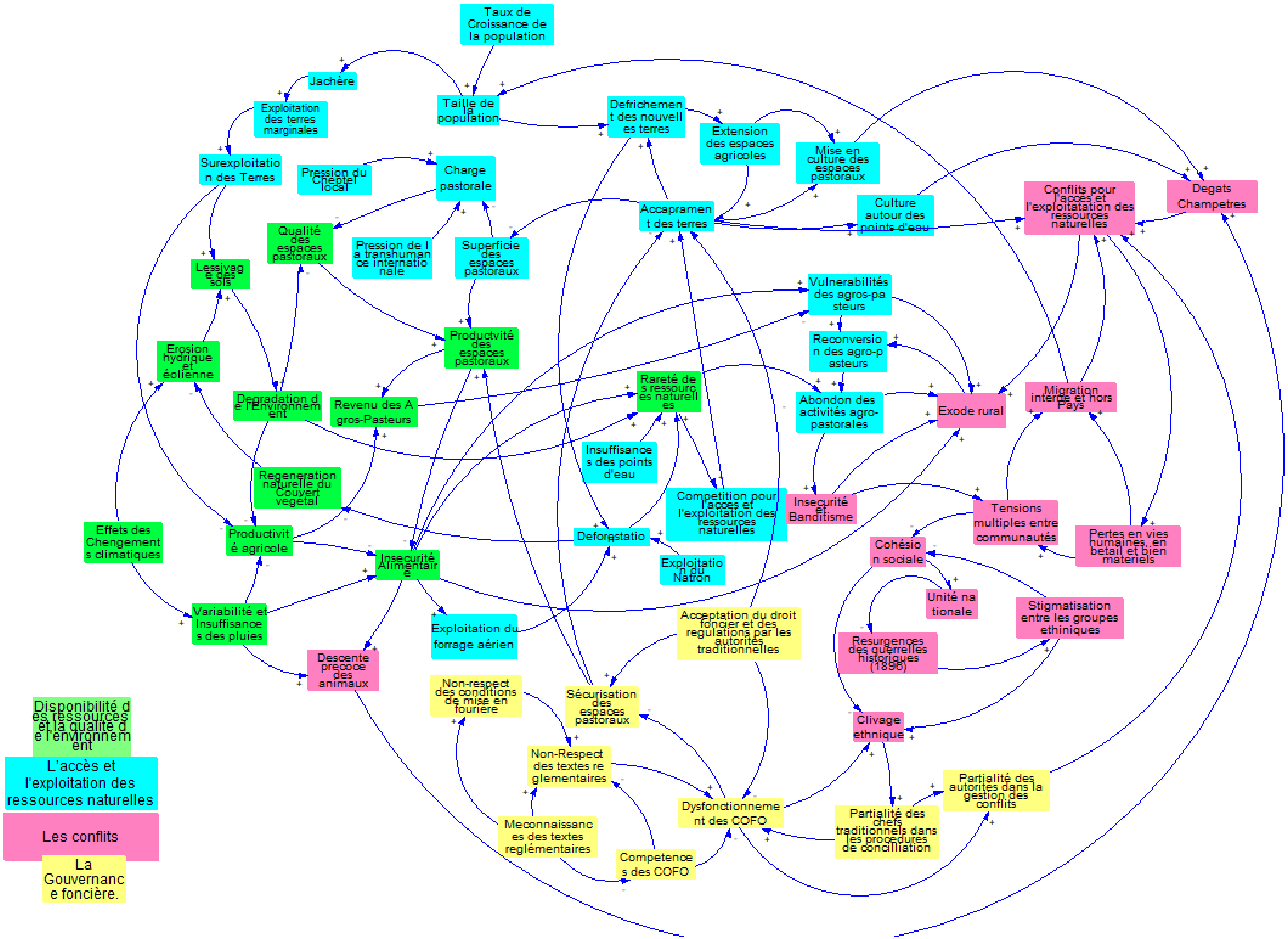


Figure 35 - Causal Loop Diagram for the case of Niger

Phase 2 – User needs and data collection

Using the Causal Loop Diagram as basis, the user cases have been discussed to identify the related information needs. As a result of the workshop, 18 user cases have been collected (see figure 29).

No	En tant que	Je voudrais savoir	Afin de
1	membre exécutif du conseil régional (2e vice de Président CR)	la situation des **espaces pastoraux partagés régionaux non sécurisés**	de mettre à jour le schéma d'aménagement foncier régional à travers leur inventaire et leur sécurisation au cours de l'année 2023.
2	« directeur Départemental de l'Hydraulique et de l'Assainissement de Dosso »	la zone qui n'aura pas assez **d'eau disponible** dans les points d'eau pastoraux (dans les 5 ans à venir)	Programmer la réalisation d'ouvrages pastoraux pour satisfaire les besoins
3	Agriculteur	Les zones où la **fertilité du sol** sera plus élevé	d'améliorer la production agricole en rehaussant le rendement.
4	Directeur Departemental de l'Elevage	le nombre des **aires de pâturages colonisées par les plantes envahissantes** non appétées par les animaux dans le département	d'améliorer la production fourragère
5	Maire de la commune de Falmey	la **date de libération des champs** au niveau de la commune	d'amener les parties prenantes à respecter la date et éviter les conflits
6	Préfet de Dosso	l'inventaire des **aires de séjour de pâturage et les couloirs de passage des animaux** dans le département	de procéder leur sécurisation dans les 5 ans avenir.
7	représentant de la commission foncière départementale (COFODEP de Falmaye)	le **nombre d'aires de pâturage** non balisées et leurs superficies	procéder à leur sécurisation ;
8	Directeur Régional de l'Elevage de la région de Dosso	**l'effectif du cheptel et le disponible fourragers** dans la région de Dosso	d'établir le bilan fourrager pour élaborer un plan d'actions pour répondre à l'insécurité alimentaire
No.	En tant que	Je voudrais savoir	Afin de
9	Environnementaliste	la **quantité de bois** à prélever par an	de gérer la ressource en bois pour permettre son exploitation tout en limitant les impacts négatifs sur la foret
10	directrice départementale de l'agriculture	les **prévisions pluviométriques** fiables	de planifier les périodes de semis pour optimiser les rendements
11	Directeur Départemental de l'Hydraulique et de l'assainissement,	la **disponibilité de la ressource en Eau** en prenant en compte le taux d'accroissement de la population	D'estimer les besoins du cheptel et des populations dans les 10 ans à venir
12	Directeur Départemental de l'Environnement de Falmey	le taux moyen annuel de **dégradation de terres**	Planifier les superficies annuelles à traiter pour compenser ces pertes.
13	Directeur Départemental de l'Environnement de Falmey	la période d'installation définitive de la saison pluvieuse annuellement (**prévision climatique annuelle**)	démarrer mes opérations de plantation sur les sites en restauration de terres dégradées
14	Secrétaire General de la Chambre Régionale d'Agriculture de Dosso	le nombre d'année de **pluviométrie** déficitaire (dans les 20 prochaines années)	d'anticiper sur les mesures d'urgences au niveau des producteurs
15	Secrétaire Permanent COFODEP	le **taux d'occupation des terres** dans les 10 ans à venir ;	prévenir les conflits pour l'accès et exploitation des ressources
16	Directeur Régional de l'Hydraulique de Dosso	**l'évolution de la taille du Cheptel** dans la Région de Dosso (durant les 10 ans à venir)	prévoir le nombre et les types d'ouvrages à réaliser
17	substitut du procureur de la République de Dosso ;	les cas d'occupation illégale des espaces pastoraux (cause de conflits) ;	d'identifier et de réprimer les auteurs de ces faits
18	SG de la préfecture de Falmaye	le taux de récolte des champs en fin septembre	de déterminer la date de libération des champs de manière précise.

Figure 36 - User cases defined for the case of Niger

From the above listed use cases, number 1, 4, 6, 11, and 17 have been specifically important for the development of the dashboard. Cases 1, 4, 6, and 17 strongly relate to the visualization of pastoral areas, transhumance corridors, and water wells that are impacted by land grabbing. This led to the development of the 'Carte' page of the dashboard where the increasing intensity of land grabbing is visualized together with the pastoral areas, corridors and water wells in the three communes of interest. Use case 11, on the other hand, is related to the availability of water resources considering external factors such as demographic growth. Although the impact of such scenarios is not quantitatively modelled in this project, the semi-quantitative approach still allows us to visualize stakeholders' perceived impact of demographic growth on water availability and the rest of the system. Since other user cases (nr 2, 10, 13, 14) also mention rainfall and drought indicators, a specific page has been devoted to this, called 'Indicators'. While long term climate projections have been mentioned in the use cases, during the co-design process it became clear that local historical data that better describes the region is more useful. It was therefore decided to include the drought and Potential Climatic Land Conflict indicators calculated based on locally measured data. It is also important to mention that the drought indicators are calculated based on daily data. Using observed local climate data at a daily granularity is however not sensible, as such climate models are designed to simulate long term changes and trends rather than daily variations.

The data collection was based on the information needs expressed by the stakeholders and the data available or possible to develop as part of the project. The next section briefly presents the data that has been collected and the semi-quantitative analysis which has been developed for data collection. Details of the local datasets and Potential Climatic Land Conflict (PCCF) calculation can be found in the Frexus report 'Analyse diagnostique de trois évaluations sur l'analyse de conflits, l'étude de référence et l'étude locale des risques climatiques dans la région de Dosso' (June 2022).

Drought indicators
We used observation data from the synoptic stations of Gaya and Dosso which are the closest to the study area and have collected data over long periods. These data come from the database of the National Meteorological Department of Niger (DMN). In addition to these data, the local project team provided derived drought indicators over the period of 1960-2020:

- End of Season
- Cumulative Seasonal Rainfall
- Length of Season
- Rainy Days
- Beginning of Season
- Total Number of Dry Days
- Frequency of Drought Events

Methodological Approach for Potential Climatic Land Conflict (PCCF)
In this part we try to introduce a new concept, which is based on the risks and perceptions of climatic risks, to characterize the possibilities of occurrence of land conflicts called PCCF. The choice of climatic parameters used, takes into account the results of the principal component analysis (PCA) and the collinearity between the variables. Also, the occurrence of one or all three parameters increases the probability of conflict occurrence. The parameters used are:

- The Standardized Precipitation Index (SPI) which allows to assess the perception of the risk of flooding or drought. Thus, we consider that there is a risk of drought if the SPI indicates at least a deficit situation. This will have consequences both on crop yields and on the filling of water points. As for the risk of flooding, it corresponds to an increased surplus situation and can lead to waterlogging of the soil and loss of crops;
- The intra-seasonal distribution of rain, which is determined based on the number of rainy days and the frequency of intra-seasonal rainfall breaks – at least six consecutive dry days. This indicator allows us to distinguish between years with favorable/unfavorable rain distribution, which can be translated into good/poor agricultural and fodder yields as well as a good/poor filling of the water points. This parameter can also lead to a delay in transhumance. A good distribution is obtained when the number of rainy days is higher than

the average and the frequency of rainfall breaks longer than five days is lower than the average. Otherwise, there is a bad distribution of rain;

- The third index used is based on the start and end dates of the season. In terms of climate-land conflict analysis, this index can be considered as the potential trigger for conflict because it combines the perception of the risk of poor agricultural season and early transhumance due to poor replenishment of water points and pasture. This index assumes an above average (late) season start date and an early or late season end. This leads us to define a situation favorable or unfavorable to the conflict.

The occurrence of these three situations at the same time and place gives the PCCF the value one (01) synonymous with an almost certain conflict situation. This leads us to weigh these perceptions of climate risks. Thus, the observation of the first two situations/indices counts for half (0.5 or 0.25 each) and the third for the other half (0.5) of the PCCF.

Semi quantitative analysis and weighting system

Quantitative data available is limited for the case of Dosso and it was therefore decided to gather semi-quantitative data by asking stakeholders to weight different causing factors leading to a resulting factor. In the example in figure 30 the resulting factor “agricultural productivity” is influenced by “degradation of the environment”, “overexploitation of the land”, and the “variability and insufficiency of the rains”. Local experts were asked to make an informed deduction as to what percentage of the change in agricultural productivity would be caused by the different factors. As there are probably also factors that have not been identified, the factor “other/unknown factors” was added. The weighting of the influence of the factors in this way is of course subjective, but the idea is that 1) when this is done by multiple stakeholders with different perspectives, the average result would be somewhere close to the reality; 2) even without being very accurate, the methodology will provide a rough indication of which factors are the most decisive towards possible solutions.

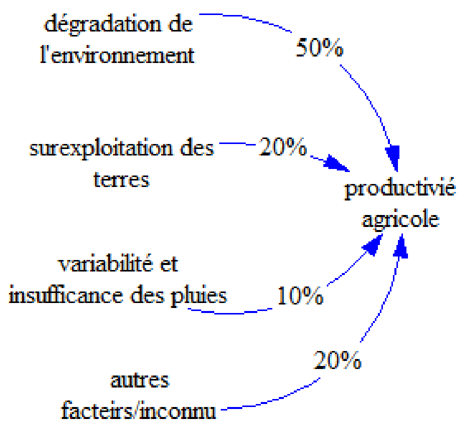


Figure 37 - Example of weighting the causing factors

In June 2022, the co-moderators visited stakeholders in bilateral meetings to discuss the relative weight of causing factors influencing a resulting factor. The stakeholders were asked to estimate the weights of the factors. In total, 11 stakeholders/organisations have shared their input. Most filled in weights for all factors; some stakeholders skipped the factors they knew the least about. The answers did not differ too much amongst the stakeholders. The averaged results (see table 1) of these weights are presented in the simplified overall causal loop in figure 31. These weighted causal relations were translated by Deltares into the policy dashboard.

Table 1: the average weights of the causing factors.

Facteur Résultant	Facteurs causant	Mesure de l'influence relative (%)
Productivité agricole	Dégradation de l'environnement	0,34
	Surexploitation des terres	0,21
	Variabilité et insuffisances des pluies	0,39
	Autres facteurs/inconnu	0,06
Dégât champêtres	Descente précoce des animaux	0,54
	Charge pastorale	0,21
	Accaparement des Terres	0,20
	Autres facteurs/inconnu	0,05
Descente précoce des animaux	Variabilité et insuffisances des pluies	0,53
	Insécurité Alimentaire	0,27
	Autres facteurs/inconnu	0,20
Accaparement des terres	Sécurisation des espaces pastoraux	0,28
	Dysfonctionnement des COFO	0,50
	Autres facteurs/inconnu	0,21
Charge pastorale	Accaparement des terres	0,57
	Autres facteurs/inconnu	0,43
Compétition pour l'accès et l'exploitation des ressources	Charge pastorale	0,29
	Accaparement des terres	0,61
	Autres facteurs/inconnu	0,05
Conflits pour l'accès et l'exploitation des ressources naturelles	Dysfonctionnement des COFO	0,25
	Dégât Champêtre	0,35
	Accaparement des terres	0,18
	Compétition pour l'accès et l'exploitation des ressources	0,24

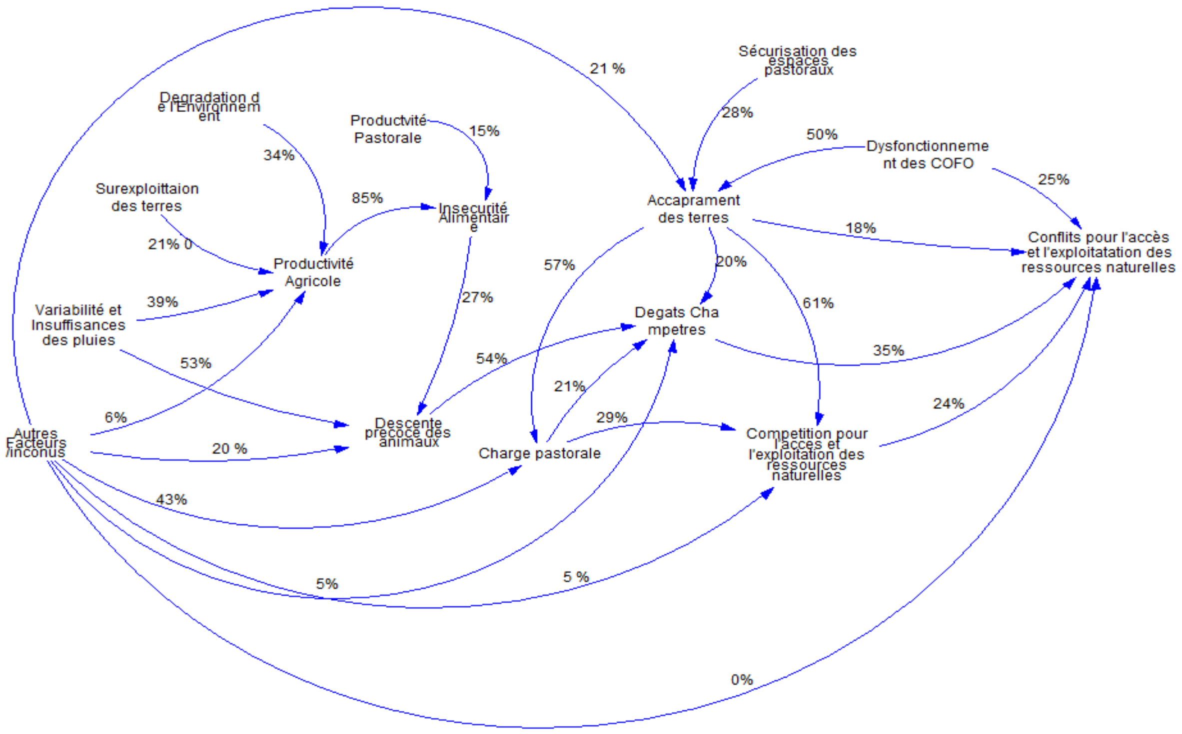


Figure 38 – Simplified Causal Loop Diagram with weights per causing factor. The weights indicate which percentage a causing factor is perceived to determine a change in the resulting factor.

Phase 3 – The policy dashboard

Several discussions were needed with the co-moderators in order to align the first ideas based on the information needs formulated by the stakeholders. As outcomes of those discussions, a dashboard mock-up was developed with the three content pages based on the initial workshop and bilateral meetings. This mock-up (see figure 32) was static and just for demonstration purposes and included three pages: page 1) with the simplified Causal Loop Diagram incorporating the weights obtained from the semi-quantitative approach; page 2) with the visualization of indicators and drought risk for two regions, and page 3) with the map of pastoral zones and corridors as well as water points.

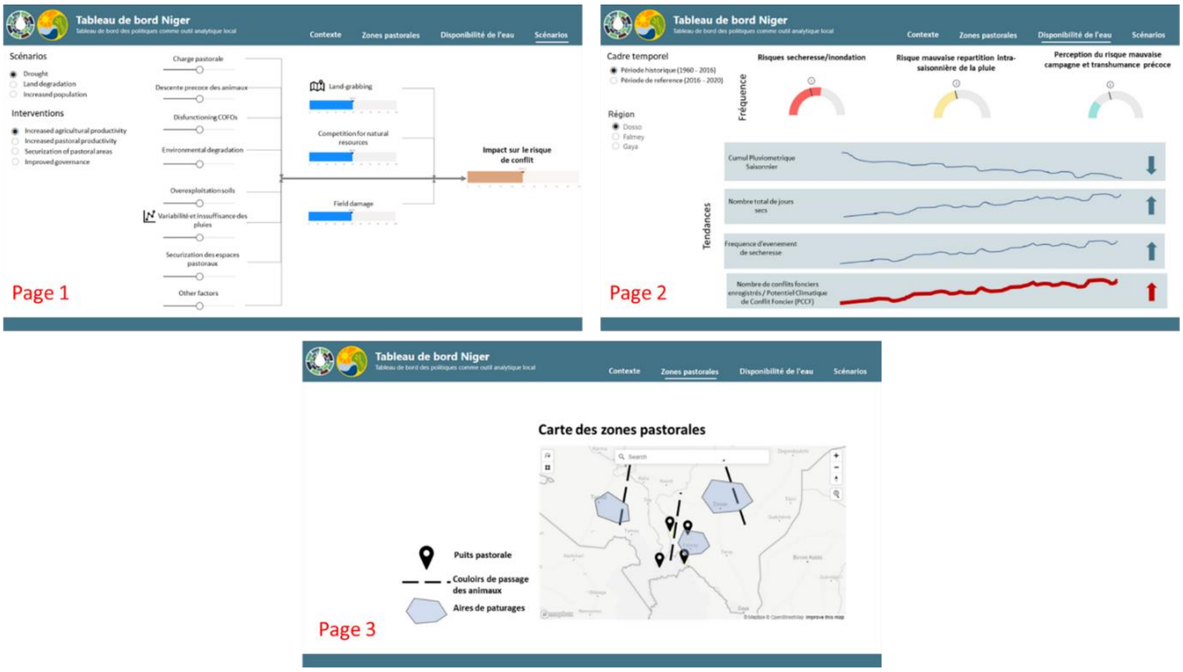


Figure 39 - Mock-up of the Niger dashboard

The mock-up was implemented into the first prototype, which was evaluated in Workshop 2. Based on the feedback received, an Introduction page has been added and several other modifications were carried out.

The final Niger policy dashboard has the following pages:

Introduction page

This introduction page (figure 33) outlines the objective of the tool and explains how to use it. The page also introduces the three main dashboard elements: simplified and semi-quantified causal loop diagram, indicators, maps. The user can navigate to the other pages form this introduction page.

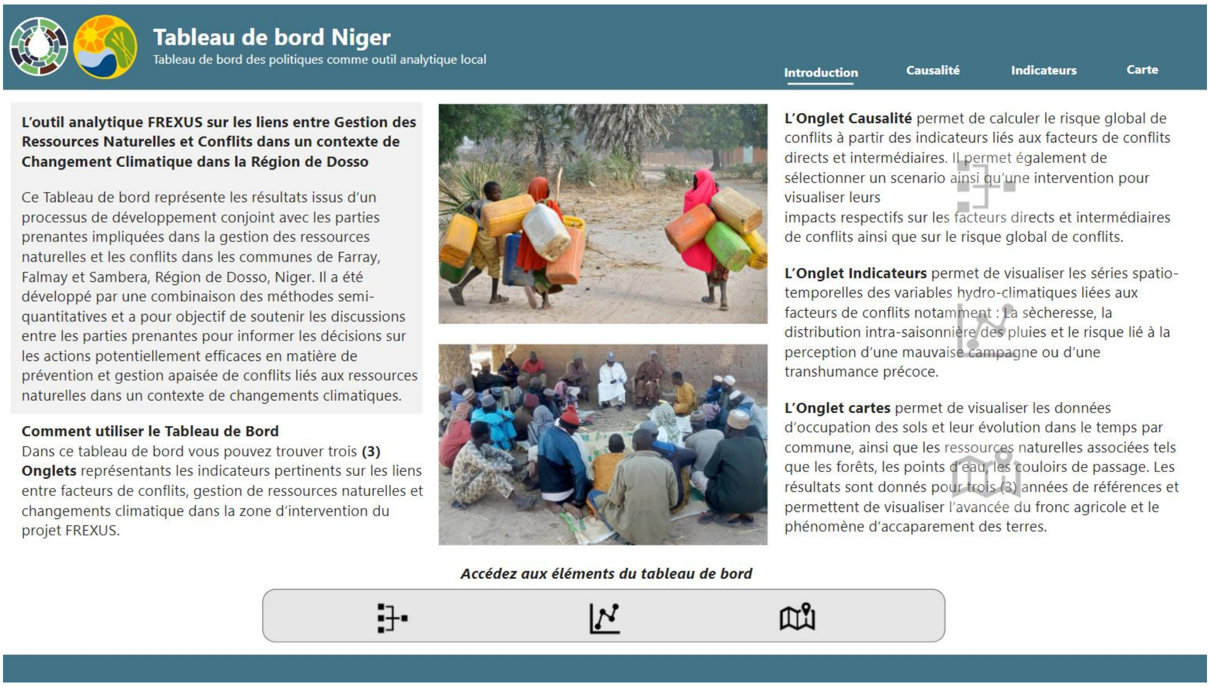


Figure 40 - Page 'Introduction' of the Niger dashboard

Causality page

The second dashboard page (figure 34) presents an easy to understand representation of the simplified causal loop diagram. Here the user can make changes to certain “causing” factors with the help of a slider (between 0-1). The changes of these causing factors have impact on the “resulting” factors, the second layer. The values of the resulting factors are visualized as probabilities between 0 and 1. Finally, the conflict likelihood is calculated based on the resulting factors. Apart from manual changes to the causing factors, the users can also investigate the impact of certain pre-defines scenarios and interventions.

Scenarios include external factors such as:

- drought,
- soil degradation,
- and population growth.

The **interventions** include potential measures that stakeholders can take locally:

- increase in agricultural productivity,
- increase in pastoral productivity,
- securitization of pastoral zones,
- and enhanced governance.

Each of these scenarios and interventions modifies a set of causing factors in the causal loop. Values can be set default with the ‘Sans scenarios’ et ‘Aucune intervention’ buttons. The users are provided with additional information that can be accessed by clicking on the info buttons next to each factor.

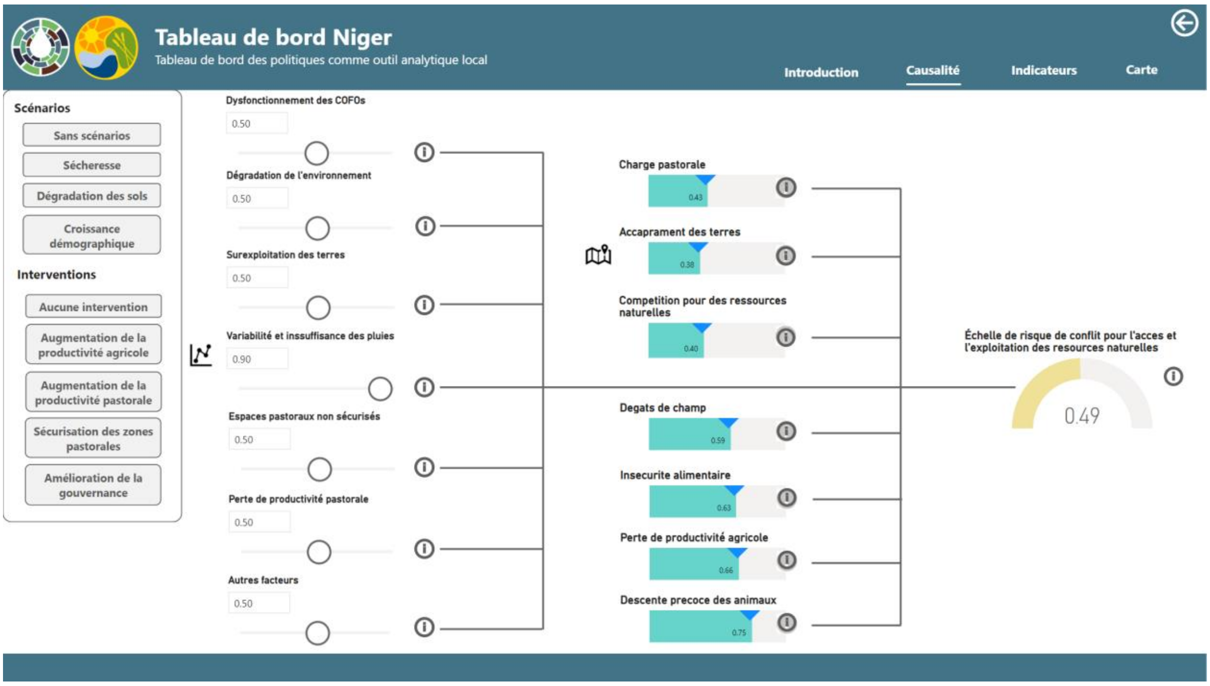


Figure 41 - Page 'Causalité' of the Niger dashboard

Indicators page

Since the causality page (figure 35) provides a locally perceived stakeholder understanding of the system and the strength of interconnections between factors, an additional page has been added that displays factual, locally measured (historical) data-based information. This data-based information helps to understand the co-evolution of drought indicators and conflict risk. This page displays three aspects:

- **Drought indicators**: the selected drought indicators are cumulative seasonal rainfall, total number of dry days, and frequency of drought events.
- **Intermediate risk indicators**: Drought/flood risk, risk of poor intra-seasonal rainfall distribution, and the risk perception of bad crop year and early transhumance. The risks are calculated based on the drought indicators and are available yearly. The gauges display the average risk within the selected period.
- **Climatic potential for land conflict**: The calculation of this indicator is explained in the previous section.

The time series and long term (linear) trends of these indicators can be visualized and analyzed, covering 60 years. The user can select a time interval with the slider on the top left corner. The user can also choose between the two regions for which locally measured data could be obtained.

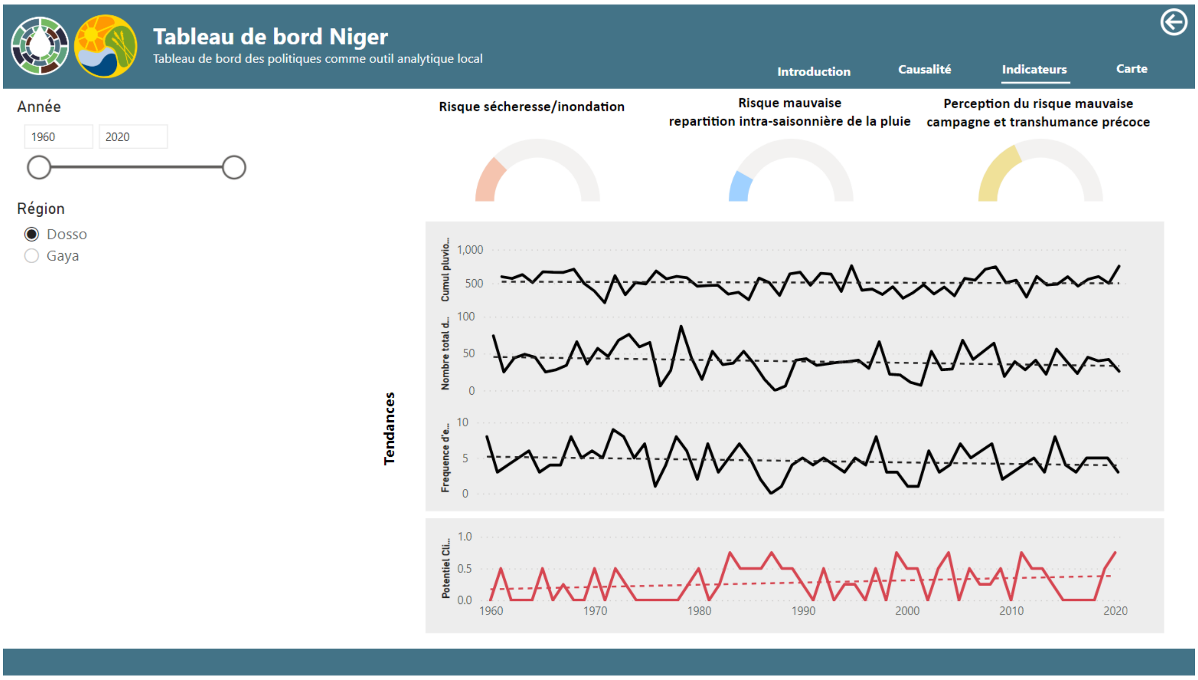


Figure 42 - Page 'Indicators' of the Niger dashboard

Map page

Similarly, to the Indicators page (figure 36), the Map page of the dashboard also aims at complementing the semi-quantitative Causal Loop Diagram approach with factual data, in this case with maps. The main objective of this page is to visualize the evolution of land grabbing. Note that land grabbing in this context is defined as the expansion of cultivated land. The expansion of cultivated land reaches into pastoral corridors, pastoral areas, and wells. Therefore, this page of the dashboard displays a map of pastoral corridors, pastoral areas, and wells together with the expansion of cultivated lands (yellow areas). The users can explore the evolution of the surface area of the cultivated lands by switching between three years: 1984, 2000, and 2021. The total area of cultivated lands is also displayed as 1) an aggregate indicator in the shape of a value, 2) in the shape of percentage difference since the reference year (1984), and 3) in the shape of a bar chart. These visual elements allow users to grasp the magnitude of the expansion.

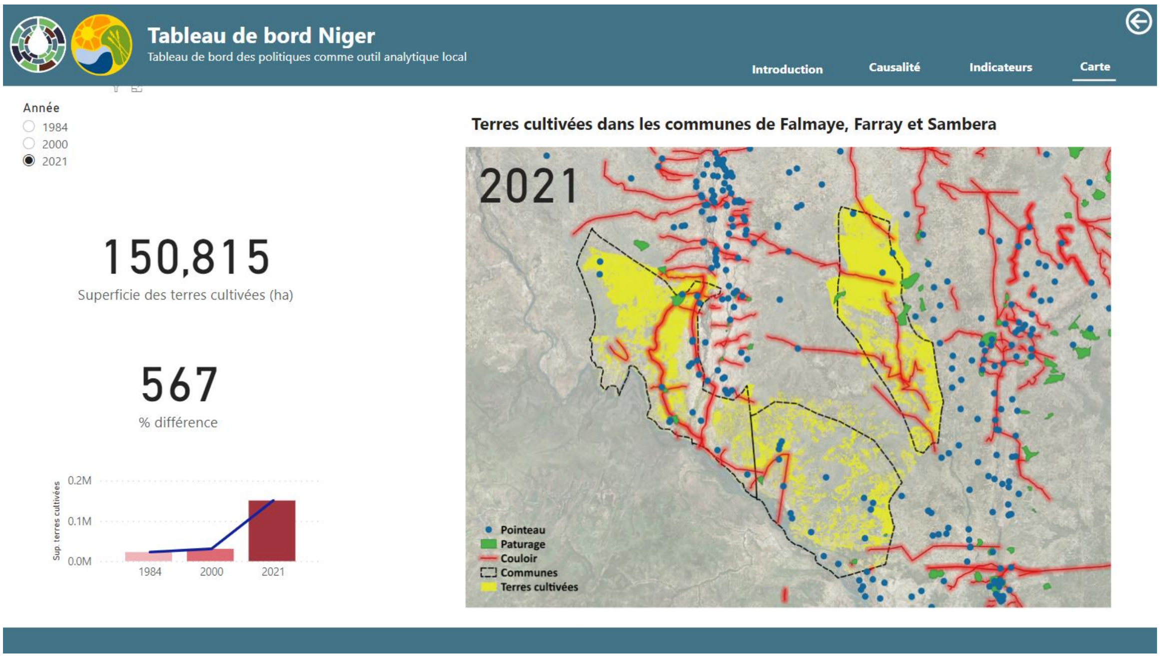


Figure 43 - Page 'Map' of the Niger dashboard

Results

On the joint development process

The stakeholder engagement process has been conducted by the local co-moderators, supervised by the team of GIZ. This document will therefore not extensively report on the process, but it is worth mentioning some feedback from the stakeholders regarding the results of the joint process development. According to the team of co-moderators, the effects of the use of the Causal Loop Diagram has successfully achieved the following:

- A way to involve the stakeholders with different perspectives
- A way to improve the stakeholders' understanding of the causes/links
- The deconstruction of some perceptions, e.g. conflict is only due to political or ethnical issues. These issues play a role, but other aspects are also relevant.
- A way to improve the stakeholders' understanding of possible solutions through discussions about e.g. indicators and actions.
- A way to facilitate the dialogue between stakeholders and thereby significantly strengthening their communication and relations. This positive outcome also trickles down to the communities.
- Improving the skills of the stakeholders to facilitate dialogues in the communities. Participants had a common understanding of problems and were able to deconstruct the different factors.

Some stakeholders have also mentioned the fact that the process 'gave a voice' to different stakeholders and brought them to the same table. The joint development process seems to have led to positive results in the system understanding locally, as other feedback included:

- Aminata Attinine Assane, the Mayor of Farray in Niger, who highlighted that the results of the Frexus project are already visible. Farmers and herders in her commune had ongoing conflicts over natural resources, especially water, but via jointly identifying the problems and thanks to dialogue, the conflict parties feel heard and there are less fights and deaths between the two livelihood groups (Frexus, 2022c).
- Professor Lawali, from the team of co-moderators, who indicated to consider integrating the Causal Loop Diagram methodology into his lectures at the University of Niamey.

On the dashboard

For the stakeholders who participated in the development process, the dashboard does not seem to add further value in understanding the situation, highlighting links between different factors, or driving discussion about causes and effects. However, the co-moderators indicate that this would probably be different for new users. They also report that although the dashboard does not show the combined effects of interventions and scenarios, it is actually helpful to create discussion around each individual intervention and scenario, and the impact of those on the system.

From the discussions with the co-moderators, the main value of the dashboard in Niger seems to be the acceptance of the conflict factors and the importance of influencing the system, such as the need to act on governance-related interventions and climate adaption. The dashboard helped to have this issue recognized and accepted by the stakeholders.

Key findings

- The Land Commissions (COFOs) constitute a framework for consultation, reflection and decision-making in the management of natural resources and conflict prevention through land tenure security. The non-functionality of COFOs, which does not allow them to carry out their tasks properly, is the most influential factor in the aggravation of land conflicts. Consequently, improving governance, hence, increasing the functioning of COFOs seem to have the strongest impact in conflict risk reduction.
- The dashboard shows, based on the semi-quantitative results, that conflict risk caused by the variability and lack of rainfall can be completely counteracted by the securitization of pastoral areas.
- Local historical data from the past 60 years show no visible changes in cumulative seasonal rainfall and even a slightly decreasing trend on the frequency and length of drought events. At the same time the perceived risk of bad agricultural season and early transhumance due to poor replenishment of water points and pasture (calculated based on the timing of the rainy season, see exact definition in section 0) shows an increase. This leads to the finding that even though the drought events do not seem to occur more frequently and last longer, the Potential Climatic Land Conflict shows increasing trends.
- The cultivated land area (in Falmaye, Farray and Sambera municipalities) has increased five times in the past 3-4 decades, and intrudes transhumance corridors, pasture areas and water wells.

These key findings provide examples of what can be learned from the local tool. It is strongly recommended that the co-moderators and the users of the dashboard can draw their own results and conclusions as they are more familiar with the local situation and that it would guide them in their use of the dashboard.

Chad

Introduction

The Republic of Chad is currently facing multiple problems. The country fights against terrorist groups, hosts more than 600,000 refugees, is affected by crises in neighboring states. The region is seriously suffering from the effects of the Sahelian crisis triggered by climate change, population growth, water scarcity, soil erosion and desertification. This crisis has caused alarming food insecurity throughout the Sahel. Kanem is one of the poorest provinces in Chad and in 2017, global malnutrition rate in Kanem was 19.2%. The main challenge for the municipalities is to provide basic services to the population (Frexus, 2022d).

Some 80% of the population lives from agriculture (mainly subsistence). Due to the difficult agro-climatic conditions, agriculture can be practiced almost exclusively in the wadis, valleys where rainwater is channeled. However, the productivity is minimal due to traditional farming practices, the lack of adaptation to climate change and the complexity of land use rights.

According to the Risk and Resilience Assessment report in the Sahel region: the Greater Kanem region is not at immediate risk of violent conflict, despite significant vulnerabilities and its proximity to Lake Chad. In the long term, the frustrations expressed with regard to the institutions could however represent a risk of contestation. This is exacerbated by a poor management of natural resources in a time of climate change which the population said to be affected by. Precipitations are reported to be irregular in space and time; which negatively influences the water availability of Kanem. The insufficiency of water points due to ignorance of water needs and the poor distribution of pastoral wells also contribute to the low availability of water. The lack of water in turn affects the practice of agriculture. The permanent monoculture, the low fertilization of these soils and the destruction of crops by livestock leads the peasants to descend into the wadis where the humidity is often permanent. But access to agricultural land in the wadis is conditioned by traditional rules of access to land. Non-compliance with traditional cultivation rules by the various stakeholders and the destruction of crops by livestock are the two drivers of food insecurity in Kanem province. The latter would be exacerbated by the lack of grazing area for breeders and their cattle, which have become too numerous. Irregular rainfall and high temperatures reduce the availability of fodder for livestock on the dunes. This forces herders to descend early, that is to say before the harvest, into the wadis in search of water and pasture. The lack of grazing area in the wadis increases the frustration of herders. They consider that the security of grazing areas is weak and that farmers refuse to recognize and accept transhumance corridors. Herders also note a strong partiality in the management of resources;

which leads to the weakening of social cohesion, which in turn can lead to conflicts between farmers and herders.

Joint development process

The joint development process for the project in the province of Kanem has formally started in December 2021 and has taken place around five seven activities. The team of the WPS Partnership has been supporting those activities in their preparation and in the processing of key results for the development of the tools. Because the local process has been led by the local team of co-moderators, this report will only present the key objectives and outcomes of each activity.

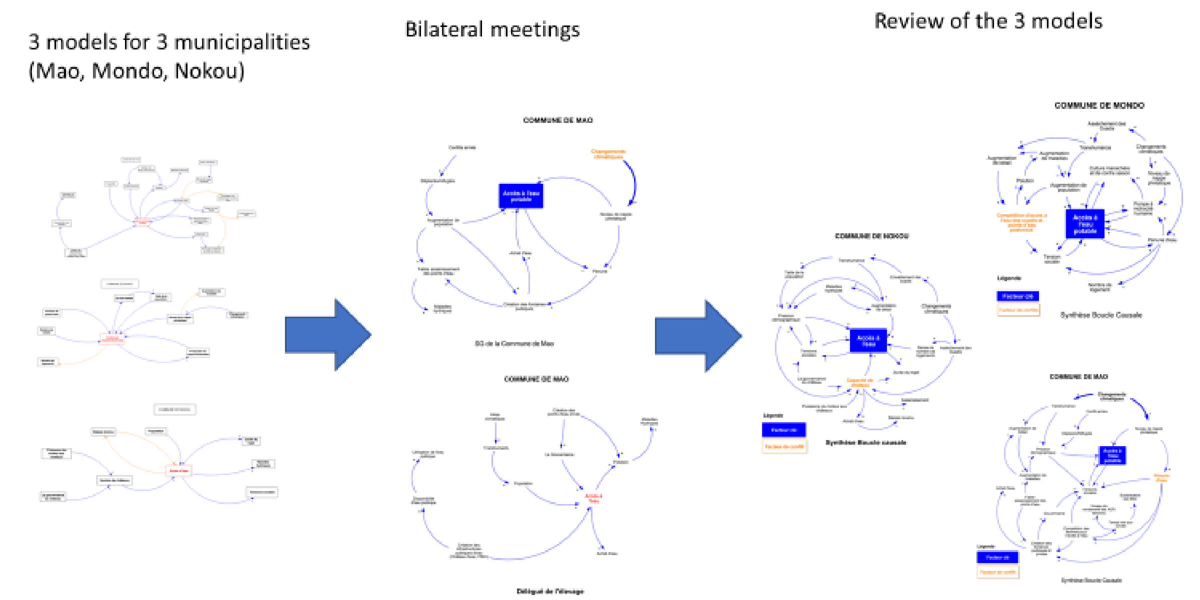
- In December 2021, a **first workshop** has been organized with local stakeholders. The workshop has been articulated around three key objectives: 1. Strengthen participants' awareness of the commitment of Frexus projects in Chad, the work objectives, the various activities and their articulation. 2. Introduce the concept of system thinking and the participative approach through group-model building; 3. Assess the perception of the stakeholders regarding main water-security issues in the province of Kanem and start the development of Causal Loop Diagram for three municipalities.
- In January **bilateral meetings** were conducted by the co-moderators – under the lead of GIZ – with a group of 11 stakeholders. The bilateral meetings have been done for three municipalities: 3 for Mondo, 4 for Mao and 4 for Nokou. The results of the bilateral meetings have been translated into 16 individual causal loop diagrams. With support of Deltares, those individual diagrams have afterwards been integrated in one single model.
- In February 2022, the **second workshop** has reviewed and validated the findings from the bilateral meetings and the aggregated Causal Loop Diagram with the larger group. The participants however shown very different level of understanding and for the development of the dashboard, it has been decided to work with a smaller group, mainly the group of co-moderators, who would consult the stakeholders on a regular basis during bilateral or small group meetings.
- In July 2022, the objectives and user cases of the dashboard and the key indicators to be integrated were formulated in an **online workshop moderated by Deltares**. Participants indicated which factors they found important and for what kind of decisions they could use the Causal Loop Diagram and the subsequent dashboard. Based on the questions and information needs identified during the first workshop, Deltares developed a first version of the dashboard.
- When developing the dashboard, **regular team meetings** took place between the team of co-moderators and Deltares/WPS Partnership. Those meetings have especially focused on: 1. Developing a simplified Causal Loop Diagram to be used in the dashboard; 2. Defining the content of the dashboard, test and validate it for the data collection; 3. Developing a semi-quantitative methodology to weigh factors from the Causal Loop Diagram.
- In September 2022, the co-moderators have conducted **bilateral meetings** in order to collect semi-quantitative data and define the weight of the factors of the Causal Loop Diagram (simplified). These meetings also allowed to already collect observations and comments on the dashboard, as well as suggestions for possible improvement of the local tool.

- In October 2022, the **third workshop** will be organized, with the aim of allowing participants to discuss the prototype version of the local tool and use the dashboard to identify actions to influence the relations between natural resources and conflicts.

This final session, however, will most likely not be enough for the participants to really get ownership on the dashboard. They will need some time to try it and improve their understanding of the different functionalities. It could be considered planning a new session in order to: 1. Analyse the present situation and future situations by using the dashboard; 2. Identify further actions to influence the connected water security system to achieve policy goals for the region.

Phase 1 – The Causal Loop Diagram

The Causal Loop Diagram for Chad (figure 46) has required several phases of developments, as summarized in the figure below. The team of co-moderators first focused on Causal Loop Diagram for three municipalities (Mao, Mondo and Nokou), before to develop them further through bilateral meetings. The three models have afterwards been aggregated in a large model, further enriched through different group discussions. Supported by Deltares, the team of co-moderator has reviewed the Causal Loop Diagram in order to make it more understandable and withdrew some factors which did not have a direct impact on the system. The all process is presented in figure 44.



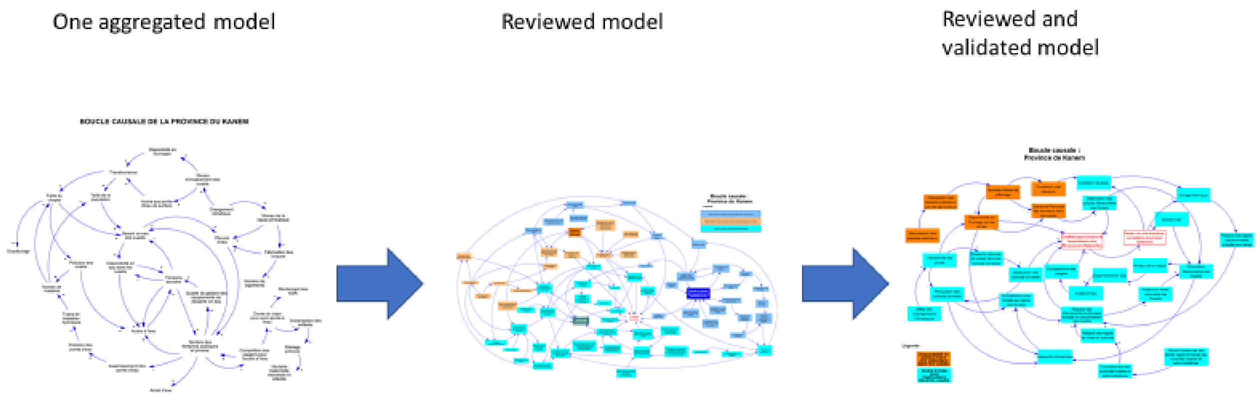


Figure 44 - Development phases for the Causal Loop Diagram Niger

The final Causal Loop Diagram has been reviewed and validated with the stakeholders, during the workshop. It reveals two different groupings of dynamics, which can be identified as follows:

A. Availability and access to grazing areas in the wadis
B. Access to water for agriculture in the wadis

Each of these groupings is presented in more detail in a separate document (Annex 3), by describing the aspects that have arisen from the stakeholder consultation. This is based on the information received during stakeholder consultations. In this sense, the descriptions presented must be considered as a working basis and not as the only possible representation of reality.

Based on discussions in bilateral and group meetings, some factors were identified as the key problems. They have been included in a simplified version of the Causal Loop Diagram:

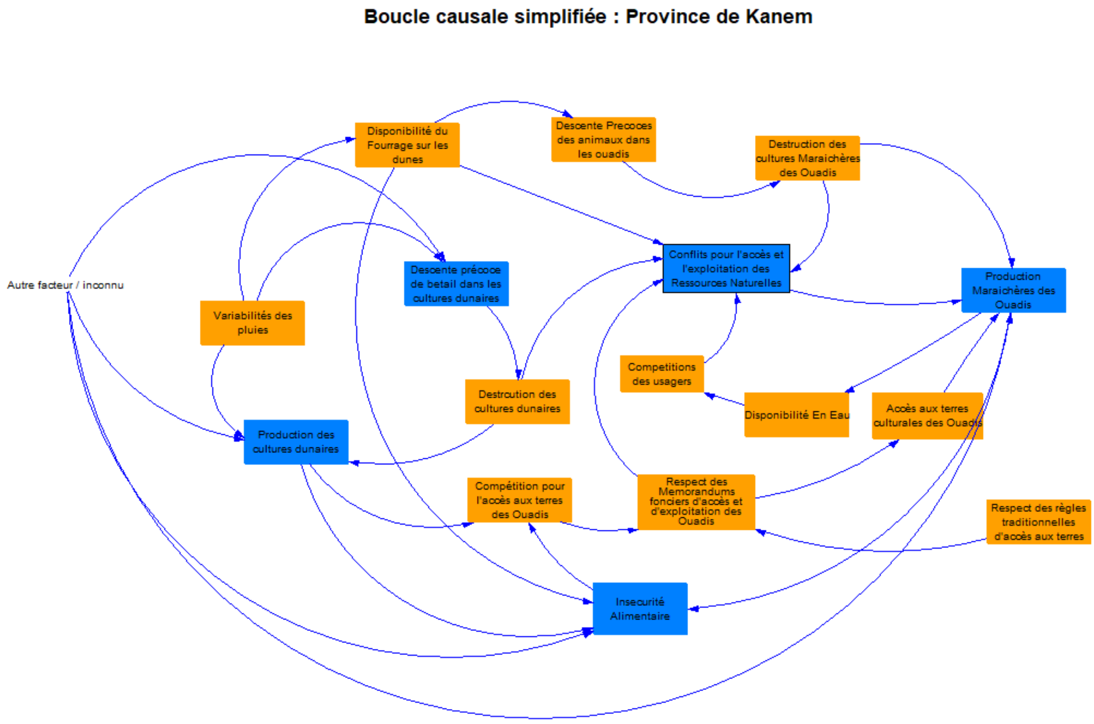


Figure 45 - Simplified Causal Loop Diagram for the case of Chad

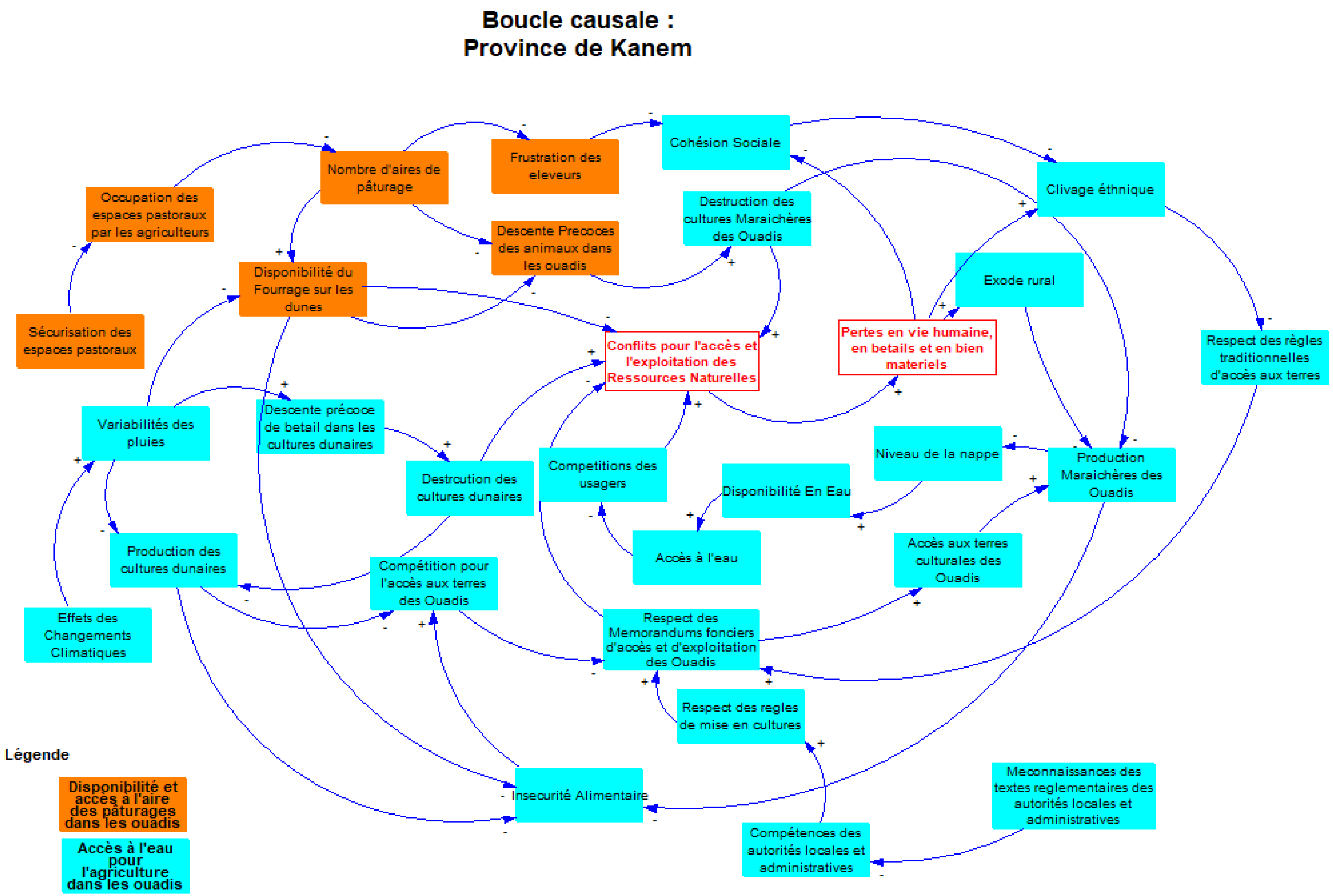


Figure 46 - Causal Loop Diagram for the case of Chad

Phase 2 – User needs and data collection

User needs
Since in Chad local stakeholders showed very different level of system understanding, it has been decided to work with a smaller group (mainly the group of workshop co-moderators) for the dashboard development process. This group consulted the stakeholders on a regular basis during bilateral or small group meetings.

The collection of user needs was also done differently from the other countries (Mali, Niger). In Chad, instead of requesting the stakeholders to formulate a list of dashboard use cases, we have taken a more proactive approach, meaning that:

- we have provided possible dashboard elements to choose from (based on the Niger dashboard, see next section), and
- we have started data collection from various available sources and presented possibilities (to choose from) for indicators. As opposed to Niger, for instance, where the local team gathered local data.

The collection of user needs in this development process was therefore done via validation (rather than expressing initial user needs which are then guiding the tool development) and regular consultation, as described in section 0.

Semi quantitative analysis and weighting system
The semi quantitative analysis and weighting system, developed for Niger, was adopted for Chad. The process was supported by the Niger expert who led the process there.

The result of the participatory process to define causing and resulting factors and weighting them, can be seen below.

Table 1: the average weights of the causing factors for Chad.

Facteurs Résultant	Facteurs causant	Mesure de l'influence relative (%)
Production des cultures dunaires	Variabilité des pluies	73.80
	Destruction des cultures dunaires	20.00
	Autres facteurs/inconnu	6.20
Insécurité alimentaire	Production des cultures dunaires	38.31
	Production maraichère des ouadis	38.13
	Destruction des cultures dunaires	14.13
	Autres facteurs/inconnu	9.50
Conflits pour l'accès et l'exploitation des ressources naturelles	Destruction des cultures maraichères des ouadis	15.83
	Destructions des cultures dunaires	20.17
	Compétition des usagers	6.00
	Descente précoce des animaux dans les ouadis	17.00
	Respect de mémorandums fonciers d'accès et d'exploitations des ouadis	13.33
	Descente précoce des bétails dans les cultures dunaires	25.33
	Autres facteurs/inconnu	2.33
Production maraichère des ouadis	Disponibilité en eau	68.13
	Accès aux terres culturales des ouadis	13.07
	Destruction des cultures maraichères des ouadis	11.46

	Autres facteurs/inconnu	5.16
Descente précoce de bétail dans les cultures dunaires	Variabilité des pluies	30.36
	Destruction des cultures dunaires	33.93
	Disponibilité du fourrage sur les dunes	28.57
	Autres facteurs/inconnu	7.14

Indicators Data

Although local data was not available, the Deltares team managed to gather relevant environmental and socio-economic data from open databases at national or regional level (gridded data from global models aggregated at national or regional level).

The data used for the indicators were obtained from the following sources:

- United Nations, Department of Economic and Social Affairs, Population Division (2022). World Population Prospects: The 2022 Revision, custom data acquired via website.
- https://population.un.org/wpp/
- World Bank, World development indicators
- https://databank.worldbank.org/reports.aspx?source=world-development-indicators#
- World Bank, Climate Change Knowledge Portal: https://climateknowledgeportal.worldbank.org/country/chad/climate-data-projections
- Deltares (Johnson et al. 2019)
- International Labor Office (2017)
- Center for International Earth Science Information Network (CIESIN) (2016)

The following indicators are displayed in the dashboard [together with spatial and temporal scale]:

- Employment in agriculture (% of total employment) [National, annual]
- Added value of Agriculture, forestry and fishing to GDP (% of total GDP) [national, annual]
- Local population density [1 km, 5 years]
- Rate of urbanization [National, 5 years]
- Precipitation [regional, annual]
- Standardized precipitation-evapotranspiration index (SPEI) [regional, annual]
- Standardized Precipitation Index (SPI) [1km, monthly]
- Standardized Precipitation Index (SPI) [1km, 3 months]
- Vegetation Health Index [4km, per week]
- Average temperature [regional, annual]
- Population (UN) [national, annual]
- Agricultural area (km2) [national, annual]
- Forest area (km2) [national, annual]

Phase 3 – The policy dashboard

The Chad policy dashboard development process greatly benefited from the work done in Niger. Although the context, the relevant indicators and the availability of data all differed, the generic dashboard elements of the Niger dashboard could be (re)used as a first proposition for the Chad dashboard. This approach was accepted and after several iterations (in form of conference calls with the relevant parties) it was agreed to formulate and introduction page, a page on causality based on the semi quantitative analysis and weighting system, and one showing available data for the most important topics: agriculture/food production, population and drought. Note that due to local conditions (slow internet) a page with map-based information was not required. The final Chad Dashboard has the following pages:

Introduction page

This introduction page (Figure 47) outlines the objective of the tool and explains how to use it. The page also introduces the used data and methods: the causal loop diagram and the real data-based indicators. The user can navigate to the other pages form this introduction page.

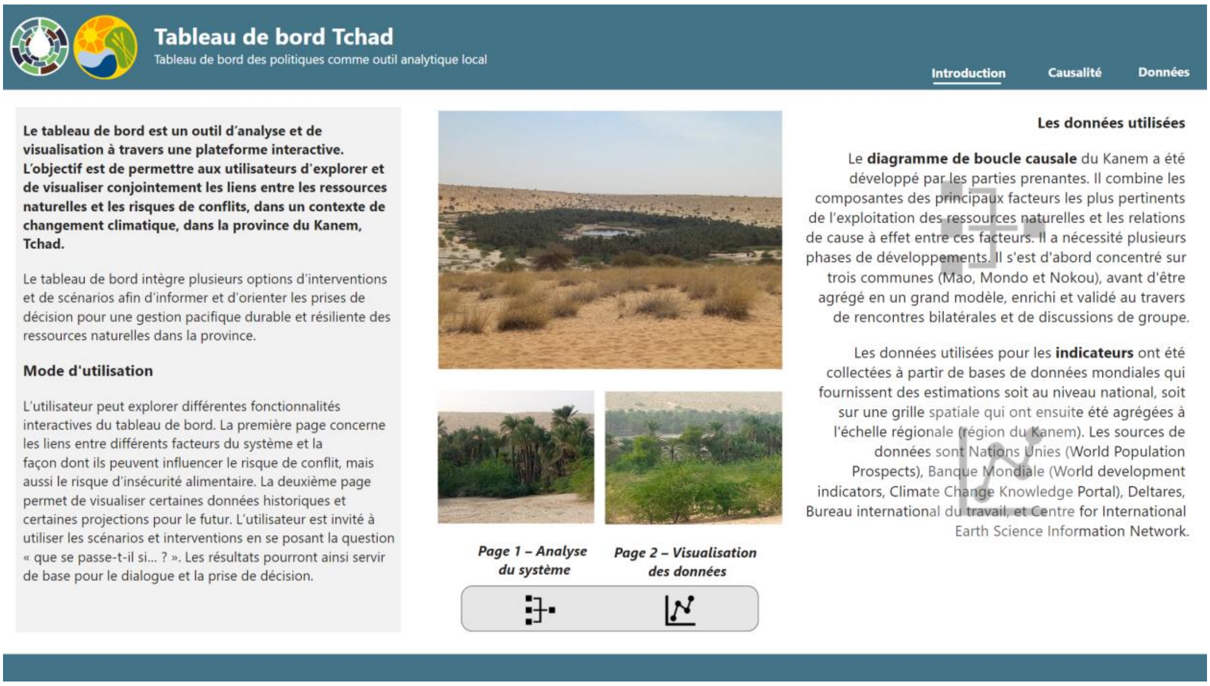


Figure 47 - Page 'Introduction' of the Chad Dashboard

Causality page

The second dashboard page (Figure 48) presents the factors of the simplified causal loop diagram. Here the user can make changes to certain "causing" factors with the help of a slider (between 0-1). The changes of these causing factors have impact on the "resulting" factors. The stakeholders specifically requested the visual separation between causing and resulting factors. The values of the resulting factors are visualized as probabilities between 0 and 1. Finally, the conflict likelihood is calculated and expressed as probabilities between 0 and 1 but using a gauge. Since several causing factors influence various different resulting factors, a color-coding system was implemented. In this system the causing factors are marked with colored dots (the colors represent the resulting factors, meaning the color of the gauges) according to the resulting factors they influence. In this way it is possible to trace back the cause-effect relationships and the users can "validate" initial expectations or at least they have guidance in the understanding of the changes in the system (caused by the modifications in the values of causing factors). Similarly to the Niger dashboard, apart from manual changes to the causing factors, the users can also investigate the impact of certain pre-defines scenarios and interventions.

Scenarios include external factors such as:

- drought,
- soil degradation,
- and livestock growth.

The **interventions** include potential measures that stakeholders can take locally:

- increase in agricultural productivity,
- increase in pastoral productivity,
- securitization of pastoral zones,
- and enhanced governance.

Each of these scenarios and interventions modifies a set of causing factors in the causal loop. Values can be set default with the 'Aucune scenarios' et 'Aucune intervention' buttons. The users are provided with additional information that can be accessed by clicking on the info buttons next to each factor. When a scenario or intervention is selected, it is highlighted.

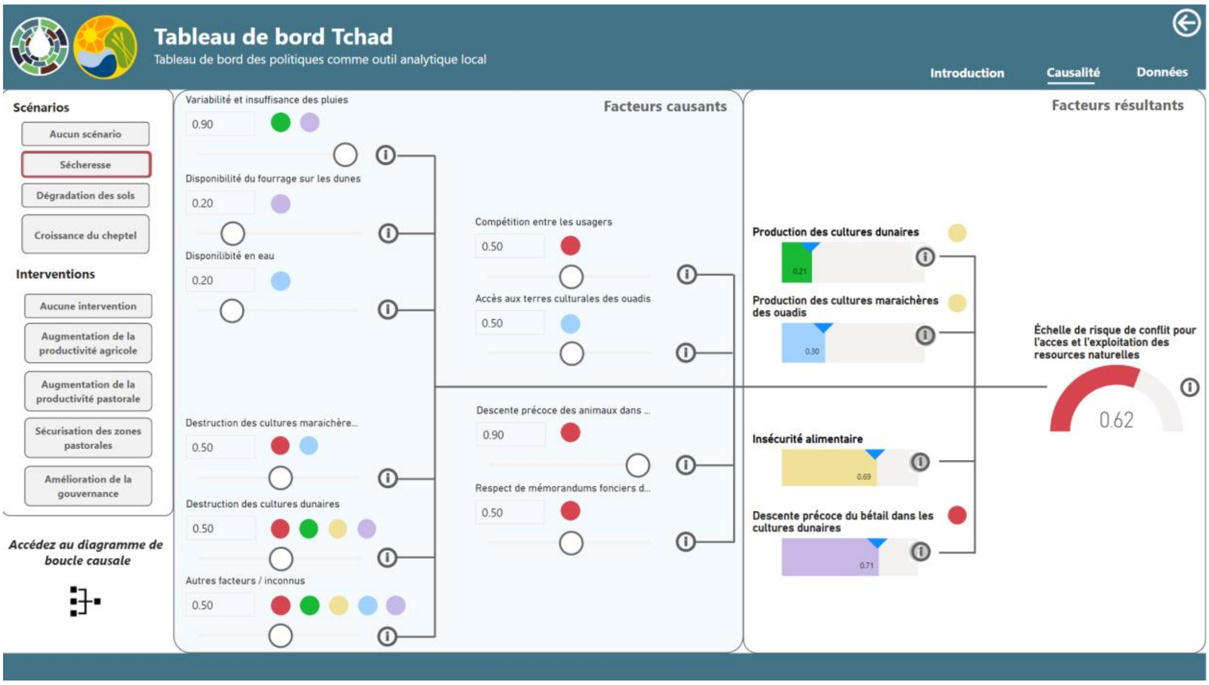


Figure 48 - Page 'Causality' of the Chad Dashboard

Data page

The third and last page is the data page (Figure 49). The previous Causality page is based on a semi-quantitative representation of the system perceived by stakeholders according to their knowledge of the dynamics of the territories, however, these system dynamics can also be described by factual data. For this reason, indicators on three thematic groups are visualized. The first is agriculture/food production as agriculture is the most important source of income in Chad. It represents almost a quarter of the gross domestic product (GDP) and employs around 80% of the active population. It thus makes an essential contribution to the economic development of the country. According to the FAO report, agricultural production increases by 9% each year, but the problem of food security remains. The second is population growth as urbanization and demographic growth impacts the competition for resources. Thirdly, drought as dune culture production, early cattle descent and ultimately food security is impacted by it.

The indicators include both historical data and future projections. Visualizing the co-evolution and trends of these indicators (for a chosen time interval) allows users to link socio-economic and environmental processes to factual data that complements the semi-quantitative approach. The user can choose one indicator for each of the three thematic groups:

- **Agriculture/food production**: the selected indicators are employment in agriculture, vegetation health index (normalized difference vegetation index), agricultural surface area, forest surface area, and the contribution of agriculture, forestry and fishery to the GDP.
- **Population**: the selected indicators are local population density, population, and urbanization rate.
- **Drought**: the selected indicators are Standardized Precipitation Index (SPI) (3-monthly or monthly window), Standardized Precipitation-Evapotranspiration Index (SPEI) (yearly time window), precipitation, and average temperature.

The time series of these indicators can be visualized and analyzed, covering 60 years historical period and future projections until 2050. The user can select a time interval with the slider on the top right corner.

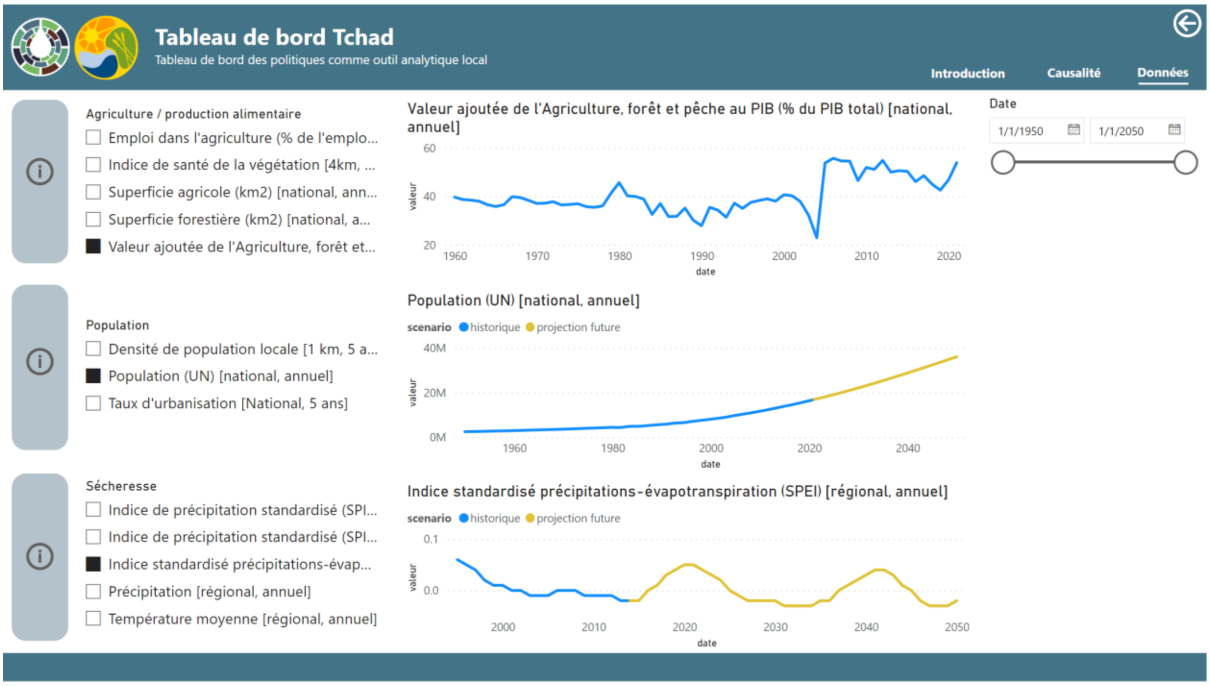


Figure 49 - Page 'Data' of the Chad Dashboard

Results

On the joint development process

The stakeholder engagement process has been conducted by the local co-moderators, supervised by the team of GIZ. The process has required more time and phases than in the other two countries but the iterative process has allowed to go step by step in the development of the Causal Loop Diagram and therefore to give stakeholders time to think about their own case and perceptions. There has been a noticeable evolution in the system understanding regarding the following aspects:

- The difference between 'what the situation is' and 'what the situation should be'. When attributing the polarity (+ or -) to the factor, the difference was not made between wat the reality is and what it should be. For instance, a positive relation was attributed between 'water scarcity' and 'water wells', meaning 'if water scarcity increases, water wells will increase'. It is a common pitfall with the Participative System Analysis, and with stakeholder engagement in general, to directly be willing to focus on the solutions. However, the strength of the approach is precisely to first understand the system in order to afterwards identify entry points for solutions. Several discussions with the team of Deltares have taken place to develop the approach and work on the system understanding, taking in first instance distance from the recommendations.
- The definition of the factors: During the process, many factors have been discussed regarding their definition and what it concretely entails. From the external perspective of Deltares, it seemed that the different participants used the same terminology for different realities (e.g. achat, nombre d'animaux, cas de maladies…). Many of those terms have been discussed and further described to increase the understanding of the situation.
- The difference between access to water, availability of water and needs of water. In the first models developed, the focus was very much on 'access to water'. However, the factors directly related to 'access to water' were of different realities. The factors 'availability of water' and 'access to water' were also used differently in several individual models. During meetings with the co-moderators, it appeared that there was some confusion amongst the stakeholders regarding the difference between: 'access to water', 'availability of water' and 'water needs'. Those concepts and their definition have been discussed with the stakeholders during the second workshop.
- The collaboration with the WPS Partnership: the collaboration between the local team and the international partners has very much evolved during the process. The collaboration has taken more time that in the two other countries in order to really start. The risk was that the process would not follow the approach suggested and that the dashboard would not meet the needs of the stakeholders. Several meeting moments have allowed to discuss the approach, the needs of information to develop the dashboard and the way to collaborate. The team of Niger has also provided their feedback on how the collaboration took place in Niger and this has facilitated the possibility for the team in Chad to further define how they wanted to further work in partnership with the international team. A stronger support from Deltares during a workshop with the comoderators has also to define the approach for the development of the dashboard. In this second phase of the process, regular meetings have been organized between Deltares and the local team.

On the dashboard

Key findings

- Stakeholders initially indicated that no data is available that could be visualized in the dashboard. The project confirmed that although provided by global models or by international organizations, but there is some data available that could be used in the dashboard to complement the semi-quantitative approach and provide measured (or estimated/modeled) data. The policy dashboard can therefore initiate discussion on data availability and on strategies to set up local models/monitoring networks based on what is required for decision making.

- Based on the causality page of the dashboard, the scenario that increases conflict likelihood is not climate related but due to the increase of livestock. Moreover, the intervention that lowers conflict likelihood the most is the securisation of pastoral zones, more than enhanced governance.

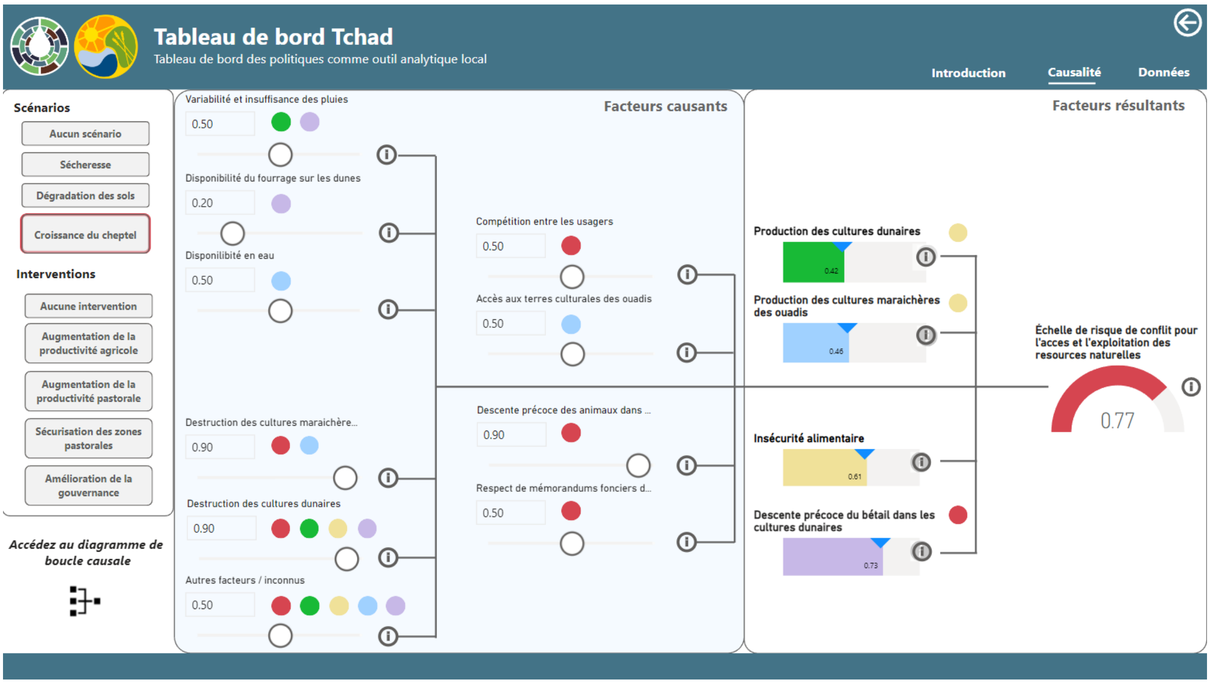


Figure 50. Perceived impact of increased livestock on the system, and ultimately on the conflict likelihood.

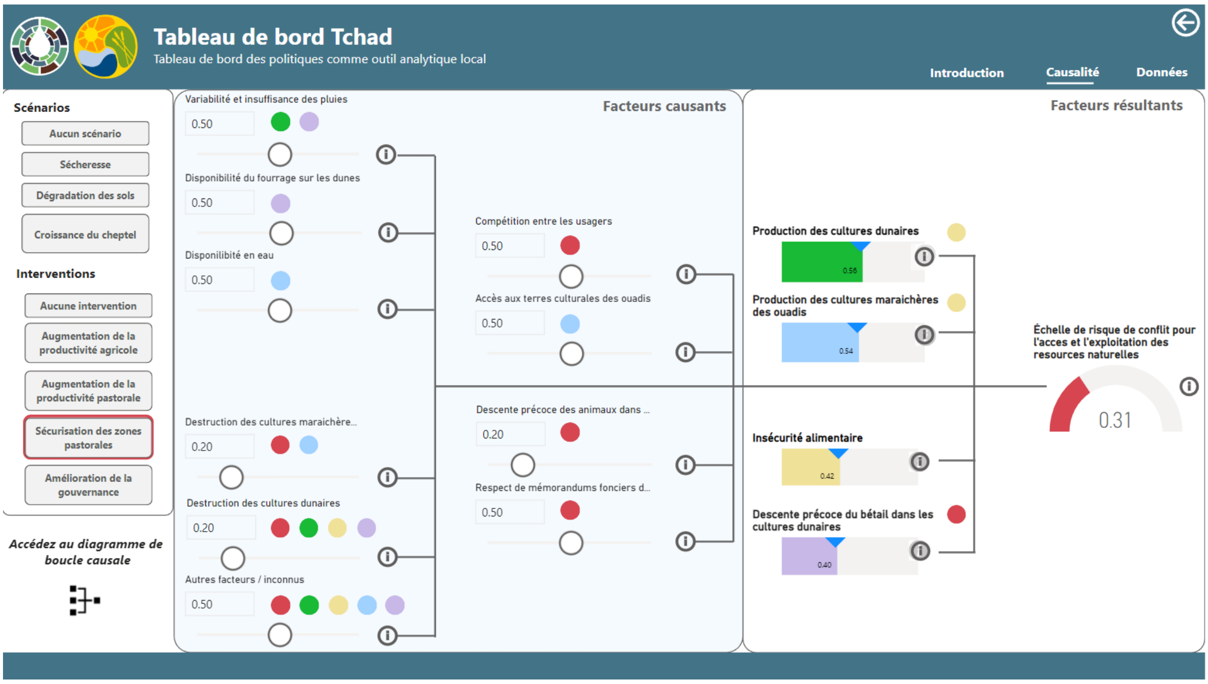


Figure 51. Perceived impact of the securization of pastoral areas on the system, and ultimately on the conflict likelihood.

- On the data page of the dashboard and from the global climate projection data, it seems that the precipitation will increase in the future. This should be taken into account when considering measures as better water storage could provide benefits to manage droughts. It can also be seen from the dashboard that while precipitation increases, so does the average temperature which causes greater evapotranspiration. This is reflected in the evapotranspiration adjusted standard precipitation index (SPEI) that shows decreasing trend in the future.

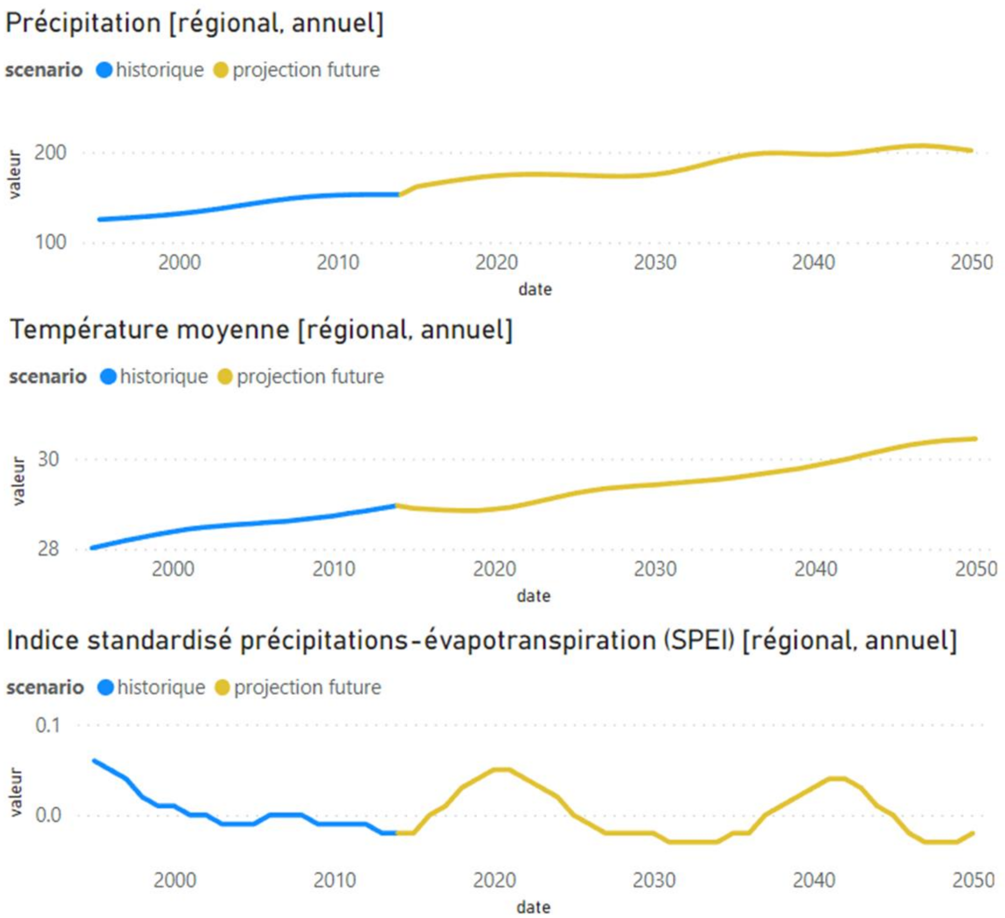


Figure 52 – Dashboard visualization of historical reanalysis and future projections of precipitation, average temperature and Standardised Precipitation-Evapotranspiration Index (SPEI)

These key findings provide examples of what can be learned from the local tool. It is strongly recommended that the co-moderators and the users of the dashboard can draw their own results and conclusions as they are more familiar with the local situation and that it would guide them in their use of the dashboard.

Note that since at the writing of this report the final workshop did not take place yet, the key conclusions/learning points of the users could not be incorporated.

Communication

During the project, Deltares and IHE-Delft have, on behalf of the WPS Partnership, supported the Frexus team with some presentations and communication items around the results of the project, such as:

1. **World Water Forum, Dakar 2022**
   During the Frexus session "Peaceful development approaches in the Niger & Lake Chad Basin", on March 23, 2022: Audrey Legat as keynote speaker and Susanne Schmeier as moderator.

2. **Article for the Water Atlas Africa, May 2022**
   For the article « Frexus : Améliorer la sécurité et la résilience au changement climatique dans les contextes fragiles à travers le Nexus EESA » (not published), contribution for the description of the global tool and of the local tool.

3. **Stockholm Water Week, 2022**
   During the session "Improving security and climate resilience in a fragile context through the Water-Energy-Food Nexus" on August 24, 2022: Audrey Legat as panelist; Susanne Schmeier as moderator.

These activities represented key milestones for the project, because they have allowed the international team of Deltares to gather feedback from the local users on the process and results, verify if the methodology was understood well enough by the co-moderators to present and discuss it for an external audience (e.g. keynote speech of Pr. Lawali - University of Niamey; panel discussions at WWF and SWW), and have a live exchange with the users on the local context and needs.

Discussion and recommendations

Discussion

Water, energy and food resources are the basis of the functioning of our societies, for economic and social activities. The nexus of water, energy and food is crucial for agriculture, livestock and fishing, key activities in the Sahel region. However, these resources face increasing pressures (e.g. urbanization, population growth, overexploitation of resources, pollution, etc.), exacerbated by climate change. In some cases, this leads to competition or certain inequalities (perceived or existing) between users and to potential conflicts. The project has looked in depth at the interplay of natural resources, climate change, and peace and conflict in Mali, Niger and Chad, resulting in analysis tools that are being applied in the three areas of intervention. The tools are based on interconnected models that include the central elements of water, energy and food security and the competition for those resources together with the associated conflict risks.

Looking back on the process, some specific aspects can be discussed regarding the joint development process and the resulting tools. Those discussion points are articulated around five aspects: the potential of the tools; the country dynamics; the data collection; the users and the clarification of what the dashboard is not (intended to be).

1. **The potential of the tools**

To manage potential conflicts in all the three regions, it is necessary to have resource management that takes into account the link with security. Tools can help actors to take joint and informed action based on in-depth system analysis with the help of a causal loop diagram. Generally speaking, the feedback on the development of the causal loop diagram is very positive, with some participants already indicating the benefits it creates in their region. The feedback on the policy dashboard tool somehow shows less enthusiasm, some participants highlighting that the dashboard tool is not as easy of use as they would have liked. In each of the three countries, this balance has been difficult to find because the stakeholders indicated interest in more data (leading to several pages per tool), and different types of data (covering various sectors), which also increases the functionalities and therefore the complexity of the tool, which should actually be tailored and simplified towards a specific user need. However, the more the stakeholders and co-moderators use it, the more it seems to raise enthusiasm for the possibilities the dashboard tool offers. Recent feedback from Mali, after three months of presenting and using the dashboard, have indicated much more appreciation for the added value of the dashboard.

The experience in the three intervention zones has shown that the analytical tools developed are in any case able to fuel dialogue between stakeholders, to contribute to developing a common understanding of the factors of conflict and the levers of intervention favoring sustainable and peaceful management of natural resources while remaining in line with national and sub-regional development policies. The participative approach and the development of the tools have been successful in bringing stakeholders together, in particular different communities, to reflect on the decision-making process and actions in the prevention and management of conflicts related to the management of natural resources. In the three regions, it is mentioned that the methodology has helped creating a useful environment for trust and co-creation. **The result of local analytical tool development is a product, although the development process, that is the means towards this objective, is equally important.**

2. **The important role of the (trained) co-moderators**

The role of the team of co-moderators has been crucial for the process in the three countries. For a successful process, it was important for the stakeholders to accept and join the dynamics needed for the appropriation of the process, of the discussion and for improvements as a group. The co-moderators have created this dynamic, supported by the technics and knowledge developed during the preliminary training. In each country, they have acted as a team and collaborated in the discussion with Deltares. Not all the trained co-moderators have been equally active, but for each country there has been a core group proactively leading the process. In this sense, it has been helpful to train five or six co-moderators per country, it has ensured enough leadership and possibility for role division.

One of the challenges faced during the process is that not all stakeholders have sent the same participants for the different activities and phases of the project. Although it has been strongly monitored and encouraged by the group of co-moderators, it is one of the aspects that had to be taken into account along the process. A solution to mitigate this problem has been to ensure enough time at the start of the workshop in order to recap on the previous phases. On the positive side, it has also allowed for the emergence of a group of really involved users who have followed the entire process.

3. **Defining the users**

The development of the dashboard has been hampered by the simple question: 'who will use it after it has been delivered'? Tools developed by researchers/consultants tend to be little used by the intended end-users, unless the end-users are involved from the beginning. The participatory approach has been beneficial to develop a dashboard that can be used by a diversity of stakeholders, but it also presents the risk of tackling too many different user cases. This can be illustrated by the case of Mali for instance, where more than fifteen users with very different profiles where identified when defining the user cases. When defining the user cases with the stakeholders it appeared that the stakeholders had different uses and information needs. In the next section, recommendations are provided on this aspect.

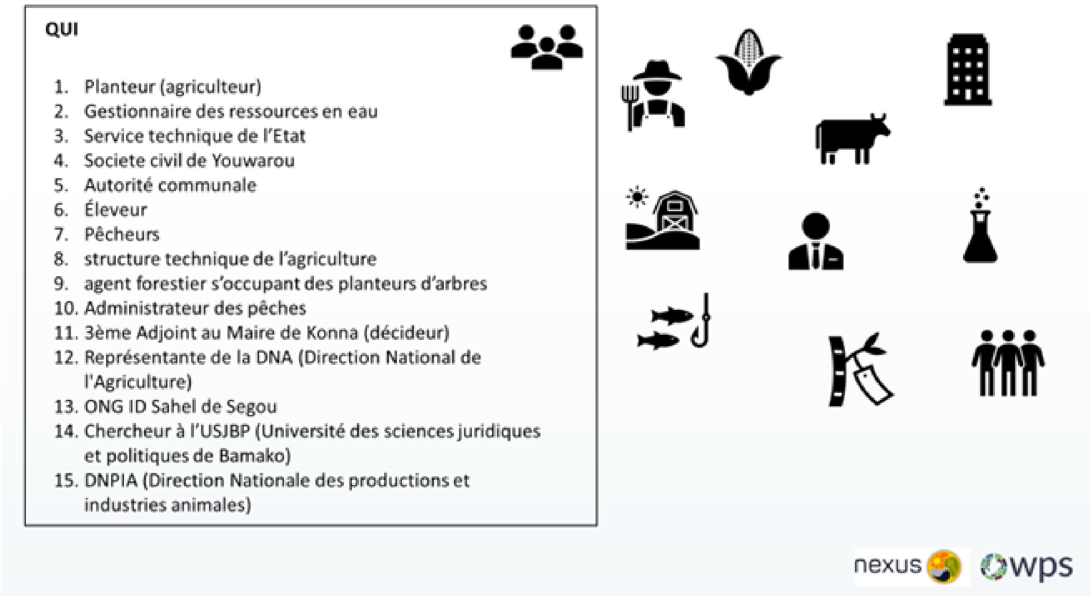


Figure 53 - The list of users identified when defining the user cases for the Mali dashboard

4. What the dashboard is not

When developing the dashboard, there has sometimes been confusion on what the objective of the dashboard is. This could raise some expectations that are not possible to meet in the scope of the project. The dashboard as local analytical tool is an interactive platform for exploring and visualizing development and natural resource management scenarios and their potential impact on security and conflict risk. Eventually it should facilitate the dialogue and inform decisions on resource allocation and conflict prevention. There are three important aspects of what the dashboard is not:

- **The tool is not designed to predict conflicts**. In fact, it is a tool which facilitates the discussion around potential scenarios and measures that have an impact on the risk of conflict. It does not have prediction capabilities and purposes.
- **The tool is not an exact representation of reality**; instead it shows possible scenarios / a set of plausible representations of changes in external factors based on estimates, perceived changes, or using physics based or data driven models that are approximations of the real processes.
- **The tool does not provide a real time analysis**. It is intended to be a policy tool that has a longer time frame reaching historical past and mid- or even long term future.

In some cases, other tools provide those types of outputs (e.g. OPIDIN in Mali gives seasonal forecast). In cases when such tools do not exist yet, those aspects are possible to develop (note that they require different types of models and techniques) and they could be complementary to the policy dashboard (operational dashboards). In the continuous use of the policy dashboard developed in this project, however, it is important to be clear on its objective and functionality.

5. The link between water-energy-food nexus and potential conflicts

The three policy dashboards integrate different indicators but for all of them, two key messages are important to take into account regarding the link between water-energy-food nexus and the link with potential conflicts:

- Most participants mention the role of climate change as a key driver for conflict. Seeing the results presented in the dashboard, it appears however that governance, e.g. accepted natural resource management and conflict resolution system, has the largest influence on the risk of conflict. Interventions should strongly consider the aspects related to governance and land/resources management.
- Especially in data poor countries, it is difficult to predict the impact of climate change on the local level and much uncertainty still exist, e.g. the impact of climate change on drought and flood risk in a specific region. This climate related uncertainty requires to be reflected in the governance system to keep the flexibility in the interventions in the future (adaptive pathways).
- One of the main objectives of the policy dashboards is to showcase the impact of possible interventions. While the "hard" engineering measures (e.g. hydraulic or agricultural measures) are easier to simulate, in most cases the stakeholders were more interested in soft measures (related to governance, awareness raising, etc.) that are more difficult to simulate. Although the Agent Based Model could help to fill in this gap, accurate representation and quantification of the impact of soft measures on the water-energy-food nexus and on potential conflict risk remains very difficult.

Recommendations

Reaching the end of the process, some recommendations can be made and will be related to possible next steps. They are articulated around three aspects: analysis of the joint system understanding; the ownership of the local tools; and the data and information gaps.

1. Analysis of the joint system understanding

The joint system understanding through the Causal Loop Diagram seemed to have facilitated the dialogue amongst the stakeholders and the understanding of the factors playing a role in the development of conflicts. At the end of the process it can be recommended:

- To continue using the causal loop diagram with local stakeholders and discuss with the co-moderators when to use the methodology in similar situations.
- To use the Causal Loop Diagram in the identification of new entry points for interventions and see how they spread along the system. Doing so, it also helps making interventions more actionable.
- To use the Causal Loop Diagram as basis to define the needs for further information, on specific factors, which will help for a deeper understanding of the system.

This approach is not only interesting for the cases mentioned above; it could probably also be of good use in other cases. Therefore, it seems worthwhile to evaluate the process and the use of this group model building methodology (in the context of the wider dashboard development and other participatory activities) and the lessons-learned before replicating it in other contexts in the three countries.

2. Users and ownership on the policy dashboard

The development of the dashboard has been hampered by a the plain question: ‘who will use it after it has been delivered’? The participatory approach has been beneficial to develop a dashboard that can be used by a diversity of stakeholders, but it also presents the risk of tackling too many different user cases. When defining the user cases with the stakeholders it appeared that the stakeholders had different uses and information needs. It is therefore recommended to further identify key users and to continue trainings and presentations with them to make sure that the key users feel ownership over the policy dashboard. If needed, the dashboard should be further adapted and updated to their needs. In the three countries, this process has already started with the river basin organizations.

3. Data and information gaps

When developed in a participative manner, a policy dashboard offers the flexibility to integrate the needs of the stakeholders. However, the data which can be integrated are also dependent on the data collection. Mali, Niger and Chad are three countries where the availability of water data is limited and the development of the dashboard had to deal with this reality. Although the project team collected and used global and local data, in parallel to the development of semi-quantitative data, the information available remains limited for a full understanding of the current and future situation. The integration of the data in the policy dashboard resulted in interesting discussions, as well as in new questions, especially regarding water availability (precipitation, groundwater, river discharge) and climate change and its projections for the future. Efforts should be made to continue collecting data and use it to study future scenarios in order to make more informed decisions.

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Appendix

Description of the Causal Loop Diagram for Mali

The final diagram reviewed and validated by all stakeholders reveals four different groupings of dynamics, which can be identified as follows:

E. Ecosystem functioning and resource availability
F. Resource exploitation and livelihoods
G. Competition, governance and conflicts
H. Violence, displacement and social cohesion

Each of these groupings is presented in more detail in a document (Annex 1) describing the factors and their interrelations in the local situation. This document is based on information received during stakeholder consultations. In this sense, the descriptions presented must be considered as a working basis and not as the only possible representation of reality.

Analyse qualitative des liens entre l'eau, l'alimentation, l'énergie et la sécurité dans le delta intérieur du Niger au Mali

Dans le cadre du projet 'Eau, Paix et Sécurité' et du projet 'Frexus', des rencontres ont été menées sur le lien entre les ressources naturelles et la sécurité pour en identifier les problèmes et facteurs (causes et conséquences) clés. Le projet EPS a organisé des réunions bilatérales tandis que le projet Frexus a organisé un atelier le jeudi 2 décembre. Les résultats ont été agencés dans un modèle (diagramme de boucles causales) qui sera discuté et soumis à validation lors de l'atelier qui se tiendra les 9 et 10 décembre à Bamako. Les acteurs précédemment consultés sont invités à participer à cet atelier, dans la perspective d'engager les parties prenantes et de développer une compréhension commune sur ce que les participants considèrent comme les principaux liens liés aux ressources naturelles et à la sécurité dans le delta intérieur du Niger.

Le présent document vise à donner une première description du résultat des rencontrés préliminaires. Les descriptions présentées doivent être considérées comme une base de travail et pas comme des affirmations en tant que telles. Ces résultats seront présentés plus en détails et discutés lors de l'atelier.

Introduction

L'analyse présentée ici est basée sur les informations recueillies lors des entretiens avec les parties prenantes. L'équipe d'expert a parfois dû procéder à quelques modifications, changements de formulation ou agrégation des suggestions faites, afin de permettre l'intégration des résultats dans un même diagramme de boucles causales qui soit compréhensible. Le modèle qui en résulte sera expliqué et discuté lors de l'atelier. Dans un premier temps, le but sera de vérifier et compléter le diagramme pour pouvoir, dans un second temps, l'utiliser comme base pour une analyse qualitative mais aussi quantitative plus poussée.

L'approche d'analyse qui sera utilisée est schématisée dans la figure ci-dessous :

1) Quatorze (14) modèles ont émergés sur la base des informations provenant des entretiens avec les parties prenantes.
2) Ces modèles ont été agrégés dans un seul modèle qualitatif (diagramme de boucles causales). Ce modèle sera revu, spécifié et complété avec les parties prenantes lors de l'atelier.
3) Le modèle sera ensuite analysé sur bases de questions telles que : « qu'adviendra-t-il de l'indicateur x,y,z, si a,b,c change ? ».
4) Cette analyse permettra à l'équipe du projet de débuter la conception d'un tableau de bord, qui sera rempli d'informations pouvant provenir de données, de modèles, d'experts ou de l'intégration d'analyses déjà existantes.

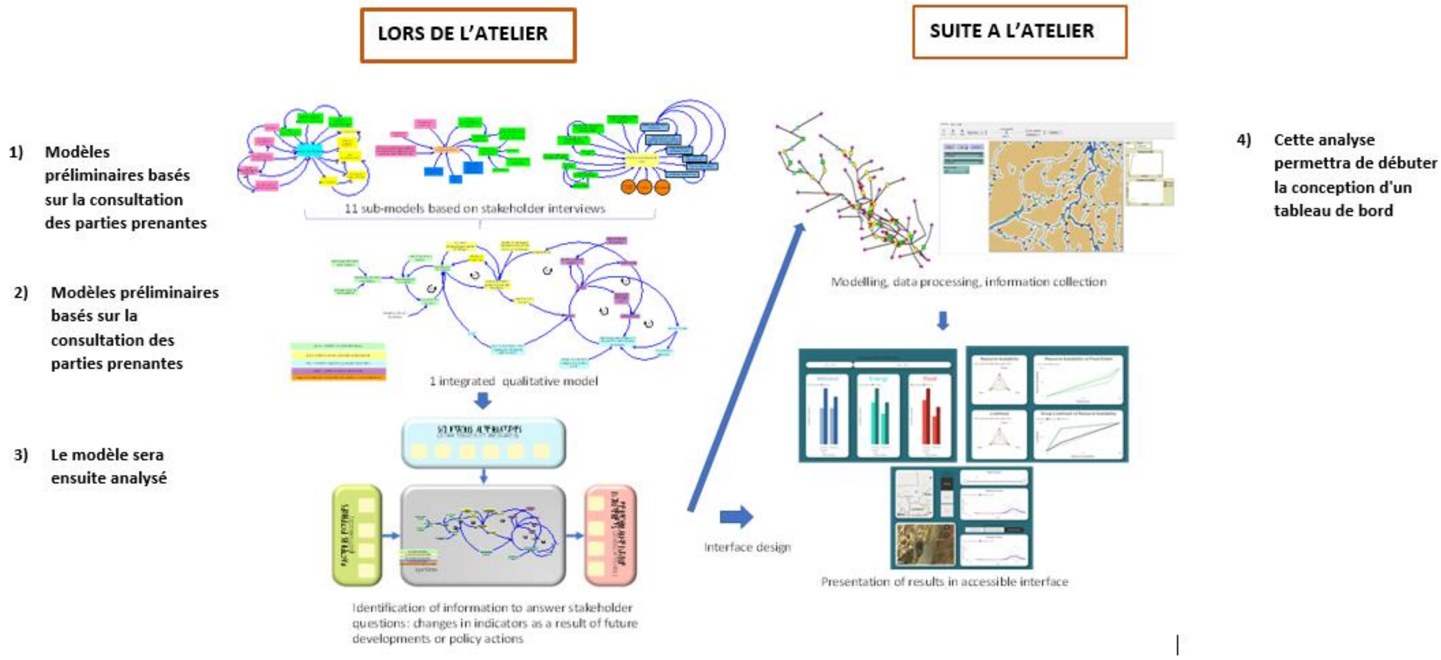
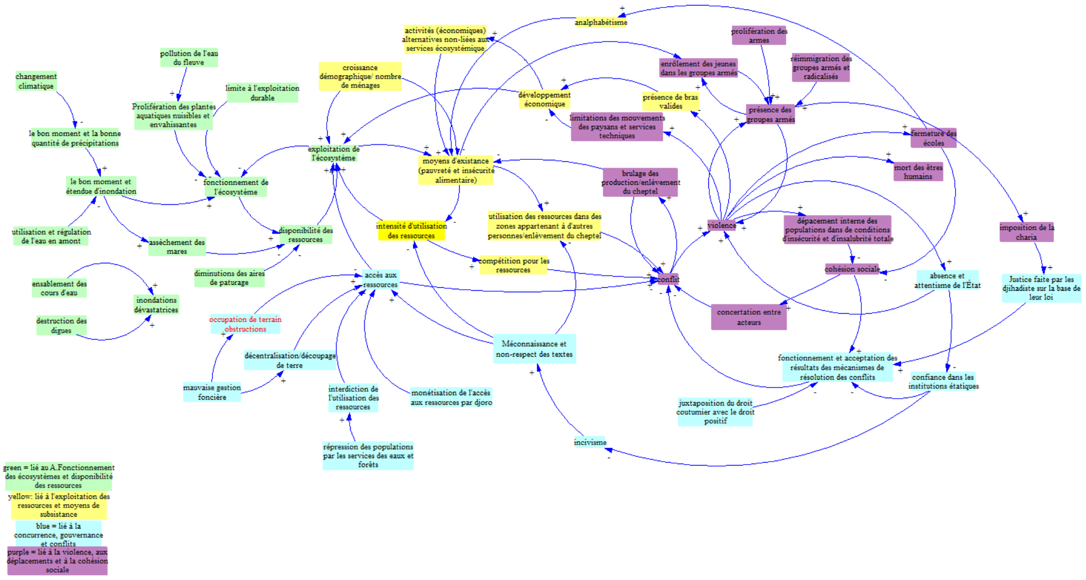


Figure 54- Résumé de l'approche suivie

Modèle global

Les résultats des différents entretiens ont donc été combinés en un seul diagramme de boucle causale, comme suit :



Quelques aspects qui caractérisent le modèle global.

- Les problèmes clés tels que perçus par les acteurs interrogés s'articulent autour des conflits entre utilisateurs, de la gouvernance pour l'utilisation des ressources, du dysfonctionnement de l'état ou encore de l'insécurité liée aux différents groupes de défense/groupes armés.
- Les conséquences d'un problème peuvent constituer les (ou contribuer aux) causes d'un autre problème.
- Nous reconnaissons que, logiquement, différentes parties prenantes ont des intérêts différents. Le but de l'analyse n'est pas de discuter quel est le problème clé le plus important, ni si les facteurs sont des causes ou des conséquences, mais plutôt de comprendre comment divers problèmes sont interconnectés/liés et comment ils s'influencent mutuellement. Ceci afin de mieux comprendre quelles mesures peuvent influencer les différentes composantes du système et l'intérêt des différents acteurs impliqués.

Division du modèle en quatre groupes

Le modèle laisse apparaitre quatre groupements de dynamiques différents, qui peuvent être identifiés comme suit :

E. Fonctionnement des écosystèmes et disponibilité des ressources
F. Exploitation des ressources et moyens de subsistance
G. Concurrence, gouvernance et conflits
H. Violence, déplacements et cohésion sociale

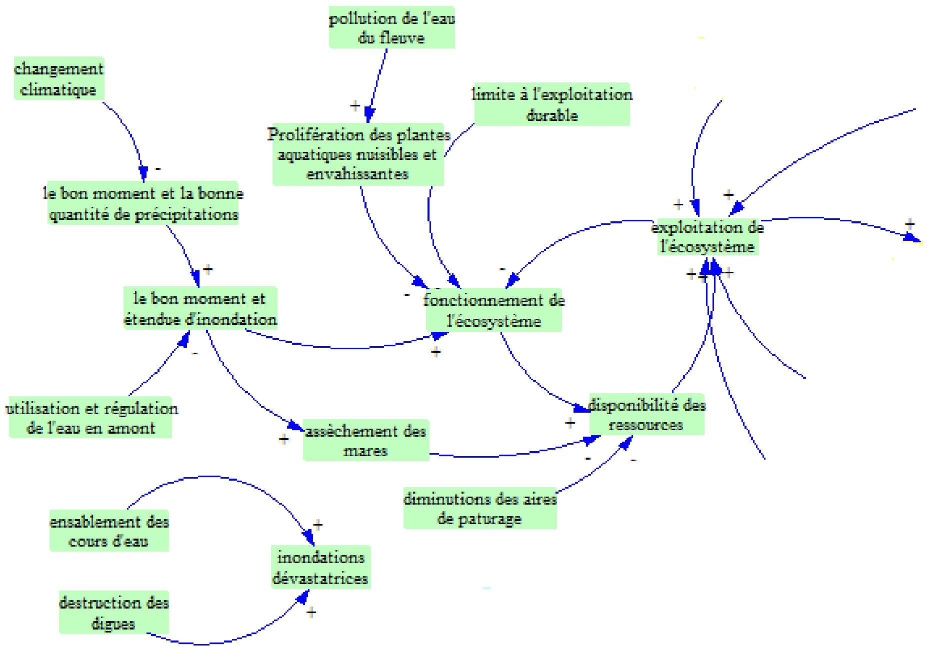
Chacun de ces groupement est présenté plus en détail ci-dessous, par la description des aspects qui ont été tiré de la consultation des parties prenantes. En ce sens, les descriptions présentées doivent être considérées comme une base de travail et pas comme des affirmations en tant que telles. Ces résultats seront présentés plus en détails et discutés lors de l'atelier.

Description des liens/fonctionnement du système

Il est à noter que, dans la description du système, nous essayons d'intégrer les spécifications indiquées par les interviewés, mais que dans le schéma de la boucle causale nous avons parfois choisi de généraliser pour rendre le modèle plus accessible et plus généralement applicable. Par exemple, nous parlons de fonctionnement des écosystèmes et de disponibilité des ressources au lieu de ressources halieutiques. Nous parlons ‘d'appropriation des ressources d'autrui’ (ce qui pourrait signifier la terre, l'eau ou le bétail) plutôt que, par exemple, de ‘vol de bétail’. Dans la description ci-dessous, nous nous sommes efforcés d'expliquer les nuances/spécifications.

A. Fonctionnement de l'écosystème et disponibilité des ressources (partie verte)

Zoom sur le groupement ‘Fonctionnement de l'écosystème et disponibilité des ressources’



<u>Description sur base de la consultation des parties prenantes</u>

Un écosystème qui fonctionne bien se traduit par la disponibilité des ressources (et d'autres services écosystémiques). L'exploitation de l'écosystème, si elle est effectuée de manière durable, contribue au maintien de l'écosystème et de ses services. Cependant, si l'exploitation dépasse certaines limites, cela devient de la surexploitation, et cela entrainera une dégradation de l'écosystème.

Par exemple lorsque le bourgou n’a pas le temps de repousser, ou lorsque les poissons juvéniles sont pêchés avant d’avoir eu le temps de se reproduire. Sur bases des résultats récoltés, c’est ce qui se passe actuellement à cause de :

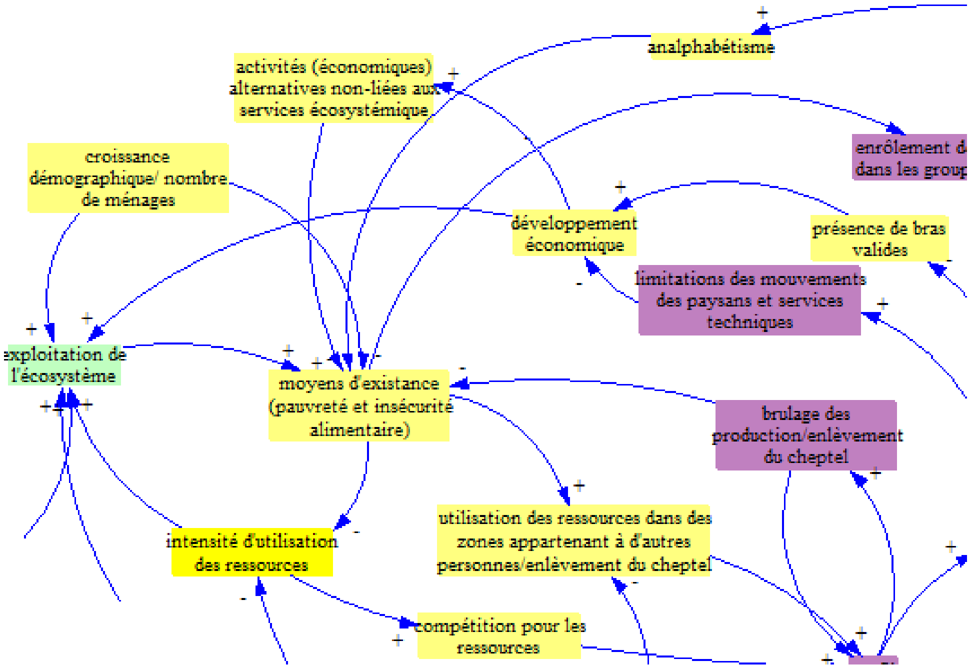
- L’augmentation de la taille des troupeaux de bovins
- L’augmentation de la population
- Des filets de pêche plus fins
- La réduction de la transhumance -> le bétail reste au même endroit toute l'année et l'herbe n'a pas le temps de se régénérer.

La surexploitation a été mentionnée par plusieurs intervenants. Dans le modèle, celle-ci est intégrée à travers deux facteurs : 1- l'intensité de l’exploitation et 2- la limite du niveau d'exploitation durable. Il sera difficile de déterminer exactement cette limite, mais l'idée est que l'utilisation des ressources de manière limitée n'a pas de ramifications négatives sur l'écosystème. En effet, une utilisation durable des ressources pourrait contribuer à la fourniture de services écosystémiques.

L'écosystème du Delta Intérieur du Niger est fortement dépendant du rythme annuel des inondations et des sécheresses. Ce régime d'écoulement est le résultat à la fois des précipitations dans le bassin versant en amont (dont le moment et la quantité peuvent changer, ou changent déjà, en raison du changement climatique) et de l'utilisation et de la régulation de l'eau en amont par les barrages et les déversoirs.

B. Exploitation des ressources et moyens de subsistance (partie jaune)

Zoom sur le groupement ‘Exploitation des ressources et moyens de subsistance’

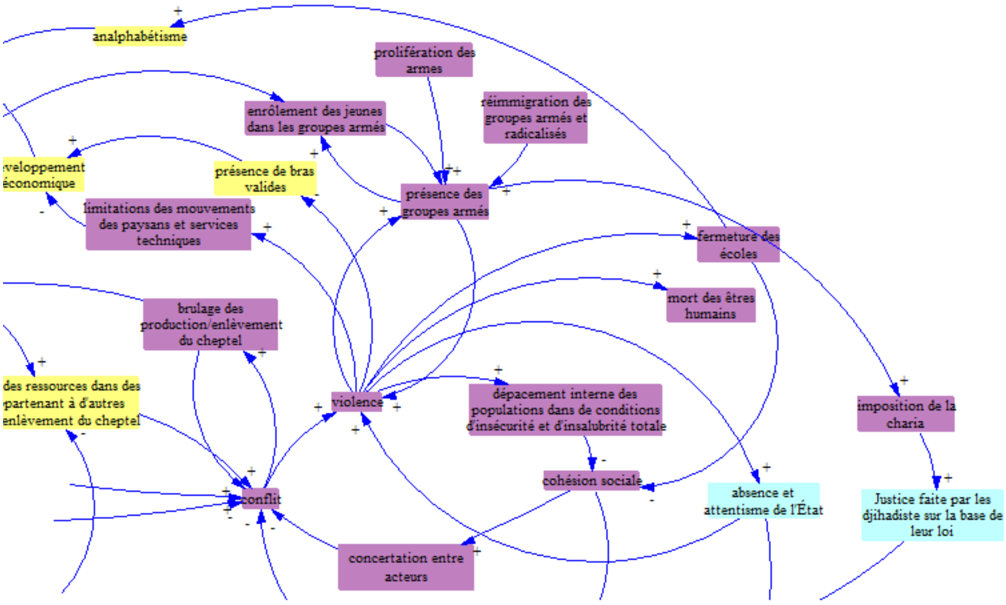


<u>Description sur base de la consultation des parties prenantes</u>

L'exploitation de l'écosystème constitue la base des moyens de subsistance de la plupart (ou de la totalité) des ménages du delta intérieur du Niger. Il y a très peu d'options alternatives disponibles, et le faible niveau d'alphabétisme limite également le développement d'autres opportunités. Une population accrue se traduit également par une base de subsistance plus faible par ménage. En conséquence, les ménages essaient d'augmenter leurs moyens de subsistance en diversifiant leur stratégie et en se lançant dans l'agriculture, l'élevage et la pêche. Ceci entraîne une concurrence accrue, ou intensifie leur stratégie en gardant le bétail plus longtemps dans les champs ou en utilisant des filets plus fins, ce qui entraîne une exploitation accrue. Cette surexploitation réduit également les possibilités pour d'autres d'utiliser les mêmes ressources ou d'utiliser la même terre ou la même eau à d'autres fins. Par exemple, l'utilisation de la terre pour la culture ne peut pas se faire avec du bétail encore présent dans les champs.

C. Violence, déplacements et cohésion sociale (partie violette)

Zoom sur le groupement ‘Concurrence, gouvernance et conflits’



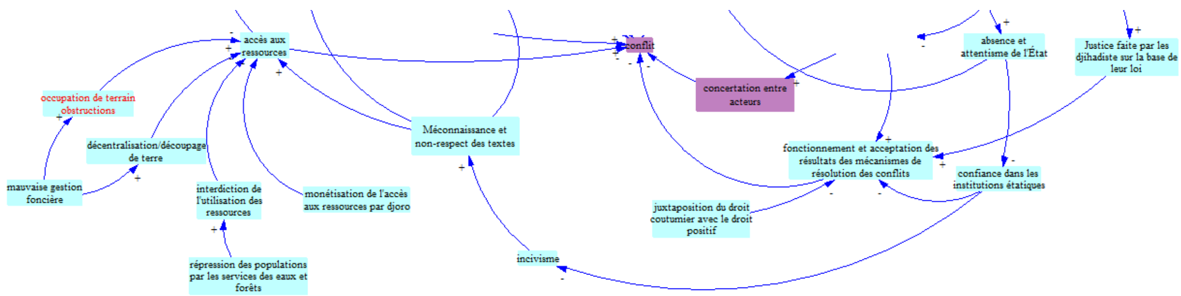
Description sur base de la consultation des parties prenantes

Il semble y avoir au moins deux façons dont l'utilisation des ressources peut entraîner ou contribuer aux conflits existants : 1- Une utilisation des ressources qui affecte l'utilisation des ressources par d'autres et/ou n'est pas conforme aux accords existants (droits coutumiers ou formels) ou 2- Un accès restreint qui empêche les gens d'utiliser les ressources et de gagner leur vie. Ces évolutions peuvent entraîner un conflit d'intérêts qui, dans certaines circonstances, peut dégénérer en violence.

Les réponses violentes sont devenues plus courantes avec la présence accrue de groupes armés. A l'inverse, la violence augmentant peut pousser certains à rejoindre ces groupes. Aussi, l'afflux de Maliens ayant séjourné en Libye contribue à la présence de groupes armés. L'augmentation de la violence a déjà causé des décès et des enlèvements. Certains ont quitté le Delta Intérieur du Niger par peur de cette violence. La violence et les déplacements réduisent la cohésion sociale. La fermeture des écoles réduit davantage encore la cohésion sociale. Sans cohésion sociale, les gens peuvent être moins susceptibles de discuter de leurs intérêts conflictuels et de trouver une solution pacifique par eux-mêmes. Ils peuvent alors se tourner vers les institutions formelles ou vers la violence.

D. Concurrence, gouvernance et conflits (partie bleue)

Zoom sur le groupement 'Concurrence, gouvernance et conflits'



Description sur base de la consultation des parties prenantes

Il est peu probable que la disponibilité des ressources et la dynamique des populations expliquent les conflits et la violence. La gouvernance revêt une importance majeure, à divers égards.

En ce qui concerne l'utilisation des ressources :

- Le manque d'accès aux ressources a une incidence sur l'utilisation des ressources et sur les conflits à leur sujet. De plus en plus, les Djowro's demandent des paiements pour l'utilisation de la terre.
- Il existe des règles coutumières (et formelles) concernant qui peut utiliser la terre et quand. Le non-respect de ces accords, et donc l'utilisation illégale des terres, entraîne des conflits.
- Absence de règles claires en matière de gouvernance de l'eau.

En ce qui concerne la résolution pacifique des conflits

- En cas de conflits d'intérêts, les utilisateurs se tournent vers xxx. Cependant, les verdicts ne sont pas toujours respectés, car… par….?
- L'État est-il considéré comme partial/corrompu ?
- La pluralité des règles (droit coutumier et droit positif) rend difficile l'application de la loi.

En ce qui concerne le maintien de l'état de droit et la sécurité

- L'Etat est considéré comme « absent ». L'État semble insuffisamment capable d'appliquer les lois et règlements et d'assurer la sécurité contre les groupes armés.

En raison de l'absence et des limites dans la capacité de l'État, de nombreuses personnes ont perdu confiance dans les autorités, ne respectent pas les jugements des tribunaux et se sentent obligées de se défendre ou de gérer elles-mêmes les conflits.

Description of the Causal Loop Diagram for Niger

The final diagram was reviewed and validated by all stakeholders and reveals four different groupings of dynamics, which can be identified as follows:

I. Availability of resources and quality of the environment
J. Access to water and use of natural resources
K. Conflicts
L. Land Governance

Analyse qualitative des liens entre l'eau, l'alimentation, l'énergie et la sécurité dans la région de Dosso au Niger

Each of these groupings is presented in more detail by describing the aspects that have been drawn from the stakeholder consultation. This is based on the information received during stakeholder consultations. In this sense, the descriptions presented must be considered as a working basis and not as the only possible representation of reality.

Introduction

L'analyse présentée ici est basée sur les informations recueillies lors des entretiens avec les parties prenantes. L'équipe d'expert a parfois dû procéder à quelques modifications, changements de formulation ou agrégation des suggestions faites, afin de permettre l'intégration des résultats dans un même diagramme de boucles causales qui soit compréhensible. Le modèle qui en résulte sera expliqué et discuté lors de l'atelier. Dans un premier temps, le but sera de vérifier et compléter le diagramme pour pouvoir, dans un second temps, l'utiliser comme base pour une analyse qualitative mais aussi quantitative plus poussée.

L'approche d'analyse qui sera utilisée est schématisée dans la figure ci-dessous :

5) Seize (16) modèles ont émergés sur la base des informations provenant des entretiens avec les parties prenantes.
6) Ces modèles ont été agrégés dans un seul modèle qualitatif (diagramme de boucles causales). Ce modèle sera revu, spécifié et complété avec les parties prenantes lors de l'atelier.
7) Le modèle sera ensuite analysé sur bases de questions telles que : « qu'adviendra-t-il de l'indicateur x,y,z, si a,b,c change ? ».

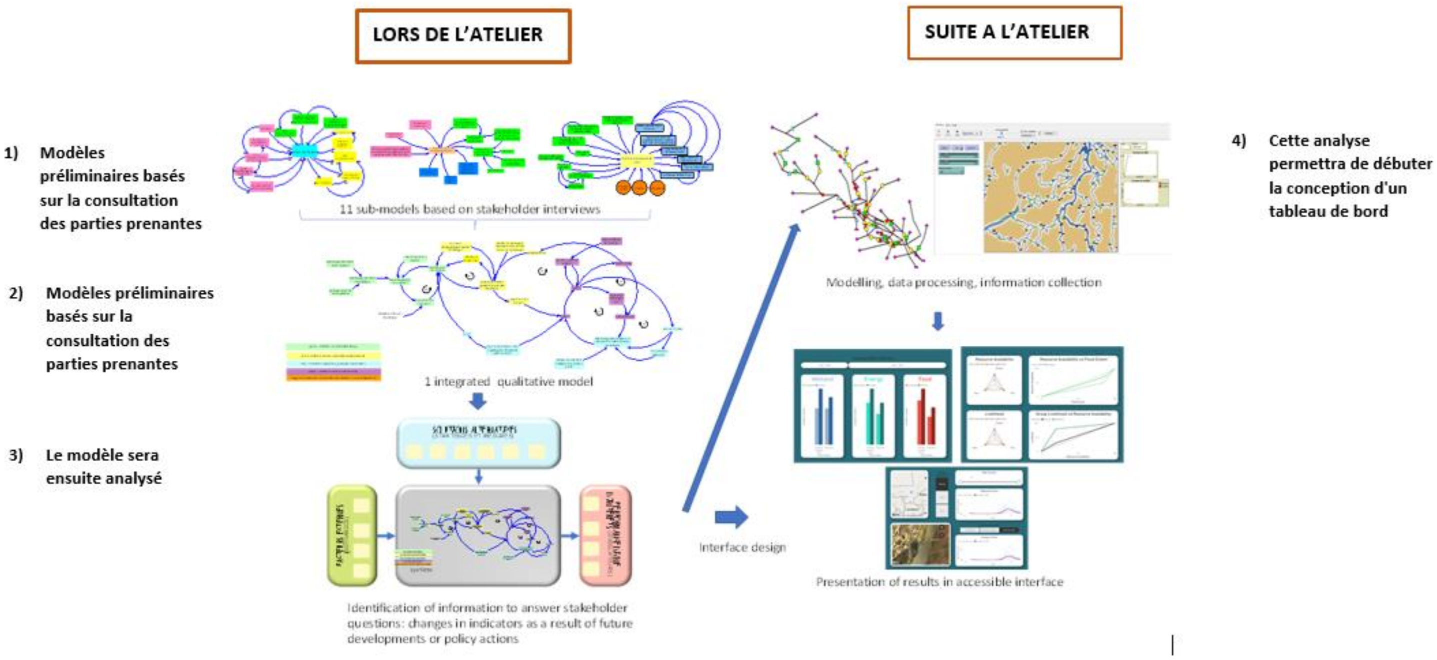
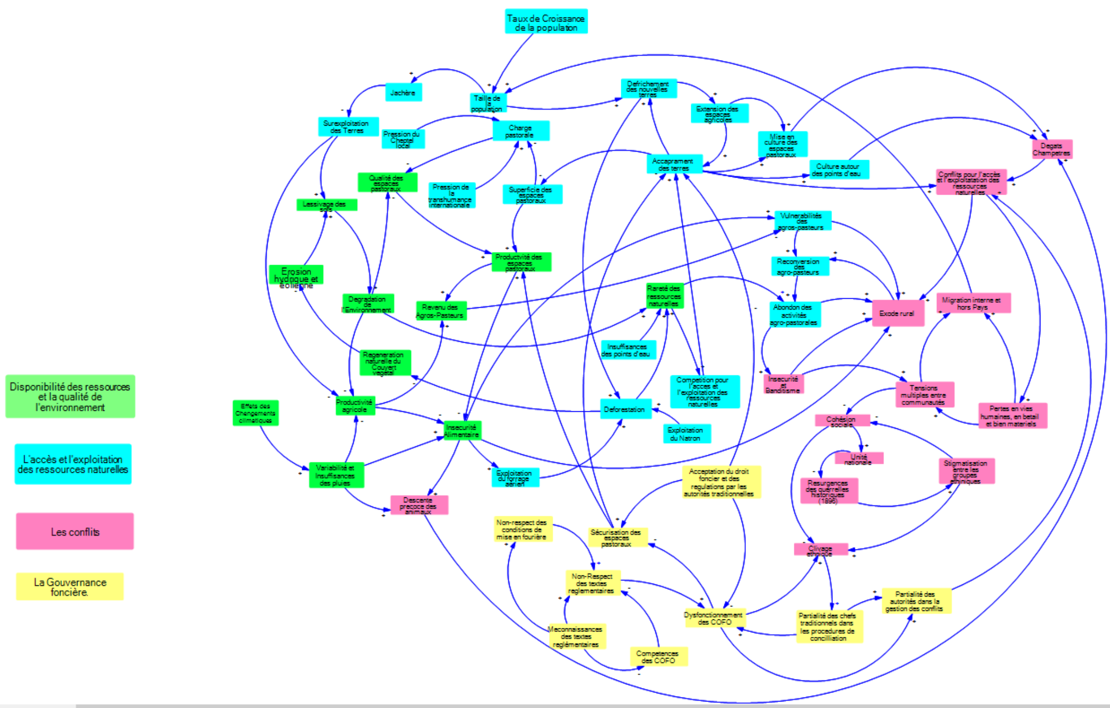


Figure 55- Résumé de l'approche suivie

8) Cette analyse permettra à l'équipe du projet de débuter la conception d'un tableau de bord, qui sera rempli d'informations pouvant provenir de données, de modèles, d'experts ou de l'intégration d'analyses déjà existantes.

Modèle global

Les résultats des différents entretiens ont donc été combinés en un seul diagramme de boucle causale, comme suit :



Quelques aspects qui caractérisent le modèle global.

- Les problèmes clés tels que perçus par les acteurs interrogés s'articulent autour de la disponibilité des ressources et la qualité de l'environnement, l'accès et l'exploitation des ressources naturelles, les conflits et la gouvernance foncière.
- Les conséquences d'un problème peuvent constituer les (ou contribuer aux) causes d'un autre problème.
- Il est reconnu que les différentes parties prenantes ont des intérêts variés souvent divergents. Le but de l'analyse n'est pas de discuter quel est le problème clé le plus important, ni si les facteurs sont des causes ou des conséquences, mais plutôt de comprendre comment divers problèmes sont interconnectés/liés et comment ils s'influencent mutuellement. Ceci afin de mieux comprendre quelles mesures peuvent influencer les différentes composantes du système et l'intérêt des différents acteurs impliqués.

Division du modèle en quatre groupes

Le modèle laisse apparaitre quatre groupements de dynamiques différents, qui peuvent être identifiés comme suit :

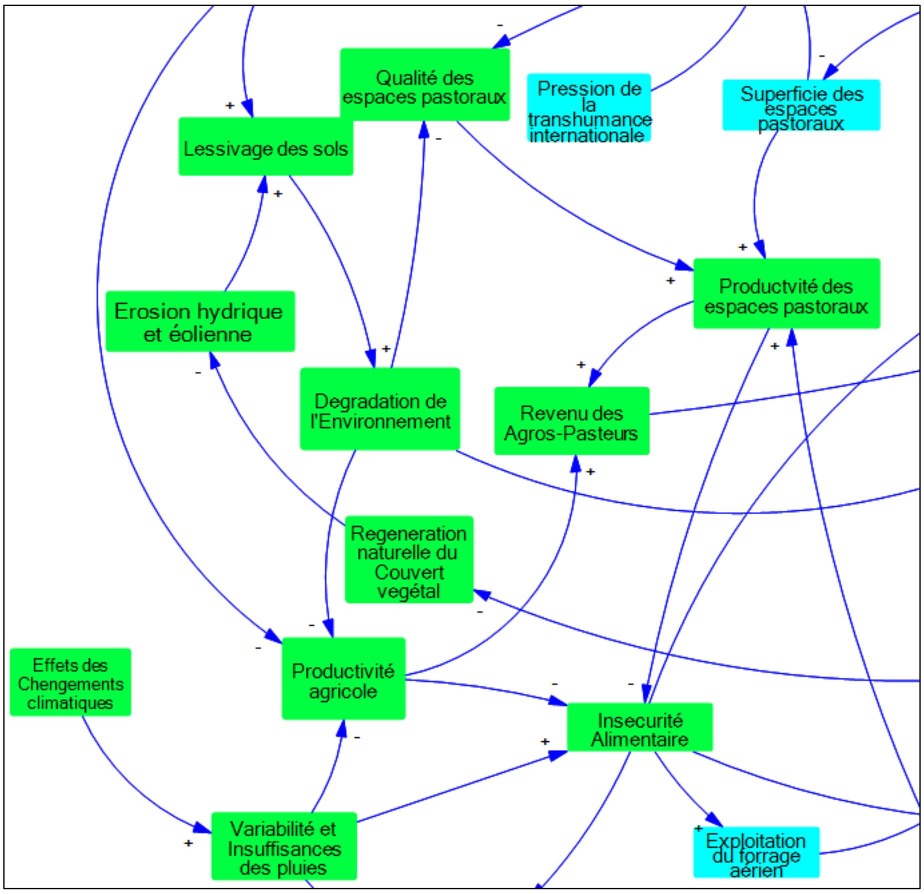
M. La Disponibilité des ressources et la qualité de l'environnement
N. L'accès et l'exploitation des ressources naturelles
O. Les conflits
P. La Gouvernance foncière.

Chacun de ce groupement est présenté plus en détail ci-dessous, par la description des aspects qui ont été tirés de la consultation des parties prenantes. En ce sens, les descriptions présentées doivent être considérées comme une base de travail et pas comme des affirmations en tant que telles. Ces résultats seront présentés plus en détails et discutés lors de l'atelier.

Description des liens/fonctionnement du système

La description du système essaie d'intégrer les spécifications indiquées par les interviewés alors qu'au niveau du schéma de la boucle causale, il est question de généraliser pour rendre le modèle plus accessible et plus applicable. Par exemple, le concept d'accaparement des terres peut regrouper la spéculation foncière, l'occupation des couloirs de passage. On parle également de la rareté des ressources naturelles qui englobe l'insuffisance des terres agricoles, l'assèchement des mares.

A. Disponibilité des ressources et la qualité de l'environnement (partie verte)



Zoom sur le groupement « Disponibilité des ressources et la qualité de l'environnement »

<u>Description sur base de la consultation des parties prenantes</u>

La disponibilité des ressources naturelles est influencée par la qualité de l'environnement qui est considérée comme facteur régulateur. La productivité agropastorale est fortement dépendante de la qualité des sols et des espaces pastoraux. Ces derniers sont influencés par l'érosion hydrique et éolienne, la régénération naturelle du couvert végétal.

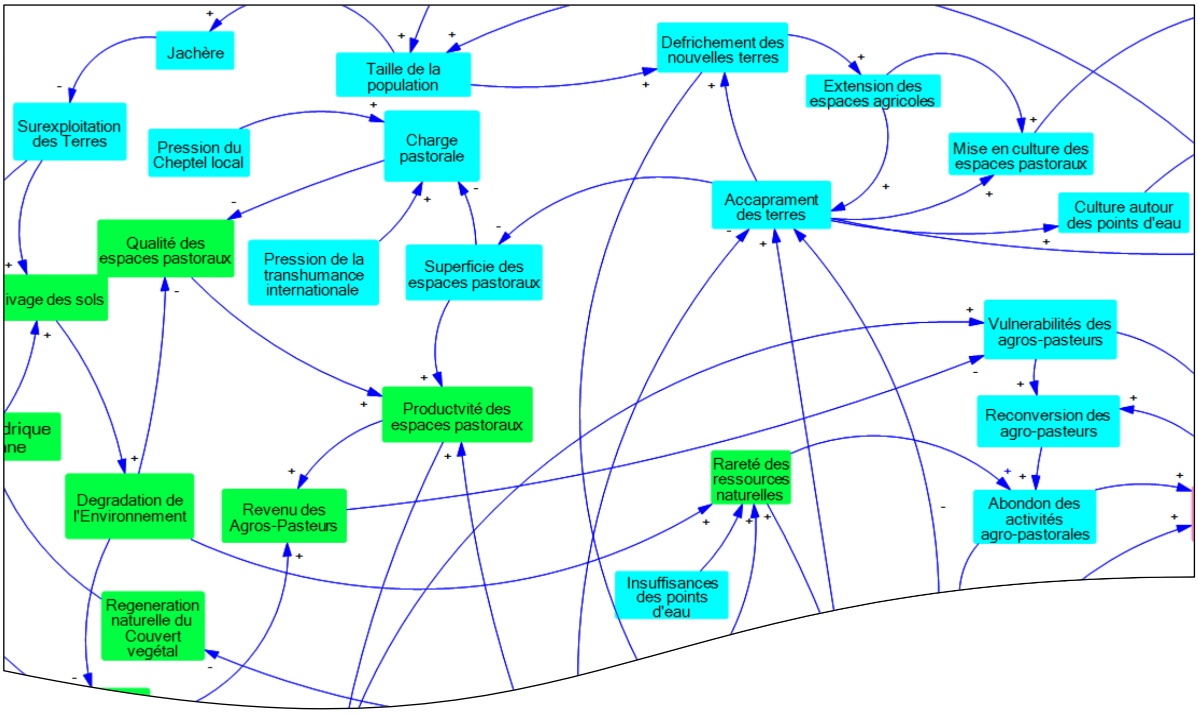
Par exemple les rendements agropastoraux seront réduits lorsque la dégradation de l'environnement est accentuée. Cette dégradation est la résultante de plusieurs facteurs :

- Surexploitation des terres ;
- Déforestation ;
- Erosion hydrique et éolienne ;
- Lessivage des sols.

Le lessivage des sols est revenu plusieurs fois lors des entretiens. C'est un facteur lié à une surexploitation des terres due à la double pression démographique et pastorale. Les fortes précipitations combinées à la déforestation constituent d'autres facteurs aggravants du phénomène.

Aussi, la production agropastorale dans la région de Dosso est principalement dépendante de l'agriculture pluviale et du pâturage d'hivernage. Les changements et la variabilité climatiques agissent sur cette production à travers la mauvaise répartition spatio-temporelle des précipitations, leur irrégularité et leur insuffisance. Ceci explique la fréquence des déficits céréaliers et fourragers se traduisant par une insécurité alimentaire chronique poussant les agro-pasteurs à l'exode rural et la migration hors du Niger.

B. L'accès et l'exploitation des ressources naturelles (partie bleue)



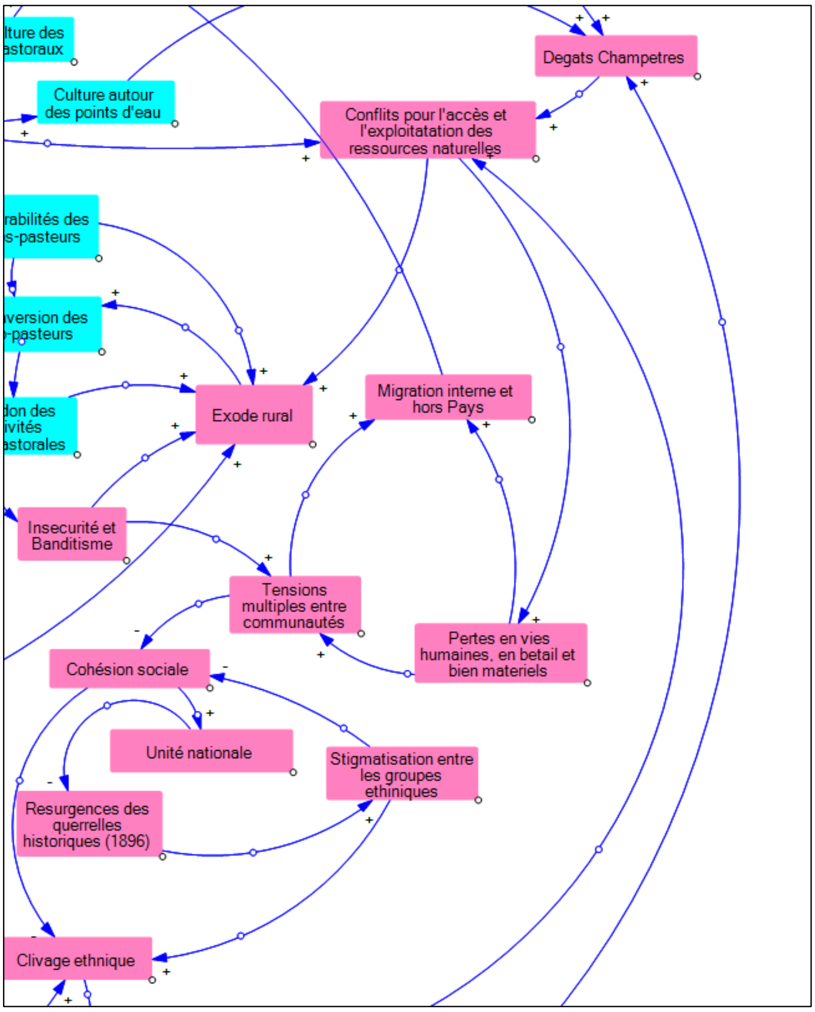
Zoom sur le groupement « L'accès et l'exploitation des ressources naturelles »

<u>Description sur base de la consultation des parties prenantes</u>

Dans la région de Dosso, l'agriculture et l'élevage constituent les deux principales activités économiques des populations. Avec la pression démographique, celle du cheptel et les effets des changements climatiques, on constate une dégradation progressive des ressources naturelles (sols, ressources en eaux, pâturage).

La pression démographique entraine une expansion des terres agricoles du fait de la pratique extensive de l'agriculture essentiellement familiale. Cette expansion se fait souvent à travers le défrichement des nouvelles terres, et ce au détriment des espaces pastoraux qui s'amenuisent. La charge pastorale augmente du fait d'une pression de cheptel accrue et de la diminution progressive des espaces pastoraux. Les impacts des changements climatiques associés à la double pression agropastorale engendrent la dégradation de l'environnement et la rareté des ressources naturelles, induisant ainsi, une compétition dans l'accès et l'exploitation de ces ressources naturelles. Ainsi, la productivité agropastorale est largement réduite, ce qui accroît la vulnérabilité des ménages dépendants de ces activités.

C. Les conflits (rouge)



Zoom sur le groupement 'Conflits'

<u>Description sur base de la consultation des parties prenantes</u>

Les causes des conflits découlant de l'accès et de l'utilisation des ressources naturelles peuvent être classées en deux groupes :

- L'utilisation concurrentielle des ressources naturelles née d'une rareté de ces dernières entraine une spéculation foncière qui se manifeste par des accaparements des terres, des points d'eau et des pâturages. Cette situation restreint l'accès et l'exploitation des ressources à d'autres utilisateurs dont les moyens de subsistance en dépendent.

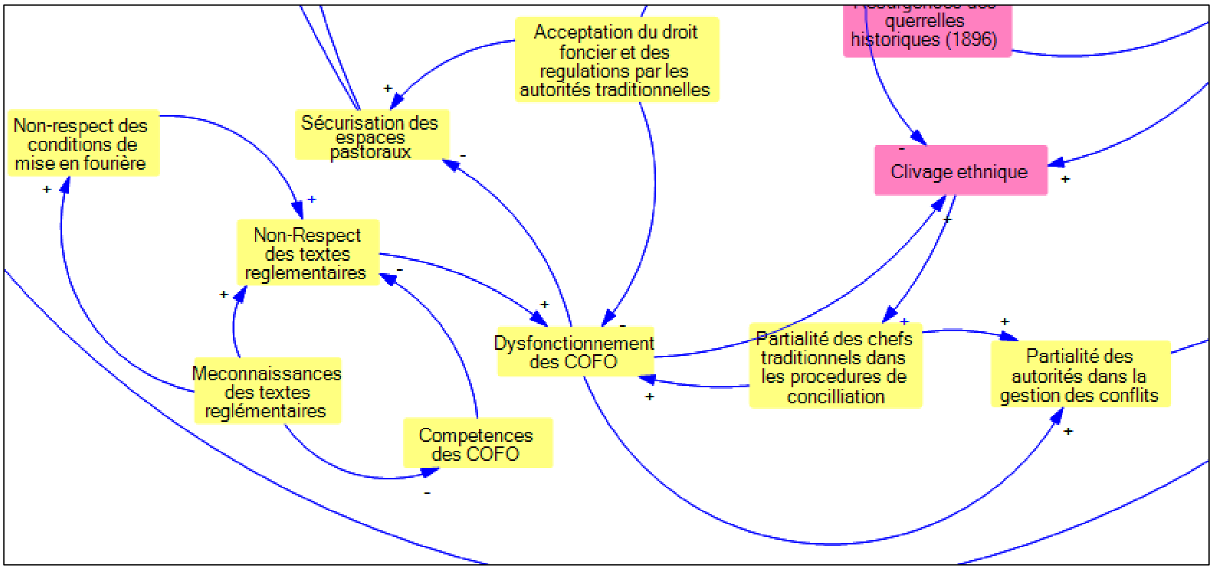
- Le dysfonctionnement du système de gouvernance affaiblit les mécanismes de sécurisation des ressources naturelles (espaces pastoraux, points d'eau, terres agricoles). En effet, l'existence d'une pluralité juridique (droit coutumier, droit moderne) accentue la mauvaise application et le non- respect des textes réglementaires par plusieurs acteurs.

La conjugaison de ces deux facteurs constitue les causes majeurs ou aggravantes des conflits opposant plusieurs acteurs dans l'accès et l'exploitation des ressources naturelles. Les réponses se traduisent en violences et affrontements aggravés ces dernières années par la prolifération des armes à feu. Les dégâts se traduisent en pertes en vies humaines, en bétails et autres bien matériels.

Certaines confrontations se transforment en conflits intercommunautaires impactant du coup la cohésion sociale et même l'unité nationale.

La Gouvernance foncière (partie Jaune)

Zoom sur le groupement 'Concurrence, gouvernance et conflits'



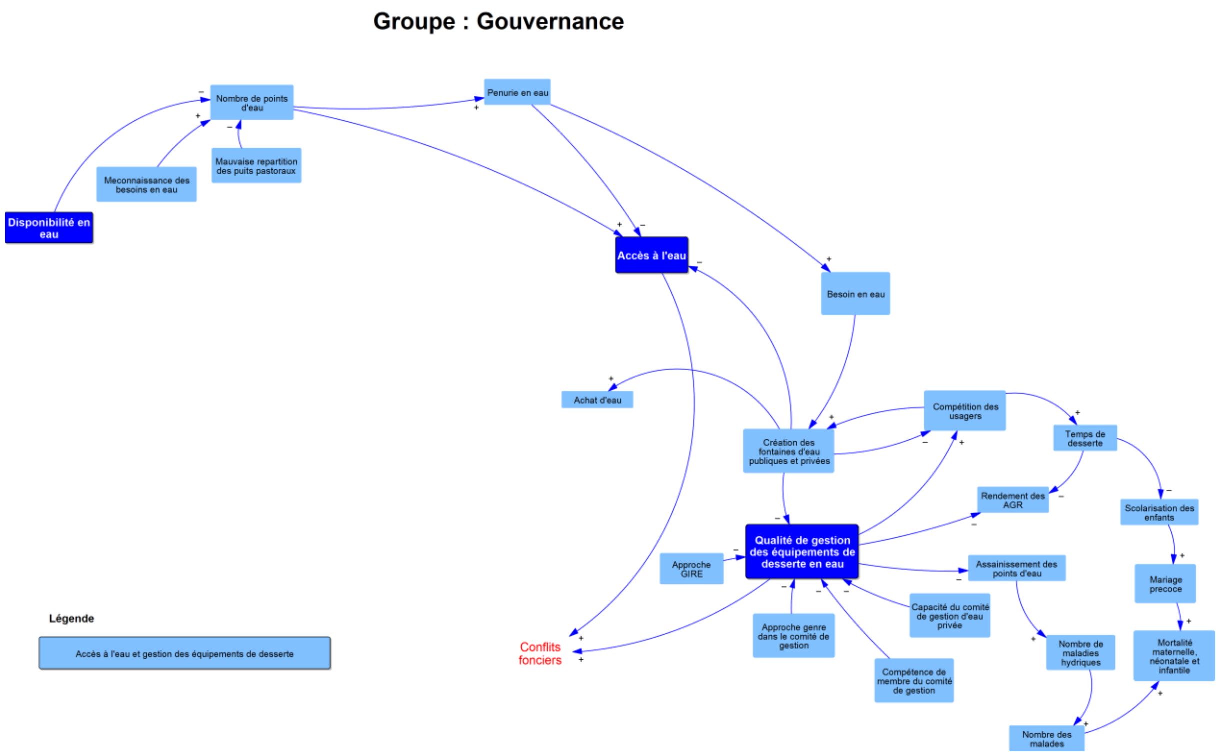
<u>Description sur base de la consultation des parties prenantes</u>

Le système de gouvernance constitue en lui-même une cause des conflits et selon les cas un facteur aggravant. Par exemple le dysfonctionnent des organes de régulation (Commissions foncières, tribunaux) peut être une source de conflits (vente illégale des espaces pastoraux) ou la partialité dans les procédures de conciliation. Aussi, la méconnaissance des textes réglementaires à laquelle s'ajoute la pluralité juridique amplifient les risques de conflits.

Description of the Causal Loop Diagram for Chad

Analyse qualitative des liens entre l'eau, l'alimentation, l'énergie et la sécurité dans la province du Kanem au Tchad

Province du Kanem



Le groupe 1 a discuté sur la gouvernance. Il s’agit en fait d’élucidé les questions d’accès à l’eau des ouadis, des puits pastoraux et la gestion des équipements de desserte des points d’eau dans les différentes communes et de faire un point d’honneur sur la province du Kanem.

De cette discussion assez enrichissante, il est retenu que :

La province subit de plein fouet les effets du changement climatique. Les précipitations sont donc irrégulières dans l’espace et dans le temps ; ce qui influence négativement sur la disponibilité en eau du Kanem. L’insuffisance des points d’eau due à la méconnaissance des besoins en eau et la mauvaise répartition des puits pastoraux concourent également à la faible disponibilité en eau. Les effets ressentis sont la pénurie d’eau et la difficulté d’accès à l’eau aussi bien des ouadis, de quelques rares puits pastoraux que des fontaines publiques et privées.

La quête de l’eau par une population de plus en plus nombreuse (population nomades migrantes qui s’installent aux alentours des villes et autour des ouadis) amène le pouvoir public et certains promoteurs à créer des fontaines d'eau publique et privée. Naturellement, on constate une forte baisse de la compétition des usagers autour des points d'eau. Plus les usagers deviennent plus nombreux, le temps de desserte augmente ; le rendement des AGR baisse, les jeunes filles sont de moins en moins scolarisées, puisqu'elles sont obligées d'attendre longtemps pour se servir de l'eau et parcourir de très longue distance avant d'atteindre un point d'eau le plus proche de chez elles. L'une des conséquences est le mariage précoce avec un taux élevé de mortalité maternelle, néonatale et infantile.

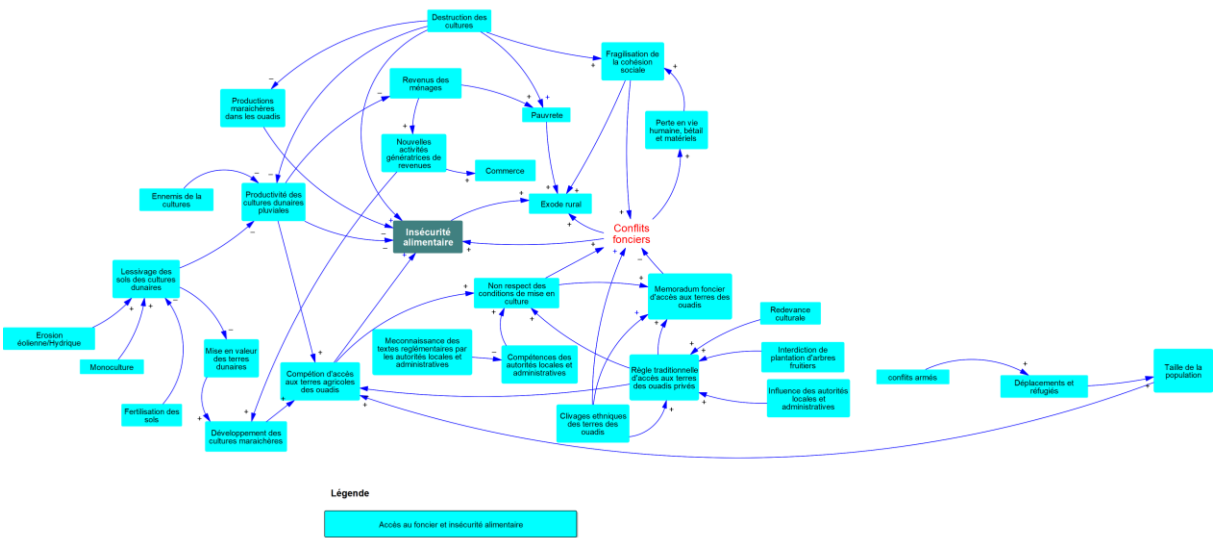
Les plus longs temps de desserte sont aussi causés par les pannes récurrentes des groupes électrogènes, sources d'énergie pour remonter de l'eau dans les châteaux. Pour ceux qui utilisent les panneaux solaires, leur mauvaise manipulation, la non-maîtrise de la technologie solaire provoque très souvent des ruptures d'eau, diminue l'accès à l'eau.

La multiplication des fontaines d'eau publiques et privées souffrirait de la mauvaise qualité de leur gestion. Les autorités communales interfèrent souvent dans les activités du comité de gestion. Les membres sont soit incompétents, soit n'ont pas la capacité managériale de gestion ou encore ne maîtrisent pas l'approche de gestion intégrée des ressources en eau (GIRE). Certains membres du comité de gestion sont aussi démis de leur fonction ou remplacés par d'autres plus proches de l'autorité administrative. Très souvent l'injonction intempestive de l'autorité dans la gestion finit toujours par des conflits entre elle et les membres du comité de gestion.

Les femmes sont souvent absentes dans le comité de gestion ; pourtant elles sont les plus nombreuses à faire usage de ces équipements. L'absence de celles-ci à la gestion des points d'eau concourent à un faible assainissement des points d'eau, source des maladies hydriques et de nombreux cas de malades observés chaque année.

Dans la plupart des cas, l'eau des bornes fontaines est vendue. L'achat d'eau souvent cité par la population concourt à la baisse de revenu familial, déjà négativement handicapé par la faible précipitation qui influence aussi négativement sur la production agricole et herbacée.

Groupe : Agriculture

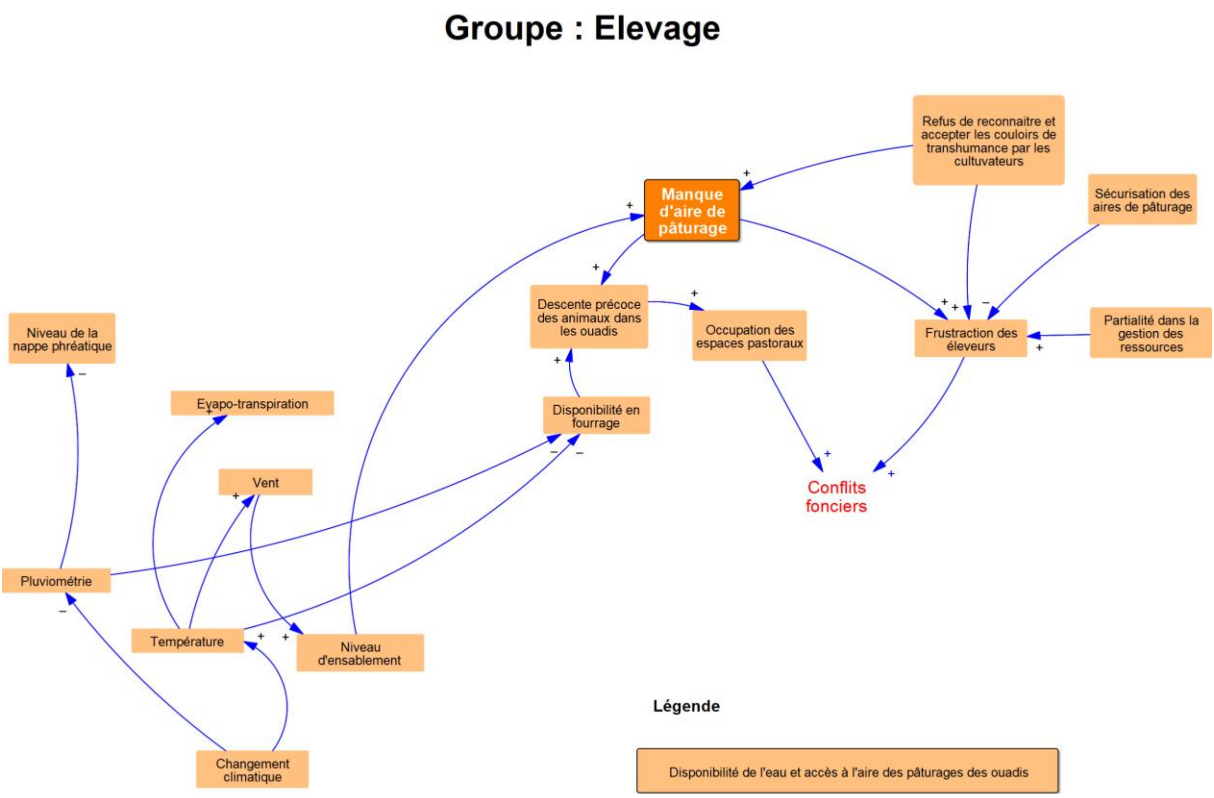


Le groupe 2 s'est penché sur l'agriculture avec point d'encrage l'accès au foncier et l'insécurité alimentaire. Il ressort de ces travaux que les faibles précipitations et les vents forts sont les principaux moteurs d'érosion éolienne/hydrique et donc sources d'ensablement des ouadis et de lessivage des sols de cultures dunaires. La production y est faible. La monoculture permanente, le faible apport en fertilisant de ces sols et la destruction des cultures par le bétail amène les paysans à descendre dans les ouadis où l’humidité est souvent permanente.

Le développement des cultures maraichères dans les ouadis qui fait baisser le niveau de la nappe phréatique et augmenter en conséquence la pénurie en eau est source de compétition d'accès aux terres agricoles des ouadis. Mais, seulement, l’accès aux terres agricoles des ouadis est conditionné par des règles traditionnelles d’accès aux fonciers (forte redevance culturale à payer avant de cultiver, interdiction formelle de planter des arbres fruitiers, forte influence des autorités locales et administratives et un fort clivage ethnique des terres des ouadis). Ces règles assez contraignantes démotivent les non propriétaires à la culture maraîchère, si elle est bien encadrée, pourrait être une source de revenu pour le ménage et réduire l’insécurité alimentaire. Le non-respect de ces règles aboutit souvent aux conflits fonciers et au départ de certains paysans frustrés vers d’autres localités.

Mais le mémorandum d’entente entre les différentes parties prenantes ou les propriétaires des terres des ouadis et les exploitants qui généralement court pour une période de 5 ans au maximum, excluant l’arboriculture, permet aux demandeurs de terres agricoles des ouadis d’exploiter une parcelle bien circonscrite pendant la période indiquée.

Le non-respect des règles traditionnelles de mise en culture par les différentes parties prenantes et la destruction des cultures par le bétail sont les deux moteurs de l’insécurité alimentaire dans la province du Kanem. Ce dernier serait exacerbé par le manque d’aire de pâturage pour les éleveurs et leur bétail devenus trop nombreux.



Le groupe 3 a travaillé sur la thématique « **élevage** ». Les discussions ont permis d'appréhender le problème sous deux angles : ***la disponibilité de l'eau et l'accès à l'aire de pâturage des ouadis***.

Il est admis par tous les membres du groupe que l'irrégularité des précipitations et la forte température réduisent la disponibilité des fourrages pour le bétail sur les dunes. Ce qui oblige les éleveurs à descendre précocement, c'est-à-dire avant la récolte, dans les ouadis à la recherche de l'eau et du pâturage.

Le manque d'aire de pâturage dans les ouadis augmente la frustration des éleveurs. Ils jugent que la sécurisation des aires de pâturage est faible et que les cultivateurs refusent de reconnaitre et d'accepter les couloirs de transhumance. Les éleveurs constatent aussi une forte partialité dans la gestion des ressources ; ce qui aboutit à la fragilisation de la cohésion sociale, par ricochet aux conflits entre agriculteurs-éleveurs. La finalité des conflits est la perte en vie humaine, bétail et matériels.