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CLIMATE CHANGE ADAPTATION AND FOOD INSECURITY IN MARADI DISTRICT – NIGER

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In Maradi district (Niger), more than 80% of the population is composed of farmers practicing a rain fed agriculture. However, because of climate variability and changes, rainfall has become uncertain, either coming too early, too late, too much or too little. On the other hand, seasons are becoming shorter and annual temperatures more extreme. During previous field visit and survey in January 2007 among Maradi district communities (Tibiri, Maradawa and Gabi), an alarming report stated the following: over 50% of interviewed farmers said that they entirely consume their harvest just after three months! During the remaining nine months in the year and before the next harvest, these communities used to develop small irrigation and income generating activities from fruit and vegetables they produced. But, because of climate variability and change, these farmers are facing a tremendous challenge in fetching surface and ground water for irrigation. As a result, any adaptation strategy via irrigation became so costly (mainly because of high oil prices and difficult access to energy services) that it is out of many small farmers' reach. In order to ensure their food security, these communities generally settle for some coping mechanisms including social networking, solidarity and alternative livelihoods, small-scale irrigation or migration. However, irrigation has become less productive because of water scarcity and higher minimum annual temperatures. The only one river (Goulbi) flowing across Maradi city and which use to flow for at least six months after the raining season, is now flowing for only one to two months because reduction in annual regional rainfall and also because of a dam[1] set upstream in Nigeria a neighbouring country of Niger. Combination of all these stressors makes Maradi district frequently exposed to food insecurity. In this case, communities tend to implement several coping mechanisms to ensure their food security. This paper attempts to understand these coping mechanisms so as to inform policy and decision makers at all levels in the exploration of ways and means of adding value on some of these coping mechanisms to transform them into adaptation. Because of the trans-boundary linkages that it implies, this paper shows that adaptation to climate change should no longer be considered only as a local but multi scale, multi level process.

Key words: food security, adaptation, coping mechanism, social capital, and policy process

[1] Jibya dam, in northern part of Nigeria, a sand dam of 165000m² unveiled in 1993 to alleviate the impacts of 1970's droughts in the Sahel and ensure food security in Nigeria.

I- Introduction

Far away from debate and controversies at international level regarding the existence of a cause and effect link between anthropogenic greenhouse gases and the observed global warming, the impacts of climate change are an undeniable reality. The adverse effects of climate change on lives and livelihoods of the poor ado no longer need to be demonstrated. In many Sahelian countries, perturbations on normal seasonal cycles are observed over time and space; the rain begins either too early or too late; total annual, monthly and daily rainfall very often reach unexpected higher or lower thresholds and the global trends are generally in decrease. Global trends of maximum and minimum temperatures are unexpectedly increasing because of global warming.

Even if grassroots communities are not able to understand the causes of global warming, they are however aware of the fact that something unusual, abnormal and negative is happening because the impacts of these changes are felt on local livelihoods.

Being aware of the present and future challenges posed by climate change on their socio economic development, local communities did not wait for external help to develop coping mechanisms and survive. In fact, these communities have lived in the same territory for generations and centuries and as a result, they have been able autonomously or assisted, to survive and even adapt to environmental changes. If the negative impacts of these changes are felt locally, the key elements needed for an effective and efficient adaptation are generally linked to parameters and factors that are beyond the local level or scale. The case study of Maradi in the southern part of Niger allows us to highlight that multi level and multi scale characteristics of climate change adaptation in a food insecure context.

II- Context of Niger

Niger is a land locked country with an area of 1 267 000 km2 out of which three quarter is barren.

Figure 1: Location of Niger

The aridity gradient which is decreasing from north to south engendered four ecological zones: (i) the Sahara zone (les than 150 mm of rainfall per year) which occupies 975 000 km² or 77% of country total area; (ii) a Sahelo Sahara zone (130-350 mm of rainfall) covering 150 000 km² or 12 % of the entire territory; (iii) the Sahelian zone (350-600 mm) covering 127 000 km² or 10%; and (iv) the Soudanian zone (more than 600 mm) which covers around 13 000 km² or 1% of the country's area. 80% of Niger's total population is settled in the Sahelian and Soudanian zone representing 11% of the total area of the country.

Since 1960, the annual rainfall has considerably decreased (see figure 2). The highest diminution was observed at the beginning of the 1970's and 80's when the rainfall index achieved minimal values, which led to serious food deficits.

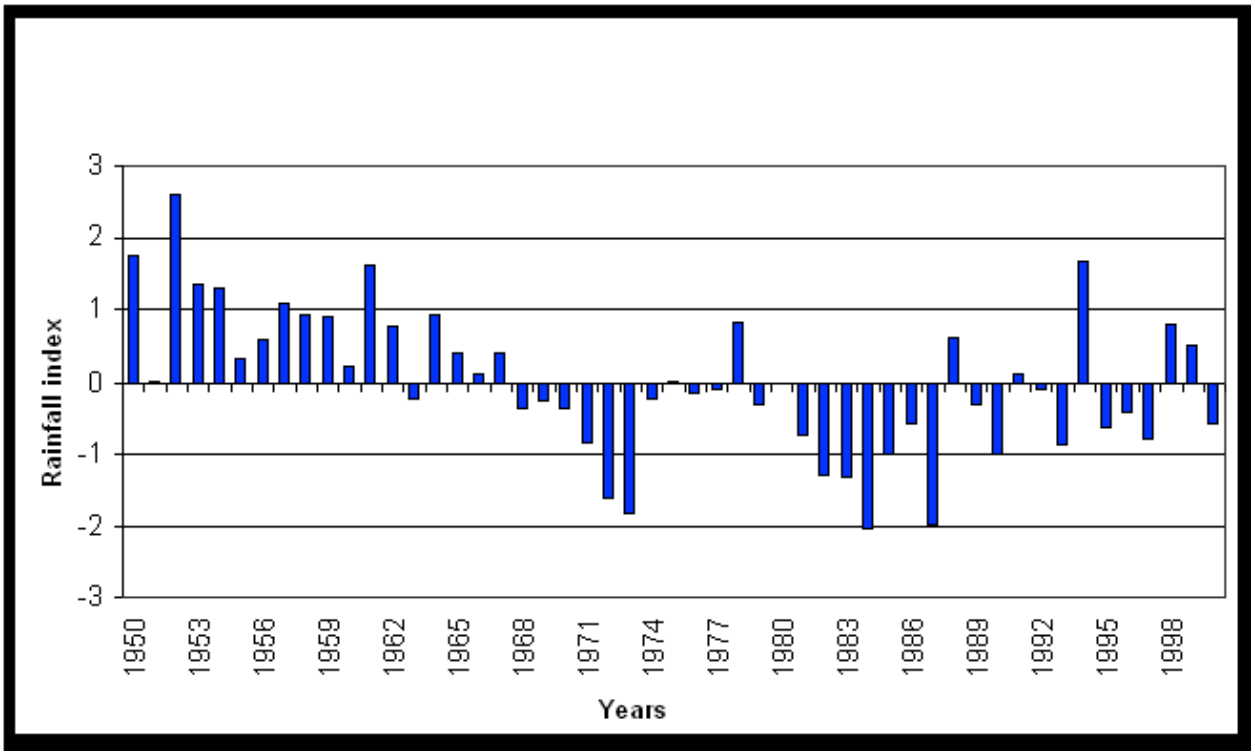

Figure 2: Annual rainfall index in Niger

Source: National Direction of Meteorology - http://www.meteo-niger.net/html/climatccI2.htm - 2003

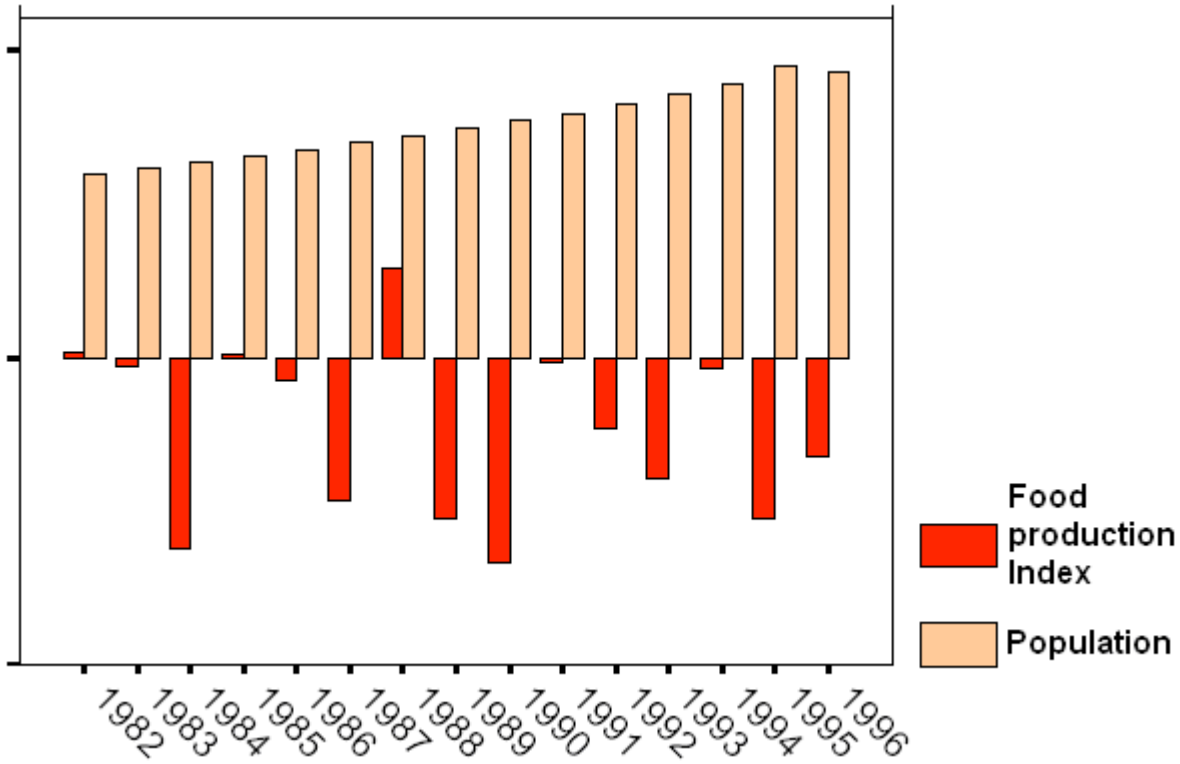

Figure 3: Evolution of agricultural production vs population in Niger from 1982 to 1996
Source: National Environmental Plan for sustainable Development - http://bch-cbd.naturalsciences.be/niger/ner-fra/implementation/documents/pnedd/chap22.htm

The above graph shows that since 1982, food production in Maradi is conversely proportional to population growth. This situation shows the extent to which people in Maradi are not resilient to any food shortage that may occur.

III- Context of Maradi region

1- Climate

Maradi region is characterised by a north-south rainfall gradient ranging from 200 mm to 750 mm. In the extreme southern part of Maradi, the normal annual rainfall is 600 – 750m and the raining season lasts 3 to 4 months. Mean temperatures vary from 23.5 °C to 32.7°C in April/May. Relative humidity achieves maximum rates (almost 100%) in August, which is also the rainiest month. Minimum relative humidity (les than 10%) is reached between December and March when the atmospheric temperature is minimal.

Maradi region could be divided into three agro-ecological zones:

- A Sahelo Saharian zone limited by the Tarka Valley and covering the main part of Dakoro, Tessaoua and Mayahi departments. This is the principal livestock-farming zone unfortunately threatened by competition in land use from agriculture. The fauna previously rich and diverse is nowadays in net regression even in reserve area of Gadabegi mainly because of droughts and poaching.

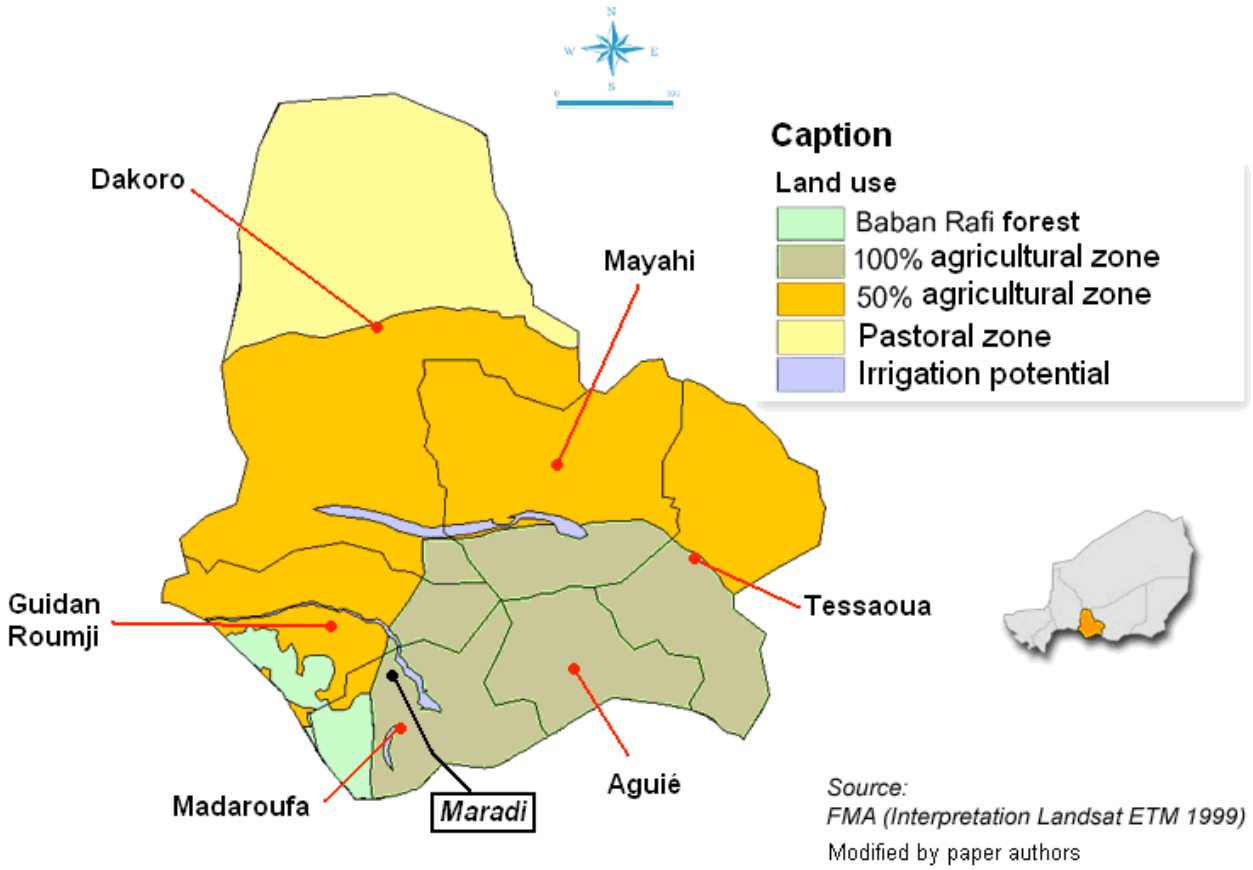

Figure 4: The Maradi region

- A sahelian zone covering the rest of Dakoro, Mayahi and Tessaoua department including a small part of the northern part of Aguié department. This zone is comprised between the Tarka Valley and the Goulbin Kaba. The main land use is agriculture and livestock breeding.

- The soudano sahelian zone is located in the extreme south of the region and covers the departments of Guidan Roumdji, Madarounfa and Aguié and begins from Goulbin Kaba up to the border with Nigeria. The main forested areas, the lake and the Goulbi (Goulbin Kaba) of Maradi as well as our study area (Tibiri, Maradawa and Gabi) are situated in that zone. The normal annual rainfall is 600 mm and demographic pressure is very high.

2- Population

In 2005, Maradi region covers 41 796 km2 (3,3%) with a population estimated at 2.202.035 inhabitants or 20.4% of Niger's population. The annual evolution rate of the population is 3.6% in Maradi region while at national level, this rate is 3.1%. The population density is 52,7 inhabitants/km2 in Maradi and 8,5 inhbts/km2 at national level.

IV- The study area

The present study entitled « Food Security and Climate Change Adaptation in Maradi » was conducted in three study areas: Maradawa (a country side around Maradi city), Tibiri village (12

km far away from Maradi city in he North-West) and Gabi (35 km from Maradi city in the south). The table below shows demography and total number of households in each site in 2005.

Table 1: Population in study sites

Sites	**Population in 2005**	**Number of households**
Maradawa	16 306	2 595
Gabi Village	2 629	395
Tibiri Village	14 409	1 869

V- Objectives

The objectives of this paper are three fold: (i) Analysis and understanding of different coping mechanisms undertaken by communities in Maradi to face climate variability and changes so as to inform policy and decision making on how to build on these coping strategies and design/implement adaptation and integrate it in policy and development planning.

(ii) Based on the comprehensive understanding of communities' multi scale multi level coping mechanism to the adverse effect of food insecurity, this paper reveals that adaptation to climate change should no longer be considered as only a local process because it's also being governed by drivers at higher levels and scales.

(iii) Because of the key importance of the social capital in the above coping mechanisms, the second objective of our research is to understand the role of social networks and facilities within the community in the fight against food insecurity in a changing climate.

VI- Methodology and tools

The analysis tools we used consist of household surveys for participative assessment of vulnerability to climate changes and links with food insecurity. An 8-pager questionnaire has been used to collect quantitative and qualitative data in each of the three sites. A literature review was also undertaken to identify previous scientific work undertaken on the issue of climate, development and food security.

For every site, (Gabi, Tibiri and Maradawa), three interviewers were in charge of data collection through the questionnaire. Every investigator was in charge of deploying the questionnaire in 30 households, which gives 90 households per site and a total of 270 households. The filled questionnaires were assessed and analysed by the use of SPSS statistical tool. The survey was conducted within three days so as o give sufficient time to the interviewers and also insure the availability of heads of households especially in the period of farming activities (August/September).

In order to insure that the interviewers have a good understanding of the expected outcomes of the survey, a one-day training was organised for them and this was an opportunity to get a common understanding of every question in the questionnaire. The questionnaire targeted subsistence farmers and the main question raised include the size (men and women) of the household, the gender of household head, the cultivated area by owned the household, the household livelihood assets, the alternatives coping strategies undertaken by the household

members in case of food insecurity, the role of social networks in the fight against food insecurity, the role of migration, etc.

VII- Ecological and social vulnerability

In that part of Niger where agriculture is the main activity (more than 80% of the population), the rainfall has considerably decreased. Seasons are becoming shorter and annual temperatures are rising.

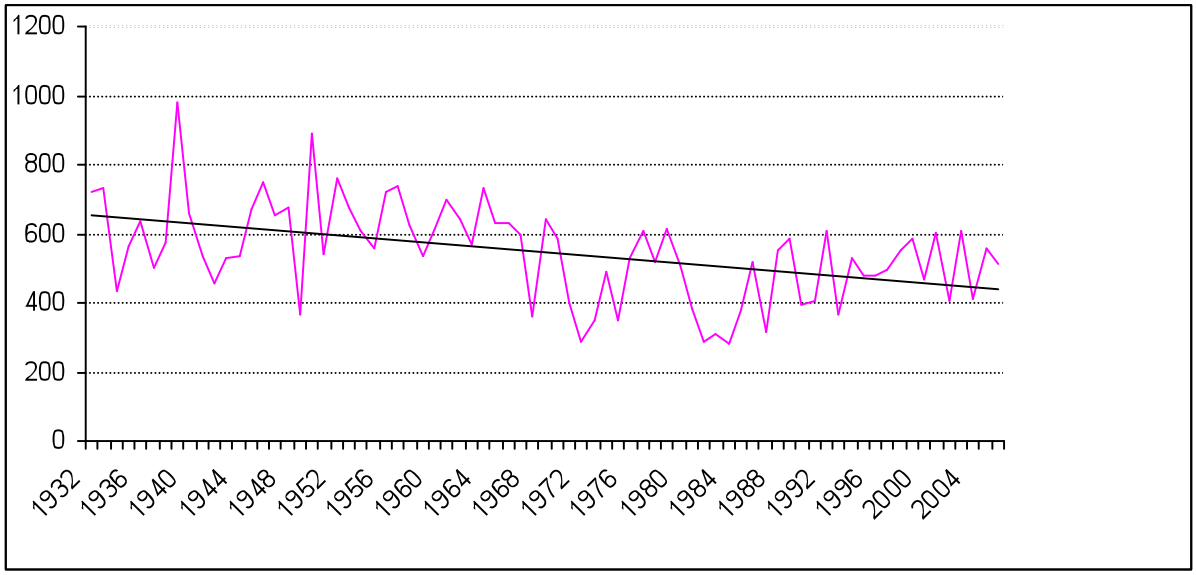

Figure 5: Evolution of rainfall in Maradi from 1932 to 2004

The above graph shows the evolution of annual rainfall from 1932 to 2006 in Maradi region. The global trend on that time period of 72 years indicate a decrease of 30% in annual rainfall.

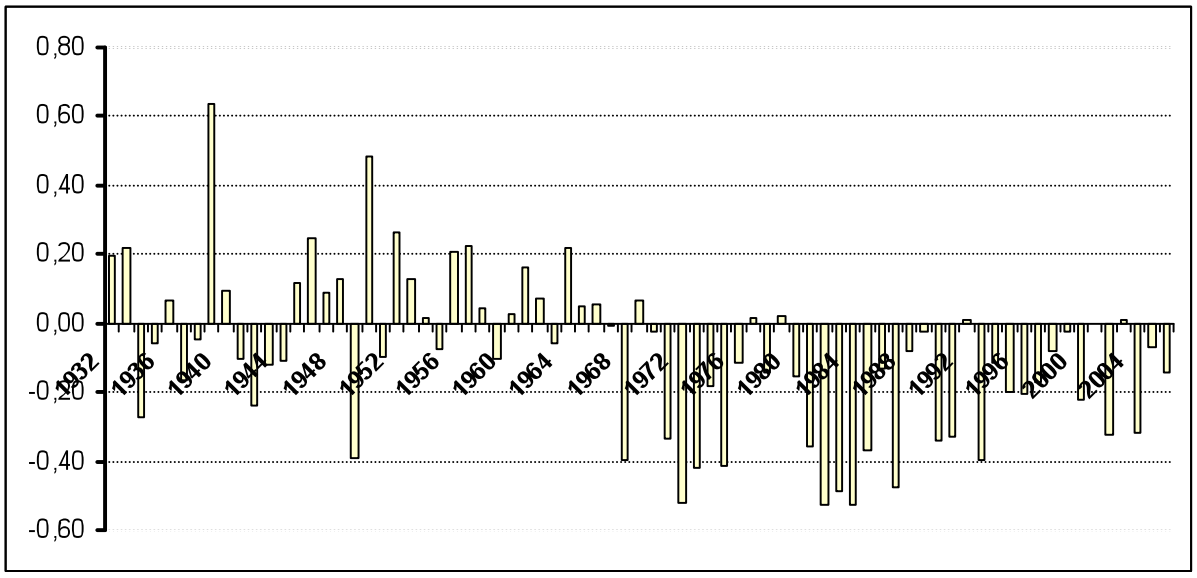

Figure 6: Rainfall anomalies in Maradi from 1932 to 2004

The above graph highlighted the observed anomalies in total annual rainfall in comparison with the normal situation, which is 600 mm/year. This graph shows that since the beginning of the 70's, the total annual rainfall in Maradi was lower than 600 mm.

Rain fed agriculture is more and more unproductive. The annual yields are no longer sufficient to cover household food needs before the next harvest.. The diagram below shows that less than 17% of interviewed household ((i) and (ii)) declared that they can entirely rely on their harvest during 09 to 12 months to cover all household food needs before the next harvest. The others (representing 83%) can rely on their food production for les than 9 months in the year.

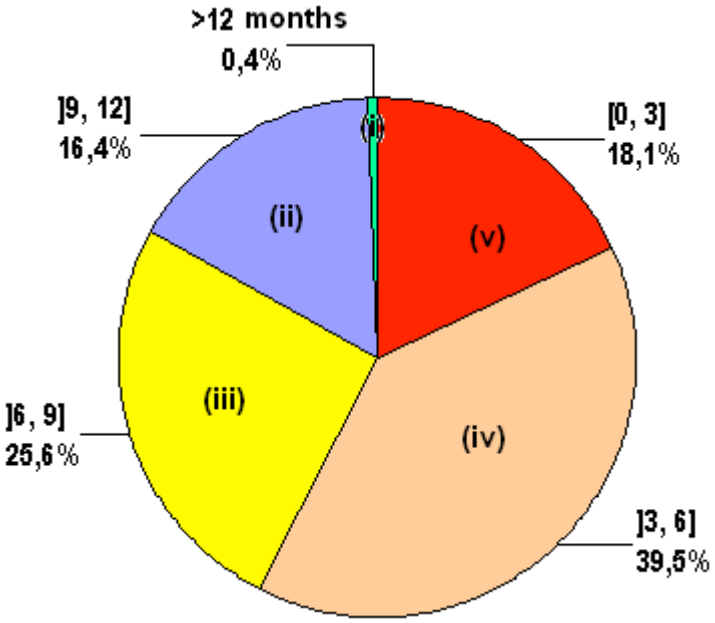

Figure 7: Number of months covered by food production in interviewed households

Small-scale irrigation has become costly and less productive because of water scarcity and too high temperatures during the cold season while fruits and vegetables need low temperatures for better development. The graph below shows the evolution of maximum (curve (i)) and minimum (curve (ii)) annual temperatures in Maradi from 1961 to 2010 in January, which is the coldest month in Maradi. The global trend is an increase.

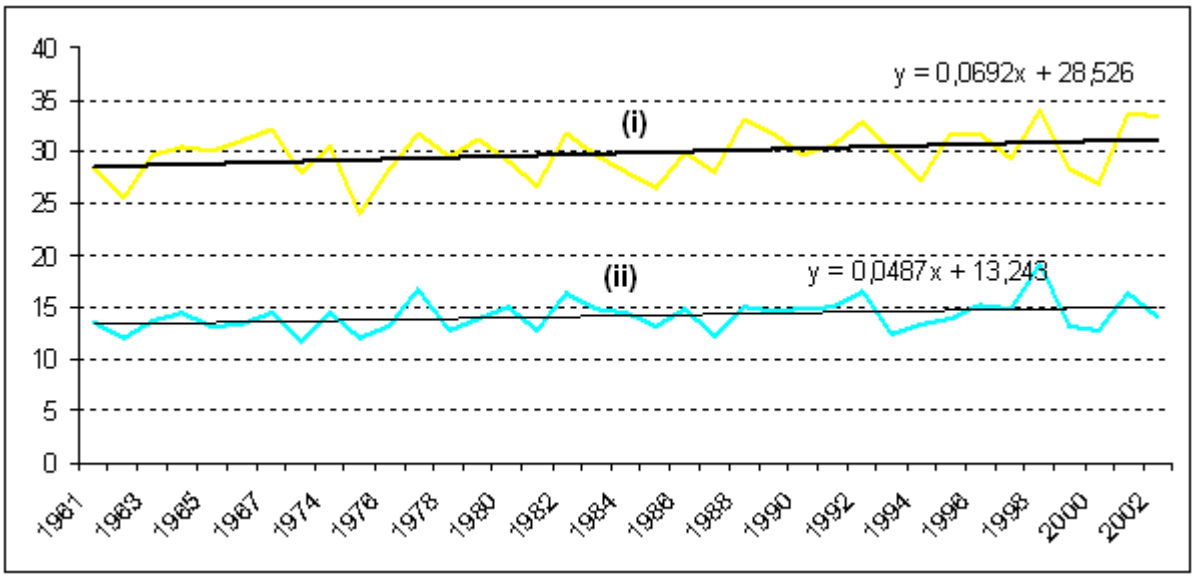

Figure 8: Evolution of minimum and maximum temperatures in Maradi from 1961 to 2002
Source: http://www.tutiempo.net/

On the other hand, as shown by the graph below, 87% of farmers we interviewed have agriculture (including livestock farming) as principal source of income.

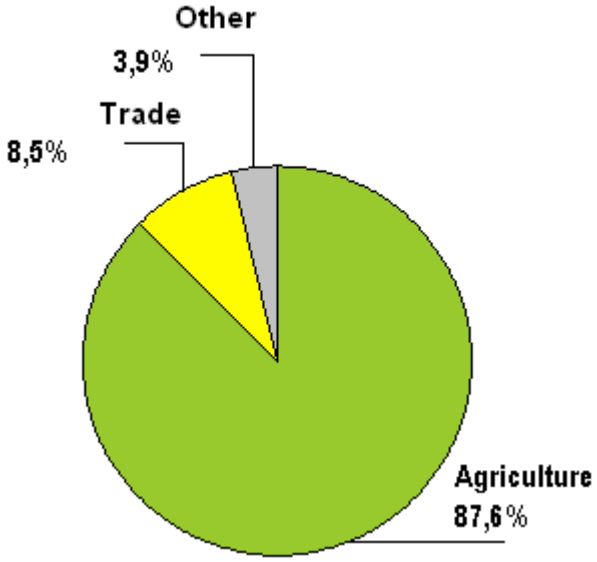

Figure 9: Main livelihoods in interviewed households

In addition, agriculture is essentially rain fed and practiced with traditional means during a ray season lasting 3 to 4 months from June to September. In that part of Niger, the annual rural income is only 50 000 CFA francs (100 USD) and the most vulnerable households are generally held by unemployed women. Population growth is also an important driver of socio ecological vulnerability in Maradi. Apart from having a high population growth rate, Maradi region is hosting 20% (2 202 035 inhabitants) of Niger's total population according to the 2001 census. Because of urbanisation, deforestation and extensive agriculture, soil fertility has considerably decreased and fertilizers are highly needed but are still out of reach of majority of farmers because of poverty and lack of subsidies from government.

VIII- Multi scale multi level coping/adaptation strategies undertaken by farmer communities in Maradi

To address the above socio ecological vulnerabilities, farmers and their relatives implemented a various set of coping mechanisms as well as other strategies for adaptation in case of bad food production led inter alia by scarce rainfall as a result of climatic variability and changes in order to ensure their food security. These mechanisms include:

1- Social networks

- Local coping strategies at household level such as sale of animals, crafts etc in order to finance purchase of food;
- Cooperation at the extended family, village or focus group level to strive for better harvests etc.;
- The search for and purchase of food at district level particularly from inter-community cereal banks;

- The search for and purchase of food from other districts and agencies within the country, especially from State cereal banks;
- The search for and purchase of food from neighbouring countries (Mali, Burkina Faso, Benin, etc.) thanks principally to cereal banks put in place in the framework of regional accords such as the *Organization Commune Bénin-Niger*;
- Temporary migration to neighbouring countries to conduct income generating activities, and make remittances in advance of following rainy season;
- Permanent migration over longer distances to where work opportunities are available either on a legitimate or clandestine basis;
- Etc.

All these coping mechanisms are mainly based on communities' social capital.

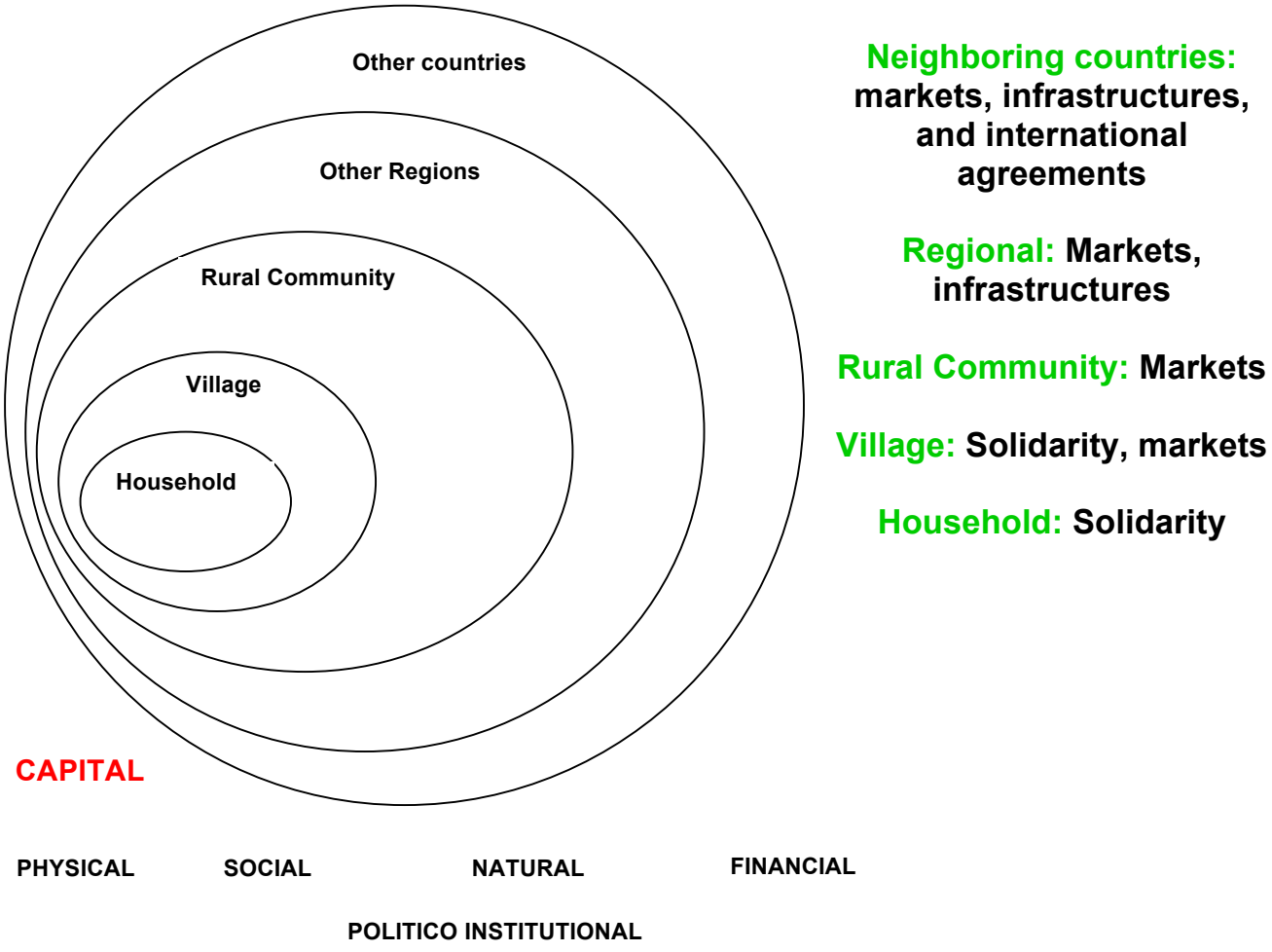

Figure 10: Multi scale multi level community coping mechanisms in Maradi

These multi level and multi scale food insecurity coping mechanisms adopted by farmers in Maradi are actually part of their day by day life since tens of years and since climate has really changed and whenever food annual production is not reliably sufficient to cover food needs at household level before next harvest.

At household level, people tend to sell their valuable items to by food. These valuable items are generally domestic animals and family other precious objects. It is important to highlight the

important role played by women at household level because they are generally the one who own the valuable items to be sold in such difficult periods. Our surveys revealed then that polygamous households (two, three or four wives) have a better coping/adaptive capacity.

At village and community level, that food insecurity coping mechanism is governed by solidarity which still existing as a social capital but between friends and relatives giving self help in difficult periods. This kind of solidarity is generally observed during wedding ceremonies and baptisms.

At higher levels of other regions and surrounding countries, the existence and proximity of food markets as well as the rules governing these markets are some key drivers of food security. The availability of road infrastructures can facilitate access to other regions in Niger or to neighbouring countries in order to supply food banks and also to lower the price of the food.. International accords between Niger and surrounding countries can also promote food and people's mobility and thus facilitating communities' mechanisms of ensuring food security.

The above shows that any adaptation action aiming at assuring food security at household, village, community, region or neighbouring countries' level, concerns and thus must take into account the condition in which the neighbouring households and villages, regions and countries are. This is particularly true because of the high migratory dynamics gained by concerned communities in the event of food insecurity. The example of food banks and related management in Maradi can also illustrate this fact.

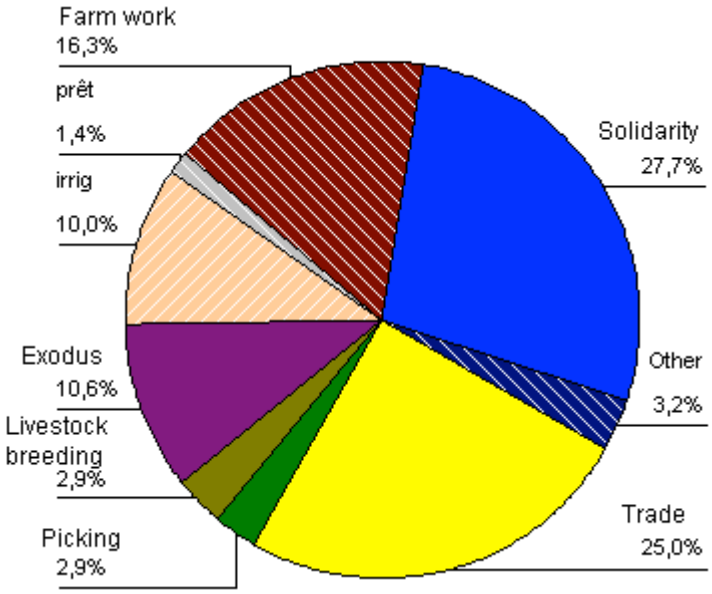

Figure 11: Coping mechanism activities undertaken by interviewed farmers in Maradi

2- Food Banks in Maradi

« Food banks » is the term commonly used to designate a community based organisation (farmer organisation) managing a food stock or simply any other storage community system. The objective of food banks is to improve food security in chronically food production deficit zones because of climate variability and change. The stocks of food are distributed for free or sold at low cost to communities in the event of food crisis subsequent to climatic constraints.

The surveys we conducted in Maradi revealed that the food stocks, which serve to supply food banks for the benefit of deficient zones, are bought and channelled fro other regions of Niger like Zinder or Tahoua respectively situated 200 km and 250 km far away from Maradi. In case these neighbouring regions are also food deficient, people have to travel to other countries like Nigeria, Burkina Faso or Mali. In some cases, for structural or climate related reasons, food is simply unavailable or at a price so high that the poor cannot afford it. In this case, the setting and supply of food banks is jeopardised, leading to the abandon of food banks as an adaptation/coping strategy. Our survey in Maradi revealed a similar case in the 80's when General Abacha ruled Nigeria and decided to close boundaries between Nigeria and Niger. This situation, combined with other drivers, made impossible the existence of food banks in Maradi and contributed to a severe famine in Niger denominated « El Bohari famine » for the circumstances.

Maradi region, in the manner of other regions in many other countries in the Sahel, has effectively encountered a period of drought coupled with locust attacks in 1983/1984. The impact of these droughts and locust invasion would have been attenuated by the supply of food products from neighbouring regions or villages where such droughts and locust attacks did not occur. By the way, one of the surprising effects of climate change observed in Maradi and strangely perceived by local communities, is was that disparity in rainfall patterns between two nearby villages and even between two areas in the same town. For example when a thunderstorm occurs, it can rain down a lot in a village while the ground is simply dry in the next village. Communities between two next areas of the same village also observed this unusual phenomenon.

It appears once again that if the impacts of climate changes are easily observed locally, adaptation to these impacts can be influenced by other processes at higher levels and thus, necessitates an approach not only a local approach, but at higher levels, as the causes of local vulnerability could be led by drivers occurring elsewhere.

3- The case of Maradi "Goulbi" ("river" in Hausa language)

The River basin of the Goulbi of Maradi covers an area of 9 787 km2 out of which 3 803 km2 are located in Nigeria and the rest in Niger.[2] The Maradi Goulbi with its intermittent hydrologic regime, rise in Nigeria, crosses Niger via Maradi and after a run of about 130 km, returns to Nigeria and finally rejoin the Rima River which in its turn, flows into the main Niger River bed.

One of the most limiting factors for climate change adaptation in the agriculture sector in Maradi is the access to water resources for irrigation. This water formerly in the past was coming from that trans-boundary Goulbi of Maradi. However, after the drought of the 70's, authorities in Nigeria decided to set a dam on that River in Jibya[3], a border city with Niger, situated around 100 km away from Maradi. Since then, the water in the Maradi Goulbi which once flows for five to six months after the raining season can nowadays flow only for one month, limiting any irrigation possibility for farmers in Maradi (Niger). Small-scale irrigation is no longer feasible for the nine remaining months of the dry season before the next raining season.

The uncertainties of irrigation as climate change adaptation strategy for rain fed agriculture in Maradi (Niger) by the means of the trans-boundary Maradi Goulbi waters, demonstrates once

[2] Project document - Integrated Ecosystem Management of Trans-boundary Areas between Niger and Nigeria – GEF, August 2005.

[3] Jibya in the northern part of Nigeriga, a sand dam of 165000m² unveiled in 1993 for irrigation and hydropower purposes.

again that adaptation is a process transcending local realities. Talks at high political level as well as at decentralised level are necessary in order to set a dialogue between the two countries for a concerted Maradi Goulbi water resource management vital for population on both sides of national boundaries.

According to the Fourth IPCC Assessment Report, the annual flow of Rivers and the availability of water may dwindle from 10 to 30% in some dry lands of middle latitudes and in dry tropics. By 2020, 75 to 250 million persons will be exposed to water scarcity because of climate change. According to the same report, poor communities will be the most vulnerable because of limited adaptive capacity and their reliance to climate-sensitive resources like water resources and agricultural production systems.

The importance of a river basin approach in the management of water resource in climate variability and change context also justifies the necessity of prospecting adaptation actions conceivable at related corresponding scale.[4].In West Africa, the Niger River, shared between 08 countries is another illustration of the global aspect of adaptation to climate change because any usage by a country state of the water of that trans-boundary ecosystem, will affect with no doubt, the availability and quality of the water in the other countries downstream.

IX- The role of social capital solidarity and community-based institutions

Experience shows that in the event of bad food production led by abnormal rainfall or other structural causes, communities in the Sahel (and in Maradi as well), recall to endogenous mechanisms on the spot in order to reduce food insecurity. As mention above, these mechanisms are essentially driven by the community-based social capital like solidarity, which constitutes, even nowadays, one of the primary anchors of these mechanisms.

In fact, a household's food security could be searched thanks to contributions from the larger family, from next village, rural community, up to the next country.[5]

Even if it tends to disappear due to economic circumstances and social changes, solidarity is an important element of human social capital which enables farmers who experience food production deficit to recourse to help from more lucky farmers (generally relatives and good friends) in the same community, village or surrounding areas.

In case the bad food production concerns the entire village, household leaders do no longer have any alternative but selling their assets (domestic animals) to buy food. Even in this case, solidarity is playing a key role because the money generated will also benefit directly or indirectly, other unlucky elements of the community.

The farmer community in Maradi also receives solidarity contribution (generally financial) from household members who migrated and are working in West African countries like Nigeria, Benin, Togo, Ivory Coast or Libya.

[4] Adaptation aux Changements Climatiques et Gestion des Ressources en Eau en Afrique de l'Ouest – Rapport de Synthèse WRITESHOP, 21-24 Février 2007.

[5] Adaptation aux changements climatiques et gestion des ressources en eau en Afrique de l'ouest – rapport de synthèse – WRITESHOP – Enda TM, février 2007.

On the other hand, the availability of infrastructures, regulatory market mechanisms or inter state accords governing food security in the Sahel can also influence the efficacy and the efficiency of that intra and inter community. The availability of road infrastructures between villages and between countries facilitates exchanges, self-help, import and export of food. A good regulation of food markets will support household's buying power whereas application of tailored bi and multi lateral accords between states will facilitate circulation of goods and people for the benefit of vulnerable populations. This is especially where we are calling upon decision makers to play a key role.

At country, region and sub regional levels, the existence of pre-colonial and indigenous community institutions has always shaped social networking and day-by-day life at community level. These institutions provide a community self-help framework either in happy or unhappy moments. As seen above, farmer households in Maradi have for many decades, been experiencing abnormal rainfall, droughts, food shortage, etc. Agriculture has always been the backbone of livelihoods and local economy in Maradi. Whenever agriculture, food production or food security are threatened by climate variability and changes, community organisations and institutions are the best structures through which people can find alternative solutions. The following describes these institutions and highlights the role such institutions are playing in community's struggle against food insecurity.

1- The "GAYYA"

The Gayya is a kind of occasional and informal self-help community groupings for farm work and whenever labour force is needed. The meaning of Gayya could be « invitation for farm work » insinuating an invitation to take part to a work generally related to farming. Gayya is therefore a collective labour in which the beneficiary is in charge of providing for restoration (breakfast and lunch). This kind of self-help could be initiated by individuals or by the entire community by way of solidarity. Gayya is generally gathering people of 10 to 50 years old.[6].The beneficiary is very often head of a big household lacking work force, a traditional authority or an agro business holder at village level. A generalisation of Gayya to the entire community is also a way of increasing community food production especially when soil productivity is threatened by climate variability and changes.

2- « Samaria »

Put in a standby by colonisation, the Samaria was revalorised in Niger since 1974 particularly in its function of social life animation and its socio economic role including alphabetization, public hygiene, etc.
The Samaria is then an association gathering youth organisations at village level. It is also a movement in which the basic principle is a group and cohesion frame of mind for the collectivity and thus an important factor for consolidation of the entire nation, a development factor and a driver of changes because in Niger, Samaria is a national wide institution. Samaria is highly organised into hierarchy and characterised by its community spirit and respect of values and traditional mores. Samaria has an important role in community capacity building and training for youth organisations especially in the event of crises like food insecurity. When education or is assured first by family, it is completed by the Samaria which is acting as a transitory structure

[6] Les pouvoirs locaux au Niger: Tome 1, A la veille de la décentralisation - Par Jean-Pierre OLIVIER DE SARDAN et Mahamam TIDJANI ALOU – 366 pages.

between the family and the village and is a framework in which young people perceive their role in the community.

3- Majalissa

Majalissa is a word with an Arabic origin meaning « assembly ». It is a structured association, generally a group of young volunteers at village level aiming at giving any needed support to local authorities in public work like street cleaning, cemetery weeding, etc. The Majalissa as well as the Gayya is also a self-help framework in case of food insecurity also offering to its members a better affinity and tends to set oneself up as a club of friends.

4- Agro-sylvo-pastoralist groupings

Agriculture and livestock are the socio economic activities the first impacted by the adverse effects of climate change in Maradi and in general in Niger. The inter-linkages, the complementarities, as well as the conflicts opposing stakeholders (farmers and livestock keepers) from these sectors, are key factors necessitating the set up of agro-sylvo-pastoralist committees for a participative and concerted management of natural resources especially when these resources become scarce. The definition of grazing areas, association of agriculture and livestock, the fight against animal diseases, collaboration between livestock keepers and farmers, etc. are some of the benefits of agro-sylvo-pastoralist groups.

5- Income generating activity groups

This kind of organisation aims at finding alternative sources of revenue because the community can no longer rely on agricultural food production, which has become uncertain. Income generating activity groups are generally composed of and administered by women organised around activities like small-scale irrigation, craft industry and other small trade so as to generate money they use to buy food and ensure food security. This function gives to women a key role in the society ensuring community food security.

6- Village development committee

Village development committee is the authority ruling and giving main orientations in terms of development at community/village level. This committee consists of community human resources, the elders, NGOs, development agencies, etc. This committee plays a key role in the event of food insecurity especially when it comes to setting food banks and in the community's relationship with external actors. This committee is also in charge of distribution of food relief when necessary.

7- Village animation unit

Like the Samaria, the village animation unit plays the role sensitisation, vulgarisation, information and training for community members. In terms of community food security, the animation unit intervenes in the vulgarisation of short cycle and high yield crop varieties, training on farming methods, sustainable production factors, water and land use.

8- Water pond management committee

Temporary or permanent water ponds are key element of community natural capital because of its importance for irrigation in its complementary role with the uncertain rain fed agriculture because of climate change. Maradi region by its agriculture and livestock vocation especially in the north, experiences water access difficulties for these socio economic activities during the course of the year. The region has 48 ponds including the Madarounfa Lake allowing irrigation and fishing. However, only the Kourfin Koura pond, the Madarounfa Lake, the impoundment of Rafin Wada and the Akadaney pond are permanent. In order to insure a concerted water resource management and avoid conflicts between users (especially after short annual rainfall), village water pond management committee is set and involves many villages.

9- Food Banks

Food bank is a food security decentralised device organised and managed by farmers at village level. It is a local development tool, which allows association and popular participation in the fight against food insecurity. Food bank collate and buy cereals, stock and conserve them and resell them at reduced prices to local population during scarce periods, so as insuring village food supply and security. The food is generally bought after harvest from producers who made food surplus, using members' savings or credits from decentralised funding systems. Food banks prospect different sources of funding to collect cereals and these sources include classical financial banks, micro finance institutions and development projects and NGOs offering better call rates.

10- Tontines ("adaché" in Hausa)

Participants in a tontine commit to give a pre-defined amount of money at a determined frequency. For every round of instalment, one of the participants is designated to be the beneficiary of the money. In a rotating tontine, the beneficiaries are designated at random before any payment or well at the beginning of the process. In a cumulative tontine, contributions are not redistributed to members but accumulated in the tontine's account until the members decide to share the remittance proportionally to everyone's contribution.

Tontine is generally for women. The savings are used to cope with difficult situations (like buying food in crises period) or simply to deal with day-by-day expenses. In cumulative tontine, the money could be invested in the form of credits granted to members with refund conditions collectively agreed beforehand. The credits can also serve for other income generating activities so as to compensate chronic agricultural deficits.

11- Resourceful women groups or "Mata Masu Dubara" (MMD) in Hausa

The MMD system consists in the creation and auto management of small savings account in villages. The MMD can be composed of 25 to 40 members giving regular financial subscriptions of 25 to 1000 CFA francs. Like the case of tontine, MMD group members are also women associated according to their capacity to save money. After many weeks of payments, the remittance is given as credits to MMD group members depending on agreed rate of interest varying from 5 to 10%. The credit, which is given for a short term (around one month), is made profitable through income generating activities. The whole process is supported by a capacity building project (training, sensitisation, etc.) for the women by non-governmental organisations.

The income generating activities serve to ensure a well being for the women and their families and are an alternative livelihood for rain fed agriculture.

12- Self-help

Apart from the above institutional forms of social capital found in Maradi, other self-help mechanisms exist between individuals within the community. These mechanisms are implemented whenever it's necessary. In the event of food insecurity, these mechanisms include food aid, gifts, subscription for the benefit of needy persons, invitation to share food, charity, cereal loans (for baptisms, wedding ceremony, death, etc.), loans of money, etc.

In this mechanism, women are playing a key role. They provide help to their husbands thanks to their income generating activities; they also invest for the benefit of the entire household, etc.

Conclusion and lessons learned

Understanding coping mechanisms undertaken by vulnerable communities in Maradi should be the entry point for any adaptation measure from government or non-government bodies. Farmers in Maradi have always experienced climate variability and changes even if they did not always adapt to these changes in a sustainable way. Adding values to community coping strategies can sustain adaptation, which is a long-term process and foster appropriation by concerned communities. It was surprising to see that implementation of adaptation and other coping strategies by communities, is often of very low cost. UNFCCC and other international NGOs estimated the cost of adaptation in developing countries. It is also important, in a participatory manner, to hear communities' perspective and evaluate the cost of coping strategies.

When there is food insecurity, people migrate temporarily from Maradi towards neighbouring West African countries. Because of permanent climatic changes, they tend to move and settle permanently in countries like Nigeria, Ivory Coast or Libya. Those who migrate to Libya tend to reach European countries legally or not. In addition, the root causes of migrations are the unreliable conditions of local livelihoods because recent surveys have shown that people may have not migrated if means of life were available locally.

This study demonstrates that adaptation to climate change should no longer be considered only as a local but a multi level multi scale process. Indeed, a proper understanding and implementation of adaptation strategies locally requires analysis both at community level and at other scales, in this case including trans-boundary, where key drivers occur. In this example, the construction of a dam at Jibya, upstream on the Goulbi River which flows from Nigeria to Maradi district in Niger, means that irrigation using the Goulbi River water as adaptation option in Maradi requires cooperation and dialogue between decision makers both in Niger and Nigeria. This is important to avoid mal-adaptation in Maradi and obviate conflicts around use of trans-boundary ecosystem like the Goulbi of Maradi.

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