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From Boreholes to Households:
Understanding the Impact of Water Access for Lives and Livelihoods in Rural Sahel

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Abstract

This thesis is the result of a ten-week field trip to rural Niger. It is based on data collected in two villages located in the Zinder region: Gouliske and Garin Tsangaya. It focuses on water and on its main drawers: women; and traces some of the links between household water supply and rural livelihoods in a semi-arid environment. It exposes the ways through which water has been accessed and managed in each site; identifies which factors have been promoting and hindering the sustainability of the local water management scheme; and ultimately, demonstrates how an unimproved water supply can jeopardize livelihood-based activities in direct and indirect ways. Its results emphasize the nature of water not only as a substance that fulfills basic needs but also as a valuable resource in the hands of productive women. This study takes a Sustainable Livelihoods Approach, and ultimately adds to the body of evidence on how sustainable and improved household water supply can lead to less vulnerable livelihoods.

Key words: improved household water supply, productive uses of water, women, sustainable livelihoods, development projects, drought, Niger.

Preface: The Origins

This thesis is the result of a ten-week field trip during which eleven master students from Stockholm University (Sweden) and the Abdou Moumouni University (Niger) collected complementary data that ultimately should provide answers to an investigative research project. The aim of this project was to uncover the social drivers of a re-greening trend that some localities in the Sahel are believed to have undergone.[1]

The re-greening discourse is a recent one. It concerns an enduring Sahel that after the devastating droughts of the 1970s and 80s, currently experiences higher levels of precipitation. Its main assertion is intriguing: that the return of rain has not been accompanied by expected trends in vegetation cover. Accordingly, various studies indicate that, in areas with similar bio-physical preconditions and precipitation levels, vegetation cover has not evolved in a similar way, implying that some areas are much "greener" than others.[2] The common conclusion is that rainfall *per se* cannot fully explain the local dynamics of vegetation (an important part of which is tree cover), and thus that additional social drivers must have contributed to the shaping of different landscapes.

Two villages in the Department of Zinder and two other in the Department of Maradi comprised the project's study sites. The rational of this selection was having in each area a sample of a "brown" and a "green" village to work with comparatively. The group of students was thus divided into these two areas in order to investigate some potential "re-greening" drivers.

Considering the important natural resource that vegetation in general, and trees in particular, constitute for rural communities, the possibility to contribute to an ongoing debate appealed us not only as a challenging quest, but also as one whose results had great potential for improving people's livelihoods. As a part of this quest, my research first aimed at investigating the impact of development projects on the vegetation of the study area. Timelines, focus groups and interviews with villagers, local authorities and project managers were planned in attempt to estimate, if not the magnitude, at least a potential correlation between projects and changes in vegetation cover.

Once in the villages, however, it became clear that my plans were made under assumptions that did not speak for the reality encountered. Although some projects had been present in the study areas from the 1980s onwards, estimating any impact or trying to establish any credible link between these and tree cover was not less than a creative task. The lack of

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[1] For understanding the re-greening discourse, see S. Hermann and C. Hutchinson, "The Changing Contexts of the Desertification Debate," *Journal of Arid Environments* 63, no. 3 (2005); S. Herrmann, A. Anyamba and C. Tucker, "Recent Trends in Vegetation Dynamics in the African Sahel and their Relationship to Climate," *Global and Environmental Change-Human and Policy Dimensions* 15, no. 4 (2005); C. Hutchinson and others, "Introduction: The ''Greening'' of the Sahel," *Journal of Arid Environments* 63, no. 3 (2005); S. Nicholson, "On the Question of the 'Recovery' of the Rains in the West African Sahel," *Journal of Arid Environments* 63, no. 3 (2005); L. Olsson, L. Eklundh and J. Ardö, "A Recent Greening of the Sahel: Trends, Patterns and Potential Causes," *Journal of Arid Environments* 63, no. 3 (2005).

[2] Trends and variances in vegetation cover have been measured mainly through the Normalized Difference Vegetation Index (NDVI). For details see M. Murzabekov, "Sahelian Re-greening: Merging a View from above with One from below" (master's thesis, Stockholm University, 2010).

official documentation, of projects' follow up, and of villagers capacity to fully recall past events meant that the entire first half of my stay in Niger, was spent trying to understand chronologically the activities of different projects at the villages. I was stubbornly convinced that links could be traced if I looked closer and further; I was convinced that another activity with a different focus group would provide me with a key piece of the puzzle I believed to assemble. However, after weeks of digging, I still didn't have enough material or evidence to write something coherent about the history of development projects in the area, and even less on their relation to re-greening.

Consequently, I had to change my research focus. The new focus, *impacts of water access on women's livelihoods*, was not accidental. It was the fruit of the previous searching process which had given me a rare insight into the lives of the villagers, and revealed one of the first projects attentive to the sustainability of improved water supply in the area: a Danish project, responsible for constructing boreholes that dramatically changed the villages' water access.

This thesis departs thus from a multi-disciplinary project centered on the re-greening discourse. Although it has distanced itself from this prior theme, this study owes to the re-greening investigation its new orientation and central findings.

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1. Introduction

The West African Sahel is home to some of the world's most vulnerable people. The Sahel is a transition belt between the arid Sahara in the north and the more humid areas of tropical Africa in the south. Due to extreme rainfall variability, which is the area's "most important dimension of weather variation"[3], livelihoods in the Sahel are intimately linked with precipitation. Seasonal variations comprise a rainy season (June to September) that tends to accumulate from 250 to 900 mm per year,[4] and a long dry season (October to May).

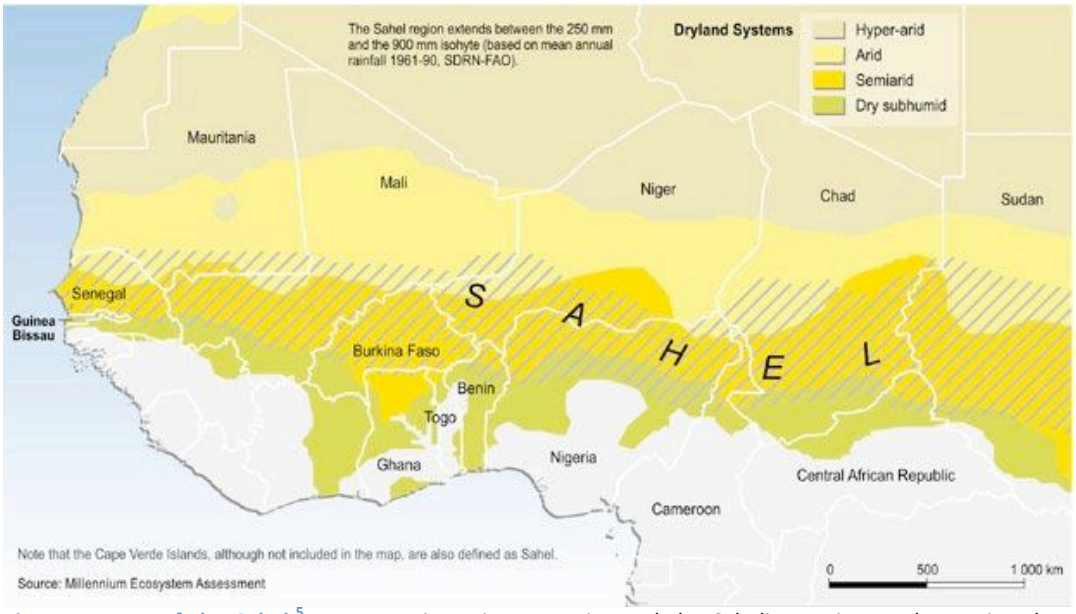

Figure 1- Map of the Sahel.[5] Map superimposing countries and the Sahelian region, and exposing the different climates within the Sahel (from arid to dry sub-humid).

Most people in the Niger, a Sahelian country, live in rural areas,[6] and base their livelihoods on rain-fed farming, mainly millet and sorghum. These crops depend on both timing and quantity of rainfall.[7] When these are not optimal, grain outputs drop and famines devastate livelihoods threatening the lives of the most vulnerable. The fact that drought often has translated into famines in the region, points to the high level of vulnerability of Niger's

[3] J. Aker, "Rainfall Shocks, Markets, and Food Crises: Evidence from the Sahel," (Working Paper 157, Center for Global Development, December 2008), 4, http://www.cgdev.org/content/publications/detail/1417887/

[4] Millennium Ecosystem Assessment, *Ecosystems and Human Well-Being: Desertification Synthesis* (Washington DC: World Resources Institute, 2005), 20, http://www.millenniumassessment.org/en/Synthesis.aspx

[5] Ibid.

[6] In accordance to data recently published by the World Bank, approximately 84 % of Niger's 14.7 million inhabitants live in rural areas, http://devdata.worldbank.org/AAG/ner_aag.pdf

[7] J. Aker, "Rainfall Shocks, Markets, and Food Crises," 5.

population. The country's vulnerability is corroborated for example by its position in the most recent Human Development Index, in which Niger occupies the lowest rank of 182.[8]

Recurrent famines constitute well known reference points in the lives of Nigeriens, as well as in the history of the country. Since 1960, Niger has undergone six different periods of famines, the most severe of which occurred between 1968-1974 and 1983-1984, when approximately 250,000 people died of drought-related causes.[9]

In this semi-arid environment, marked by uncertain rainfall and water-scarcity in general, access to modern water points all year around can have a tremendous impact on lives and livelihoods. The impact of water access on the health of individuals have been widely acknowledged and discussed by previous researches. Nevertheless, only recently attention has been given to the importance of water as a productive resource that helps sustain households.

This study takes a Sustainable Livelihood Approach, and focus on the water access of the study sites: the villages of Gouliske and Garin Tsangaya, located in southern Niger. It departs from the fact that water access differs considerably between these villages, and attempts to answer the following main research question: "How does water access impact **women's li**velihoods in the study sites?"

Accordingly, its main goals are to:

- Understand the evolution of water access and water management in the villages;
- Understand the productive activities comprising women's livelihoods, and how these may be impacted by a better or worse water access;
- Understand which factors promote and which factors hinder the sustainability of improved water sources at the villages.

In order to pursue the above goals and answer to the main research question, this study also attempts to understand some of the main aspects of the study villages: their main natural and social events and actors.

The relevance of the theme embraced by this study derives from the continuous effort to increase the social sustainability of livelihoods in developing countries, helping them to better respond to adversity. With this ultimate end in mind, this study aims to add to the growing body of evidence on the importance of ensuring improved water supply to water-scarce areas, and on the remaining obstacles for doing. It thus touches and enters a multiplicity of subjects that enabling, maintaining and losing improved water access entail.

[8] UNDP, *Human Development Report 2009, Overcoming Barriers: Human Mobility and Development* (New York: UNDP, 2009), http://hdr.undp.org/en/media/HDR_2009_EN_Complete.pdf
[9] J. Aker, "Rainfall Shocks, Markets, and Food Crises," 6.

2. The Lens: A Sustainable Livelihoods Approach

2.1. A Framework

The framework chosen to guide and structure this work is the Sustainable Livelihoods Approach.[10] Its choice is partly justified by the methods carried out, mainly participatory ones; but also by its action-oriented character towards the reduction of rural poverty. This choice of theory implies that the results exposed and the analysis developed here are intended to have some level of applicability. In other words, this research has its origins on the field, where it hopes to also have its ends.

Sustainable Livelihoods Approaches emerged and gained visibility through the work of Robert Chambers in the mid-1980s. They derive from various literatures on poverty, vulnerability, and coping and adaptation to social and natural changes.[11] Increasingly, they have developed towards an accepted means of analysis and of action, by depicting the processes through which individuals and households use all in their reach to make their living, in an inconstant scenario marked by micro and macro, social and ecological, gradual and abrupt modifications. DFID's Sustainable Livelihoods, CARE's Household Livelihood Security, and UNDP's Sustainable Human Development, are example of agencies using Sustainable Livelihood Approaches to guide their interventions.[12]

These approaches haven been depicted through different frameworks and diagrams, all of which take the form of 'assets-access-activities',[13] as illustrated by the figure 2.

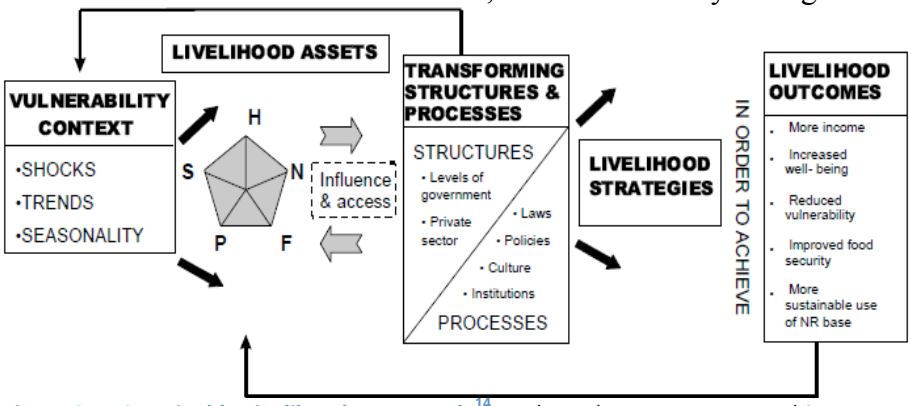

Figure 2- A Sustainable Livelihood Framework.[14] It shows how assets are used in pursue of different livelihood strategies and outcomes, a process which occurs within a context of vulnerability and is mediated by different structures and processes.

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[10] R. Chambers and G. Conway, "Sustainable Rural Livelihoods: Practical Concepts for the 21st Century," (IDS Discussion Paper 296, January 1992), http://www.ids.ac.uk/go/idspublication/sustainable-rural-livelihoods-practical-concepts-for-the-21st-century; I. Scoones, "Sustainable Rural Livelihoods: A Framework for Analysis," (IDS Working Paper 72, Institute for Development Studies, January 1998), http://www.ids.ac.uk/go/idspublication/sustainable-rural-livelihoods-a-framework-for-analysis

[11] F. Ellis, *Rural Livelihoods and Diversity in Developing Countries* (Oxford: Oxford University Press, 2000), 231.

[12] P. Moriarty and others, "Water, Poverty and Productive Uses of Water at the Household Level," in *Beyond Domestic: Case Studies on Poverty and Productive Uses of Water at the Household Level*, ed. P. Moriarty, J. Butterworth and B. van Koppen (Technical Paper Series 41, IRC International Water and Sanitation Centre, 2004), 33, http://www.irc.nl/page/6129

[13] F. Ellis, *Rural Livelihoods and Diversity in Developing Countries*, 231.

What underlies the above drawing is the centrality of peoples' capabilities to drive positive processes and to resist harmful ones. Their "force" is a function of assets owned or controlled by them, also understood as livelihood resources or stocks of capital. It has been said that "livelihood resources may be seen as the capital base from which productive streams are derived from which livelihoods are constructed"[15], and also that "assets may be described as stocks of capital that are used directly, or indirectly, to generate the means of survival of the household or to sustain its material well-being at differing levels above survival."[16] In line with these parallel definitions, the framework above portrays in a pentagon figure five categories of capitals: natural (N), physical (P), financial (F), human (H), and social (S).

2.2. Capitals

The five capital categories have derived from Swifts classification of tangible and intangible resources.[17] According to Swifts ideas of tangibility, it is possible to say that:

> "If physical capital is wholly tangible, being embodied in observable material form, and human capital is less tangible, being embodied in the skills and knowledge acquired by an individual, social capital is less tangible yet, for it exists in the relations among persons."[18]

Natural capital refers to the natural resources such as land, water, forests, air quality, biodiversity, etc. These resources are particularly important to the rural poor who derive important parts of their livelihoods directly from the local natural-resource base.[19] This study is centered on the importance of water for women's productive activities, and thus understands water as an asset pertaining to the natural capital base.

Physical capital refers to producer-goods and infrastructure such as tools and machines, transportation and roads, electricity, appropriate water and sanitation systems, etc. For our study site, an area where all natural water sources remain dry for most part of the year, functioning water infrastructure such as a well is decisive in determining whether people can promptly access water.

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[14] D. Carney and others, "Livelihoods Approaches Compared: A Brief Comparison of the Livelihoods Approaches of the UK Department for International Development (DFID), CARE, Oxfam and the United Nations Development Programme (UNDP)," (DFID, November 1999), 9, http://www.eldis.org/vfile/upload/1/document/0812/lacv3.pdf

[15] I. Scoones, "Sustainable Rural Livelihoods: A Framework for Analysis," 2.

[16] F. Ellis, *Rural Livelihoods and Diversity in Developing Countries*, 31.

[17] J. Swift, "Why are Rural People Vulnerable to Famine?" (IDS Bulletin 37, Institute for Development Studies, September 2006), http://community.eldis.org/?233@@.598d23fe!enclosure=.598d23ff

[18] J. Coleman, "Social Capital in the Creation of Human Capital," in *Social Capital: A Multifaceted Perspective*, ed. I. Serageldin and P. Dasgupta (Washington DC: World Bank, 1999), 19, http://lnweb90.worldbank.org/ext/epic.nsf/ImportDocs/0C353B9EA035C877852573150053B6EE?opendocument&query=KE

[19] P. Baumann, "Improving Access to Natural Resources for the Rural Poor: A critical Analysis of Central Concepts and Emerging Trends from a Sustainable Livelihoods Perspective," (Working Paper 1, Livelihood Support Programme FAO, July 2002), ftp://ftp.fao.org/docrep/fao/006/ad683e/ad683e00.pdf

Financial capital includes the stocks or savings of different nature such as bank deposits, jewelry, cattle, as well as access to inflows of money through pensions, remittances, etc. It is increasingly acknowledged that rural areas in developing countries are undergoing a "monetarization" process,[20] which implies an increasing trend of cash-based exchanges. For the rural and developing semi-arid world, the absence of financial institutions as we know, make livestock work as cash deposits which can be sold and converted into other forms of capital. [21] Indeed in Niger, women's savings normally take the form of livestock (goats).

Human capital refers to people's skills, abilities, knowledge, and health conditions, and as such, characterizes thus the amount and quality of labor available in each household. Its importance is accentuated in African poor and rural areas where people's own labor is often their prime asset and chief resource.[22] For decades, the impacts of domestic water supply were analyzed strictly in terms of human capital loses. People's health and consequently their ability to work were seen as the potential impacted areas of improved water access. As the results of this study will show, compromising human capital through health costs is only one of the ways water interacts with lives and livelihoods.

Last, but certainly not least, the category of social capital refers to the "community and wider social claims on which individuals and households can draw by virtue of their belonging to social groups of varying degrees of inclusiveness in a society at large."[23] Social capital is thus mainly referent to consolidated relations that can facilitate future actions. Some authors see social capital in terms of "horizontal associations" that facilitate cooperation and generate mutual benefits to the parts involved.[24] Others include in the analysis "vertical associations" that may generate differentiated products to the parts involved.[25] All definitions permeated though the concepts of trust and cooperation,[26] that shape personalized networks meant to improve future livelihood security. [27]

2.3. Access, Structures and Processes

The intangible social capital is strictly related to another important concept in livelihood approaches: access. Access is the real opportunity people have to use the resources. It is dependent both on the capital base of individuals and households but it is also related to the

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[20] B. Campbell and others, *Household Livelihoods in Semi-Arid Regions: Options and* Constraints (Jakarta: Center for International Forestry Research, 2002), XII, http://www.cifor.cgiar.org/publications/pdf_files/Books/Household.pdf

[21] F. Ellis, *Rural Livelihoods and Diversity in Developing Countries*, 34.

[22] B. Campbell and others, *Household Livelihoods in Semi-Arid Regions*, 33.

[23] F. Ellis, *Rural Livelihoods and Diversity in Developing Countries*, 36.

[24] R. Putnam, "The Prosperous Community-Social Capital and Public Life," cited in I. Serageldin and C. Grootaert, "Defining Social Capital," in *Social Capital,* 45-46.

[25] J. Coleman, "Social Capital in the Creation of Human Capital," cited in I. Serageldin and C. Grootaert, "Defining Social Capital," in *Social Capital*, 46.

[26] A. Krishna, "Creating and Harnessing Social Capital," in *Social Capital*, 75.

[27] S. Berry "Social Institutions and Access to Resources," *Africa* 59, no. 1 (1989) and *No Condition is Permanent: The Social Dynamics of Agrarian Change in Sub-Saharan Africa*, cited in F. Ellis, *Rural Livelihoods and Diversity in Developing Countries*, 9.

social environment in which livelihoods are constructed.[28] On the one hand, "access" refers to ones means and capacity to influence, which pertains to the capital domain (most specifically to social capital). But on the other hand, much of one's capacity to access something is often related to the context he/she is immersed. The concept of access extrapolates thus the capital domain, to reveal the structures and processes that characterize particular contexts.

In the study villages, for example, having sustainable access to water depends both on local capitals (physical, financial, social, human, and natural), but also on regional level structures and processes that are necessary to the longevity of the local water systems.

Sustainable Livelihood Approaches have described structures and processes as "institutions, organizations, policies and legislation that shape livelihoods."[29] They refer to all formal and informal power relations that directly or indirectly impact an individual or household. They play thus a significant role in determining livelihoods, as they "mediate the ability to carry out […] strategies and achieve […] outcomes".[30] They derive from the recognition that what activities one ultimately carries out and with what results are not a direct function of possessed assets, but depends also on the greater social, cultural, economical and political contexts.[31] Structures and processes constitute thus the social arena in which livelihoods are constructed, and they have the potential to offer incentives but also disincentives to different activities that make livelihoods more or less sustainable.

2.4. Livelihood Sustainability and Vulnerability

Sustainability here refers to the way through which assets are utilized, maintained and enhanced.[32] Chambers and Conway have elaborated the following definition: "a livelihood is sustainable when it can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation."[33]

Under such understanding, sustainability has at least two sides: an external (environmental), and an internal (social). Environmental sustainability refers to the effects of livelihoods on the local and global resources. And, social sustainability refers to the capacity of livelihoods to cope and adapt when facing adversity.[34]

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[28] F. Ellis, *Rural Livelihoods and Diversity in Developing Countries*, 9-10.
[29] DFID, "Sustainable Rural Livelihoods Guidance Sheets: Framework Introduction," (Department For International Development, April 1999), http://www.nssd.net/pdf/sectiont.pdf
[30] I. Scoones, "Sustainable Rural Livelihoods: A Framework for Analysis," 3.
[31] F. Ellis, *Rural Livelihoods and Diversity in Developing Countries*, 37.
[32] R. Chambers and G. Conway, "Sustainable Rural Livelihoods," 9.
[33] Ibid.
[34] According to these two sides, enhancing the sustainability of livelihoods in the North is normally advocated in terms of managing their external environmental impacts, while the sustainability discourse in the rural and developing South is mainly advocated in terms of enhancing people's capacity to cope with the external social and environmental circumstances. See R. Chambers and G. Conway, "Sustainable Rural Livelihoods," 9-10.

On the household level, a socially sustainable household is one that can adapt to better or worse periods without irrecoverable major losses. On the contrary, non-socially sustainable households (vulnerable) are those that easily reach the threshold of collapse when facing a crisis.[35] It is important to have in mind that vulnerability doesn't mean "lack or want, but defenseless, and exposure to risk, shocks, and stress."[36] Differently from poverty, vulnerability is not defined by fixed attributes,[37] but always and only in relation to an external phenomenon. It is a measure of one's means and capacity, and also of the pressure one is subjected to. Accordingly, vulnerability also comprises two sides: an external, to which one is subjected, and an internal, referent to one's means and capacities.

In order to analyze social sustainability and vulnerability, in addition to understand the capital base and the social arena determining livelihoods, it is also crucial to understand the surrounding external environment, also known as the "vulnerability context".

2.5. The Vulnerability Context: Shocks, Trends and Seasonality

The vulnerability context is said to be "the part of the framework that lies furthest outside people's control."[38] It refers to an uncertain scenario of more or less predictable changes. Progressive and more predictable changes are called trends, which when recurrent are termed seasonality, while sudden changes are known as shocks. Examples of the former are "having to go further and spend longer for less, for fuel, fodder, grazing or water; declining water tables; declining rainfall; population pressures on resources leading to declining returns to labour [etc]."[39] Examples of shocks are "wars, persecutions and civil violence, droughts, storms, floods, fires, famines, landslips, epidemics of crop pests or of animal or human illness, (…) the collapse of a market [etc]."[40]

An assumed positive trend that was the starting point of this research, as already mentioned, was the re-greening. Some other trends that are often cited in the literature referent to the Sahel are: increased population growth, increased diversification of income activities and "monetarization" of livelihoods, overgrazing of rangelands, increased soil erosion, decrease of fallow land, and decrease of women's land ownership.[41]

A common shock to which the Sahel is recurrently subjected is drought, often followed by famines. Recurrent and unpredictable droughts exacerbate the effects of seasonality on people's livelihoods compromising survival in its basic requirements. Seasonality means that the changes in seasons constrain certain activities and encourage different opportunities along the year. It implies "that continuous household consumption needs are

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[35] J. Swift, "Why are Rural People Vulnerable to Famine?" 46.
[36] R. Chambers, "Vulnerability, Coping and Policy," (IDS Bulletin 37, Institute for Development Studies, September 2006), 33, http://community.eldis.org/?233@@.598d23f8!enclosure=.598d23f9
[37] Ibid.
[38] DFID, "Sustainable Rural Livelihoods Guidance Sheets."
[39] R. Chambers and G. Conway, "Sustainable Rural Livelihoods," 10.
[40] Ibid.
[41] B. Campbell and others, *Household Livelihoods in Semi-Arid Regions*, 3; X. Crombé and J. Jézéquel, J. eds., *A Not so Natural Disaster: Niger 2005* (London: Hurst / Médecins Sans Frontières, 2009), 132.

mismatched with uneven income flows."[42] This mismatch characterizes many rural households and more perversely those unable to produce and store enough provisions for the entire year. Trends, shocks and seasonality – or in other words, the external environment in which a household exists[43] – play an important role in determining which livelihood strategies are going to be undertaken and with which intensity.

2.6. Livelihood Strategies and Diversification

Livelihood strategies denote the combination of activities undertaken by each household.[44] They vary from planned and deliberated actions to spontaneous responses in face of threatening stresses. These different guiding rationales give rise to what is denominated risk management strategies, and coping strategies. The former comprises the activities executed before and in preparedness to likely future stresses, and the latter comprises the activities executed in face of an installed crisis.[45] Three clusters of livelihood strategies are commonly identified: migration, agricultural intensification or extensification, and diversification. Each of these they take various forms from well planned and programmed activities that can contribute to the accumulation of assets in the long run, to "reflex" responses in a desperate attempt to ensure immediate survival, with the potential to erode ones capital base and further compromise future strategies.

Among the above mentioned clusters and the ways through which they can be carried out, risk management diversification in response to seasonality is the central strategy analyzed by this study. As defined by Ellis, rural livelihood diversification is "a process by which rural families construct an increasingly diverse portfolio of activities and social support capabilities in order to survive and to improve their standards of living."[46] And livelihood diversification as risk management "is interpreted as a deliberate household strategy to anticipate failures in individual income streams by maintaining a spread of activities."[47] This choice of focus does not ignore the fact that dividing diversification determinants into a more or less voluntary criteria can probably be misleading, especially in areas where stress and struggle to survive is constantly varying, and not simply present or not.

The diversification phenomenon identified in the study area has also been noticed in research elsewhere.[48] Overall, from 30 to 50 percent reliance on non-farm income is believed to be a common place in Sub-Saharan Africa.[49]

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[42] F. Ellis, "Household Strategies and Rural Livelihood Diversification," *The Journal of Development Studies* 35, no. 1 (1998): 11.
[43] DFID, "Sustainable Rural Livelihoods Guidance Sheets."
[44] Ibid.
[45] P. Webb, J. von Braun and Y. Yohannes, "Famine in Ethiopia: Policy Implications of Coping Failure at National and Household Levels," cited in F. Ellis, *Rural Livelihoods and Diversity in Developing Countries*, 61.
[46] F. Ellis, *Rural Livelihoods and Diversity in Developing Countries*, 15.
[47] T. Walker and N. Jodha, "How Small Farm Households Adapt to Risk," cited in F. Ellis, "Household Strategies and Rural Livelihood Diversification," 13.
[48] D. Bryceson, "African Rural Labour, Income Diversification and Livelihood Approaches: A Long-term Development Perspective," *Review of African Political Economy* 26, no. 80 (1999): 171.
[49] F. Ellis, "Household Strategies and Rural Livelihood Diversification," 10; E. Francis, *Making a Living: Changing Livelihoods in Rural Africa* (London: Routledge, 2000), 46.

This section has introduced the theory – with its terminology and concepts – that constitutes the lens through which the study sites have been approached and the results have been analyzed. Shortly, this theory separates different assets (capitals) used by people in order to execute various livelihood activities, which result on more or less sustainable livelihood outcomes. These processes occur under, and to some extent are shaped by, the constraints and incentives of structures and processes (the social environment), and respond to a dynamic scenario of multiple trends, recurrent shocks, and seasonal variations (the natural environment).

The above approach, its assumptions and implications, permeates this thesis purposely not simply as a thread that ties chapters together, but as the fundament on which ideas are developed together with the rational for their exposition: the attempt '"to identify what the poor have rather than what they do not have' and '[to] strengthen people's own inventive solutions, rather than substitute for, block or undermine them"'[50]. Accordingly, the following pages will expose how women, despite multiple constraints, actively build a capital base through their engagement in water-dependent productive activities, and how this process can be affected by the deterioration of water access.

[50] C. Moser, "The Asset Vulnerability Framework: Reassessing Urban Poverty Reduction Strategies," cited in F. Ellis, *Rural Livelihoods and Diversity in Developing Countries*, 28.

3. The Issue: Household Water Supply

3.1. Improved Water Supply: An Old Challenge

In accordance to an international classification set by the United Nations agencies, improved water supply means having access to improved water supply technologies within the range of one kilometer from the dwelling.[51] The table below shows which supply technologies are considered improved and which are considered unimproved.

Table 1- Water Supply Technologies.[52] The table shows the classification of water supply technologies in accordance to WHO and UNICEF.

WATER SUPPLY TECHNOLOGIES CONSIDERED IMPROVED AND NOT IMPROVED
Improved: household connection, public standpipe, borehole, protected dug well, protected spring, rainwater collection
Not improved: unprotected well, unprotected spring, vendor-provided water, bottled water, tanker truck provision of water

Improved water supply, and its importance to peoples' health and livelihoods, has been for decades a central subject in research, as well as the focus for concerted international commitments and actions.

The 1980s was proclaimed the first international decade for clean drinking water. Back then, around 2.5 billion people lacked access to improved water supply,[53] situation which encouraged the world's leaders to pursue the common target of "Water and Sanitation for all by 1990s".[54] Despite large amounts of investments, the results from that decade were not as expected, and in 1990 more than 1.6 billion people remained without improved water supply.[55]

In the beginning of the current decade, the fact that still 1.1 billion people didn't have access to improved water supply, [56] led to a new international commitment through the Millennium Development Goals. Accordingly, its target 10, paragraph 19, states the resolution to halve, by 2015, "the proportion of people who are unable to reach or afford safe drinking water."[57]

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[51] UNDP, *Human Development Report 2006, Beyond Scarcity: Power, Poverty and the Global Water Crisis* (New York: UNDP, 2006), 34, http://hdr.undp.org/en/media/HDR06-complete.pdf

[52] WHO and UNICEF, *Global Water Supply and Sanitation Assessment 2000 Report* (New York: WHO and UNICEF, 2000), 4, http://www.who.int/water_sanitation_health/monitoring/jmp2000.pdf

[53] B. Mathew, "Ensuring Sustained Beneficial Outcomes for Water and Sanitation Programmes in the Developing World," (Occasional Paper Series 40, IRC International Water and Sanitation Centre , 2005), 12, http://www.bvsde.paho.org/bvsacd/cd47/ensuring.pdf

[54] UNDP, *Human Development Report 2006: Beyond Scarcity*, 55.

[55] B. Mathew, "Ensuring Sustained Beneficial Outcomes for Water and Sanitation Programmes in the Developing World," 12.

[56] WHO and UNICEF, *Global Water Supply and Sanitation Assessment 2000 Report*, 1.

[57] UN General Assembly, "United Nations Millennium Declaration," (Resolution adopted by the UN General Assembly, 18 September, 2000), p. 5, http://www.undemocracy.com/A-RES-55-2.pdf

Water access has thus remained in the international agenda as a central topic in the last decades. Its permanence derives from the common consensus surrounding the importance of water to various aspects of people's lives, and nevertheless also from the inability of various projects based on different paradigms to achieve their intended goals.

Most of the people without access to improved water supply inhabit the developing countries, with the rural areas lagging behind urban ones.[58] In rural Africa, only 47% of individuals have access to improved water supply.[59] In rural Niger, official statistics point to a 36% coverage.[60]

3.2. Water Supply: From a Sectoral to a Multiple-Use Approach

Traditionally, water supply has been approached as pertaining to different sectors. Industrial, agricultural, and domestic water supplies were seen as related to exclusive uses. According to this sectoral perspective, the domestic sector's main sphere of action was the provision of clean and reliable supply to the execution of basic-needs activities.[61] These narrowly comprised drinking, hygiene, bathing, and cooking,[62] activities to which water of sufficient quality and in sufficient quantity should be available.

The costs and benefits of not being able to access the minimum requirements of water for these daily activities were calculated mainly in terms of human health. The lack of water was thus related to a series of diseases that not only compromised people's capacity to work, indirectly threatening their survival, also constituted a serious life threat to more vulnerable groups such as small children and elders.[63]

This basic-needs paradigm presumed peoples' preferences and needs were fixed. It focused on women, as these are not only the main drawers of water in most parts of rural Africa and the developing world but also the main promoters of hygiene practices in their households;[64] and assumed that water in their hands was exclusively utilized in domestic chores, through a rationale guided foremost by health concerns.

Although these assumptions are still present in today's rural development mentality, it is now increasingly accepted that they can only tell one part of the story.[65] It is in fact an important part, considering that still "unclean water is the world's second biggest killer of

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[58] WHO and UNICEF, *Global Water Supply and Sanitation Assessment 2000 Report*, 1.
[59] Ibid., 41.
[60] World Bank, *African Development Indicators 2007* (Washington DC: World Bank, 2007), 71, http://siteresources.worldbank.org/INTSTATINAFR/Resources/adi2007_final.pdf
[61] P. Moriarty and J. Butterworth, "The Productive Use of Domestic Water Supplies: How Water Supplies Can Play a Wider Role in Livelihood Improvement and Poverty Reduction," (Thematic Overview Paper, International Water and Sanitation Centre, May 2003), 7, http://www.irc.nl/page/3733
[62] P. Moriarty and others, "Water, Poverty and Productive Uses of Water at the Household Level," in *Beyond Domestic*, 40.
[63] See list of water-related diseases in annex 1.
[64] B. Upadhyay, "Gendered livelihoods and multiple water use in North Gujarat," Agriculture and Human Values 22, no. 4 (2005): 412.
[65] J. Soussan, *Water and Poverty: Fighting Poverty through Water Management* (Kyoto: Asian Development Bank, 2004), 216, http://www.adb.org/Documents/Books/Water_for_All_Series/Water_and_poverty/Water_01.pdf

children".[66] Nevertheless, in order to holistically understand the role of water at the household domain, one must address all water uses that occur at this level, which are not limited to the previously defined familial basic-needs, but comprise a wider assortment of activities, including productive ones. [67]

Productive uses of water at the household level are defined as "water used for small-scale, often informal activities whose primary purpose is improved nutrition and/or income generation."[68]

An increasing number of studies and reports have been targeting the identification of the productive benefits derived from improved water supply at the household level.[69] These studies represent an ongoing attempt not only to map productive activities but also to understand the ways through which improved water supply impacts these and consequently peoples' lives and livelihoods. One of the most comprehensive studies within this matter is presented by Moriarty and Butterworth, who have compiled an extensive list of potential impacts.[70] In their words, "Improved domestic water supplies and the institutions surrounding (…) can reduce sickness, save time, generate income, enhance food security, strengthen local organizations and build cooperation between people."[71]

Evidence brought by Moriarty, Butterworth, and other researchers and practitioners supports the assertion that "for the rural poor, who make up some 75% of the world's poorest people, access to water is essential both for basic needs and for productive purposes. Lack of access is often the main factor limiting their ability to secure their livelihoods."[72] Accordingly, the nature of water as not only a basic need fulfillment but as a productive resource, a valuable asset on the hands of productive individuals is emphasized.

Altogether, recognizing and promoting the productive uses of water at the household level marks a shift in approach within the field of water supply, from a rigid sectoral to a

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[66] UNDP, *Human Development Report 2006: Beyond Scarcity*, 43. See also S. Cairncross and V. Valdmanis, "Water Supply, Sanitation, and Hygiene Promotion," in *Disease Control Priorities in Developing Countries*, ed. S. Crairncross and V. Valdmanis (New York: Oxford University Press, 2006).

[67] P. Moriarty and others, "Water, Poverty and Productive Uses of Water at the Household Level," in *Beyond Domestic*, 43.

[68] Ibid., 21.

[69] WaterAid, *Looking Back: The Long Term Impacts of Water and Sanitation Projects* (London: WaterAid, 2001), http://www.wateraid.org/documents/lookingback.pdf; P. Moriarty., J. Butterwort and B. van Koppen (eds.), *Beyond Domestic*; P. Moriarty and J. Butterworth, "The Productive Use of Domestic Water Supplies"; Koppen B. van, Moriarty P. and Boelee E., "Multiple-Use Water Services to Advance the Millennium Development Goals," (Research Report 98, International Water Management Institute, 2006), http://www.irc.nl/docsearch/title/152051.

[70] See list of benefits from household water supply in annex 2.

[71] P. Moriarty and others, "Water, Poverty and Productive Uses of Water at the Household Level," in *Beyond Domestic*, 24.

[72] World Water Assessment Programme, *The United Nations World Water Development Report 3: Water in Changing World* (Paris: UNESCO / London: Earthscan, 2009), 85, http://www.unesco.org/water/wwap/wwdr/wwdr3/pdf/WWDR3_Water_in_a_Changing_World.pdf

multiple-use water services approach.[73] In accordance to this later, peoples multiple water needs are recognized as a starting point for the provision of integrated services, which implies moving beyond the understanding of distinct domestic and productive sectors, traditionally associated to the domestic, and to the agricultural domain, respectively.

Still today, the productive aspect of water is very much associated to irrigation schemes that enable the enhancement of agricultural productivity.[74] This is certainly an important aspect of the productive potential of water in rural settings. Nevertheless, as we realize that the notion of a famer, strictly dependent on agriculture, does not withstand the increasingly pervasive diversification trend that characterizes rural strategies, addressing additional productive water uses become central for understanding the impact of water on people's lives.

To sum up, research and rural water interventions were for decades guided by the conception that water supply at the household level mainly impacts human health. Under such perspective, improving household water access was advocated as a necessary measure towards the reduction of water-related diseases. To spare human capital (in terms of the available quantity and quality of labor) and consequently financial capital (in terms of medical expenses) were seen as the ultimate objectives of improving water access. In complement to this previous conception, a multiple-use approach has recently emerged. According to this latter, household water access has additional important impacts, among which the promotion or hindering of productive activities, that constitute an important income source for women and for the household in general.

Through the lens of a livelihood approach, addressing water's productive potential means recognizing that water is a crucial resource to which secure access must be enabled if livelihoods are to be less vulnerable. The rural poor are already deprived from a solid resource base, which means that the rationale behind the construction of their livelihoods is normally based on a restricted set of choices.[75] To identify and promote their chosen livelihood-based activities by facilitating their access to an important resource means building on and strengthening their own strategy towards more diverse and sustainable livelihoods. As it will be shown, in our study sites, women's household productive activities can be seen as a risk strategy that provides them with some extra income and contributes to making a difference between "getting by and destitution" [76] in the face of distress.

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[73] For a detailed discussion, see B. van Koppen, P. Moriarty and E. Boelee, "Multiple-Use Water Services to Advance the Millennium Development Goals."

[74] J. Castresana, "Productive Uses of Water at the Household Level", in *Beyond Domestic*, 71.

[75] Poverty is often associated with the lack of options. As mentioned by C. Barretta, T. Reardon and P. Webb, "The key point is that the wealthy have greater freedom to choose among a wider range of options than do the poor." "Nonfarm Income Diversification and Household Livelihood Strategies in Rural Africa: Concepts, Dynamics, and Policy Implications," *Food Policy* 26, no. 4 (2001): 326.

[76] J. Soussan and others, "Allocating Water for Home-Based Productive Activities in Bushbuckridge, South Africa," in *Water and Poverty, the realities: Experiences from the Field*, ADB Water Awareness Program, 139-152 (Manila: Asian Development Bank, 2004), 148, http://www.adb.org/Documents/Books/Water_for_All_Series/Water_Poverty_Realities/Water_05.pdf

4. Methods

4.1. Participatory Methods: A Brief Reflection

In accordance to the chosen framework theory, the majority of the methods carried out were participatory. Accordingly "livelihoods and sustainable livelihoods are concepts which have evolved more from open-ended fieldwork than from the closed concerns of surveys and statistics."[77]

As already mentioned, people lie at the centre of the livelihoods approach, and should thus stand not only as the objects of researches and interventions, but also and more importantly as active subjects. This change reflects a change in development research and programs (from top-down to bottom up) that has gradually evolved in the last thirty years.[78] Enabling beneficiaries to be actors in the telling of their stories and in the choice, implementation and maintenance of beneficial investments, are increasingly understood as crucial, if one attempts to document a realistic version of the story, and ensure that investments will in fact be effective and long-lasting.[79]

From its timid emergence to today's widespread use, participatory methods have been used in diverse ways, and to diverse extents.[80] Among these ways, one divide is particularly interesting: whether participation is a means or an end. As a means, participation implies mobilization of beneficiaries so these may contribute with punctual actions and resources; as an end, participation implies building capacity in attempt to increase the beneficiaries' power to bring about structural change. [81] Mikkelsen calls this divide "efficiency or empowerment", and the nature of each participation, as "instrumental and transformational".[82]

To question the nature of participation extrapolates thus accepting the beneficiaries as subjects or objects. It implies questioning "subjects or objects to what?" towards the management of a punctual intervention or activity? Or towards "social justice, equity and democracy?"[83] This is a quite complex and probably blurred divide. It concerns stated goals but also understated intentions. Aiming for the former nature of participation is less ambitious and more pragmatically measurable. Aiming for the latter means touching established power relations, and implies that a certain input can potentially alter these relations from the bottom.

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[77] R. Chambers and G. Conway, "Sustainable Rural Livelihoods," 18.

[78] For a deep account on these changes in approach, see O. Therkildsen, *Watering White Elephants: Lessons from Donor Funded Planning and Implementation of Rural Water Supplies in Tanzania* (Uppsala: Scandinavian Institute of African Studies, 1988).

[79] See R. Chambers, *Rural Development: Putting the Last First* (New York: Longman / John Wiley & Sons, 1983), 210-212.

[80] See B. Mikkelsen, *Methods for Development Work and Research: A Guide for Practitioners* (New Delhi: Sage Publications, 1995), 62-67.

[81] See O. Therkildsen, *Watering White Elephants*, 61-63.

[82] B. Mikkelsen, *Methods for Development Work and Research*, 63.

[83] Ibid.

It has been said though that these rationales for participation are not exclusive, and often occur concomitantly.[84] My choice for participatory methods contemplated these empowerment and transformational potentials, although a more decisive factor was the possibility to acquire more in-depth qualitative information within a short period and in a socially acceptable way.

From the first day, it was clear that my intentions and goals at the villages were not clear to their inhabitants. Many of those who opened their homes and welcomed me into their routines asked "What is the purpose of your stay? What are you planning to give us?" These questions would follow my stay, and demand more than answers once I started approaching women, who were reluctant to speak without a material gratification.

Women's time is extremely constrained, and thus valuable. At no moment of the day they sit around and relax, but their socialization is normally concomitant to their chores. They chat while pilling the millet, walking to fetch water, waiting in the queue of the borehole, on the way to fetch wood, while cooking, washing dishes and clothes. To speak to them, there was no other choice than joining their routine or inconveniently stopping by during the evenings. In both situations, a gift such as a soap, batteries, or cola nuts was indispensable to a calm activity.

4.2. Chronology of Activities

1- Timelines

The first activities conducted at the villages were with men: timelines were drawn in attempt to capture the recalled major natural events such as droughts, crop pests and animal epidemics. The construction of these timelines was done during five different meetings in each village with varying number of male participants (5-15members). Men were selected by the villages' chiefs, who according to my request tried to ensure that the participants varied. The purpose with these timelines was to better understand these villages' histories.

Taking the timelines on natural events as a basis, new information referent to the execution of development projects was added. Here I attempted to assemble the most influential men at the villages, which meant that the villages' chiefs and their closest men were encouraged to participate. This choice was purposely biased due to the fact that, when arriving to the village, project representatives must first speak to the village chief to obtain his consent; and as a matter of rule project representatives interact most with the ones closest to the chief.

These latter timelines revealed some of the external actors that had been at these villages as well as some of their actions and investments. From the villagers' account, it was possible to infer that projects had invested in several areas (capital domains), and that the clearest and long-lasting investments had been on physical, and social and human capitals in the form of local infrastructure, and skills and networks respectively.

In general, these meetings were very interesting. Quite often the initial group was joined by other men who gathered around listening and interfering as they wished. It was impossible

[84] B. Mikkelsen, *Methods for Development Work and Research*, 63.

and seemed unnecessary to prevent these interferences from happening. The story telling of some was complemented and sometimes confronted by other versions from their contemporaries; and the past narratives told by the few elders were attentively listened by the younger men. Most often, the timeline sections were not only very revealing, but I believe also instructive and interesting to the ones taking part in it by sharing or listening to a history that if not told will not survive in an illiterate society.

2- Village Maps

In accordance to the findings of the timelines, the history of the villages' infrastructure was pursued though the drawing of village maps. Their purpose was both to increase my awareness of the surroundings, but also to understand which parts of the infrastructure had its origins on previous investments from development projects. Through these maps, information such as who had been responsible for building the school, the cereal bank, the boreholes, etc. could be obtained.

3- Venn Diagrams and Focus Groups

Also departing from the findings from the timelines, the villages' organizational structures were investigated. The objective was to understand the actions and functioning of each group, and most importantly to find out which of them had been originated by development project's inputs. Accordingly, Venn diagrams were made depicting all groups present in the villages. Consecutively, meetings were organized with members from each of these groups. Acquiring concrete information on these more or less formal bodies was not always an easy process. While some groups could provide concrete answers on their activities and rationale, others could only provide vague answers in support to some general goals.

4- Focus Groups on Cited Projects

Group meetings were conducted with those having the most contact with each investigated project. As the above focus groups meetings, these took the form of a conversation which I tried to guide towards sufficient answers on projects actions. These meetings could last for hours, and had sometimes to be continued in other days. Their extensity was though not a measure of productivity, instead it was mainly due to the difficulties in acquiring precise answers on the accomplishments of each recalled project. Every point had to be translated, explained and often recapitulated.

At the end of each meeting, not much new had been revealed about the focused project, rather than a greater realization that the terrain I tried to enter was much more complex than I had expected and wished for. With a few exceptions, that will be addressed later, it was clear that villagers' involvement in projects had been minimum, and so was their capacity to recall and explain the interventions.

5- Unstructured Interviews and Assessment of Archives

After having gathered some information on projects at the villages, I moved on in attempt to investigate further each of the mentioned projects. Unstructured interviews were conducted with government representatives in the different departments in Mirria and Zinder. These interviews took the form of an informal conversation, through which I tried to learn more about the actions of the mentioned projects. As a matter of rule, these

meetings were not fruitful, and even the basic information obtained at the villages was often news to the interviewees.

Unstructured interviews were also conducted with the remaining projects' officials in Zinder. The plan was to confirm their involvement in the focused project, cover the main unanswered issues and double check the answered ones. Some of these interviews were useful to the extent that they provided me with some insight on the general goals of the investigated project. Nevertheless this was dependent on finding someone still working at the office who could recall past actions, since none of the organizations kept archives.

Several attempts were made to access secondary sources such as projects' reports and assessments kept in the organization's and/or the government's archives. This was certainly the most difficult part of the data gathering process. I was confronted with the lack of a documented memory that characterizes past interventions in the area.

Although no report relevant for this study was found, and the interviews with government and project officials generally were of limited use, the time spent at these offices helped me to consolidate some relationships that ultimately enabled the access to some complementary material (such as maps), and to some central people (such as past project managers that later were reached through email).

Change of Focus

After returning back and forth from the villages to Mirria and Zinder, I came to realize that the lack of information on projects was a result that although not sufficient, already indicated that answering my research question on projects' impacts on vegetation was if impractical in an eight-week period.

From that point on, my research took a major shift. The data already collected was not disregarded. Instead, it enabled the better understanding of the study sites, and revealed a central intervention at these villages: the advent of improved water supply through the construction of boreholes in the 1980s.

The study thus changed its focus, and from attempting to understand the impact of projects on re-greening, went to attempting to understand the impact that changes in water access (derived from the implementation and collapse of development projects' investments) have on livelihoods. New activities were thus planned targeting mainly women, who are the main responsible for fetching water, and thus the ones most likely to be directly impacted by the improvement of deterioration of water supply.

6- Participatory Observations

Four participatory observations we made (two in each village). In these, I spent the entire day with a woman, aged from 20-30 years old. Finding women who were willing to share their day with me was not easy, most women were reluctant and a couple after having accepted, changed their mind in the following morning. Thus, no demands were made with regards to their selection, other than an average age range, and that I would be welcomed to spend the entire day and follow them in their everyday chores.

The objective of these observations was to better understand how their daily routines work in general, how much time some basic chores consume, and how water is accessed, handled from the boreholes to their households, and used. Additionally, I believe that by sharing their chores with me, these women became more comfortable with my presence, which contributed to diminish the distance that existed between us, and our worlds.

7- Focus groups

New focus groups were organized with several objectives. Four focus groups in each village (two with younger women and other two with elder women) had the purpose of revealing the past and current water sources, their usages, and relative quantities.

From these focus groups, it started to become clear that the biggest impact of changes in water access, in accordance to women's perceptions, was on their time. The location of the mentioned water sources that were situated outside the villages were thus captured through a GPS (Global Positioning System) equipment[85] in order to enable the estimation of time expenditure on the water fetching chore.

Subsequently other three focus groups were organized in each village (one with younger, one with elder women, and one of mixed age ranges). The objective of these meetings was to understand how women's routines had evolved through the past decades. Accordingly, the aim was to estimate changes in the time expenditure of women's most time-consuming domestic activities (fetching water, wood, and pilling millet), and thus contextualize the drawing of water in relation to their other chores. Although these focus groups aimed at achieving estimations of time, they were also an arena in which women shared their view and opinion on the consequences of these trends.

8- Structured interview, and additional focus groups

According to women's opinions expressed in the above mentioned focus groups, the more time they spent in the execution of basic domestic chores, the less time they had for, among other things, carry out productive activities. Thus, in attempt to understand how the different time-requirements of changing water accesses had impacted these activities, personal interviews and new focus groups were planned.

Twenty (ten in each village) personal interviews were made with women from various age (20-45) on their performed productive activities. The interview was divided in two phases, focusing on the past and on the present respectively. For both periods, the questions tried to capture the activities engaged by each woman, and the maximum profit derived from each activity per week.

Initially, an attempt was made to select women through a wealth ranking exercise which had been made by colleagues at the beginning of our stay. Talking to women about their income was nevertheless a complicated task, among other reasons, because women themselves became very apprehensive when informed of the interview's theme; and because these were extensive interviews that could last for more than an hour, time which women were reluctant to share. Thus, in order to have at least ten interviews in each

[85] Procedure done by Lisen Runsten.

village, women had ultimately to be selected in accordance to their availability and willingness to talk. The main requirement was that they had been living in the study village for at least five years (the investigated period, in which one of the villages had undergone a major change in water access).

It is possible that the prevalent selection criteria contributed to a bias in the sample towards more poor (and willingly to "sell" their time to an interview) or less poor women (and less concerned with time constraints). Thus, and as it will be readdressed, the results are probably not ideal for an inter-village comparison (as we may be comparing representatives from different social groups). Nevertheless the results serve an intra-village analysis as they reveal common changes in the individual level that altogether point to clear village trends.

9- Unstructured interviews and email exchanges

Unstructured interviews, which were in fact scheduled conversations, were carried out with government officials of the Hydrology Department in Zinder. The main objective was to achieve some understanding on how improved water supply is seen and dealt with at the government level, and more specifically how the processes of constructing and repairing improved water sources, in specifically boreholes, are enabled in the region.

Finally, through email exchanges, information on the project responsible for improving water supply in the villages was obtained.

4.3. Final Remarks on the Methodology

As already mentioned, relating to women was tricky and compromises had to be made from both parts. Talking to them was always a negotiation process which was made easier by a skillful translator. A good translator was central for obtaining quality data. When approaching women's productive activities and revenues, a good translator proved to be indispensible. By a good translator I mean one that belongs to the local culture; that can relate to villagers as an equal (and not as an interrogator external authority); that can blend in among them in formal and informal moments, and consequently contribute for the welcoming of the researcher.

It turned out that several of the translators I worked with considered themselves somehow above the villagers because they held university diplomas. This had several implications, among which was their refusal to ask questions that involved numbers (years, hours, amounts) assuming that the innumerate villagers were not capable to answer. On the other hand, I had the support of one translator, who skillfully and creatively helped me to obtain the desired information, who was attentive to discrete signs, and who could confront villagers on the sincerity of their answers without embarrassments but with laughs followed by rectifications.

In general, the above activities were informal and pleasant exchanges that enabled the collection of reliable and sufficient data for the purpose of my work. Participatory methods are by nature open to information outside the facilitator's agenda, and were thus responsible for revealing relations that would probably not have been captured through closed surveys. Accordingly, the sequence of activities explained above was not planned

off-site and in advance. Instead, it was the findings of one activity that determined the subsequent issue of investigation.

It is hard to affirm what impact these activities may have had on the villagers themselves. I wish to think that our conversations and interaction in general have not only provided me with a greater understanding and critical view of their reality (and of my own), but that they may have undergone a similar process.

5. Results

5.1. Site Description

Gouliske and Garin Tsangaya are Islamized Haussa villages located in the department of Zinder, in the southern part of Niger. They are villages of different sizes, the former counting with approximately 1204 habitants divided into 214 households, and the latter with 782 inhabitants dived into 144 households.[86]

They are communities who significantly rely on rain-fed agriculture,[87] in which human labor is the main if not the sole input for the cultivation of their main crops: millet and sorghum intercropped with cowpea. In the last decades, the increase of population has made land more scarce and hard to acquire.[88] In a society dominated by men, this has implied the progressive exclusion of women from land rights.[89] Despite this trend, women have remained responsible for some parts of cultivation cycle.[90]

Figure 3- Map with the Location of Villages.[91] The map shows the two studied villages and their surroundings.

In the region, Mirria is the largest city with approximately 20,000 inhabitants and a lively Sunday market that attracts men and women from the surroundings. As the above map shows, Gouliske is located closer to Mirria than Garin Tsangaya. In reality, the distance between Garin Tsangaya and Mirria's commercial centre is enlarged by poor roads.

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[86] I. Baggnian "Rôle des dynamiques démographiques et migratoires sur l'évolution des écosystèmes sahéliens : Cas d'un terroir villageois reverdi et non reverdi du département de Mirriah dans la région de Zinder au Niger" (master's thesis, Abdou Moumouni University, 2010), 56-57.

[87] The average rainfall in Mirriah is of 356 mm. C. Lund, *Law, Power and Politics in Niger: Land Struggles and the Rural Code* (Hamburg: Lit Verlag, 1998), 53.

[88] C. Lund, *Law, Power and Politics in Niger*, 58.

[89] X. Crombé and J. Jézéquel, J. eds., *A Not so Natural Disaster*, 130-132.

[90] For understanding women's roles in the agricultural cycle, see annex 3.

[91] Adapted from a regional electronic map obtained from the Hydrology Department in Zinder.

Distance to markets is in fact one of the variables influencing household welfare.[92] The relation is explained as following: "The inability to diversify incomes due to remoteness is cited as one of the reasons that distant rural areas tent to exhibit a disproportionately high incidence of poverty."[93] In agreement with such statement, a participatory wealth ranking exercise pointed to a greater wealth in Gouliske than in Garin Tsangaya in terms of locally meaningful categories such as number of food-secured months (from own crops), number of small and large ruminants, and number of migrants in the family. Below is a summary of the findings from this exercise:

Table 2 - Wealth in the Villages.[94] The table shows the percentage of families within different wealth categories. It points to a greater wealth in Gouliske than in Garin Tsangaya.

	Low	Medium	High
Gouliske	25%	50%	25%
Garin Tsangaya	50%	30%	20%

5.1.1. History of Projects

As already mentioned, the initial focus of this research was to understand and evaluate the historical effect of development projects on vegetation. Although there was a change in focus, still the gathered data constitute an important part of the villages' recent history. Altogether, the documented projects help us to understand parts of the infrastructure and of the organization at the village level.

The timelines below show the main natural events as reported by villagers, and the main actions of recalled projects. Projects' contributions are here categorized in terms of different capital enhancements.

[92] See C. Barretta, T. Reardon and P. Webb, "Nonfarm Income Diversification and Household Livelihood Strategies in Rural Africa," 326.

[93] World Bank, *World Development Report 1990: Poverty*, cited in F. Ellis, *Rural Livelihoods and Diversity in Developing Countries*, 90.

[94] Based on wealth ranking exercises executed by Issoufou Baggnian, Friederike Mikulcak, and Lisen Runsten.

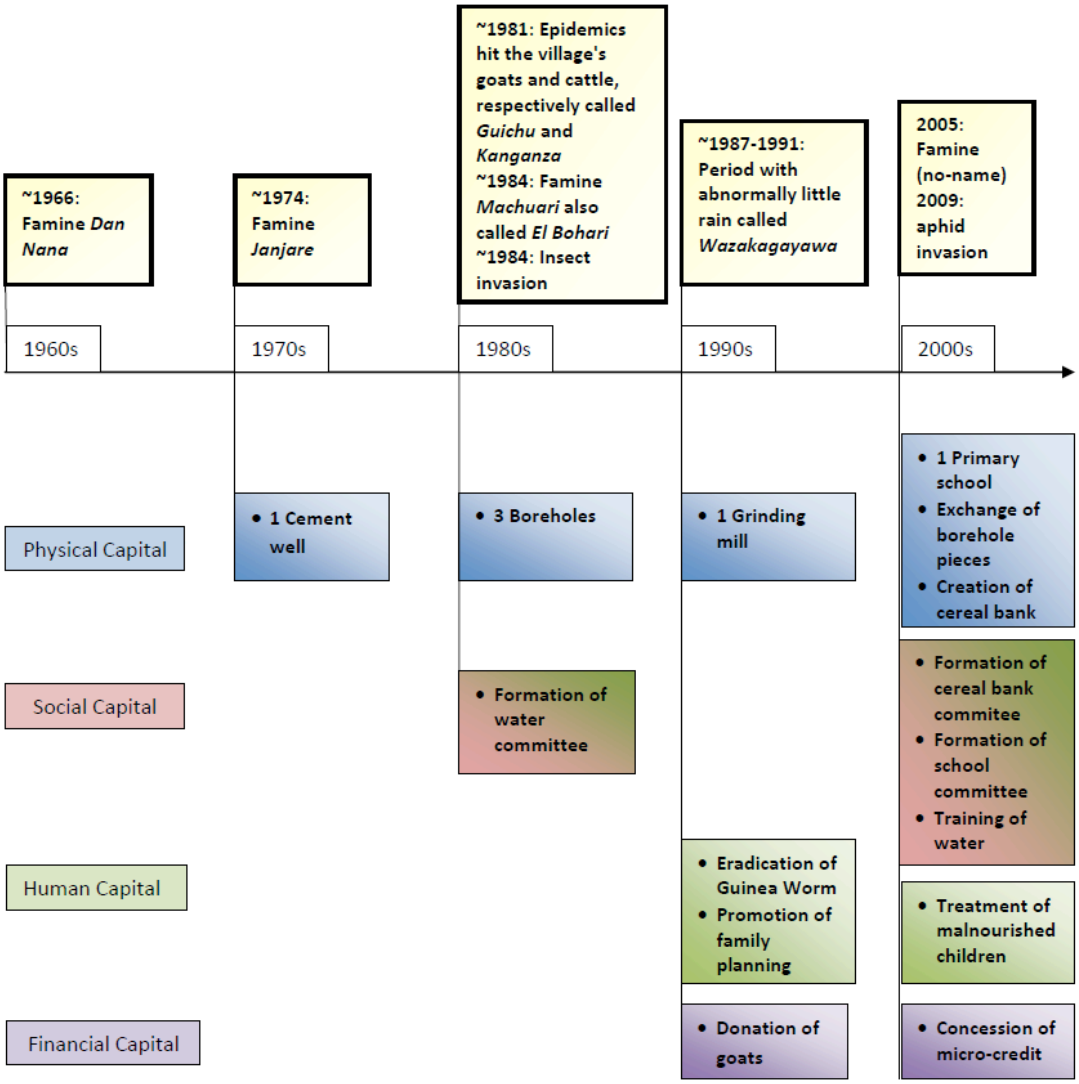


Figure 4- Timeline of Gouliske. The timeline shows the major natural events in the village, and the different development investments (in terms of capital enhancements) through time.

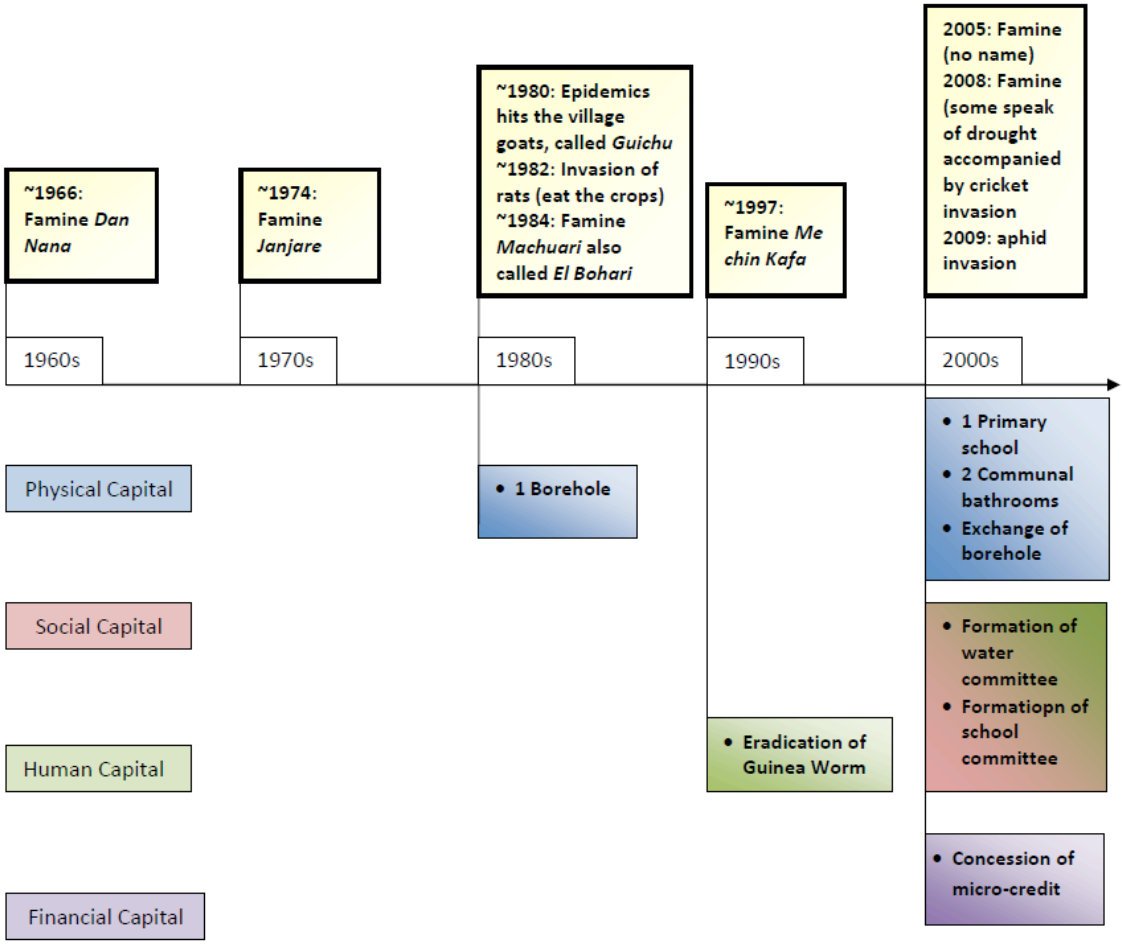


Figure 5- Timeline of Garin Tsangaya. The timeline shows the major natural events in the village, and the different development investments (in terms of capital enhancements) through time.

As the timelines show, Gouliske has been benefited by a larger number of projects than Garin Tsangaya. Some of the projects were punctual donations or loan concessions; some attempted to eradicate diseases or promote better child nutrition; some invested in infrastructure and machinery; and some on spreading skills and awareness within the villages.

In terms of capital enhancements, it is thus noticeable that almost all projects that invested in the local physical capital have also invested in social and human capitals by forming groups and associations and teaching skills necessary for the operation and maintenance of the donated infrastructure. The rationale for this double investment was the achievement of projects' sustainability, here simply equated to longevity or in other words "the capacity of a project to continue to deliver its intended benefits over the long term."[95]

[95] M. Bamerger and S. Cheema, "Case Studies of Project Sustainability," cited in UNDP and World Bank, *Making Rural Water Supply Sustainable: Report on the Impact of Project Rules* (Washington DC: UNDP and World Bank, 1998), 30, http://www.wsp.org/UserFiles/file/global_ruralreport.pdf

Project sustainability has been for decades a problematic issue. In the 1980s, there was a rising realization that projects' neglect of non-engineering and emphasis on technical aspects were causing many schemes to stop functioning as soon as they were handed to users.[96] In line with that, it has been increasingly acknowledged that "physical capital cannot operate over time without human capital in the form of the knowledge and skills needed to use and maintain physical assets (…)."[97] The project described below was one of the first in the region to address sustainability through investments in social and human capitals.

From 1982 onwards, a Danish project (*Projet Danois*) was responsible for constructing more than 580 boreholes in the region of Zinder. During its first years of action, the project periodically checked and assured the performance of the boreholes through technical follow-ups and reparations. This centralized model posed some expected sustainability problems such as: how to transfer competences to the locals?; how to make the villagers less dependent from projects constant inputs?; how to decrease the project's maintenance costs with the boreholes?

In attempt to overcome these challenges, the Danish Project embraced an innovative participatory approach, based on a decentralized scheme for the operation and maintenance of the water infrastructure. This scheme was based on the ideas and experiences of a UNDP and UNICEF project, working in the area south of the Danish intervention site.

In 1988, the first fixed sociologist of the Danish Project was hired to promote the transference of responsibilities to the local level and thus ensure that sustainability was not an issue.

The new scheme emerged as a network between an active village committee, a local mechanic (*artisan reparateur*), and external authorities represented by the Project and the Hydrology Department.

Accordingly, mechanics were selected based on geographic criteria and their previous experience with similar work (preference was given to blacksmith, carpenters, construction workers etc.) These artisans were trained and prepared to detect and fix the most common problems threatening the functioning of the boreholes.

Concomitantly, village level committees were formed. These consisted of five members: a president, a secretary, a cashier, and two female hygienists, whose main responsibilities were to periodically collect money from each household, keep the funds and contact their preferred mechanic whenever necessary.

To close the scheme, external authorities, ultimately the Hydrology Department, should conceive a system for the technical follow up of the boreholes, and be responsible for handling more complicated breakdowns beyond the competence of the local mechanics.

For photos, see Annex 5.

Figure 6- The Danish Project. The text shortly describes the Danish intervention in the region.

The scheme described above has not been implemented uniformly among the villages, as some had more intense contact with the project's officials. It has nevertheless contributed to set the basis for the today's widespread model for rural water management in Niger, which is intrinsically community-based.[98]

[96] O. Therkildsen, *Watering White Elephants*, 15.
[97] E. Ostrom, "Social Capital: A Fad or a Fundamental Concept?" in *Social Capital*, 175.
[98] As described by J. Sardan and A. Dagobi, "The privileged management mode of the village hydraulic is communitarian. [...] the modern water points lie under the responsibility of village management

5.1.2. The Villagers Physical and Social Capital

These simultaneous investments on physical, and social and human capital in pursue of sustainability have meant that in parallel to a more robust infrastructure at the village level, there has been a tendency for a more complex organization to be formed. This tendency is stronger and better visualized in Gouliske than in Garin Tsangaya, as the village maps and diagrams below portray:

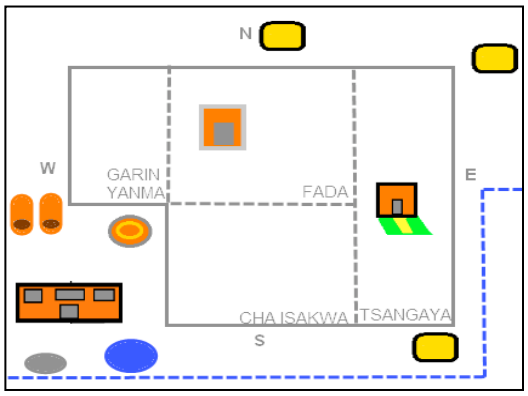


Figure 7- Map of Garin Tsangaya

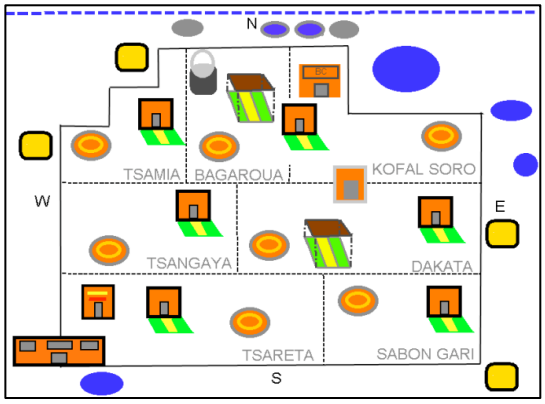
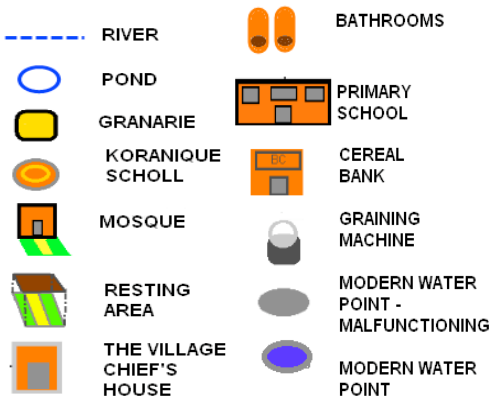


Figure 8- Map of Gouliske



The maps show the main infrastructure (physical capital) of the villages, as well as their natural water points (river and ponds). It points to a better infrastructure in Gouliske than in Garin Tsangaya.

committees, responsible to assure the continuation of the water structure through the maintenance of funds."[98] "La Gestion Communautaire Sert-Elle l'Intérêt Public?: Le Cas de l'Hydraulique Villageoise au Niger," *Politique Africaine*, no. 80 (2000): 153 (My translation).

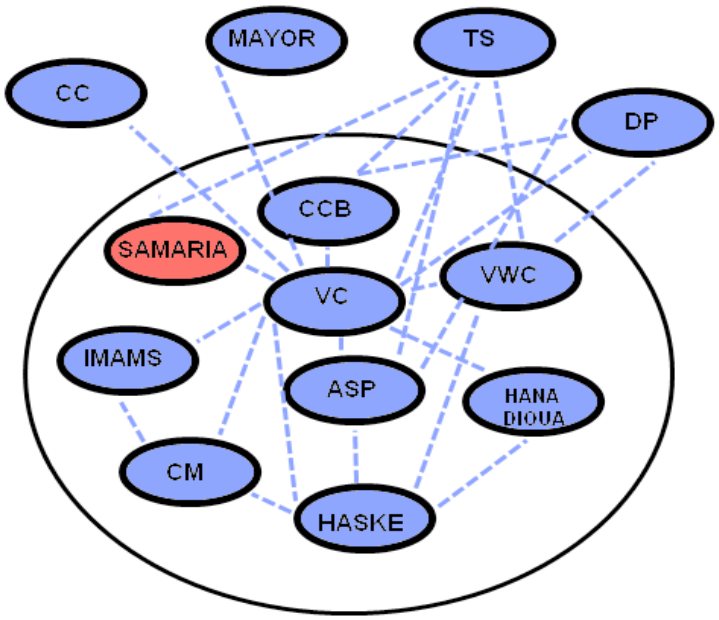
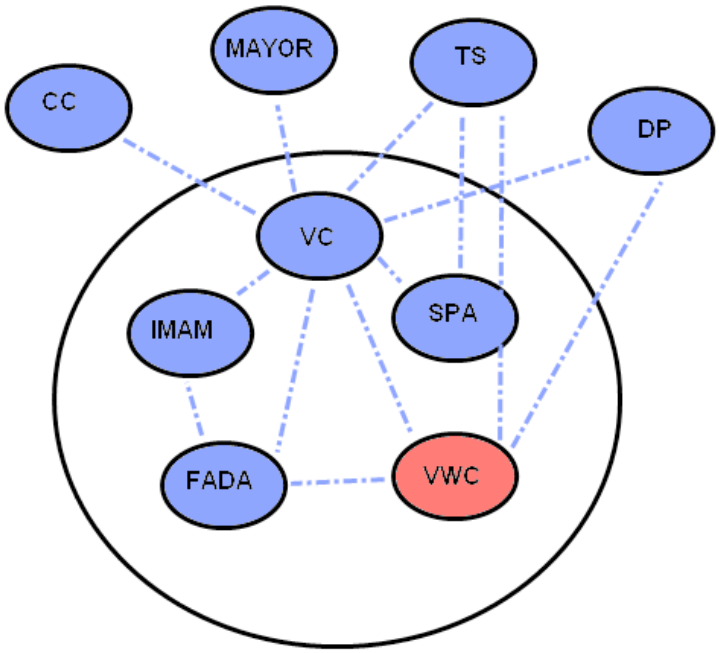


Figure 9- Organizational Structure of Gouliske



Acronyms:

CC: Canton Chief

TS: Technical Service (Various Departments)

VC: Village Chief

VWC: Village Water Committee

CCB: Committee of Cereal Bank

ASP: Association of the Students' Parents

CM: Committee of Mosques

DP: Development Projects

Figure 10- Organizational Structure of Garin Tsangaya

The diagrams portray the actors with the villages (main circle) and outside them. Red stands for past and currently inoperative actors, while blue stands for active ones. The lines represent the interaction among these actors. The diagrams point to a larger number of actors in Gouliske than in Garin Tsangaya.

5.1.3. Understanding Actors and Groups from Gouliske

Some of the actors portrayed by the diagrams above are traditional entities that date from an unmemorable age, such as the village chief (*Maigari)*, and the religious leader (*Imam).* These are the most important authorities in Garin Tsangaya, Gouliske as well as in all Islamized Haussa villages in the region.

In Gouliske, in addition to the Maigari and the Imams, another traditional body is the committee of the Mosques. This committee is a central one in which all men participate, under the leadership of six Imams (each of which is responsible for one Mosque). In addition to these traditional bodies, Gouliske has had other groups since the 1970s.

Back then, a few men from Gouliske along with other men from the surrounding villages pertained to a government-formed group called *Samaria*. The members of Samaria interacted closely with government officials. These men received training within agricultural implements which they tested at their villages for both advertising and instructive purposes. In addition, in accordance to an interview with its only remaining former member in Gouliske, the Samaria was "the eyes of the government in the villages"[99] and comprised the most skilled and wise men from the area.

In the 1980s, following the construction of the boreholes, a water committee was created. As already mentioned, the committee was intended to ensure the operation and maintenance of the water infrastructure. Since its implementation, in Gouliske, this scheme has not ceased to function. The formation of the committee has of course changed during this period, and new members have been selected in accordance to their relations and influence within the village.

In a long conversation, with the local mechanic in charge of Gouliske's boreholes, he explains that before him, his father used to repair Gouliske's boreholes. His father along with other men from the area belonged to the first group to be trained in Mirria by the Danish Project. In addition to learn how to detect and fix common problems, this group of men was also informed on which places in Zinder to find replacement pieces. By accompanying his father, the current mechanic learned his skills and when his father deceased, he occupied his position. According to him, the local system implemented in 1980s works almost exactly the same today, except from the fact that it has become more efficient, as communication has been facilitated by mobile phones. The mechanic estimates that a common breakdown takes no longer than one week to be fixed.

Another externally instituted body in Gouliske is the association of students' parents which was formed by the government when the school was constructed. This is a forum of deliberation and interaction between the parents of students, tutors, and officials from the Department of Education in Mirria.

Finally, a committee in charge of a Cereal Bank benefits Gouliske by increasing food security at the village. This committee was formed by UNICEF as a pre-condition to their initial millet input in 2005. It is composed by a group of women who are responsible for buying the millet after the harvest, storing, and selling it before the following harvest in the

[99] In the translator's words "les yeux du gouvernement dans le village." (Gouliske, 30 Sep. 2009).

period known as *soudure*. The soudure generally lasts from April to September when the villagers are confronted with the strongest scarcity of food, as their grain stocks have been consumed and the new harvest is yet not ripe. This is a common phenomenon, as the following sentence describes: "Because of the importance of the seasonal cycle of rain, food security also tends to vary on a seasonal basis. It tends to be highest during the rainy season, when stocks from the previous harvest are low and physical demands are high with the initiation of planting."[100] Thus, during the soudure, the grain price reaches the highest in the market, and having a functioning cereal bank with more moderate prices at the village certainly helps households to better endure this period.

In addition to these externally instituted committees, Gouliske also has two committees originated by internal initiatives: *Haske* and *Hana Dioua* (or *Hanou-dayawa*). Haske was initially formed around 1998, by the initiative of a group of men who were determined to create a school in the village. After advocating at the mayor's and at the Canton's Chief offices, their claim was heard and a school was created in Gouliske. This school took place in a provisory construction until a modern building was constructed by the government in 2000. After their initial success, Haske continued to meet. They present their current goal to be the propagation of *Gaya* within their village, a name that stands for inter-aide in Haussa. They raise money that is used to support other committees, and as loans to ceremonies and to men who wish to migrate. Haske also organizes and executes common activities such as sporadic cleanings of the village, and roughcast and reparation of common areas such as mosques and hangars (resting areas).

Last but not least, Hana Dioua was also constituted through the initiative of a group of local young men. Its members state their main concern to be the decrease of trees in the village's territory and the problems derived from it. They are aware of the fertilizer effects of some trees. In the words of one member, "Acacia Albida fertilizes the soil."[101] Other members mentioned that if they don't stop trees from disappearing, their women will have to engage in longer journeys in their constant search for wood; and that eventually the desert will advance over their village. They present themselves as a type of guards or law enforcers, always attentive to the fatal pruning of trees. In accordance to them, if a man is seen practicing harmful pruning, Hana Dioua denounces him to the village chief who adverts and forces him to swear on the Quran never to repeat the act again. In a last case scenario, the village chief may denounce the ones responsible for the illegal pruning of trees to the forest brigade in Mirria. In accordance to the members of Hana Dioua, this extreme measure has never been necessary. As it has been noticed by researches on the area, in the Islamic Haussa society "religion is an important normative referent, and swearing on the Quran is almost universally accepted to be a gesture of truth. Lying while under oath subjects the perjurer to unpleasant supernatural sanctions such as leprosy, impoverishment etc."[102]

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[100] J. Aker, "Rainfall Shocks, Markets, and Food Crises," 6.
[101] In the translator's words "*Gao donne des engrais au chan.*" (Gouliske, 21 Sep. 2009).
[102] C. Lund, *Law, Power and Politics in Niger*, 76.

5.1.4. Understanding Actors and Groups from Garin Tsangaya

In Garin Tsangaya in addition to the Maigari and the Imam, although fewer, there are also some externally and internally instituted bodies. Differently from Gousliske, in Garin Tsangaya no water committee was created in the 1980s when the borehole was constructed. Instead, the village chief was in charge of raising funds and calling upon a mechanic when necessary, a situation also documented elsewhere as "communities which do not have water committees often rely on traditional leaders to manage the water system."[103] Furthermore, with regards to villages' water management, it has been noticed that "communities in which water committees were trained performed significantly better than the average. Those where committees were not trained performed significantly worse."[104]

Since Garin Tsangaya's current village chief is not the same as the one from the 1980s and early 1990s (which is the case in Gouliske), it was not possible to hear direct from the chief himself how the local operation and maintenance of the borehole had been working in the past. A focus group with elders revealed that money was collected from households irregularly, mainly in response to, instead of in preparedness to a breakdown.

Garin Tsangaya's borehole functioned with some minor problems, all of which were handled by various local mechanics until 2004. From then on, it has worked intermittently: some water during the rainy season can be found in it, but once the rain ceases the borehole dries completely.

By chance, two international NGOs arrived at Garin Tsangaya in the 2005. On their agenda was the rehabilitation of modern water points and the formation and training of village water committees. Accordingly, through standard procedures one NGO after the other changed component pieces of the pump, and, despite the unfruitfulness of this procedure, trained a local committee whose paradoxical function was to manage an out-of-function borehole. The absurdity of this situation is unfortunately not unique, as aspects of control-oriented projects that implement externally planned actions without considering the local specificities and necessities are still common, and the lack of coordination between NGOs often generate replication, wasting resources and sometimes even undermining previous investments. [105] In an email exchange, the former chief hydrogeologist for the Danish Project explains that it is not rare for NGOs operating in the Zinder area to make indiscriminate interventions. In his own words: "in 2006, I was informed that (…) NGOs even had rehabilitated pumps which we had rehabilitated two years earlier, an outrageous situation, which destroys all incitement for maintenance!"[106]

Not surprisingly, the water committee in Garin Tsagaya did not withstand the departure of the NGOs, as villagers refused to pay for the maintenance of an unreliable water source

[103] UNDP and World Bank, *Making Rural Water Supply Sustainable*, 47.
[104] Ibid., 46.
[105] See O. Therkildsen, *Watering White Elephants*, 66-67 for an account on centralized control-oriented projects.
[106] Email correspondence with Karl Jørgensen (Former chief hydrogeologist for Projet Danois, 1982-92), Jan. 28, 2010.

when they already had to pay to water committees in the surrounding villages to access their water points.

Despite though the NGOs failure to rehabilitate Garin Tsangaya's borehole, they left behind in the village an organizational model. This model was replicated by a group of young men determined to find a solution to their single borehole, and restore improved water supply in their village. They called themselves *Fada*. During months, the members of Fada saved money from migration to bring to the village a mechanic from Zinder. As the previous mechanics, this one did not succeed, and repeated the previous verdict: the problem was not on the machinery of the pump, which could have been fixed. The borehole had simply gone dry. The periodical lack of water was probably a combination of natural causes such as the decrease in the water table aggravated by the construction of a dam upstream in the Zermou River.[107]

Despite the failure of their mission, the young men members of Fada continued to meet sporadic. In a focus group with them they are proud to speak about their formation and members. They regret the water situation of their village, and say that their goal now is to carry on and propagate Gaya. They have continued to raise money among its members which is used for the common interest such as reforms in the Mosque, the construction of a guest house, and as loans for ceremonies and seasonal migration.

In addition to the internally formed committee of Fada, and to the short-lived externally instituted water committee, Garin Tsangaya also has an association with origins in the school management which was formed by the government when the school was constructed. Similarly to Gouliske's association, this is a forum for the interaction among parents, educators and sporadically also government officials in Mirria.

These village-level actors interact among themselves and with external entities, as the Venn diagrams show (fig. 9 and 10).

In sum, the participatory timelines (fig. 4 and 5), village maps (fig. 7 and 8) and Venn diagrams (fig. 9 and 10) portray aspects of the past and current history of these villages. Altogether, they depict parts of the villages' physical and social environments. The history of these reveal some patterns such as: a tendency for projects' investments in common infrastructure to be followed by the promotion of associational skills intended to support the longevity of the started schemes; and a tendency towards the perpetuation of the introduced associational skills, considering that both villages have recently seen the emergence of internally organized groups, with similar models, vested with various and in principal common interests.

5.2. Water Access

5.2.1. The Evolution of Water Access

The water sources available to the villagers of Gouliske and Garin Tsangaya were for decades very similar. Until the 1970s both villages relied mainly on unimproved sources. During the wet season these sources comprised a nearby stream (effluent from the Zermou

[107] As explained by official from the Hydrology Department (Zinder, 29 Oct. 2009).

river) and ponds of various sizes. In the dry season villagers had to hand-dig traditional wells along the riverbed. When these were insufficient, the women went to fetch water in cement-made wells in the surrounding villages, engaging in three daily trips.[108] Elders from Garin Tsagaya narrated their daily walks to Korota, while elders from Gouliske narrated their walks to Jankaya and Fotoro.

An improvement in water access took place in Gouliske in the 1970s, when a cement-made well was constructed by the government. The situation only changed significantly though in the 1980s when boreholes were constructed in both villages by the Danish Project. From then on long quests for water elsewhere ceased. In the wet season, people continued relying on natural sources mainly for watering animals. In the dry season, the boreholes became the sole source for life, which meant that all beings and all activities were dependent on it. Table 3 schematizes the above mentioned changes in water access. And the photos below illustrate some of the different water sources.

Table 3- Changes in Water Sources and Usages. The table shows the different sources for humans and animals usage in the dry and wet periods, accessed by each village throughout the decades. Highlighted are the sources considered improved.

Villages	1960	1970s	1980s	1990s	2000s
Gouliske	Dry period: local traditional wells, and cement-made wells in the surrounding villages (human and animal) Wet period: local river and ponds (human and animal)	Dry period: local traditional wells and cement-made well (human and animal) Wet period: local river, ponds and cement-made well (human and animal)	Dry period: local boreholes (human and animal) Wet period: local boreholes (human and animal); river and ponds (animal)		
Garin Tsangaya	Dry period: local traditional wells, and cement-made wells in the surrounding villages (human and animal) Wet period: local river and ponds (human and animal)		Dry period: local boreholes (human and animal) Wet period: local boreholes (human and animal), and river and ponds (animal)		Dry period: local traditional wells (animal), and boreholes in surrounding village (human and animal) Wet period: local borehole (human and animal), and river and ponds (animal)

[108] This average seems to be consistent with estimations from other research. In accordance to G. White, D. Bradley and A. White, "the average number of trips a woman makes daily to the source varies between 2.5 and 3.5 in the areas studied." *Drawers of Water: Domestic Water Use in East Africa* (Chicago: The University of Chicago Press, 1972), 254.

Figure 11- Photo of Traditional Well in Garin Tsangaya

Figure 12- Photo of Borehole in Gouliske

5.2.2. The Impacts of Improved Access on Human Health

The advent of boreholes at the villages had a tremendous impact on the lives of both men and women. Under the basic-needs domestic water perspective in vigor at the time, these boreholes should mainly have a direct impact on health. In fact the change from unimproved to improved water supply was a fundamental part of the eradication of a water-related disease: Guinea Worm.[109]

Until the 1990s, the entire Zinder region was endemic with this disease that although doesn't kill, leaves people incapacitated to work. Accordingly, "The guinea worm, *Dracunculus medinensis* (…) kills few peoples, and though a long subcutaneous worm usually in the leg, may not appear a serious infection, its economic effects are very great."[110] Focus groups with elders at both villages revealed that in the 1970s and 1980s most inhabitants were infected with at least one worm.

With regards to the incidence of other water-related diseases it was not possible to estimate any changes. Although we may assume some improvement, we should not overstate this belief as water-related diseases are not only a measure of water quality, but also of quantity and hygiene practices.[111] The challenges involving changes in hygiene practices have been widely acknowledged by previous research, all of which point to the importance of hygiene practices from the water source to the household.[112]

Both in Gouliske and in Garin Tsangaya a certain level of hygiene has been kept around the boreholes, thanks to surrounding cement walls that keeps animals away. In addition, most

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[109] The power of boreholes against Guinea Worm is clear in the description of G. White, D. Bradley and A. White, "once the local ponds and unedged wells had been replaced by bored wells for one year, there were no guinea worm epidemics, whereas they had previously been a yearly event." *Drawers of Water*, 174; see also W. Brieger and others, "Eradicating Guinea Worm without Wells: Unrealized Hopes of the Water Decade," *Health Policy and Planning* 12, no. 4 (1997).

[110] G. White, D. Bradley and A. White, *Drawers of Water*, 173.

[111] Water-related diseases are usually divided into four categories: *waterborne*, *water-washed*, *water-based,* and diseases caused by insect vectors. See UNDP, *Human Development Report 2006, Beyond Scarcity*, p. 46; see also annex 1 for list of water-related diseases.

[112] See for example A. Nyong and P. Kanaroglou, "A Survey of Household Domestic Water-Use Patterns in Rural Semi-Arid Nigeria," *Journal of Arid Environments* 49 no. 2 (2001).

people have the practice of taking off their sandals before entering the area. The water is mainly transported on plastic buckets or clay jars. At home, water is stored in large clay jars with capacity to hold from 15 to 40 liters. These jars remain covered. On their top, lies a plastic cup or a metal can which are not properly cleaned, and may contaminate the jars as other research has indicated.[113]

5.2.3. Impacts of Improved Access on Time-Expenditure

In addition to more or less clear health impacts, the boreholes also implied significant savings of time used to fetch water. With the help of a GPS, the coordinates below were captured, and through the Google Earth program, the map below was constructed and the distances calculated.

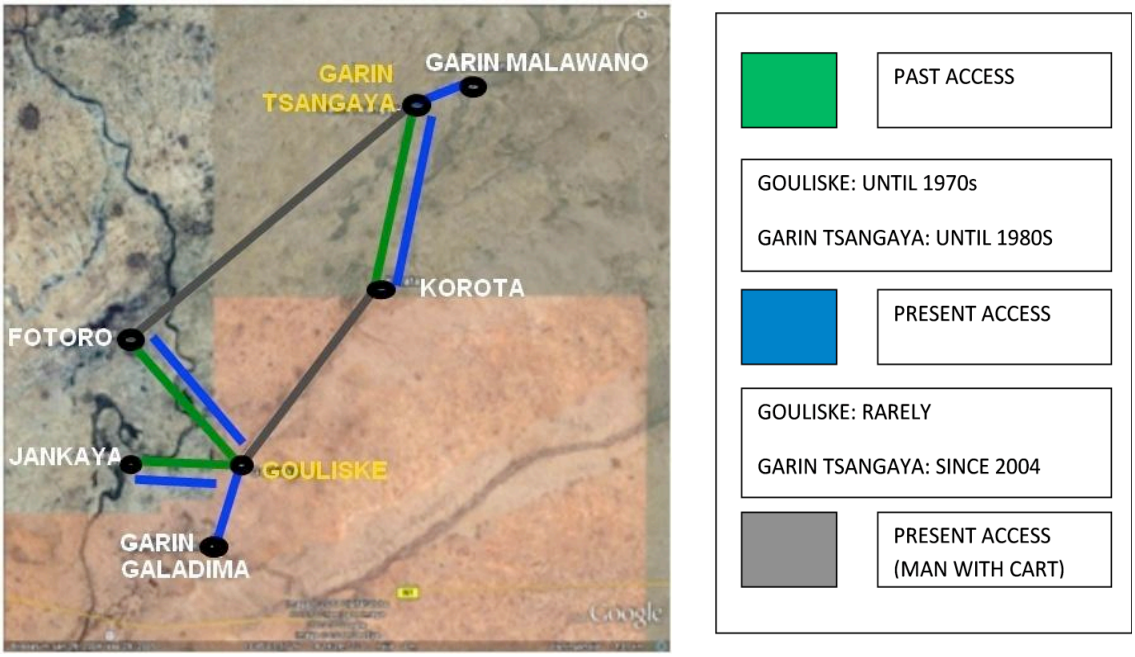

Figure 13- Map with Villages' Main Past and Current Water Points. The map shows the different routes used to access water in the past and in the present. Green represents the routes used in the past; while blue and grey are the routes currently in use by women and men with carts pulled by bulls respectively.

Table 4- Distances to Main Water Points. The table shows the distances between Gouliske and Garin Tsangaya and the surrounding villages were they fetched water in the past and/or in the present.

	Garin Galadima (1 borehole)	Jankaya (1 borehole and 2 cement wells)	Fotoro (4 boreholes and 3 cement wells)	Korota (3 boreholes)	Garin Malawano
Gouliske	1.5 km	2.2 km	3.2 km	4.2 km	-
Garin Tsangaya	-	-	7.2 km	3.6 km	1.1 km

[113] A. Nyong and P. Kanaroglou, "A Survey of Household Domestic Water-Use Patterns in Rural Semi-Arid Nigeria," 396.

If we assume a walking speed average of 2.56 miles/h (4.12 km/h), which has been said to be a "reasonable speed for women walking to a water source"[114], and use the distances above, the calculations show that women from Garin Tsangaya gained about 4 hours and 45 minutes when being spared from three trips to Korota. Comparatively, women from Gouliske saved about 3 hours and 20 minutes from avoiding 3 trips per day to Jankaya, or about 4 hours and 30 minutes from avoiding 3 daily trips to Fotoro. These time estimations do not include waiting time at queues which could also be significant in water points serving various villages.

The numbers above are consistent with current data elsewhere indicating that it is not uncommon for women to spend "up to four hours a day walking, waiting in queues and carrying water."[115] Altogether, they explain why for the women who must fetch water in water-scarce environments "the chore is one of her first in the morning and her last outdoor in the evening."[116]

5.2.4. Comparing Access and Consumption Levels between the Villages

The gains in time indicated above for Garin Tsangaya were recently nullified by the drying of the village's single borehole. The village has thus in the last half decade faced a retrocession in terms of water access which has forced women to reengage in long quests for water elsewhere during most part of the year.

In accordance to data obtained in focus groups and in personal interviews, women from Garin Tsangaya, accompanied and helped by children, must nowadays make three daily trips to the villages of Korota or Garin Malawano (most often to the former as the latter offers only one borehole which is utilized by six surrounding small villages). Men who possess a cart can also use it to bring water from Fotoro. In all these villages, water must be paid for. The monetary costs are not different from those they would have paid in their own village for the maintenance of their borehole.[117]

Currently thus water access in the studied villages differ considerably.

In Gouliske women find water all year long in two reliable boreholes (the third one has also dried in the last years). Although the distance from the dwellings to these boreholes is not significant, time waiting in queues is in the rise, and women may have to spend up to 20 minutes to fetch one jar of water during peak-time (early morning and late afternoon). In addition, once in a while the pumps of the boreholes break, forcing women to engage in trips to Fotoro, Jankaya, and Garin Galadima.

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[114] G. White, D. Bradley and A. White, *Drawers of Water*, 94.
[115] UNDP, *Human Development Report 2006: Beyond Scarcity*, 23.
[116] G. White, D. Bradley and A. White, *Drawers of Water*, 4.
[117] Around 150 CFAs (~0.22 EUR) is charged monthly per each woman who fetches water. This is also the amount charged in Gouliske. If fetched by men with a cart, the fee is of 500 CFA (~0.75 EUR).

In Garin Tsangaya, women can only use their borehole for approximately a three-months period, after which they are forced to spend a significant part of their days (from 1 hour and 35 minutes[118] to 4 hours and 45 minutes[119]) searching for water elsewhere.

One would expect that this difference in access would be reflected in differences in quantities used. The data in table five matches to a certain extent these expectations:

Table 5- Water Consumption.[120] The table show the amount of liters consumed per person and per animal (goat) in each village. It points to a larger consumption in Gouliske than in Garin Tsangaya.

	Liters/person/daily	Liters/Goat/daily
Gouliske	~15 Standard deviation of 4.37	~9 Standard deviation of 3.94
Garin Tsangaya	~10 Standard deviation of 2.20	~6 Standard deviation of 1.03

The data summarized in the table above hides some differences within the villages, as indicated by their standard deviations. Bearing these differences in mind, the above calculated amounts point to a larger per capita water consumption in Gouliske than in Garin Tsangaya. If assumed representative, this difference could be related to the recent deterioration of Garin Tsangaya's water access. Nevertheless, in order to affirm this, historical data on past consumed quantities would have been necessary.

Overall, if anything can be affirmed from the above data is that it is consistent with an official national average of 20-30 liters per person per day,[121] considering that rural households are recognized to have worse water access and lower water consumption when compared to urban households. And when compared to international standards[122] or consumption elsewhere,[123] the apparent difference between these villages is overshadowed by the fact that in both of them, people are living with much less water than the necessary for a healthy and dignified life.[124]

When asked if the amount of water used in the wet and dry seasons differed, women from both villages answered that the amount used to satisfy human requirements remains the same. Nevertheless, additional litters (and thus trips) were needed to water animals in the

[118] If they make 3 trips to Garin Malawano, where one borehole serves six different surrounding villages. Calculation does not take into consideration the time waiting in queues, which was not measured but according to women can surpass the walking time.

[119] If they make 3 trips to Korota. As for other time estimations, waiting time in queues was not added to the equation.

[120] Table constructed from a sample of 10 respondents in each village.

[121] UNDP, *Human Development Report 2006: Beyond Scarcity*, 34.

[122] WHO and UNICEF's Joint Monitoring Programme recommends a minimum of 20 liters per person per day to satisfy metabolic needs (drinking, cooking and personal hygiene). Factoring in bathing and laundry raises the minimum to 50 liters. See WHO and UNICEF, *Global Water Supply and Sanitation Assessment 2000 Report*, 77; UNDP, *Human Development Report 2006: Beyond Scarcity*, 34.

[123] For an account on the average consumption of developed and developing countries, see UNDP, *Human Development Report 2006: Beyond Scarcity*, 34.

[124] As stated by the UNDP, "Below this level [of 20 liters per person per day] people are constrained in their ability to maintain their physical wellbeing and the dignity that comes with being clean." *Human Development Report 2006: Beyond Scarcity*, 34.

dry season, as these cannot drink from ponds or from the river then. Their answers contradict the idea that water use in the dry season tends to fall, as affirmed by research elsewhere and exemplified in the following statements: "Dry season use falls sharply as the distance to water sources increases. In arid areas of western India, the Sahel and East Africa dry season water availability can fall well below five liters a day";[125] and "households adapt to the scarcity in the dry season by reducing the quantity of water they use for activities that pertain to cleanliness and hygiene."[126]

If anything, the dry season seems to raise the quantity of water needed at the household level, demanding an additional amount to suffice to both humans and animals.

In sum, the data presented indicate that currently women from Gouliske have an easier access to water and spend less time in this chore than women from Garin Tsangaya. In addition, there seems to be a higher water consumption in Gouliske than in Garin Tsangaya, a difference that should not overshadow the fact that both villages are below the minimum international water standards.

5.2.5. Impact of Water Access on Women's Household Productive Activities

Women in rural Niger occupy a restricted space in society. Their presence in common spheres of deliberation is normally forbidden, and they are not allowed in most village meetings such as some of the ones promoted by the village-level organizations already mentioned. One could thus have the impression that women play a limited role in the studied society, which would certainly be a precipitated conclusion.

In both villages, society is in fact male dominated, and women's choices are constrained by and subordinated to men's authority. Women's centrality is nevertheless revealed as their daily relentless efforts are fundamental to the more or less successful sustaining of their households.

The prevailing social, cultural and religious norms influencing the household division of labor, determine that "looking after children, caring for the sick and elderly, preparing food and collecting water and firewood are tasks dominated by women."[127] In addition to executing these domestic activities, it is apparent that in both villages women have found "niches"[128] of productive activities in which they engage from their households in attempt to generate an extra income.

It is interesting to notice that, as allowed by Islamic rules, espousing up to four women is a common local strategy to increase a man's status and means. The more wives a man has, not only the more prestige[129] but also the better livelihood chances he will be offered

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[125] UNDP, *Human Development Report 2006: Beyond Scarcity*, 34.

[126] A. Nyong and P. Kanaroglou, "A Survey of Household Domestic Water-Use Patterns in Rural Semi-Arid Nigeria," 399.

[127] UNDP, *Human Development Report 2006: Beyond Scarcity*, 87.

[128] According to Frank Ellis, "women discover 'niches' in the market economy that enable them to engage in activities that men do not find so threatening as to take them over or to foreclose them." *Rural Livelihoods and Diversity in Developing Countries*, 159.

[129] As acknowledged by C. Raynaut, "marriage constitutes a central social institution. For the man, polygamy is a social ambition demonstrating force, virility, wealth and political alliances." *Structures Normatives et*

through the hands of the new members or the family: working women and their future children. One can thus say that due to women's (and children's) relentless work, espousing many wives constitute a popular livelihood strategy embraced by men in the studied villages.

All year long, women in Gouliske and Garin Tsangaya spend most of their time engaged in domestic chores. In addition to these, during the wet period, women may also devote up to three hours per day to agricultural activities. Between one errand and another, almost all women engage in household productive activities. Their engagement reflects many variables out of which the availability of time seems to be fundamental.[130]

The figure below attempts to roughly portray the evolution of time expenditure in the execution of women's three main time-consuming chores during the dry period in each of the villages.

Table 6- The Time Expenditure of Women's Main Chores in Gouliske. The table shows the amount of time spent in each of women's main chores in Gouliske. The Y axis represents hours and the X axis represents the decades. It shows a trend of less time spent in the drawing of water and in the pilling of grains; and a trend of more time spent in fetching wood.

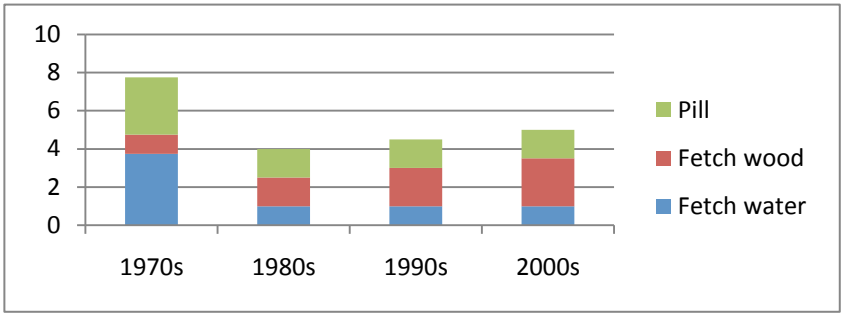
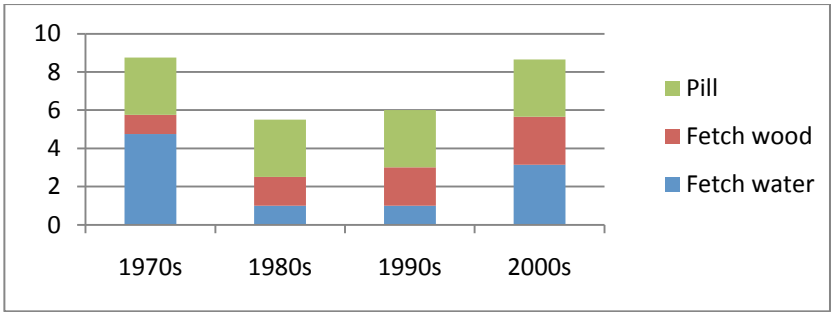


Table 7- The Time Expenditure of Women's Main Chores in Garin Tsangaya. The table shows that time spent fetching water in Garin Tsangaya has returned to being an intense time-consuming activity; that time spent fetching wood has been rising; and no specific trend concerning time spent in the pilling of grains.



The category fetching water reflects calculations of time in accordance to distance and walking speed as already explained; the categories pilling and fetching wood are based on

Relations Électives: Étude d'une Communauté Villageoise Haoussa cited in C. Lund, *Law, Power and Politics in Niger*, 60.

[130] See photos of women's activities in annex 6.

participatory observations in which current time expenditure was measured, as well as on women's answers during focus groups. The diagrams show important facts and perception of trends that have a considerable impact on women's routines: the lack of a grinding mill in Garin Tsangaya, and the advent of a grinding mill in Gouliske in the 1980s; the advent of boreholes in both villages in the 1980s, and the drying of the borehole in Garin Tsangaya during the dry period in the current decade; and women's perceptions that fetching wood has increasingly become a more time-consuming activity, as they perceive tree cover to have decreased in the last decades in the surroundings of their villages.

In accordance to the findings depicted by the above diagrams, women in Gouliske has considerably more time available today than in the past, while the same cannot be said about women from Garin Tsangaya. Accordingly, and in agreement with the above time trends, during a focus group conversation with elder women in Gouliske, a woman expressed the following feeling:

> "Women today complain. They think their life is hard but they don't know what suffering means. When we were young there was no borehole and no grinding mill in our village. We had no time. Life then was hard."[131]

Focus groups under this same theme revealed quite different perceptions in Garin Tsangaya. There, elder women corroborated younger women's laments and complaints of lack of time. They explained that their lives had improved with the borehole, only to worsen again since it dried. They narrated their constant and daily battle for food, which now has been exacerbated in the dry season with the extra quest for water. In a focus group with younger women, one of them clearly explained their position:

> "Since the borehole stopped working properly, the search for water in the dry season compromises even our search for food."[132]

The relation implied on her sentence is an indirect one, which has also been noticed elsewhere: "Excessive time demands for essential labour lead to exhaustion, reduce the time available (…) and limit choice – they reduce the substantive freedoms that women enjoy".[133] Thus the search for water elsewhere constrains time and compromises diverse activities, among which are the productive ones. This indirect relation is better visualized in the dry period, when women tend to intensify their productive activities. With most men away for migration, and no compromises regarding agricultural chores, [134] the dry period is in principle one in which women have the most time, and one in which unsatisfied needs are mounting until the next crop.

The impact of water access on women's rural enterprises in Garin Tsangaya was first revealed during informal conversations, then on focus groups, and ultimately captured

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[131] In the translator's words: "Les femmes d'aujourd'hui se plaindre. Ils pensent que leur vie est dure, mais ils ne savent pas ce qu'est la souffrance. Quand nous étions jeunes il n'y a pas de forage et aucun moulin dans notre village. Nous n'avions pas de temps. Alors la vie était difficile." (Gouliske, 22 Oct. 2009).

[132] In the translators words: "Depuis que la pompe à arrête de marche pendant la saison sèche, chercher de l'eau nous empêche meme chercher de la nourriture." (Garin Tsangaya, 5 Oct. 2009).

[133] UNDP, *Human Development Report 2006: Beyond Scarcity*, 87.

[134] See annex 3 for women's agricultural activities.

through an attempt to quantify trends in women's incomes. During focus groups in Garin Tsangaya, women emphatically repeated that since the failure of their borehole their capacity to undertake productive activities has been severely compromised. Lack of time was pointed as their main obstacle. In Gouliske, in similar focus groups, women pointed to lack of capital and a growing competition within the village as the main obstacles for the increment of their household productive activities.

In attempt to quantify potential changes in women's income from productive activities, ten women (from 25 to 40 years old) were interviewed in each village. The focus of these interviews was to find out which productive activities were being executed, and whether they had undergone any substantial change in the last years. The main questions were thus which income-generating activities had each woman carried out in the past and which ones were they carrying out in the present; and what was their maximum week income derived from each of these activities.

Activities were listed and values attributed for the past and present. In Garin Tsangaya, the point in the past was approximately five years ago which was referred to "the last year the borehole worked properly" or "the year before the last famine (2005)". In Gouliske, only the latter reference was a point of comparison. From these twenty interviews, the tables below were constructed:

Table 8- Women's Productive Activities.[135] The table shows the activities executed by women in 2009. It shows that more activities are carried out in Gouliske than in Garin Tsangaya.

CATEGORY	*Sub-category*	Gouliske	Garin Tsangaya
SELLING ANIMALS	Sheep	X	X
	Goat	X	X
	Chicken	X	X
ARTISANAL WORK /SKILLS	Pottery	X	
	Straw products	X	X
	Braiding hair	X	X
SALE (OF FIELD PRODUCTS AND NATURAL RESOURCES)	Beans	X	
	Okra	X	
	Cassia Tora leaves (*Tafasa*)	X	
	Ceratotheca Sesamoides leaves (*Yodo*)	X	
	Adonia (Baobab)	X	
	Wood	X	
	Sorghum		X
RE-SALE	Manioc wheat	X	X
	Rice	X	X
	Salt	X	X
	Pepper	X	X
	Cola Nuts	X	
	Sugar	X	
	Maggi bouillon	X	
	Matches	X	

[135] From a sample of 20 respondents (10 in each village).

	Soap	X	
	Potassium	X	
ENHANCEMENT (OF FIELD AND NON-FIELD PRODUCTS)	Sweet potatoes	X	
	Tomatoes	X	
	Millet cakes	X	X
	Beans	X	X
	Wheat cakes		X
	Groundnut cakes and oil	X	X
	Spaghetti	X	X
	SUM	*28*	*15*

Table 9- Evolution of Number of Activities and their Potential Maximum Monthly Income.[136] The table shows the average number of activities been executed in Gouliske and Garin Tsangaya in 2004, and in 2009; as well as their potential maximum monthly income. Its data shows that the income that could be derived from women's productive activities has halved in Garin Tsangaya, while it has not changed considerably in Gouliske.

	2004		2009		
	# activities	Potential maximum monthly income (CFA)	# activities	Potential maximum monthly income (CFA)	Change in potential Income
GARIN TSANGAYA (Average)	4.3	~10500	3.4	~5500	~ -50%
	SD=1.63	SD=2800	SD=2.17	SD=3200	SD=27%
GOULISKE (Average)	6.3	~18000	6.7	~20000	~ +4.5%
	SD=2.79	SD=7300	SD=2.62	SD=8000	SD=6.3%

The data summarized in the above tables points to differences between the villages and within the villages over time. Altogether, the data show that there are (and have been) more female household productive activities executed in Gouliske than in Garin Tsangaya. In addition, a substantial difference between potential incomes is also noticeable. These inter-village differences in both number of activities and potential incomes may have multiple explanatory factors that were not investigated here. Some of these factors may be referent to the villages' size, differentiated market accesses, and different levels of wealth.

Despite these inter-village differences, the central information presented in the above tables, is that for the examined period, despite the fact that no major changes occurred in the number of activities in both villages, the potential income that could be derived from them has fallen dramatically in Garin Tsangaya, while it has remained constant, or even increased slightly in Gouliske.

The values showing these trends are referred to as "potential maximum monthly income". They indicate more a potential income of each woman if they were to carry all productive activities simultaneously, than their actual monthly income. This difference (potential vs. real) derives from the fact that women undertake their productive activities in a dynamic mode of varying intensities reflecting their adaptation to several constraints faced in a yearly-base. Some of these constrains are: lack of financial capital for new investments, of

[136] From a sample of 20 respondents (10 in each village). SD stands for standard deviation. For more details, see annex 4.

natural and field resources (as raw materials for activities), of costumers in their villages (once many men spend more than half of the year away in migration), health impediments, and finally time-constraints. All of these factors, and probably others, limit and shape women's rationale on how much, and which productive activities they undertake. This inconstant scenario and conditions are an intrinsic part of the dynamism that characterizes livelihoods, as described in the following sentence: "The construction of a livelihood (…) has to be seen as an ongoing process, in which it cannot be assumed that the elements remain the same from one season (…) to the next."[137]

The above dynamism made estimating an income ceiling more feasible than calculating actual values. Accordingly, when asking a women how much she profited when she sold for instance bean cakes, the most common answer was "it depends on the day and on the period of the year". Subsequently, my following question clarified "so, when you make the most, how much is your profit?"

Bearing in mind that the values above are probably somewhat artificial, one can still see their consistent trend that ultimately points to the decrease in approximately 50% in the potential maximum income in Garin Tsangaya, and a minor increase in Gouliske.

With regards to Gouliske, the fact that women's incomes and activities haven't varied significantly is probably related to the fact that women have a more or less fixed portfolio of activities whose necessary skills are taught to them by their mothers and/or other women in the family. The only extraordinary common event that women in this village have experienced in the referred period was a severe national famine in 2005, from which women's economies seem to have recovered well.

With regards to Garin Tsangaya, the data does not indicate a significant variance in number or type of activities. Nevertheless, the calculated potential maximum income has fallen dramatically for all ten interviewed women. This trend is probably related to the 2005 famine and to an additional local famine that the villagers from Garin Tsangaya seem to have undergone in 2008, from which women's economy hadn't managed to totally recover, but also and probably more importantly in accordance to women's opinions, to the lack of time implied by the malfunctioning of the village's borehole during the entire dry season in the previous five years.

As it is widely acknowledged, famines tend to make afflicted communities more vulnerable than before, "because they [communities] have used up or lost most or all of their tangible assets, and have so little opportunity to build them up again. In consequence, it now requires a less severe crisis to bring them to dependence on outside support."[138] Furthermore, during a famine, "livestock perish and crops fail, poor households lose income and nutrition worsens." [139] All these depletions imply that restoring household assets can be a long process without guarantees. As indicated by the above data, women in Gouliske seem to have rebuilt their assets and even expanded them after the last famine,

[137] F. Ellis, *Rural Livelihoods and Diversity in Developing Countries*, 10.
[138] R. Chambers, "Vulnerability, Coping and Policy," 36.
[139] UNDP, *Human Development Report 2006: Beyond Scarcity*, 156.

while women in Garin Tsangaya seem have been facing additional constraints that impede them from restoring their capital base.[140]

In the study area, although the income from women's household productive activities is seen as belonging to women themselves, during crisis or difficulties it becomes supplementary or even crucial to the sustenance of all household members. Accordingly, in focus group discussions women from both villages explained that in principle the income derived from their enterprises is used solely in function of them and their children. They may spend it on personal items such as clothes, body ornaments, and food; on gifts to ceremonies (nurturing their social relations);[141] on loans to other women; and whenever enough on buying small ruminants such as goat and sheep. In practice however the financial capital accumulated by women, in the form of small ruminants or cash is used with the common intent of assuring the survival of their household during difficult times. These findings are in agreement with other researches pointing to the importance of the income derived from women's productive activities as it can be drawn upon to endure crises such as drought and illness.[142]

Figure 14- Photo: Women Selling Products in Gouliske

[140] A situation described in previous research as "poverty trap". For better understanding this phenomenon, see T. Lybbert and others, "Stochastic Wealth Dynamics and Risk Management among a Poor Population," *Economic Journal* 114, no. 498 (2004); see also E. Enfors and L. Gordon, "Dealing with Drought: The Challenge of Using Water System Technologies to Break Dryland Poverty Traps," Global Environmental Change 18, no. 4 (2008): 608.

[141] As noticed by J. Swift, in rural communities in the developing world there are various kinds of redistributive taxes created to ensure the survival of the poor in times of crisis such as "collective work parties, shared meals, community granaries, rainmaking ceremonies or collective prayers in times of food shortage which include the redistribution of food or money from richer to poorer." "Why are Rural People Vulnerable to Famine?" 45. Women's revenues contribute thus to nurturing part of the local social network, adding to their own social capital.

[142] A. James, "Linking Water Supply and Rural Enterprise," in *Beyond Domestic*, 199.

6. Discussion

6.1. Different Water Accesses but Similar Consumption and Practices

The data referent to water in both Garin Tsangaya and Gouliske corroborate the emerging argument that the emphasized health impacts derived from improved water access is only one aspect of a multifaceted relation. In fact, although important, this aspect does not denote a straight forward and direct relation in which an improved water access automatically leads to much higher amounts of water consumed and hygiene levels. As the data presented indicate, despite the fact that Gouliske has two functioning boreholes within the village with water of seemingly good quality, the average daily water consumption there is not significantly higher than in Garin Tsangaya.

Accordingly, the similar and extremely low water quantities consumed at these villages imply the prevalence of poor health as a consequence of limited water resources, and poor sanitation and hygiene standards. This assertion, although not based on quantitative measurements, is supported by the numerous funerals (most often of children) that permeate the daily life at these villages, adding to the international estimations of water-related child mortality.[143]

The small amount of water brought to the households means thus that it must be used with parsimony, and reutilized whenever possible, as illustrated in the photo below:

Figure 15- Photo: Woman Engaging in Household Chores in Garin Tsangaya. Women re-using the water that served to wash the millet grains to wash the dishes. Consecutively, the same water is given to the animals.

[143] In accordance to recent data, "every year some 1.8 million children die as a result of diarrhoea and other diseases caused by unclean water and poor sanitation." UNDP, *Human Development Report 2006: Beyond Scarcity*, 6.

The fact that a better water supply in Gouliske is not translated into amounts per capita that surpass the recommended to basic metabolic needs,[144] deserves thus some considerations. First, it is important to notice that in accordance to Niger's water guidelines, a village with Gouliske's population should entitled to four functioning modern water points (1 for every 250 persons). Thus, despite the improvement that two boreholes imply, these may be already beyond their capacity to serve the village's demand, as increasing queue times indicate. Second, it seems like women's rationale is not exactly to have much more water available for consumption. They have adapted their household water practices to very little water amounts, which means that even if they can fetch an extra jar they may choose not to.

6.2. Impact of Water Access on Household Productive Activities

6.2.1. Direct Impacts

In accordance to the multiple-use water services approach, the data presented in the previous pages point to additional aspects of the above mentioned multifaceted relation between water, lives, and livelihoods. One aspect is the nature of water, not only as a consumption item that fulfills survival needs, but also as an asset or resource on which certain productive activities are directly dependent.

As personal interviews showed, in Gouliske pottery making is a widespread artisanal activity that requires considerable amounts of water. In Garin Tsangaya, this activity is not undertaken, and instead women engage in the making of straw (*kaba*) products that does not require water directly. In both villages, although most common in Gouliske, keeping small ruminants is an activity aspired by women, that requires large amounts of water on a daily basis. Additionally, the enhancement of food for selling purposes is a popular productive activity that requires small amounts of water, being undertaken evenly in both villages.

The above examples indicate that water can constitute a resource whose abundance or restriction can encourage or inhibit some productive activities that are directly dependent on it.

6.2.2. Indirect Impacts

In addition, the collected data reveals another aspect related to the potential impact of different household water supplies. This aspect denotes the "opportunity cost of activities that individuals could be doing if they were not collecting water."[145] And points thus to an indirect relationship through which water can compromise from leisure activities, to productive ones (water based and non-water based).

Findings from previous researches support the importance of this relationship. Accordingly, studies on diverse developing areas have shown how improved household water supply, by

[144] See note 122.

[145] J. Thompson ed., *Drawers of Water II: 30 Years of Change in Domestic Water Use and Environmental Health in East Africa* (London: International Institute for Environment and Development, 2001), 66, http://www.iied.org/pubs/pdfs/9049IIED.pdf

freeing time, has enabled women to spend more time on leisure and housework;[146] with personal and common activities such as attending meetings, carrying out group work, and even sleeping;[147] and how it was translated into "better child care (…), reductions in stress levels, increased status and self-esteem, better family and community relations, and increased ability to observe religious rites and customs."[148]

Additionally, some studies have identified a series of water-based and non-water based productive activities that are impacted by household water supply, such as brick making, hair dressing, livestock (cattle and goats) and ice block making, grassmat weaving, smearing and plastering of walls and floors, medication and religious uses, baking, poultry, duck ponds, dairy, piggery, poultry, gold panning, pottery, and handicrafts.[149]

The reduction in women's capacity to undertake their productive activities in Garin Tsangaya illustrate the backside of this indirect relationship. Accordingly, while women's time was freed significantly in the 1980s (up to four hours in both villages), in Garin Tsangaya water access has gone back to being an extremely time-intensive chore in the last half-decade. This regress has implied the dramatic decrease of women's engagement in all their productive activities in Garin Tsangaya. There, the data shows that their derived income has fallen in average 50% in this period, as revealed by in-depth interviews.

Ultimately, previous studies and the findings of this thesis support the assertion that the time and labor saved from water collection can and do improve women's economic status.[150] And that, alternatively, lack of improved water supply "reinforces time-poverty, disempowers women and lowers income."[151]

6.3. Impacts on the Social Sustainability of Rural Livelihoods

For women, having independent sources of income is important as it adds to their limited options and freedom in a society where the space reserved to them is quite limited. The gender inequality that constitutes the structures of Gouliske's and Garin Tsangaya's society is not unique. It exists with high level of similarities in many other places, where "women have unequal ownership or access rights to land, their access to productive resources occur through the mediation of men, their decision-making capabilities concerning resource use and output choices are often severely restricted."[152] In such a scenario, engaging in small

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[146] S. Cairncross and J. Cliff, "Water Use and Health in Mueda Mozambique," cited in H. Aiga and T. Umenai, "Impact of Improvement of Water Supply on Household Economy in a Squatter Area of Manila," *Social Science & Medicine* 55, no. 4 (2002), 628.

[147] A. James, "Linking Water Supply and Rural Enterprise," in *Beyond Domestic*, 210.

[148] WaterAid, *Looking Back*, 2.

[149] A. James, "Linking Water Supply and Rural Enterprise," in *Beyond Domestic*, 200; J. Castresana, "Productive Uses of Water at the Household Level," in *Beyond Domestic*, 58; L. Katsi and others, "Assessment of Factors which Affect Multiple Uses of Water Sources at Household Level in Rural Zimbabwe: A case Study of Marondera, Murehwa and Uzumba Maramba Pfungwe Districts," *Physics and Chemistry of the Earth* 32, no. 15-18 (2007): 1160.

[150] WaterAid, *Looking Back*, 25.

[151] UNDP, *Human Development Report 2006: Beyond Scarcity*, 47.

[152] F. Ellis, *Rural Livelihoods and Diversity in Developing Countries*, 158.

enterprise activities from their household is one of the few ways women can accumulate financial capital, and construct a more solid capital base.

Through a sustainable livelihood lens, women's engagement in enterprises can be understood as pertaining to the diversification of rural households, under a risk management rationale. In other words, women's productive activities broaden the portfolio of the household, and add options not only to themselves in "normal" times, but to the entire household in more difficult periods.

In Gouliske and Garin Tsangaya, one certainty that equates households is that sooner or later, all will be administrating more or less critical needs.

The above assertion is based on a wealth ranking exercise that indicated that, despite villagers identifying themselves mainly as farmers, only a minority can be sustained by crops all year long.[153] The additional period, soudure, can become fatal for those without complementary sources of income. In some years, the soudure is prolonged. This phenomenon happens when crops fail due to insufficient rain and/or the invasion of insects. If villagers are not able to purchase grains during these long and critical phases, household members may starve, and in a national scale the situation may be called a famine.

Households that are better off, holding a diversified portfolio of activities and consequently detaining a more solid capital base from which alternatives can be drawn, can thus better cope with the soudure and with crop failure. They may be able to transit with some room and choose between wider assortments of coping activities. These may imply some or a combination of the following: adjusting the intensity and type of productive activities; applying their skills and social networks to obtain a job in a city such as Zinder, Niamey or even across the Nigerien border; using their social networks to obtain loans or gifts from better off family members; drawing straight from the surrounding natural capital, and eating herbs and leaves; and ultimately using up, selling, exchanging or depleting all types of savings. This latter option is avoided as much as possible by households, once it compromises the capital base that secured their long term survival.[154] Households may engage on it as a last resort when their immediate survival is fatally threatened.

6.4. Potential Impacts on the Environmental Sustainability of Rural Livelihoods

Although not central to this study, it is interesting to notice that the water-dependent household productive activities carried out by women at their households (the main wood collectors) may yield benefits also to their surrounding environment. Having in mind that wood collection is an exhausting and time-intensive activity, once other income-generating activities (with the potential to generate similar or even higher returns than wood selling) are available, it is more than likely that women will prefer these latter. This potential

[153] In accordance to data derived from the wealth ranking exercise (see note 93), in Gouliske, 40% of the families can feed themselves from their own agriculture from 2 to 6 months; approximately 45% can feed themselves from 7 to 9 months; and 15% from 10 to 12 months. In Garin Tsangaya, approximately 90% of the families can feed themselves from 1 to 6 months; and only 10% can feed themselves from 7 to 9 months.

[154] An important step in the poverty trap cycle. See T. Lybbert and others, "Stochastic Wealth Dynamics and Risk Management among a Poor Population"; see also E. Enfors and L. Gordon, "Dealing with Drought".

relation is described in the literature of diversification as following: "diversification can potentially yield environmental benefits. (…) by providing options that make time spend in exploiting natural resources, for example gathering activities in forests, less remunerative than time spend doing other things"[155]

Although the data collected at the villages do not directly confirm this potential benefit, it allows strong inferences. As a matter of exemplification, no women in Garin Tsangaya said to sell wood, even when confronted directly on this matter.[156] One women, nevertheless, with whom I spent a day, after being asked whether she would sell wood if she didn't have other sources of income, answered as following:

> "You know, when you are hungry and your children are hungry, you must do what it takes to eat and feed them."[157]

6.5. The Sustainability of Water Access: Its Progress and Remaining Obstacles

Better water access, in the studied area, means an improved supply from functioning boreholes within the village. The importance of these, as a communal asset pertaining to the physical capital category, can thus hardly be overemphasized. Their operation and maintenance was in focus when in the 1980s Danish Project implemented a communal water management scheme. The data gathered point to some interesting developments of this scheme.

As the experience in Gouliske shows, this scheme has the potential to work over generations, ensuring that water is less of a constraint in the village. There, common breakdowns have successfully been handled by the water committee and a trained mechanic. This scheme that ensures the sustainability of Gouliske's water access is illustrated in the diagram below.

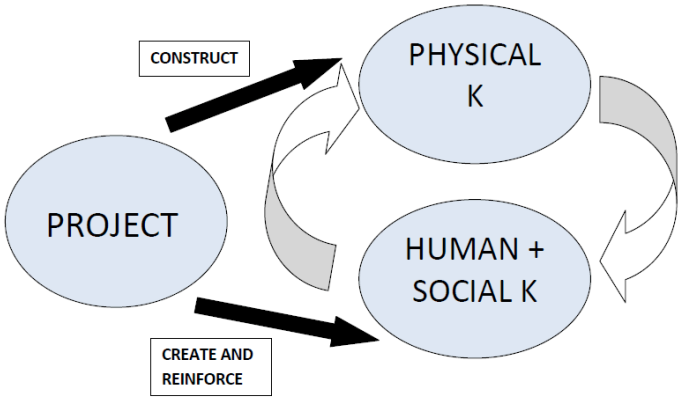


Figure 16- The Sustainability of the Village's Water Schemes. The figure shows how investments in physical, and social and human capitals feed into each other, in attempt to ensure the sustainability of improved water schemes.

[155] F. Ellis, *Rural Livelihoods and Diversity in Developing Countries*, 236.
[156] To sell wood without a permit is an illegal activity in the country.
[157] In the translator's words: "Vous savez, quand on a faim et ses enfants ont faim, il faut faire ce qu'il faut pour les nourrir." (Garin Tsangaya, 26 Oct. 2009).

As portrayed by the diagram, investments in physical, and in social and human capitals, at the local level feed into each other, contributing to the operation and maintenance of the water infrastructure. Two of the three boreholes in Gouliske reinforce the potential of this scheme, while the remaining one and the single borehole of Garin Tsangaya tell another part of the story. According to the latter cases, although inter-dependent, the local physical, human and social capitals are not self-sufficient, and the sustainability of the scheme above is compromised whenever a borehole faces a problem that is outside the competence of a local mechanic.

It can be inferred thus that local participation by the villagers (organized through committees or directly through the village chief) and skilled mechanics can in fact contribute to a certain level of longevity of improved water supply, but cannot guarantee its sustainability. The factors compromising its long term sustainability are related no longer to local participation in the operation and maintenance of the infrastructure. Instead, what seems to check-mate the sustainability of water schemes in the area is the absence of inclusive structures, prepared to respond to the local needs.

When facing a major borehole breakdown, villagers are left to their own fate. There are no efficient mechanisms in place assuring a constant exchange of information on the water situation of the villagers and the regional Hydrology Department. Insufficient communication channels and lack of means to intervene are some of the causes behind the isolation of villages.

In accordance to national procedures,[158] only the villages' chiefs or members of the villages' water committees can address the Hydrology Department to inform it on major breakdowns compromising modern water points. After the information is conveyed, the village enters an unpredictable waiting list that is shared with international projects intervening within water management in the region. These projects then select their sites of intervention according to the following rationale: every village regardless of its population should have one functioning modern water point; and, there should be at least one modern water point for every 250 inhabitants. In accordance to these rules, both Gouliske and Garin Tsangaya were under irregular situations.

The above-described process is far from effective. Villagers (be the chiefs or members of committees) are reluctant to travel to Mirria or Zinder in order to meet an authority. And, even if they would do so, there are no guarantees that their needs will be contemplated in the near-future.

Thus, water management in Gouliske and Garin Tsangaya provides some complementary lessons: although local participation is critical for the operation and maintenance of the water infrastructure, it is not sufficient to ensure its long-term sustainability.

Today's performance of the scheme instituted by the Danish Project in the 1980s point to the fact that ultimately improved water access in the these villages hangs on change: the chance that local resources suffice, and no outside help is needed, because, despite legal provisions, there is a huge abysm separating villages from the resources distributed by or

[158] As revealed through an interview with an official from the Hydrology Department (Zinder, 29 Oct. 2009).

managed by regional authorities. Accordingly, through a livelihood perspective, the villages have no real means to interfere in the broader social arena to which they pertain. In it, hierarchical structures and processes imply that villagers are often left to hope for the next project to coincidentally match their needs.

The situation of these villages is not unique, and the importance of connecting them to the broader social arena has been recognized by other research, as the following sentences imply: "legal and policy provisions, as well as institutional reform, are needed to protect the rights of poor people to access water resources"[159], furthermore, "[beyond the community level] adequate institutional capacities and structures are needed in local and regional administration in order to implement government policies and respond to local needs in a constructive way."[160] Thus, as supported by these sentences and the remaining obstacles to the sustainability of water access in the studied sites, it is apparent that the promotion of local participation through investments in social and human capital at the local level is not a silver-bullet that ensures the operation and maintenance of improved water sources. Beyond the local level, support is needed to inject resources in the correct moments for reparations that exceed the capacity of the local scheme.

6.6. Indirect Impact of Investments in Social and Human Capitals: a Spill-Over Phenomenon

From the data on the villages' organization, and the formation of their various groups, it is noticeable that investments in social and human capital tend to be perpetuated and to extrapolate their primary domain. Accordingly, the several meetings with the different groups at both villages revealed that all of them followed more or less management models previously introduced by development projects.

In Gouliske, the model of the water committee seems to have been replicated by internally initiated groups such as *Haske* and *Hana Dioua*. Both groups function on the basis of raising money (among members or the entire village) to carry on activities under a certain domain, a process administrated by a group composed of a president, sometimes a vice-president, a cashier, and a secretary. In Garin Tsangaya a similar phenomenon can be observed, with the formation of *Fada* after the formation of the village's water committee.

One can't help to notice thus that there seems to be a trend in both villages, by which investments in social and human capital have a spill-over effect to other areas. Accordingly, organizational skills are transferred within the village, giving rise to different organized groups vested with various, although in principal common, interests.

The implications of the above described trend are hard to draw. One may wish to think that a village counting on groups organized in a model recognized by modern authorities would be better off to relate to these authorities, and thus have higher chances in successfully advocating its agenda. This may be the case, although it was not specifically focused by this study whose findings do not allow such affirmation. In addition, the various focus

[159] J. Soussan, *Water and Poverty*, 12.

[160] C. Sullivan, J. Meigh and A. Giacomello, "The Water Poverty Index: Development and Application at the Community Scale", *Natural Resources Forum* 27, no. 3 (2003): 191.

discussions with locally initiated groups could not sufficiently explain and verify whether the villages experience in fact concrete benefits derived from their activities.

6.7. Final Considerations

As portrait by the experiences of women from Gouliske and Garin Tsangaya, although an improved water supply may not necessarily increase the amount consumed by their households to healthy levels, it contributes to create an environment in which people are better off to meet their needs.

As the paragraphs above demonstrate, ensuring sustainable access to improved water sources requires more than simply constructing a borehole in each village. It requires also local human and social capital, as well as inclusive structures, responsive to the local needs.

Furthermore, although not factors investigated here, it is important to notice that if we are to maximize the productive benefits of water at the household level, there are also additional and important areas of intervention for future development projects in the study sites. Parallel investments that reinforce each other are required, such as the provision of credit, and promotion of skills that allows the intensification and expansion of women's activities; the improvement of infrastructure and transportation systems that connects household's to markets; the provision of machines such as grinding mills that also relieves women's working load; and programs promoting reforestation and conservation of trees as these constitute an important resource whose daily collection is a time-intensive chore.

7. Conclusion

This study has described how water has been accessed and managed in two villages located in the semi-arid Sahel. It has explained the dynamics of the water infrastructure, revealed its communal scheme for operation and maintenance, and exposed the aspects in this scheme that promote or hinder its sustainability. Furthermore, it has also pointed to a potential indirect impact of investments primary meant to enable local participation within water management; and showed how inputs in the local social and human capitals may have a spill-over effect to other domains and groups within the villages.

Most importantly, this study has attempted to understand how changes in water access may impact women's livelihoods in the study sites. Through analyzing the recent deterioration of Garin Tsangaya's water supply, this study has shown that an unimproved water supply deprives women both from a valuable resource and from time, jeopardizing their capacity to engage in productive activities.

Accordingly, the existence of functioning and improved water sources within the villages is a pre-requisite to women's capacity to keep a portfolio of productive activities and, despite diverse constraints (social and natural), actively build a capital-base.

The findings of this study indicate that, despite many similarities between these villages, women and their households in Garin Tsangaya are more vulnerable today than when they had improved water supply all year long. Furthermore, overall, the currently different water supplies of Garin Tsangaya and Gouliske contributes to make livelihoods in the former also more vulnerable and less prepared to cope with the recurrent natural adversities that characterize their common environment.

By realizing that differences in water supplies can distance livelihoods even in so similar villages, we can grasp the consequences of dramatically difference water supplies between countries and within them. Moreover, we can see the potential that sustainable water schemes have to diminish inequalities among villages, countries and continents, using local resources, and based on peoples' own initiative.

As the experiences of Gouliske and Garin Tsangaya illustrate, water is not only a vital substance, but also an asset of inestimable value to livelihoods. In such a water-scarce region, the costs and benefits generated or inflicted by this asset should not be underestimated. Working towards better understanding these impacts can thus be a way not only to reveal local trends and realities, but also to build evidence that guides future investments towards better rural water supplies, and less vulnerable households.

Bibliography

ADB Water Awareness Program, *Water and Poverty, The Realities: Experiences from the Field*. Manila: Asian Development Bank, 2004, http://www.adb.org/Documents/Books/Water_for_All_Series/Water_Poverty_Realities/Water_05.pdf

Aiga H. and Umenai T., "Impact of Improvement of Water Supply on Household Economy in a Squatter Area of Manila," *Social Science & Medicine* 55, no. 4 (2002).

Aker J., "Rainfall Shocks, Markets, and Food Crises: Evidence from the Sahel," (Working Paper 157, Center for Global Development, December 2008), http://www.cgdev.org/content/publications/detail/1417887/

Baggnian I., "Rôle des Dynamiques Démographiques et Migratoires sur l'Évolution des Écosystèmes Sahéliens : Cas d'un Terroir Villageois Reverdi et non Reverdi du Département de Mirriah dans la Région de Zinder au Niger." Master's Thesis, Abdou Moumouni University, 2010.

Barretta C., Reardon T. and Webb P., "Nonfarm Income Diversification and Household Livelihood Strategies in Rural Africa: Concepts, Dynamics, and Policy Implications," *Food Policy* 26, no. 4 (2001).

Baumann P., "Improving Access to Natural Resources for the Rural Poor: A critical Analysis of Central Concepts and Emerging Trends from a Sustainable Livelihoods Perspective," (Working Paper 1, Livelihood Support Programme FAO, July 2002), ftp://ftp.fao.org/docrep/fao/006/ad683e/ad683e00.pdf

Berry S., "Social Institutions and Access to Resources," Africa 59, no. 1(1989).

Berry S., *No Condition is Permanent: The Social Dynamics of Agrarian Change in Sub-Saharan Africa*. Madison: University of Wisconsin Press, 1993.

Brieger W., Otusanya S., Adeniyi J., Tijani J., Banjoko M., "Eradicating Guinea Worm without Wells: Unrealized Hopes of the Water Decade," *Health Policy and Planning* 12, no. 4 (1997).

Bryceson D., "African Rural Labour, Income Diversification and Livelihood Approaches: A Long-term Development Perspective," *Review of African Political Economy* 26, no. 80 (1999).

Cairncross, S. and Cliff, J., "Water Use and Health in Mueda, Mozambique," *Transactions of the Royal Society of Tropical Medicine and Hygiene* 81, no. 1 (1987).

Cairncross S. and Valdmanis V., "Water Supply, Sanitation, and Hygiene Promotion," in *Disease Control Priorities in Developing Countries*, 771-792.

Cairncross S. and Valdmanis V. eds., *Disease Control Priorities in Developing Countries*. New York: Oxford University Press, 2006.

Campbell B., Jeffrey S., Kozanayi W., Luckert M., Mutamba M. and Zindi C., *Household Livelihoods in Semi-Arid Regions: Options and Constraints*. Jakarta: Center for International Forestry Research, 2002, http://www.cifor.cgiar.org/publications/pdf_files/Books/Household.pdf

Carney D., Drinkwater M., Rusinow T., Neefjes K., Wanmali S. and Singhand N., "Livelihoods Approaches Compared: A Brief Comparison of the Livelihoods Approaches of the UK Department for International Development (DFID), CARE, Oxfam and the United Nations Development Programme (UNDP)," (DFID, November 1999), http://www.eldis.org/vfile/upload/1/document/0812/lacv3.pdf

Castresana J., "Productive Uses of Water at the Household Level: Evidence from Bushbuckridge, South Africa," in Moriarty P., Butterworth J. and Koppen B. van eds., *Beyond Domestic*, 49-74.

Chambers R., *Rural Development: Putting the Last First*. New York: Longman / John Wiley & Sons, 1983.

Chambers R. and Conway G., "Sustainable Rural Livelihoods: Practical Concepts for the 21st Century," (IDS Discussion Paper 296, January 1992), http://www.ids.ac.uk/go/idspublication/sustainable-rural-livelihoods-practical-concepts-for-the-21st-century

Chambers R., "Vulnerability, Coping and Policy," (IDS Bulletin 37, Institute for Development Studies, September 2006), http://community.eldis.org/?233@@.598d23f8!enclosure=.598d23f9

Coleman J., "Social Capital in the Creation of Human Capital," in Serageldin I. and Dasgupta P. eds., *Social Capital: A Multifaceted Perspective*, 13-39.

Crombé X. and Jézéquel J. eds., *A Not so Natural Disaster. Niger 2005*. London: Hurst / Médecins Sans Frontières, 2009.

Development (DFID), CARE, Oxfam and the United Nations Development Programme (UNDP)," (November 1999, DFID), http://www.eldis.org/vfile/upload/1/document/0812/lacv3.pdf

DFID, "Sustainable Rural Livelihoods Guidance Sheets: Framework Introduction," (Department For International Development, April 1999), http://www.nssd.net/pdf/sectiont.pdf

Enfors E. and Gordon L., "Dealing with Drought: The Challenge of Using Water System Technologies to Break Dryland Poverty Traps," *Global Environmental Change* 18, no. 4, (2008).

Ellis F., "Household Strategies and Rural Livelihood Diversification," *The Journal of Development Studies* 35, no. 1 (1998).

Ellis F., *Rural Livelihoods and Diversity in Developing Countries*. Oxford: Oxford University Press, 2000.

Eyles J. and Smith D., *Qualitative Methods in Human Geography*. Cambridge: Polity Press, 1988.

Faurès, J. and Santini, G. eds., *Water and the Rural Poor. Interventions for Improving Livelihoods in Sub-Saharan Africa*. Rome: FAO, 2008, http://www.fao.org/docrep/010/i0132e/i0132e00.htm

Francis E., *Making a Living: Changing Livelihoods in Rural Africa*. London: Routledge, 2000.

Gleick P., "Basic Water Requirements for Human Activities: Meeting Basic Needs," *Water International* 21, no. 2 (1996).

Hazell P., Pomareda C. and Valdés A. eds., *Crop Insurance for Agricultural Development: Issues and Experiences*, Baltimore, MD: Johns Hopkins University, 1986, http://www.ifpri.org/sites/default/files/publications/hazell86.pdf

Herrmann S., Anyamba A. and Tucker C., "Recent Trends in Vegetation Dynamics in the African Sahel and their Relationship to Climate," *Global and Environmental Change-Human and Policy Dimensions* 15, no. 4 (2005).

Hermann S. and Hutchinson C., "The Changing Contexts of the Desertification Debate," *Journal of Arid Environments* 63, no. 3 (2005).

Hutchinson C., Herrmann S., Maukonen T. and Weber J., "Introduction: The ''Greening'' of the Sahel," *Journal of Arid Environments* 63, no. 3 (2005).

James A., "Linking Water Supply and Rural Enterprise: Issues and Illustrations from India," in Moriarty P., Butterworth J. and Koppen B. van eds., *Beyond Domestic*, 199-216.

Katsi L., Siwadi J., Guzha E., Makoni F., Smits S., "Assessment of Factors which Affect Multiple Uses of Water Sources at Household Level in Rural Zimbabwe: A Case Study of Marondera, Murehwa and Uzumba Maramba Pfungwe Districts," *Physics and Chemistry of the Earth* 32, no. 15-18 (2007).

Koppen B. van, Moriarty P. and Boelee E., "Multiple-Use Water Services to Advance the Millennium Development Goals," (Research Report 98, International Water Management Institute, 2006), http://www.irc.nl/docsearch/title/152051

Krishna A., "Creating and Harnessing Social Capital," in Serageldin I. and Dasgupta P. eds., *Social Capital: A Multifaceted Perspective*, 71-93.

Lund C., *Law, Power and Politics in Niger: Land Struggles and the Rural Code*. Hamburg: Lit Verlag, 1998.

Lybbert T., Barrett C., Desta S. and Coppock L., "Stochastic Wealth Dynamics and Risk Management among a Poor Population," *Economic Journal* 114, no. 498 (2004).

Makoni F., Manase G. and Ndamba J., "Patterns of Domestic Water Use in Rural Areas of Zimbabwe, Gender Roles and Realities," *Physics and Chemistry of the Earth* 29, no. 15-18 (2004).

Mathew B., "Ensuring Sustained Beneficial Outcomes for Water and Sanitation Programmes in the Developing World," (Occasional Paper Series 40, IRC International Water and Sanitation Centre , 2005), http://www.bvsde.paho.org/bvsacd/cd47/ensuring.pdf

Mikkelsen B., *Methods for Development Work and Research: A Guide for Practitioners*. New Delhi: Sage Publications, 1995.

Millennium Ecosystem Assessment, *Ecosystems and Human Well-Being: Desertification Synthesis*. Washington DC: World Resources Institute, 2005, http://www.millenniumassessment.org/en/Synthesis.aspx

Morgan P., *Rural Water Supplies and Sanitation: A Text from Zimbabwe's Blair Research Laboratory*. London: Macmillan Publishers, 1990.

Moriarty P. and Butterworth J., "The Productive Use of Domestic Water Supplies: How Water Supplies Can Play a Wider Role in Livelihood Improvement and Poverty Reduction," (Thematic Overview Paper, International Water and Sanitation Centre, May 2003), http://www.irc.nl/page/3733

Moriarty P., Butterworth J. and Koppen B. van eds., *Beyond Domestic: Case Studies on Poverty and Productive Uses of Water at the Household Level* (Technical Paper Series 41, IRC International Water and Sanitation Centre, 2004), http://www.irc.nl/page/6129

Moriarty P., Butterworth J., Koppen B. van and Soussan J., "Water, Poverty and Productive Uses of Water at the Household Level," in Moriarty P., Butterworth J. and Koppen B. van eds., *Beyond Domestic*, 20-48.

Mortimore M., *Roots in the African Dust: Sustaining the Sub-Saharan Drylands*. Cambridge: Cambridge University, 1998.

Moser C., "The Asset Vulnerability Framework: Reassessing Urban Poverty Reduction Strategies," *World Development* 26, no. 1 (1998).

Murzabekov M., "Sahelian Re-greening: Merging a View from above with One from below." Master's thesis, Stockholm University, 2010.

Nicholson S., "On the Question of the 'Recovery' of the Rains in the West African Sahel," *Journal of Arid Environments* 63, no. 3 (2005).

Nyong A. and Kanaroglou P., "A Survey of Household Domestic Water-Use Patterns in Rural Semi-Arid Nigeria," *Journal of Arid Environments* 49 no. 2 (2001).

Olsson L., Eklundh L. and Ardö J., "A Recent Greening of the Sahel: Trends, Patterns and Potential Causes," *Journal of Arid Environments* 63, no. 3 (2005).

Oström E., "Social Capital: A Fad or a Fundamental Concept?" in Serageldin I. and Dasgupta P. eds., *Social Capital: A Multifaceted Perspective*, 172-214.

Polak P., Deepak A., Nanes B., Salter D. And Surywanshi S., "Transforming Access to Rural Water into Profitable Business Opportunities," in Moriarty P., Butterworth J. and Koppen B. van eds., *Beyond Domestic*, 153-172.

Putnam R., "The Prosperous Community-Social Capital and Public Life," *The American Prospect* (March 21, 1993), http://www.prospect.org/cs/articles?article=the_prosperous_community

Raynaut C., Structures Normatives et Relations Électives: Étude d'une Communauté Villageoise Haoussa. Paris: Mouton, 1972.

Rogaly, B., "Embedded Markets: Hired Labour Arrangements in West Bengal Agriculture," Oxford Development Studies 25, no. 2 (1997).

Sardan J. and A. Dagobi A., "La Gestion Communautaire Sert-Elle l'Intérêt Public?: Le Cas de l'Hydraulique Villageoise au Niger," *Politique Africaine*, no. 80 (2000), http://www.politique-africaine.com/numeros/pdf/080153.pdf

Scoones I., "Sustainable Rural Livelihoods: A Framework for Analysis," (IDS Working Paper 72, Institute for Development Studies, January 1998), http://www.ids.ac.uk/go/idspublication/sustainable-rural-livelihoods-a-framework-for-analysis

Serageldin I. and Dasgupta P. eds., *Social Capital: A Multifaceted Perspective*. Washington DC: The World Bank, 1999, http://lnweb90.worldbank.org/ext/epic.nsf/ImportDocs/0C353B9EA035C87785257315005 3B6EE?opendocument&query=KE

Serageldin I. and Grootaert C., "Defining Social Capital," in Serageldin I. and Dasgupta P. eds., *Social Capital: A Multifaceted Perspective*, 40-58.

Soussan J., *Water and Poverty: Fighting Poverty through Water Management*. Kyoto: Asian Development Bank, 2004, http://www.adb.org/Documents/Books/Water_for_All_Series/Water_and_poverty/Water_01.pdf

Soussan J., Pollard S., Mendiguren J. and Butterworth J., "Allocating Water for Home-Based Productive Activities in Bushbuckridge, South Africa," in *Water and Poverty, the Realities,* 139-152.

Sullivan C., Meigh J. and Giacomello A., "The Water Poverty Index: Development and Application at the Community Scale", *Natural Resources Forum* 27, no. 3 (2003).

Swift J., "Why are Rural People Vulnerable to Famine?" (IDS Bulletin 37, Institute for Development Studies, September 2006), http://community.eldis.org/?233@@.598d23fe!enclosure=.598d23ff

Sydney R. and Vincent J., "Household Water Resources and Rural Productivity in Sub-Saharan Africa: A Review of the Evidence," (Development Discussion Paper 673, Harvard Institute of International Development, February 1999), http://www.cid.harvard.edu/hiid/673.pdf

Therkildsen O., *Watering White Elephants: Lessons from Donor Funded Planning and Implementation of Rural Water Supplies in Tanzania*. Uppsala: Scandinavian Institute of African Studies, 1988.

Thompson J. ed., *Drawers of Water II: 30 Years of Change in Domestic Water Use and Environmental Health in East Africa*. London: International Institute for Environment and Development, 2001, http://www.iied.org/pubs/pdfs/9049IIED.pdf

UN General Assembly, "United Nations Millennium Declaration," (Resolution adopted by the UN General Assembly, 18 September, 2000), http://www.undemocracy.com/A-RES-55-2.pdf

UNDP, *Human Development Report, Beyond Scarcity: Power, Poverty and the Global Water Crisis*. New York: UNDP, 2006, http://hdr.undp.org/en/media/HDR06-complete.pdf

UNDP, *Human Development Report 2009, Overcoming Barriers: Human Mobility and Development*. New York: UNDP, 2009, http://hdr.undp.org/en/media/HDR_2009_EN_Complete.pdf

UNDP and World Bank, *Making Rural Water Supply Sustainable: Report on the Impact of Project Rules*. Washington DC: UNDP and World Bank, 1998, http://www.wsp.org/UserFiles/file/global_ruralreport.pdf

Upadhyay B., "Gendered livelihoods and multiple water use in North Gujarat," *Agriculture and Human* Values 22, no. 4 (2005).

Walker T. and Jodha N., "How Small Farm Households Adapt to Risk," in *Crop Insurance for Agricultural Development*, 17-34.

WaterAid, *Looking Back: The Long Term Impacts of Water and Sanitation Projects*. London: WaterAid, 2001, http://www.wateraid.org/documents/lookingback.pdf

Webb P., Braun J. von and Yohannes Y., "Famine in Ethiopia: Policy Implications of Coping Failure at National and Household Levels," (Research Report No. 92, International Food Policy Research Institute, 1992), http://ageconsearch.umn.edu/bitstream/37973/2/rr92.pdf

White G., Bradley D. and White A., *Drawers of Water: Domestic Water Use in East Africa*. Chicago: The University of Chicago Press, Chicago, 1972.

WHO and UNICEF, *Global Water Supply and Sanitation Assessment 2000 Report*. New York: WHO and UNICEF, 2000, http://www.who.int/water_sanitation_health/monitoring/jmp2000.pdf

World Bank, *World Development Report 1990: Poverty*. Oxford: Oxford University, 1990, http://www-wds.worldbank.org/external/default/WDSContentServer/IW3P/IB/2000/12/13/000178830_98101903345649/Rendered/PDF/multi_page.pdf

World Bank, *African Development Indicators 2007*. Washington DC: World Bank, 2007, http://siteresources.worldbank.org/INTSTATINAFR/Resources/adi2007_final.pdf

World Water Assessment Programme, *The United Nations World Water Development Report 3: Water in Changing World*. Paris: UNESCO / London: Earthscan, 2009, http://www.unesco.org/water/wwap/wwdr/wwdr3/pdf/WWDR3_Water_in_a_Changing_World.pdf

World Bank, "Niger at a Glance." http://devdata.worldbank.org/AAG/ner_aag.pdf

Annexes

Annex 1- The Bradley Classification of Water-Related Infections:

Transmission route	Description	Disease group	Examples
Waterborne	The pathogen is in water that is ingested	Feco-oral	Diarrheas, dysenteries, typhoid fever
Water-washed (or water-scarce)	Person-to-person transmission because of a lack of water for hygiene	Skin and eye infections	Scabies, trachoma
Water-based	Transmission via an aquatic intermediate host (for example, a snail)	Water-based	Schistosomiasis, guinea worm
Water-related insect vector	Transmission by insects that breed in water or bite near water	Water-related insect vecto	Dengue, malaria, trypanosomiasis

Source: S. Cairncross and R. Feachem, *Environmental Health Engineering in the Tropics* (Chichester, U.K.: John Wiley & Sons, 1993) in S. Cairncross and V. Valdmanis eds., *Disease Control Priorities in Developing Countries*. New York: Oxford University Press, 2006, 775.

Annex 2- Potential Impacts of Better Household Water Supplies

Better health: it has been widely established and accepted that more and better quality water, and improved hygiene, reduces diseases. Healthy people are able to work and live more productive lives.

Time savings: time and effort spent collecting water can be reduced by improved water supplies. Especially for women and children who shoulder the burden of water collection. Given suitable opportunities this saved time can be turned into money by poor people.

Expenditure savings: improved water supplies lead to reduced expenditure on the generally expensive water provided by vendors, and less money is spent on drugs to cure sickness.

Well-being: better water supplies reduce pressure on people, especially women. As well as time saved, there is less stress, anxiety, and improved safety when water supplies are available close to home.

Education: with more time and improved health, children are able to attend and perform better at school. Adult learning can also be facilitated through water projects.

Environmental sanitation: good drainage at water-points can improve the local environment, and reduce the risks of diseases transmitted by water-based vectors like malaria.

Empowerment - ensuring that the powerless are given a voice and increasing their capacity to participate in community decision-making can help empower marginalized women, the poor and other groups.

Community capacity: the ability of local institutions to manage resources and systems can be enhanced through projects that build capacity e.g. through organizational and financial skills, O&M etc.

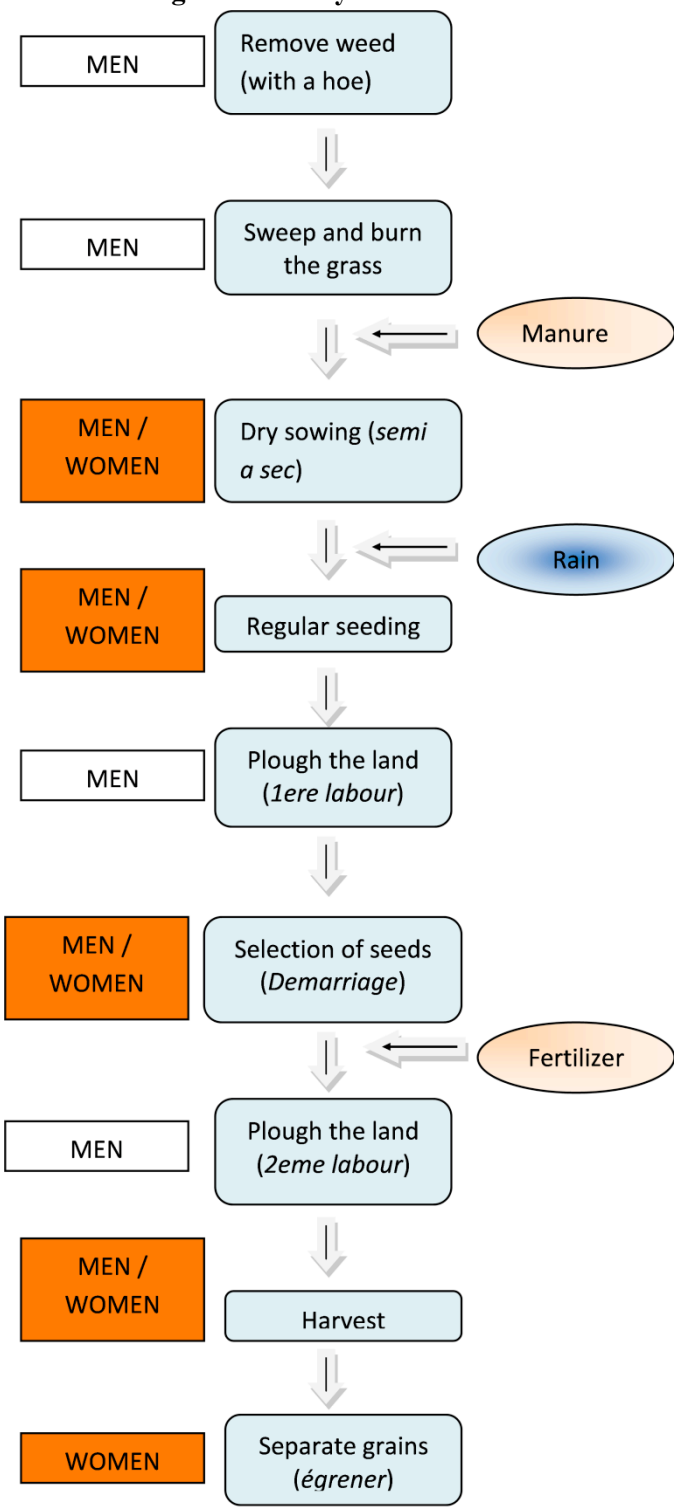
Productivity and income: more opportunities for home-based activities lead to improved employment, productivity and incomes. Non-water-based livelihood activities are possible because of time savings, better health and opportunities to invest expenditure savings. Opportunities for water-based livelihoods activities are increase because people can access improved (more reliable, greater quantity) supplies. Improved incomes lead to improved status: for example, of women when their economic contribution to the household is visibly improved.

Investment: expenditure savings and improved incomes associated with water supplies have a multiplier effect. Money can be invested in other activities leading to greater returns. This leads to improved markets for goods and services.

Food security / nutrition: is enhanced when improved water supplies make backyard irrigation or keeping livestock easier. Home-based production may be small in amounts but is often nutritions e.g. vegetables, milk, eggs, meat.

Source: P. Moriarty P. and J. Butterworth, "The Productive Use of Domestic Water Supplies: How Water Supplies Can Play a Wider Role in Livelihood Improvement and Poverty Reduction," (Thematic Overview Paper, International Water and Sanitation Centre, May 2003), 12, http://www.irc.nl/page/3733

Annex 3- **Women's Roles in the Agricultural Cycle**



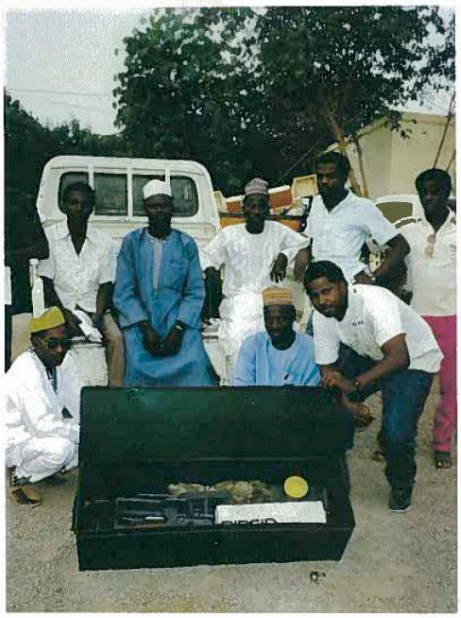
Annex 4- **Women's Activities and their Potential Maximum Monthly Income**

Gouliske						
	2004		2009		Net income change	Percentual income change
	# activities	monthly income	# activities	monthly income		
1	10	25500	10	25500	0	0
2	8	16100	9	17100	1000	6
3	5	20200	6	27200	7000	3.5
4	6	28250	6	28090	-160	-0.5
5	4	22250	5	23250	1000	4.5
6	4	3155	4	3155	0	0
7	8	17200	8	17200	0	0
8	3	10450	4	11650	1200	11.5
9	4	21500	4	25500	4000	18.5
10	11	16050	11	16050	0	0
Mean:		18065.5		19469.5		4.5
Standard deviation	2.8	7300	2.6	8000		6.3%

Garin Tsangaya						
	2004		2009		Net income change	Percentual income change
	# activities	monthly income	# activities	monthly income		
1	4	11333	4	6333	-5000	-44.12
2	3	8350	3	3188	-5162	-61.82
3	5	11150	0	0	-11150	-100.00
4	3	5650	3	2250	-3400	-60.18
5	3	6672	3	5658	-1014	-15.20
6	7	13000	7	11000	-2000	-15.38
7	5	14408	3	3708	-10700	-74.26
8	3	12000	2	8000	-4000	-33.33
9	7	13100	7	6850	-6250	-47.71
10	3	10200	2	7600	-2600	-25.49
Mean		10586		5459		-47.7
Standard deviation	1.6	2800	2.2	3200		27%

	2004		2009		
	# activities	Potential maximum monthly income (CFA)	# activities	Potential maximum monthly income (CFA)	Change in potential Income
GARIN TSANGAYA Average	4.3	~10500	3.4	~5500	~ -50%
	Standard deviation of 1.63	Standard deviation of 2800	Standard deviation of 2.17	Standard deviation of 3200	Standard deviation of 27%
GOULISKE Average	6.3	~18000	6.7	~20000	~ +4.5%
	Standard deviation of 2.79	Standard deviation of 7300	Standard deviation of 2.62	Standard deviation of ~8000	Standard deviation of 6.3%

Annex 5- Photos of the Danish Project



Source: email correspondence with Jens Lillebæk (March 10, 2010).

Annex 6- **Photos of Women's Household Activities**

Boreholes in Gouliske

Young women using the borehole in Garin Tsangaya

Women washing clothes in Garin Tsangaya

Women pilling in Gouliske

Woman fetching wood in Garin Tsangaya

Woman carrying wood in Gouliske

Woman with her spaghetti machine in Gouliske

Woman cooking in Gouliske