Katharina Graf

Drinking Water Supply in the Middle Drâa Valley, South Morocco

Options for Action in the Context of Water Scarcity and Institutional Constraints

KÖLNER ETHNOLOGISCHE BEITRÄGE

Herausgegeben von Michael J. Casimir

Heft 34

2010

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Druck und Bindung: Hundt Druck GmbH, Köln
Tel: +49 (0) 221 940 68-0 · www.hundt-druck.de

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ISSN 1611 - 4531

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Publisher's Preface

In the light of global environmental change, aridity in the South of Morocco is expected to increase while water availability is projected to decrease. Human activities, especially irrigation agriculture, are further impacting on resource degradation. Though the government has attempted to respond to these challenges, the rural South remains poorly developed. Water institutions are created on national and regional level to improve drinking water supply in rural settlements, but seem unable to respond to the most pressing problems. The access to safe drinking water is not guaranteed and water management is ineffective. Katharina Graf, supervised by Professor Dr. Bernd Diekkrüger (Department of Geography, University of Bonn) and Professor Dr. Martin Rössler (Department of Ethnology, University of Cologne), studies the drinking water supply in rural southern Morocco and explores the local options for action against a background of institutional constraints and increasing water scarcity.

In 1995 a new water policy was adopted to improve the access to safe drinking water in rural Morocco. Since then, household water management has been based on two water facilities: a conventional draw well and a domestic tap connection. Assuming a scenario of increased water usage, Katharina Graf compares two villages located in the arid Middle Drâa Valley to assess to what extent rural water withdrawal and management are influenced by the above mentioned global, national and regional trends. She looks at these factors and their inter-linkages through an actor-oriented approach to investigate the options local actors have in managing the scarce resource. Drawing on both New Institutionalism and the Natural Resource Management approach, she analyses rural patterns of drinking water management. The analysis suggests that water management is dysfunctional due to the prefabrication of water institutions outside of the village context, while the rising withdrawal is determined by a local adaptation to it. The latter process draws on existing informal institutions which fill the gaps left by formal ones, and together these institutions constitute a flexible but fragile water management solution. The options for local action subject to these constraints appear reduced and leave doubts on the ability of rural households to flexibly manage an ever scarcer water availability.

Michael J. Casimir

Acknowledgements

This study originated within the IMPETUS-project West Africa and was financially supported by the Federal Ministry of Education and Research (BMBF), sponsorship number 01 LW 06001B and by the Federal Ministry for Innovation, Science, Research and Technology of Northrhine-Westphalia (MIWFT), sponsorship number 313-21200200.

I am particularly indebted to Prof. Dr. Bernd Diekkrüger of the Hydrology Working Group of the Department of Geography (University of Bonn) who made this study possible and always provided his assistance and also to Prof. Dr. Martin Rössler from the Department of Ethnology (University of Cologne) for his voluntary and invaluable support of this study. Furthermore, I want to thank the IMPETUS research team, especially Anna and Stephan Klose, Christina Rademacher and Henning Busche, who assisted the process of this study in different contexts. Their critiques and proposals were significant during the preparation, in the field and in writing.

Many thanks also to the IMPETUS project management team in Germany: Dr. Michael Christoph, Dr. Andreas Fink and Prof. Dr. Barbara Reichert and to the Moroccan project management team around Jamal Ait El Hadj in Ouarzazate.

My special thanks go to all those who assisted my research in the Drâa Valley. This includes my assistants, who supported the research with the biggest effort: Mbarka Hammou, Zakia Bounir and Ali Benyachou. And I am especially thankful to the villagers of 'Àfra and Qsbat al-Ghamàd – especially to my two host families for their facilitation of the research – without all of whom I could not have undertaken this study and in particular to a family in Ouled Yaoub helping to introduce me to the villagers.

And last but not least I want to express my gratitude to all those who further supported me writing this work or who distracted me from it if needed: my family and friends as well as my studying group. Above all, I have to thank my partner, Andrej Sokol, who not only contributed with his support but also with his patience to this work.

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Glossary

The Moroccan Arab terms in the glossary adhere to the Standard English transliteration (following the ALA-LC Romanization method), unless the French transliteration is more established. Names of Moroccan cities, families and other names that have an established transliteration – mostly French – are not enlisted.

'abid	Ethnic group, former slaves
'id al-kbir	Religious feast ('the grand feast')
'iyyān, pl. mu'ayyanīn	Representative for land and water rights
al-Magrib	Morocco ('The West')
al-Mamlakah al-Magribiyyah	Kingdom of Morocco
alawite	Moroccan dynasty
amazigh	Umbrella term for all Berber dialects
bidu	Bottle of 5 litres
bayoud	Fungus disease of date palms
blad l-Makhzan	'Land of the (central) power'
blad as-siba	'Land of the dissidents'
douār, pl. diour	Dispersed village
drawa	Ethnic group ('autochthonous people of the Drâa Valley')
feija	Steppe outside of the oases
firqa, pl. firaq	Group; often an interest group in the village council
foum	Hydrological barrier between two oases ('mouth')
ḥaratīn	Ethnic group, former slaves
ḥrar	Ethnic group ('free men')
jbel	Mountain
jma'a	Village council
Ka'āba	Subgroup of the ouled Yahya
khammās	Tenant who rents agricultural land for a 5th of the harvest
kudya	Tribal land outside the oases
l-aghrour	Donkey pulled well
l-ghnina	Balanced well
marabout	Islamic saint
mrābt, pl. mrabtīn	Religious group, descendants of saints
mūl ad-dār	Head of household (male)
muqaddim	Head of village
oued	Wadi river with ephemeral flow
ouled	Lineage
qabīla	Tribe, means also village
qāid	Head of rural community administration
qiyāda, pl. qiyādat	Rural community, administration
qsār	Fortified compound
sāqiya	Irrigation canal
shaykh	'Mayor' of several villages

Shergui	Dry summer wind from the East
Shirocco	Dry summer wind from the West
shurfa, pl. shurafā'	Religious group, descendants of the prophet
sikh	Hard bedrock, general term
stol	Bucket of 10 litres
tamazigh	Berber dialect of the Middle Atlas
tarifit	Berber dialect of the Rif mountains
tashelhit	Berber dialect of the High and Anti Atlas

List of Abbreviations

The original language of each abbreviation is marked with either (fr.) for French, (en.) for English or (ger.) for German. In the course of this work, abbreviations will be named once in their full length at the beginning of a chapter and then be referred to only as their abbreviation.

ABH	(fr.)	*Agences Bassins Hydrauliques - Hydraulic Basin Agency*
a.s.l.	(en.)	*above sea level [m]*
AU	(fr.)	*Association d'Usagers - User Association*
BMBF	(ger.)	*Bundesministerium für Bildung und Forschung - Federal Ministry of Education and Research*
C	(en.)	*Temperature [°C]*
CLCR	(fr.)	*Centres Chefs Lieux des Communes Rurales - Administrative Rural Centres*
CMV	(fr.)	*Centre de Mise en Valeur - Enhancement Centre (agric. term)*
CPR	(en.)	*Common Property Ressource*
CR	(fr.)	*Commune Rurale - Rural Community*
CSEC	(fr.)	*Conseil Superieur de l'Eau et du Climat - National Council of Water and Climate*
DAPE	(fr.)	*Dispositif d'Alerte Précoce Environnement - Environmental Early-warning System*
DGH	(fr.)	*Diréction Générale Hydraulique - General Hydraulic Directorate*
DH	(ar.)	*Dirham - Moroccan Currency*
ENSO	(en.)	*El Niño Southern Oscillation*
GLOWA	(ger.)	*Globaler Wandel des Wasserkreislaufes - Global Change of the Hydrological Cycle*
IMPETUS	(ger.)	*Integratives Management-Projekt für einen Effizienten und Tragfähigen Umgang mit Süßwasser in Westafrika - An Integrated Approach to the Efficient Management of Scarce Water Resources in West Africa*
IPCC	(en.)	*Intergovernmental Panel on Climate Change*
IWRM	(en.)	*Integrated Water Resource Management*
MATEE	(fr.)	*Ministère de l'Aménagement du Territoire, des Eaux et de l'Environnement - Ministry of Spatial Planning, Water and Environment*
MIE	(fr.)	*Ministère de l'Intérieur et de l'Équipement - Ministry of the Interior*
NIE	(en.)	*New Institutional Economics*
NOA	(en.)	*Northern Atlantic Oscillation*
ONE	(fr.)	*Office Nationale de l'Électricité - National Electricity Office*
ONEP	(fr.)	*Office Nationale de l'Eau Potable - National Drinking Water Office*
ORMVA	(fr.)	*Office Regionale de Mise en Valeur de l'Agriculture - Regional Agricultural Enhancement Office*
ORMVAO	(fr.)	*Office Regionale de Mise en Valeur de l'Agriculture, Ouarzazate - Regional Agricultural Enhancement Office*

PAGER	(fr.)	*Programme d' Approvisionnement Groupé en Eau Potable en Zones Rurales - Rural Drinking Water Supply Programme*
PD	(en.)	*Prisoner's Dilemma*
PDAIRE	(fr.)	*Programme d'Aménagement Intégré des Ressources en Eau - Integrated Water Resources Management Programme*
PK	(ger.)	*Problemkomplex - Set of problems*
SAEP	(fr.)	*Système d'Alimentation en Eau potable - Drinking Water Supply System*
TLU	(en.)	*Tropical Livestock Unit*
TRWR	(en.)	*Total Actual Renewable Water Resources*
WHO	(en.)	*World Health Organisation*

1. Drinking Water Supply in the Context of Water Scarcity

> "There is more than enough water in the world for domestic purposes, for agriculture and for industry. The problem is that some people […] are systematically excluded from access by their poverty, by their limited legal rights or by public policies that limit access to the infrastructures that provide water for life and for livelihoods. In short, scarcity is manufactured through political processes and institutions that disadvantage the poor." (UNDP 2006: 3)

Water is as important for life as is oxygen, especially for primary uses such as drinking, food preparation or hygiene. This means that water is embedded in the social context of families and forms part of livelihood strategies and their interaction with the natural environment. Local water management practices must therefore be part of an institutional repertoire of a given society which revolves around these complex inter-linkages between natural and socio-political environments. Water management may be very flexible in response to changing situations, and humans in all parts of the world have adapted specific patterns of water usage. However, many people face difficulties in accessing the valued resource and there are global, regional and even local disparities in its availability. Especially rural areas in arid environments have often no safe access to potable water and lack possibilities to secure the resource. In the last decades water withdrawal has grown twice as much as the global population (UN Water 2006) and it is especially these arid regions which face the increasing water scarcity and feel the growing impact of global environmental change. Against this background, local patterns of drinking water management are often powerless.

The Middle Drâa Valley in the South of Morocco (Fig. 1.1), where the present study took place, is among these unprivileged regions. Aridity and water scarcity determine the natural environment, while high dependence on agriculture and low industrialisation force many people to leave the Valley in search for new income. Especially rural households are exposed to the impacts of environmental and societal change: their daily struggle includes securing access to drinking water, often suffering from reduced availability and/or bad quality. In the light of population growth and human development, however, the desire to use safe water rises. And in the course of these changes, natural and societal aspects clash with one another and are expressed in specific and flexible patterns of water withdrawal and management.

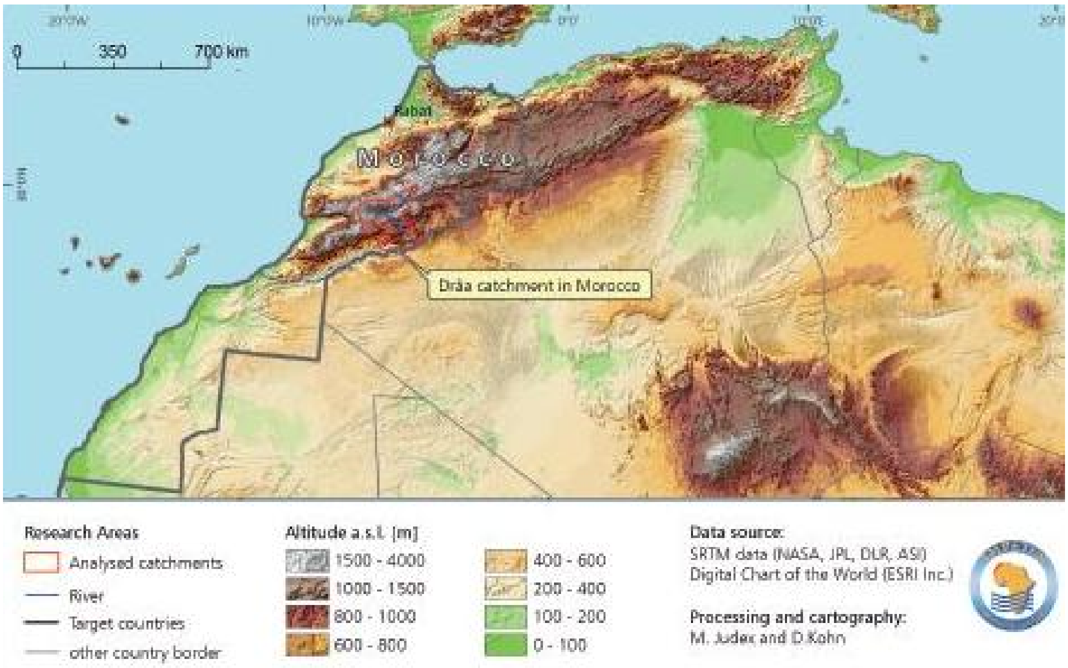

Figure 1.1: Morocco and the Location of the Drâa Catchment (modified according to Schulz and Judex 2008: 4)

Though Morocco has a long history of water management, its focus was mainly on irrigation agriculture or urban water supply whilst neglecting the importance of water for human development in the countryside. Less than two decades ago the state realized the consequences of this one-sided development, when labour migrants swept the urban centres in the West. Despite economic development in some parts of the country, poverty and hunger increased in others, thus deepening the gap between urban and rural populations. At the same time, the global debate on environmental change tackled the issue of sustainable resource management, its inter-linkage with water scarcity and the relevance of water for human development – which was institutionalised in the UN declaration of the Millennium Development Goals in 2000. Morocco joined this consensus and lastly extended the scope of its water policy to the rural margins.

The management of rural drinking water gained a new priority in development policies and a new national water law set the institutional frame for this endeavour. However, the present rural realities suggest a different development than that which the global and national water discourse had in mind: While the access to water improves, water use increases at the same time and thus causes further degradation of water resources. Not only do the increasing needs of water for irrigation agriculture impinge on the sustainability of the management, but so does the rising demand of urban and rural households. The aim of a sustainable use of water *and* the improvement of access to it for all people seems to be counterproductive.

This raises the question of how people in the Drâa Valley manage the scarce water. The study of underlying patterns of water withdrawal and the specific household water management constitutes a major pathway to understand local action. To reach such understanding, this work explores the relation between environmental and societal change and the implications for water supply of rural households. An actor-oriented approach to drinking water management helps to approximate the emic[1] side of the problem. By looking at this issue from a New Institutional perspective, it is possible to identify underlying institutional constraints impinging on local water management. Linking moreover the Natural Resource Management approach with this theory, the influence of national water policy can be related to processes of global environmental change.

However, research on rural household water withdrawal in Morocco remains scarce (cp. Hajji 2005) and while national water policy estimates a minimal water demand in rural regions, the empirical data of this study suggests a much higher and also increasing withdrawal. This gap has implications not only on national but also on local management and it is the main objective of this study to unveil the disparities in water policy and local action. The present study gives new insights into rural water withdrawal and identifies local *options* for action and national *need* for action through analysing local management strategies.

1.1. Conception

This study contributes to yet scarcely existent information on rural household water withdrawal and tries to do so from an emic perspective on water management. The empirical data was gathered during two field trips to the Middle Drâa Valley in November 2008 and May 2009. The research was conducted in the villages of 'Àfra and Qsbat al-Ghamàd in the oasis of Tinzouline, the second of six oases stretching from North to South along the Wadi Drâa in south-eastern Morocco (Fig. 1.1 and 1.2).

By addressing this issue from the interface between hydrology and social anthropology, this study explores in how far withdrawal and management of drinking water in rural households are determined by water scarcity and institutional constraints.

[1] Emic, as opposed to etic, describes a linguistic distinction between phon*emes* (set of underlying constructs generating sounds) and their phon*etic* representations (what can be heard). This notion was adopted by cognitive anthropology to distinguish between what people do (etic) and which grammar is underlying their behaviour (emic) (Bernard 1994: 238f).

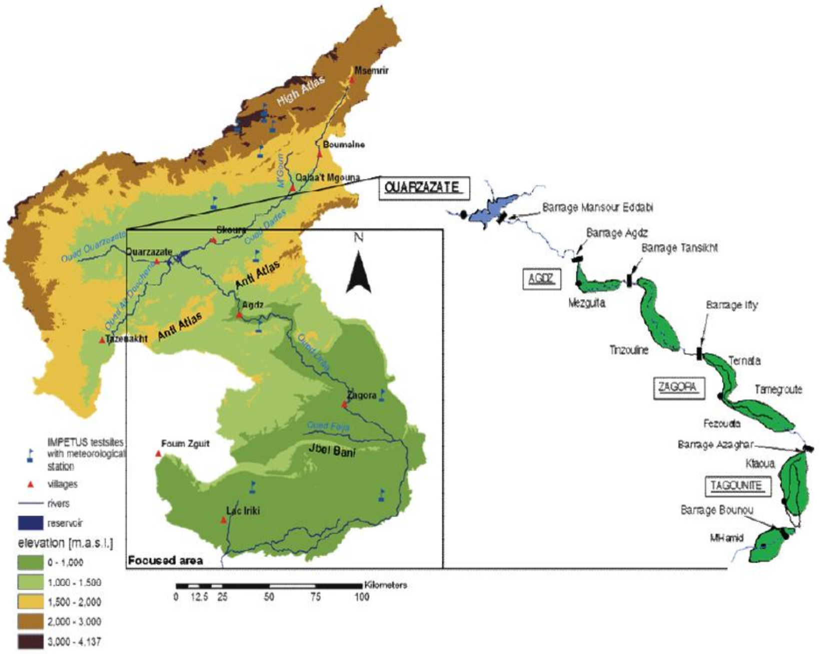

Figure 1.2: The Middle Drâa Valley and its Six Oases, South-east Morocco
(edited by Anna Klose, IMPETUS)

I begin by stating the underlying motivation for this research (1.1.1), and then specify the research interest and basic constraints (1.1.2). These sections are followed by a delineation of the organisation and frame of the research (1.1.3). The rest of the chapter then presents the underlying methods and the operationalisation of the research (1.2) and specifies the theoretical perspective (1.3). The concluding section discusses the limits and chances of this study (1.4).

1.1.1. Motivation

The motivation for this work originated in the interdisciplinary research project IMPETUS: 'An Integrated Approach to the Efficient Management of Scarce Water Resources in West Africa' (**I**ntegratives **M**anagement-**P**rojekt für einen **E**ffizienten und **T**ragfähigen **U**mgang mit **S**üßwasser in Westafrika) carried out by the Universities of Bonn and Cologne. The two project sites are located in the Ouémé basin in Benin and the Drâa catchment in Morocco. The research of IMPETUS aims at elaborating options for the sustainable management of various components of the hydrological cycle and their interaction. IMPETUS is part of the programme GLOWA (**Glo**baler Wandel des **Wa**sserkreislaufes), which was launched in 1998 by the German Ministry of Education and Research (BMBF). The overarching theme of this programme is a secure water availability, quality and equal distribution of water resources.

The IMPETUS research in Morocco is divided in several disciplinary components, such as hydrology, meteorology or society, and eleven underlying sets of problems (ger.:

Problemkomplexe) integrate these components on a meta-level. The work of IMPETUS is closely related to Moroccan interest groups and the development of scenarios until 2020 aims at providing options for action for decision-makers. The present study is related to the set of problems called PK Ma-H.2, which integrates the linkages between water usage, groundwater and soil. One motivation for this study is to provide further data to feed a simulation model and decision support system for future action and thus extend and compare it to the few existent data of rural household water demand (cp. IMPETUS 2003). Within the framework of IMPETUS and the PK Ma-H.2, this study is placed between two disciplines, namely hydrology and social anthropology. This interface offers the possibility to look at drinking water supply from two different perspectives and allows for understanding both environmental and institutional constraints. To what extent these impinge on drinking water supply is specified subsequently.

1.1.2. Research Interest

The quote on the first page denoted already a biased meaning of water scarcity. It is both a qualitative and a quantitative concept: it is at once "a relative term to describe the relationship between water demand and its availability" (UN Water 2006), and can also be expressed with a threshold below 1000 m³ of water[2] per year and inhabitant of a country (FAO 2003: 21). A water *scarce* country is thus a country which does not dispose of at least 1000 m³ per inhabitant and year, while a water *stressed* country comprises of less than 500 m³ per head and year (ibid.: 21).

In terms of total actual renewable water resources (TRWR) per person and year in a country, Morocco figures below this minimum of 1000 m³ with a potential of 940 m³ per person and year (in 2007, FAO 2009). In contrast, one German can potentially use double as much water, i.e. 1863 m³ per year (in 2007, ibid.). But the implications of water scarcity as being also a man-made problem become clear by giving more numbers: Morocco, which is determined by varying climate influences, disposes of both semi-humid and arid regions and is, compared to other North African countries, on average endowed with enough freshwater (cp. e.g. Algeria: TRWR of 350 m³ per person and year in 2007, ibid.). However, due to disparities between the semi-humid and urban west and the arid, rural south and east of the country, the range of TRWR per person is more indicative: while in the West up to 1850 m³ is potentially available per person and year, the rural regions in the

[2] In this study the terminology proposed by Gleick will be employed (explicited in Falkenmark and Rockström 2004: 47f). The term water withdrawal, which is employed here, designates water use without specifiying whether it is reusable or not. This term is thus to be distinguished from consumptive use, i.e. the actual loss of water in one system.

South-east dispose in the least of 180 m³ per person and year (Bzioui 2004: 18). Now, these figures depict not only drinking water, but all water that can potentially be withdrawn by humans (i.e. TRWR). In Morocco, however, most of this water is withdrawn for agriculture, especially in the arid regions, amounting to 87% of the total withdrawal of water in one year (in 2000, FAO 2009). In areas such as the Middle Drâa Valley, this results in a depletion of water resources and a decreasing availability. Water scarcity is thus an environmental constraints reinforced through human activities. Furthermore, the Middle Drâa Valley suffers from deficient water management institutions.

Institutions in general describe (internal or external) social structures that coordinate human behaviour and enable the organisation of several actors within an activity. In terms of Moroccan water policy, which promotes the access to drinking water through rural water supply programmes, local user associations can be considered as such institutions that are created outside local contexts. If these water institutions do not work, either because they do not provide an enabling structure or because they are absent, institutions can constrain rather than enable the access to water.

The increase of water withdrawal is thus the result of both environmental constraints such as water scarcity but also of dysfunctional institutions, reflected in withdrawal patterns. In order to understand to what extent these constraints are interlinked, I want to answer the question of why the local water management remains unable to handle these challenges and spot which options local actors have for managing the scarce resource. I formulated three research questions (see Fig. 1.3), which not only decompose the research interest into separable elements but also guide the structure of this work and build upon one another:

I. Within which natural and institutional context is local water management taking place?

II. According to which patterns is water withdrawal proceeding in rural households?

III. Which options for action do local actors have in managing water?

1.1.3. Research Frame

According to these three research questions the work is divided into three main parts (Fig. 1.3): Part (I) introduces the research concept and the context, part (II) is based mostly on empirical data and provides first interpretations and part (III) includes an analysis and evaluation of the findings along with prospects of possible future processes according to three IMPETUS-Scenarios.

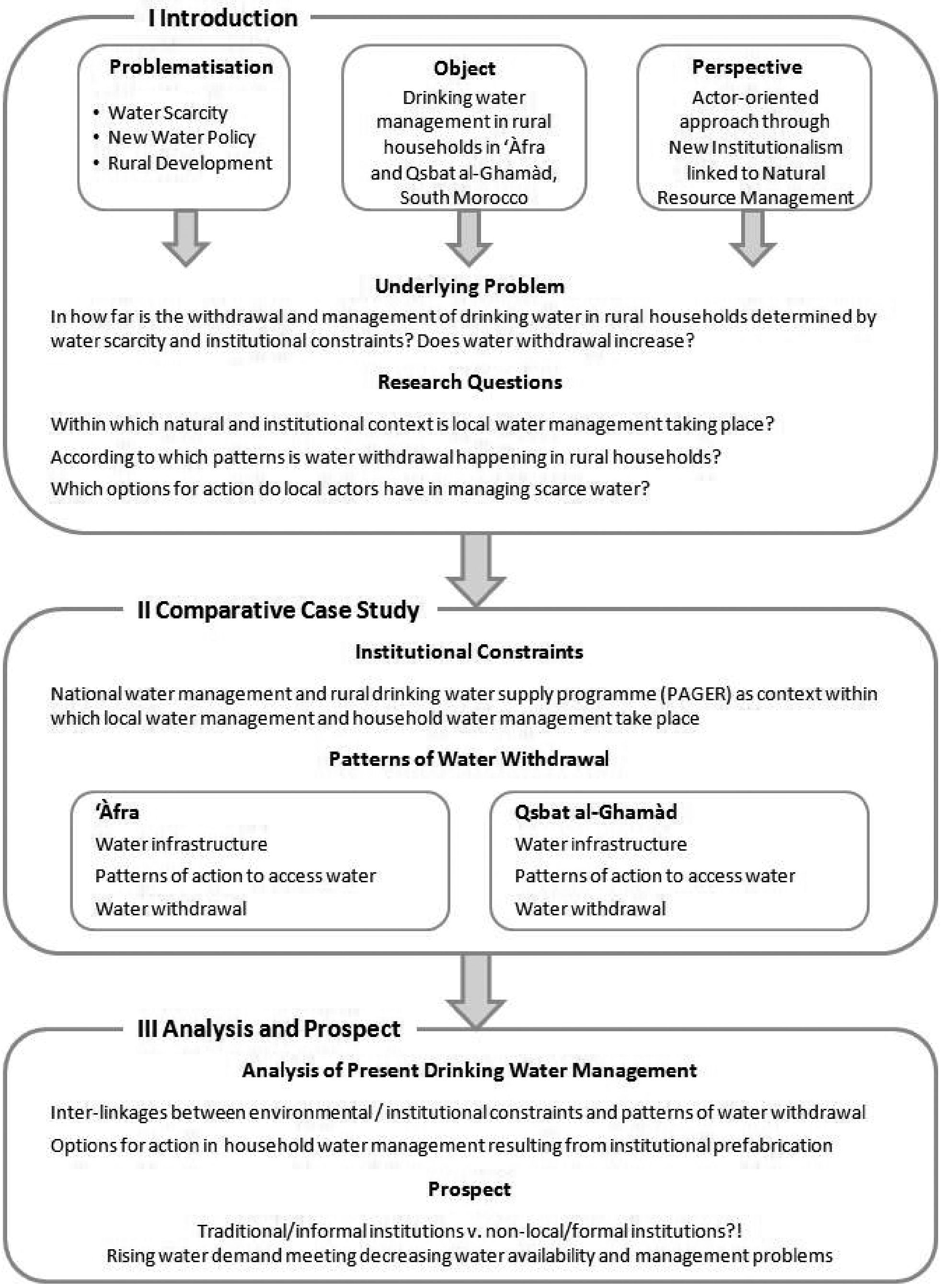

Figure 1.3: Research Frame (modified according to Schlütter 2006: 37)

Part (I) is composed of a general introduction, including a methodological and theoretical placement (chapter 1) and a description of the geography and society of the Middle Drâa Valley (chapter 2). Aim of chapter two is to tackle the issue of aridity, water scarcity and climate variability (2.1). Moreover, socio-political issues, such as migration and societal change, are discussed (2.2) and the villages 'Àfra and Qsbat al-Ghamàd presented (2.3).

The core of this study is embodied in part (II), where a distinction is made between information on water institutions (chapter 3) and local agency (chapter 4). Chapter three focuses on the institutional setting, which sets the formal frame for local drinking water management. The resulting institutional constraints are deduced from the national (3.1) to the local level of water policy, which consists of the rural drinking water supply programme PAGER (3.2) and the local User Associations created by PAGER (3.3). In chapter four, the water withdrawal of both ‘Àfra and Qsbat al-Ghamàd is compared, including some results from another village that at the time of research did not yet comprise of a tap water access. Here, the local patterns of water withdrawal are in the focus of interest.

In part (III) I decompose the findings on water institutions (chapter 5) and thereby analyse the local drinking water management. The inter-linkages of external factors and institutional constraints allow viewing water withdrawal in the light of resource scarcity and institutional constraints (5.1). By means of this analytical decomposition, I evaluate the local management performance (5.2). These results are then compared to three IMPETUS-storylines in a short projection of future options for local action (5.3). The study closes with a conclusion in chapter six.

1.2. Methodology

As the concept of the present study is interdisciplinary, so are the methods. Both quantitative and qualitative methods were employed, thus coupling environmental change and social action. The aim of the first part in this section is to give insights into the research context and choice of the villages and shortly depict the data availability and the operationalisation of the research (1.2.1). In the second part I want to talk about my experience with the research, the data collection and present the methods I employed (1.2.2).

1.2.1. Before the Field Trip: Research Context and Operationalisation

Choice of Villages

Above I have mentioned the frame within which I conducted the research in the Drâa catchment. While the regional choice was thus somewhat predetermined, the choice of the villages remained. My initial idea was to compare the access of rural households to drinking water and study conflicts arising from the change from traditional draw wells to tap water systems in at least two villages. Accordingly, the decision-making was influenced by three parameters: First of all, in order to study and compare rural households and their drinking water supply, I chose a village which has made experience with tap water already and a village which did not yet have tap water. This had influence on the second parameter, which determined the size of the villages. To allow for a comparative study, I sought to choose two villages of equal and small size. The third determinant was to build upon existing relationships of other IMPETUS staff with the Valley to increase the chances of access to the field. Christina Rademacher, an anthropologist, was very familiar with the village of Ouled Yaoub in the oasis of Tinzouline and I profited from her knowledge of the area. 'Her' village was part of a bigger assembly of small Arab speaking villages in the oasis of Tinzouline and owing to the close kinship ties between the eight villages a link was soon found. The host family of Christina Rademacher has relatives in the village of Qsbat al-Ghamàd, north of Ouled Yaoub, which I then chose as entry point to my research. This village has a considerably long experience with tap water. To find a match for this village, which consists of ca. 30 households, I chose the village of 'Àfra, which has a similar size and did – according to my information – not comprise of tap water yet. The two villages are only five km apart and are tied through kinship.

Data Availability

The choice of 'Àfra and Qsbat al-Ghamàd had furthermore the advantage that more data was available than for most other rural settlements of the Moroccan south. Tanks not only to Christina Rademacher's ethnography of Ouled Yaoub, but also to the experience of other IMPETUS staff of MA-H.2 in the oasis of Tinzouline, I had access to a lot of information to prepare my field trip. Furthermore, the withdrawal measurements undertaken for the model C.E.M.Drâa of the Ma-H.2 were based on data of the household water withdrawal in Ouled Yaoub (a neighbouring Ka'āba village), which is withdrawn only from draw wells. One aim of this study is therefore to base my assumptions on these findings and compare them to 'Àfra and Qsbat al-Ghamàd. The fairly homogenous ethnic, political and environmental background of these three villages allows for a comparison of each village's withdrawal and water management against a changing background.

Operationalisation of the Problem

Based on the available information, I operationalised the research questions (Fig. 1.4): By defining the variables (e.g. water demand or water policy) which impact on water withdrawal and water management, I created a so called *problem tree* which allows for understanding the causal linkages inherent in the domain of drinking water and shows which variables are quantifiable (i.e. water demand and access). I further decomposed these variables into their single indicators (e.g. number of users or financial management), which I then matched with specific methods (see Appendix A2). This way, it is possible to entangle the causes and effects of water withdrawal and management and spot options for action which lie in between of local and national parameters. How the empirical research then fills these hypothetical assumptions of the problem tree is depicted below.

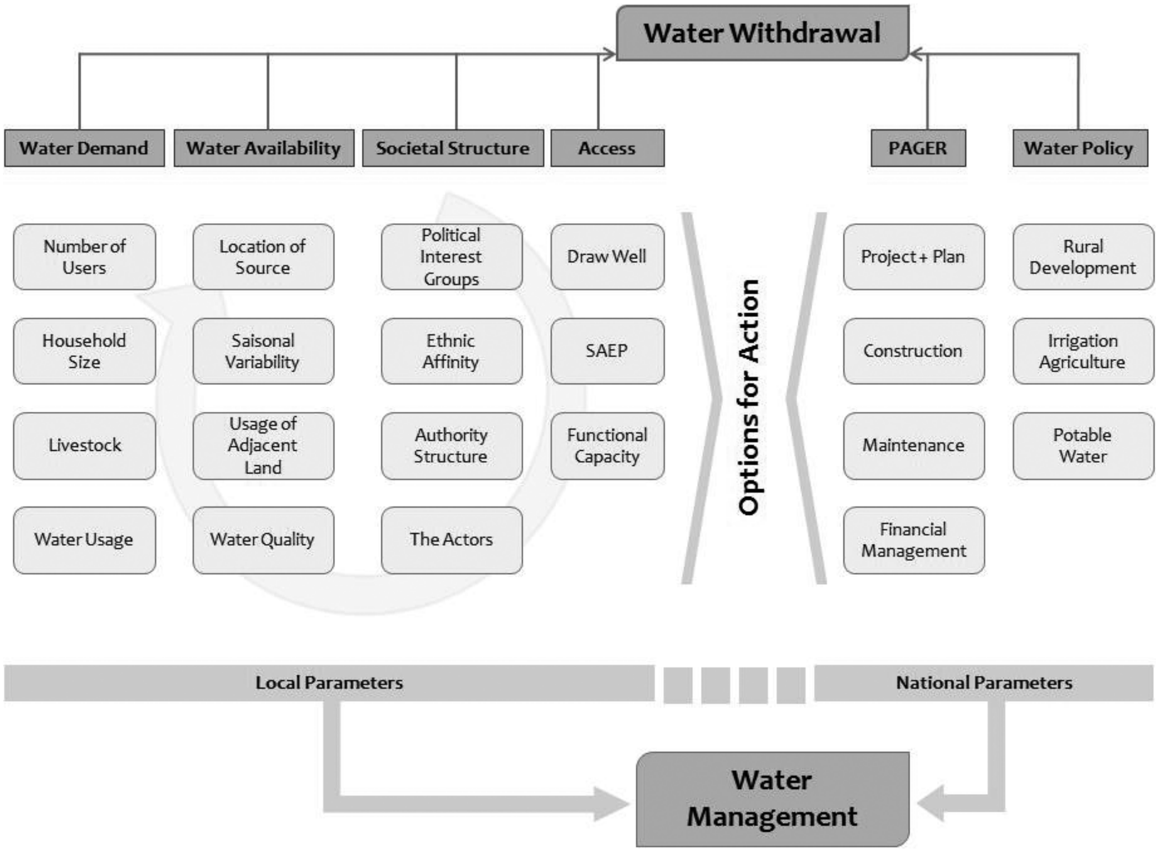

Figure 1.4: Operationalisation of the Research Questions (including variables, indicators and outcome)

1.2.2. In the Field: Empirical Research and Data Collection

In the field, however, it became soon clear that theory and practice seldom match. When I arrived in the villages for the first time beginning of November 2008, the situation was different from what I expected and prepared for: Two weeks before my arrival, the households of ‘Àfra had received a domestic tap connection. My original idea to compare one village *with* and one village *without* tap water connection was thus spoiled. But instead of choosing a different village, I reoriented myself within a few days and realized the great chance behind this unexpected turn of facts. The new development in ‘Àfra allowed for many interesting insights into the installation process of a tap water system. It altered the research interest towards studying the different patterns of accessing water instead of conflicts surrounding it. Furthermore, this new setting allowed comparing the evolution of water withdrawal and its steady rise with the combined use of water facilities.

In the course of the first field trip, from the beginning of November 2008 until mid-December 2008, I adapted my research questions and methods to this new focus (which equals the research interest stated in section 1.1). Half a year later, during a second visit in May 2009, I had the chance to observe the changes in ‘Àfra since the inauguration of the tap system. This helped to exclude most coincidences and confirmed the data which I had collected during the first field trip. It also served testing and reinforcing the theoretical ideas developed since the first visit.

My Assistants

In total, I spent two months commuting between the two villages from my hostel room in Zagora, and in this period I had three different assistants, owing to their availability but also in order to work both with male and female assistants. During the first weeks, my male assistant helped me not only in translating[3], but also in mapping the villages and in conducting a household survey in each village. He also accompanied me to the *qiyāda* of Tinzouline to receive an official approval for my research. Here, it proved helpful to have a male assistant not only because the administration is a male domain, but also because typically most households present themselves through their (mostly) male head (*mūl ad-dār*) first. When I knew both villages and the locals more and when they were aware of my motif, this changed and women and men equally participated in the research. In the course of the second half of the first trip, I was then assisted by a young woman from Zagora. She assisted most qualitative and participatory methods and with her assistance I was able to stay overnight in the households of both key informants for two weeks. During the second visit in May, I had yet another female assistant from Zagora whom I met through my former female assistant, who was unavailable during May. All three assistants had experience with scientific research as they all hold a university degree in geography and conducted their own research or even worked for IMPETUS staff in variable contexts.

Key Informants

Thanks to Christina Rademacher’s host family in Ouled Yaoub and their family ties in Qsbat al-Ghamàd first contacts could be established in advance. Jemaa, the female head of the household (the *mūl ad-dār* was absent, seasonally working in western Morocco) welcomed my assistant and me warmly and her whole family engaged in giving us first information about the village. She also accompanied us during the first visits to households. As our host in Qsbat al-Ghamàd, she remained a key informant during both

[3] Though I do speak basic Moroccan Arab dialect, owing to a longer stay in Marrakech in 2007, I was not able to conduct interviews. Nonetheless, I improved my skills during the research and soon understood many conversations and interview responses.

field trips. Also in ‘Àfra the access was unproblematic, although I hadn’t established contact before. Just the fact that most villagers had heard of Christina Rademacher’s work in Ouled Yaoub helped to explain my own interests and we were welcomed warmly. The fact, that the tap water system has just been inaugurated, further facilitated first conversations. Soon I met Zohra, my future host and key informant. As a midwife she is well-known in ‘Àfra and beyond and most women trust her. Thanks to her openness and curiosity, she was eager to help, and the reliance people had in her, was soon transferred to my assistants and me, too. The help of these two women allowed us – despite the short time – to establish a friendly and open atmosphere with all interested households. However, there were other households, which were not interested in participating in the research. The support of the former households increased when I came back for the second field trip in May 2009, and even the most doubtful inhabitants seemed assured of my sincere motivation.

The Methods

The methods that I employed during the first trip are numerous (cp. Appendix A2 and A3): I used quantitative, qualitative and participatory methods. The integration of these methods bases on two blocks: quantifiable data and non-quantifiable data. While the first aims at describing local water withdrawal, the second aims at detecting patterns of local action and perception. Through this approach I tried to bypass this problem by finding aspects of human activity that can actually be statistically described. This is the case for water demand and the access to it (Fig. 1.4). By measuring water withdrawal and mapping water infrastructure, it is possible to find out why specific patterns of action evolve. Adding to this the information gained through, for instance, interviews, institutional ranking or observation, it is then possible to understand local water management within the context of water scarcity and detect other constraining parameters as well.

Among the first block of methods was the **Mapping** of draw wells in both villages (excluding agriculturally used wells in the oases): their location, condition and usage. This way, the water infrastructure was detected. At the same time, this method served as a useful approach to local people. Many villagers could observe my assistant and me from a distance and it was left to them whether to interact or not. In many cases we were invited into the compounds for a cup of tea. The curiosity of most villagers made contacting easy and we established first relations, without intruding into their privacy at once. Based on these first contacts, a **Household Survey** followed, covering more than 50% of both villages. The choice of households depended on a **Pre-Survey**, which was conducted with several people in one group in each village before starting the actual survey. This Pre-Survey delivered most household names and their characteristics, for instance household size or ownership of a draw well. Based on this Pre-Survey, I chose a representative sample, based on household size and type of water facility used by these. My key informants then helped to contact the chosen households. However, there were some households which did not want to participate and yet others which explicitly asked to participate, so that in the end the survey rather based on a random sample. The target groups were the heads of the households, which in many cases were women, too, because their husbands were absent labour migrants. Through this method, I tried to get a first insight into patterns of water withdrawal and local preferences and constraints. The survey also served as a general database on household traits, such as average household size or number of domestic tap connections per village. One key method of this block, the **Withdrawal Measurements**, were undertaken at a later stage of the research – both in November and May – so as to rely on the established trust by participants. Due to the specific data generated through this method, however, it will be explained separately and in more detail in chapter four (section 4.1.3).

During the Household Survey, which lasted about two weeks, we also conducted **Interviews**, belonging to the second block of methods. This strategy owes to the fact that in order to meet people for methods, we were fixing appointments in advance. This is necessary, since most men and many women are farmers and work on their fields in the oasis during the day and the spontaneous choice of interview partners would have resulted in not meeting any at all. Consequently, if we were able to fix an appointment with an expert from water User Associations, we conducted an **Expert Interview**. If, in contrast, we met someone belonging to a household that has already participated in the survey, we conducted a **Semi-Structured Interview**. These methods mainly took place in the first half of the first field trip. In order to research on non-local institutions, further Expert Interviews were undertaken with professionals from either ABH or ONEP.

In the course of these methods and with the time that passed, the trust in my assistants and me grew steadily and allowed for many **Informal Interviews** to take place as well as the employment of participatory methods. One major participatory method was the **Venn Diagram**, which aims at visualising power relations or institutional settings. The target group was particularly men, as most women claimed not to be aware of most institutional aspects of national water policy. The latter method was not always successful in terms of methodology[4], but the information gained was valuable. Furthermore, in order to grasp the daily management of the household water, I observed all daily ‘water’ tasks within one household in each village. This way I sketched a **Daily Activity Schedule** and gained insights into the meaning of water and its usage for the local’s livelihoods. By asking elderly villagers to draw **Time Lines** we were also able to find out about the history of most draw wells and my understanding of the various processes of change grew. However, my experience with participatory methods was rather biased and though they all served the purpose to gain information, they did not actively challenge the people’s behaviour nor alter their role as interviewees; the participation I hoped to create through these methods was reduced to some individuals and even then remained disputable.

The second field trip had a different intention than the first visit and so the methods were adapted as well. In order to broaden the quantitative data on household water withdrawal I again operated Withdrawal Measurements in both villages (see 4.1.3). Additionally I employed **Free-Listing**, a kind of brainstorming, which aims at bringing up all activities around water and naming all adjective traits of water. The repetition of measurements and Free-Listing served as a validation of the existent data, not only on withdrawal patterns but also on the local’s individual perceptions of the tap water. Additionally, I undertook again Semi-Structured Interviews at a random choice of target groups in ‘Åfra, which served as a method to observe changes in popularity of the tap water since its inauguration shortly before the first visit. Several Informal Interviews further helped to verify existing information or learn more about water withdrawal.

Concluding Remarks on Methodology

To conclude this section, it has to be emphasized how enthusiast most participants in the research were. After an initial clarification of my institutional background – a student researcher for the project IMPETUS – the locals soon realised that I came researching for a diploma thesis and not as a development practitioner. Despite no apparent advantage for the villagers, they were willing to answer my questions and most people were reliable and respectful of appointments. The recording of interviews – which in the villages were all conducted in Moroccan dialect, however, was not possible. Most villagers didn’t feel

[4] Most interviewees were confused by this method, because we asked them to *draw* their knowledge on the ground and *play* with the information. Some were even laughing at us and asking if we could not ask ‘normal’ questions, then they would simply answer and we would save time. In addition to the very good experience I had with most ‘common’ interview methods, this reaction shows that Moroccans are familiar with the ‘classical’ concept of research. In their view, participatory methods are fun and somewhat comic, but a waste of time. One participant put it like this: “Come on, instead of putting circles you can just ask me and I will answer everything you want to know”.

comfortable with audio records and the awareness of the recorder created intimidation, which might owe to their experience with local 'spies' (pro-government people, e.g. the *muqaddim*, see 2.3) working for the government. Hence, my data consists of detailed hand written protocols. Furthermore, thanks to the work with both male and female assistants, it was possible to have conversations with both men and women. I, as a foreign woman, was considered almost of neutral sex and was in both domains equally accepted.[5] This enabled us to enter both spheres and get close to the emic perspective of water withdrawal and management.

In sum, the combination of methods was favourable in many ways, as they allowed for approaching the locals without hassling into their lives and this way established trust. I was quite fast placed as a researcher, who has specific interests, and wherever the people could help me, they did so with great interest.

1.3. Theoretical Perspective

In the course of two field trips I was guided by the idea to grasp the emic perspective of local water withdrawal and I was, during the two months of research, trying to approach the villager's points of view. From the beginning of my research it seemed that the best possibility to get closest to emic perceptions[6] of water and its management was through adopting an actor-oriented approach. This approach allows at the same time to dissolve the disciplinary differences between hydrology and social anthropology, because it looks at the construction of society and those who construct it within a changing environment and changing socio-political structures. The actor is thus the one who moves in a certain structure, whereas at the same time he changes it through his action (cp. Giddens 1984). In this process the natural environment and the social actor get involved with each other. The interface between two disciplines further enables to understand this interaction. But what are structures and where do they come from?

During the field trips I was asking myself this, and it was in conversation with local women and men that I began to see that there are different forms of structures. Some are apparent to the untrained eye, whilst others are more subtle. In the end, it was the diverse methods which helped to identify that there are environmental constraints, which form one

[5] One example for this is the habit of eating on separate tables according to gender relations: depending on the sex of my assistants, we were eating either with the men or with the women. Or, when I was in male company, we did not get further than the reception room (reserved for male visitors or strangers), whereas in female company I was allowed beyond that room.

[6] I speak of the 'closest possible to emic', because for me, as an outsider and foreigner, it is not possible to grasp the emic perspectives as such. Rather, I 'approach' the local perceptions by letting the villagers speak about it from their daily experience.

set of structures and that there are institutions which form the other constraining set of structures. It is in this structured field that the inhabitants of ‘Àfra and Qsbat al-Ghamàd move. The tool for understanding and analysing the institutions was soon found in the New Institutionalism approach, which allows for looking at institutions as social structures which shape and are shaped by human actions. By linking this theory with Natural Resource Management it is then possible to comprehend the relationship between institutions and resource management.
The following sections review the main aspects of the New Institutionalism (1.3.1) and then link it to the Natural Resource Management approach (1.3.2). The perspective evolving from this display enables understanding in how far water withdrawal and management are determined by water scarcity and dubious water institutions, and help to give answers to the question of why the local water management is seemingly ineffective.

1.3.1. Literature Review: The New Institutionalism

Global problems such as environmental change and the overuse of scarce resources pose complex problems to science and therefore need approaches that account for this complexity and go beyond the focus of mere resource mismanagement (cp. Haller 2002). An example of such complexity is the problem addressed in this study, dealing with the options for action of local actors in the context of water scarcity and institutional constraints. To understand the underlying problem, a multidisciplinary and multi-level approach is required, tackling environmental and societal factors, covering national and local levels of action. The New Institutionalism provides the theoretical and analytical tools to address such a complex problem, while maintaining an actor-oriented perspective.
The broad set of approaches labelled New Institutionalism as well as their linkages to natural resource management are discussed mainly in development research and social anthropology and have been excellently reviewed by several authors (cp. Powell 2007 for a general review, and Haller 2002 or Saleth and Dinar 2004 for environmental institutions). I don’t provide a comprehensive review of New Institutionalism, but present a compact overview sufficient to lay the theoretical and analytical foundations for the present study.
The New Institutionalism evolved, first and foremost, from an ‘Old’ Institutional Economics approach that developed in the early 20th century around the economist Veblen, who focussed on the meaning of institutions as special types of social structures for economic performance, and the shaping influence of actors within an institution (Hodgson 2006). The emergence of the New Institutional Economics (NIE) approach with the

publication of Coase's 'The Nature of the Firm' (1937) developed the thought further by arguing that institutions matter when it is costly to transact. According to him, and later also to North[7], institutions help decision-making in complex markets and respond to the problem of incomplete information (North 1990: 12; Rössler 2005; Acheson 2002). The core idea is that institutions are embedded in and shaped by social and political environments and thus reflect rules, beliefs or conventions within a society (Powell 2007). Briefly, "institutions make up the stuff of social life" (Hodgson 2006: 2).

The awareness that reality is a construction and that human action has influence on (economic) behaviour opened the NIE theory to many other disciplines, among which geography and anthropology (Rössler 2005; Mehta et al. 1999). These disciplines then speak of New Institutionalism. Scholars belonging to the current of New Institutionalism refer widely to formal and informal institutions as what North calls "rules of the game" (North 1990: 3), designating norms and values, as well as incentives and constraints (Haller 2002: 10). There are three pillars of institutional order, which Scott defined as: (1) regulative: rule setting and sanctioning, (2) normative: moral evaluation and legitimization, (3) cultural/cognitive: shared world view and frames of meanings (2001, cited in Powell 2007: 2). The approach is inherently historical, as institutions are created and changed by humans as well as through feedback mechanisms with organizations (see below and North 1990: 5ff).

Much speculation has dominated the debate since North claimed organizations to be the players of the game and institutions the rules (North 1990: 4f). This has led to a debate on whether organizations and institutions are the same or not (cp. Acheson 2002: 31f). Hodgson has devoted himself to clear that matter by defining organizations as

> "*special institutions* that involve (a) criteria to establish their boundaries and to distinguish their members from non-members, (b) principles of sovereignty concerning who is in charge, and (c) chains of command delineating responsibilities with the organization." (Hodgson 2006: 18, emphasis by author)

In the course of this work I apply this definition, as it allows for distinguishing between drinking water institutions and inherent organizations.

From a social anthropological point of view, institutions are defined as processes and "social structures, which provide cohesion" (Eguavoen 2008: 26), coordinate practices and are closely linked to power and knowledge. Institutions help individuals form expectations about other people's conduct and thus enable the coordination of several actors. They

[7] Both authors won the Nobel Prize for their work in institutional economics; Coase in 1991 and North in 1993.

interact on several levels: formal institutions are developed by the state (e.g. property rights, water laws etc.), whereas informal institutions (e.g. norms, values) develop at the local level and are embedded in a culture[8] (Haller 2002). As institutions shape and are shaped by human actions, they are prone to change and in this process of institutionalization, according to Cleaver (2001a), reconfigure themselves. The result is then what Cleaver calls

> "institutional bricolage [...] a process by which people consciously and unconsciously draw on existing social and cultural arrangements to shape institutions in response to changing situations." (Cleaver 2001a: 26)

This means "newly created or emerging institutions are most of the time not complete innovations but new conglomerates of pre-existing institutions" (Eguavoen 2008: 27f). This is particularly true for the southern Moroccan context where "much that is new co-exists and modifies the old, rather than replacing it entirely" (Moore 1973, cited in Eguavoen 2008: 28). The notion of institutional bricolage has also been denominated the "messy middle" by Mehta et al. (1999: 16), which further signifies that institutions are contested and often neither formal nor informal but somewhere in the middle, hard to identify. With growing global or national interventions in remote areas, the local institutional settings are prone to change, without giving up old forms of organization. The "messy middle" of institutions has thus to be placed within people's ways of life and is closely connected to their adaptive livelihoods, particularly in unfavourable regions like southern Morocco. When attempts such as the installation of drinking water facilities in rural areas neglect history, traditional institutions as well as recent political developments of a given community, the programmes are bound to fail (see chapter 5).

1.3.2. New Institutionalism linked to Natural Resource Management

The link between institutions and Natural Resource Management was initially made by Hardin in his article on 'the Tragedy of the Commons' (Hardin 1968). He argued that a resource accessed by a number of people is prone to overuse and declining sustainability, because people are likely to use it as much as possible for their own benefit until its degradation. Without dwelling upon the concept of Common Property Research (CPR), which has been thoroughly discussed by the recent Economics Nobel Prize winner Ostrom (Ostrom et al. 2002), it is the notion of sustainable use of common resources that is of

[8] According to Cleaver (2001b: Footn. 1), the distinction between formal and informal is slightly misleading, because it states that traditional forms of institutions are informal. Quite the contrary, these 'informal' social institutions can reach formal legitimacy, without being of bureaucratic forms we know.

interest here. Contrary to Hardin's framing of the issue as a prisoner's dilemma[9] and to the consequent view that common property should be controlled by the state (ibid.: 11), actors of a village know each other well and share resources within a web of shared norms and rules that guide their behaviour and enable the prediction of other people's behaviour (Haller 2002). Thus local institutions coordinate the actors' motivations and allow for cooperation instead of the egoistic depletion of a resource. Efficient institutions follow the rule of "restraint for gain" (Ruttan 1998, cited in Haller 2002: 10) and thus allow the sustainable use of a resource by several actors over long time spans. The use of a common resource is therefore highly dependent on the society and its web of institutions that determine the rules of the game. While most authors agree on this notion, the opinions vary in explaining how institutions evolve and change. Whereas Ostrom (Ostrom et al. 2002) believes in the possibility of actively crafting institutions and thus the possibility to enable institutions to be fitted according to needs, Cleaver (2001a) believes that institutionalization is not always a conscious process and can thus not be entirely planned or controlled.

The latter argument can be applied to the Moroccan context as well. A government like Morocco's can play a crucial role by delivering policies and laws, but it cannot guarantee the success of the institutions it is crafting, because the process of institutional bricolage is also influenced by local processes. That aspect of limited possibilities by national strategies is also raised by Cleaver and concerns the idea of participative development:

> "Discourses of participation are strongly influenced by the new institutionalism [...]. In participatory approaches institutions are seen as particularly important. Associations, committees and contracts channel participation in predictable and recognizable ways, the aim of many development interventions apparently being to establish community structures that most clearly mirror bureaucratic structures." (Cleaver 2001b: 39f)

She further argues that formalized institutions are considered to be more robust and enduring than informal ones, and that its advantageous characteristics include clearly specified user groups and boundaries. Participation is thus seen as the link, which allows for a "progression from traditional (implicitly 'weak') forms of management to modern (implicitly 'strong') forms [and is] considered desirable and [...] the focus of much 'institution building' in development" (ibid.: 40f, original emphasis). The reality of participative development is, however, often quite different:

[9] The prisoner's dilemma (PD) is a game-theoretical approach that tests the decision-making of two actors in a situation of incomplete information about the opponent. The application of this experiment in villages where the actors know each other does not work and hence suggests the existence of institutions that allow the prediction of behaviour (Ostrom et al. 2002: 12).

> "Even where a community appears well motivated, dynamic and well organized, severe limitations are presented by an inadequacy of material resources, by the very real structural constraints that impede the functioning of community-based institutions." (Ibid.: 46)

Furthermore, there is one link between New Institutionalism and Natural Resource Management which is placed in exactly this ground between formal and informal institutions: uncertainty. In chapter two I explain in how far climate variability is determined by uncertainty; but how does this connect to a theoretical approach to household water management? According to how institutions have been described above, they provide predictability and a specific structure in order to evaluate social behaviour. But in the context of uncertainty, such as the one surrounding water scarcity, institutions are challenged. Institutions need to be flexible and adaptive. However, Mehta et al. (1999) show that formal institutions, typically on the national level, are not designed for rapid and continuous adaptation to changing resource availability. Rather, adaptability is a typical feature of local institutions, which often are neither formalised nor adhere to an overarching policy. As environments change, the heterogeneous social setting within a locality is usually able to cope with this change: already before the implementation of water supply facilities rural households accessed water. In the process of institutional bricolage, institutions adapt to the new challenge by keeping old elements and integrating suitable new ones. The resulting values and guidelines are then able to adapt to these changes, and if they are not, institutions change and adapt again. Mehta et al. hence conclude that "local institutions matter" (ibid.: 29) in the context of increasing uncertainty due to global environmental change.

1.4. Conclusion: Limits and Chances of Research

Water withdrawal of rural households is rising despite an equally rising water scarcity. In this introduction, I suggested that not only external factors such as global environmental change, but also institutions play a crucial role in this setting and that the latter might be a starting point to understand why local water management is ineffective. An actor-oriented perspective allows for reaching an understanding of this phenomenon. Linking moreover the New Institutionalism to the notion of Natural Resource Management, it is furthermore possible to understand water institutions in the context of global environmental change.

But just as environments change and institutions adapt, so I had to adapt to a changing local reality. The description of methods above showed that conceptions and reality seldom match and that research, too, has to take into consideration uncertainties. This leads me to talk about the limits of research in the present study: On one side, two months of research are not long and surely don't allow for assuming an emic perspective of local water management. By approaching the problem from a western perspective – which I surely cannot avoid – I unwillingly argue in western terms of management efficiency and hence apply western concepts of evaluating the local options for action. I am aware of these undisputable elements and maintain an awareness of these limits by integrating them into my research. My role as an external and temporary researcher allows me to look at local water management from different angles and this might help in uncovering problems and also possibilities that create a new understanding.

Hence, by approaching the emic perception of water management in rural households through local accounts, while inevitably keeping a non-local perspective, this study tries to unveil the underlying constraints of water management and their inter-linkages. In applying not only a hydrological but also an anthropological approach, it is possible to translate distinct patterns of water withdrawal into options for local action in a long-term perspective.

2. The Geographical and Social Context

The kingdom of Morocco, al-Mamlakah al-Magribiyyah (ar.: or short *Al Magrib)*, is situated on the north-western edge of Africa (between 28° and 36°N – excluding West Sahara – and 1° and 13°W), borders both the North Atlantic Ocean and the Mediterranean Sea and is with its 458 730 km² the second smallest country of North Africa (Fig. 1.1). The kingdom features an antithetic geography: divided by the large Atlas Mountains that determine not only its climate – ranging from Oceanic humidity in the North and West to Saharan aridity in the South and East – most of the country suffers from water scarcity, despite being rich in water resources. Resource degradation, resulting among others from population growth and agricultural intensification, continues to deplete the country's freshwater, a prerequisite for development. It is especially the rural population on the periphery of the kingdom that is confronted with demographical, social and environmental change, and it is in this context that the present study is located: in the Middle Drâa Valley in south-east Morocco (Fig. 2.1).

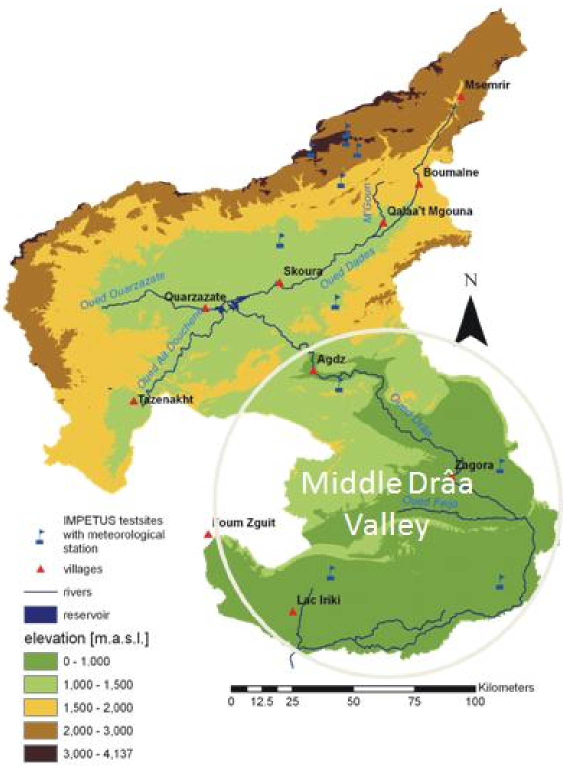

Figure 2.1: The Middle Drâa Valley, South-east Morocco (IMPETUS)

The Valley is part of one of the country's largest water basins, the whole Drâa catchment covering about 29 000 km² (Schulz 2007: 27), only small portions of which sustain water perennially. The Drâa itself begins on the confluence of its main tributaries Wadi Dadès, M'Goun and Ouarzazate, draining the High Atlas in the Province of Ouarzazate. It ends near M'hamid on the south-eastern border of Morocco with Algeria, in the Province of Zagora. Stretching from NW to SE for about 200 km, the Middle Drâa Valley includes six oases, thus separating the occidental from the oriental part of the Anti-Atlas. Its geography is variable and complex, strongly determined by arid climate and unpredictable successions of rainfalls and droughts. The disparity between the oases and the plains manifests itself in the demography of the Valley: the green riverbanks of the Drâa are densely populated and cultivated, in contrast to the arid steppe between the oases and the surrounding mountains: the *feija*.

Connecting the Sahara with the Atlantic and Mediterranean Coasts, the Valley has a long history of trade. Owing to its past it features a very diverse population: Arabs, Berbers and Blacks, peasants, nomads and former slaves shape until today the structure of its society. Despite hundreds of years of importance as a passage way, from an economic point of view the Drâa Valley was considered, until about 50 years ago, part of *Maroc inutile* ("useless Morocco") and was consequently neglected in development attempts, both during the French Protectorate and after. Except for the two bigger towns of Agdez and Zagora, the Valley is mainly rural and suffers from typical structural problems of rural areas in the developing world: its educational, health and water infrastructure is poorly developed, and its economy still highly dependent on irrigation agriculture, whereas industries or other sources of income for the rural population have not developed significantly. Due to the delayed national interest for and investment in the region, the resulting national (and international) labour migration accelerates urbanization, thus further contributing to demographical change. At the same time, migrants contribute to localized development in their hometowns, creating a dependency on remittances.

Water plays a major role in the people's life as it constitutes an element that connects the natural and the social environment. In the course of this chapter, I depict their interlinkages, first, by presenting some general elements such as climate, geology and land use (2.1). I focus on hydrology (2.1.1), which is among others influenced by global environmental change (2.1.2). In the following section (2.2) the demography of the Middle Drâa Valley is presented, with a focus on society and ethnicity (2.2.1) and on social and environmental change of the Valley within the last decades (2.2.2). The last section (2.3) is dedicated to the Ka'āba villages of 'Àfra (2.3.1) and Qsbat al-Ghamàd (2.3.2). In order to conclude the chapter, the last section (2.4) presents rural household water management against the background of water scarcity.

2.1. The Geography of the Middle Drâa Valley

The catchment of the Wadi Drâa (ar.: *oued*), can be geographically divided into three main parts: the upper catchment in the basin of Ouarzazate and the northern Anti Atlas, the actual Wadi Drâa in the Middle Drâa Valley and the lower reaches of the Wadi Drâa in the Pre-Saharan desert, which is dry most years due to high evaporation. The Drâa River constitutes a typical Wadi, determined by an ephemeral flow mostly originating from the

Atlas Mountains and dry during the summer months (Schulz 2007). Since 1972 the Drâa water is managed through the Al Mansour Eddahbi reservoir and the Wadi is only seldom filled with water and only for few days a year, for the purpose of irrigation.
One cause for the arid climate of the Middle Drâa Valley is its location in the south-east of the High Atlas and Anti Atlas that shade the Valley from the humid influence of the Atlantic Ocean. It is therefore not only the vicinity of the Sahara, but also the geology that shape the arid climate of this area. By shortly describing climate, geology, soils, vegetation and land use, I show to what extent the water availability determines and is determined by these natural and anthropogenic factors, which is further described in section 2.1.1.

Climate
The climate of the Middle Drâa Valley is classified as BWh, an arid and hot desert climate, according to the climate classification of Koeppen (Martin 2006, Ouhajou 1996). Precipitation in the Valley is low, following a gradient from North to South and from high to low altitudes: There is 118 mm yearly average precipitation in Ouarzazate, on the southern edge of the High Atlas (1115 m a.s.l.), 100 mm in Agdez (1100 m a.s.l.), in the northernmost of the six oases and only 58 mm in Zagora (713 m a.s.l.), halfway south of the Valley (Schulz 2007: 27f, Ouhajou 1996: 25). The precipitation is determined by a bimodal distribution and high variability: from April to August there is on average no precipitation at all, whereas the autumn, from September to December, is marked by rather intense rainfall; this constitutes the first precipitation peak. Two less humid months follow, January and February, while March constitutes the second precipitation peak.
In addition to very limited rainfall, the temperatures are those of an arid climate as well: ranging from only -7 to -1 °C in the cold winter period and averaging 40 °C in the hot summer period (Schulz 2007: 27), a high variability can be noticed again. The gradient effect is such that Ouarzazate has a yearly average temperature of 19.7 °C, whereas in Zagora the yearly average is 22.4 °C. This difference owes to the increasing influence of the Sahara from South to North and its hot, dry summer winds from the South (*Shirocco*) or the East (*Shergui*) (Schulz 2007: 21), as well as the barrier effect of the mountains (see below). In direct relation to precipitation and temperatures lies the evaporation, which varies strongly between the oases (3% of the surface area of the Drâa Valley) and the vast Hamada steppe (*feija*). The potential Evapotranspiration is on average 2900 mm (measured 60 km south of Ouarzazate), whereas the real Evapotranspiration equals the precipitation and is sometimes even higher, causing the capillary rise of water (Ouhajou 1996: 29ff).

Geology

The geology of the Middle Drâa Valley is determined by three out of five vast geologic structures in Morocco (Piqué 2001): the Anti and High Atlas and the Pre-Sahara. The High Atlas, being part of the Atlas Mountains, and the Anti Atlas are of different tectonic genesis: Whereas the High Atlas stretches from the Atlantic coast north of Agadir to the Algerian border in a WSW-ENE direction, its other part, the Middle Atlas, connects the High Atlas with the Rif Mountains in northern Morocco in SW-NE direction. South of this formation lies the Anti Atlas, divided from the High Atlas by the sedimentary basin of Ouarzazate in the East and the Souss in the West. The Anti Atlas stretches 750 km in WSW-ENE direction, thus parallel to the High Atlas and the Pre-Sahara on the Algerian border. On its eastern borders it ends in the sedimentary plains of *jbel* Bani (en.: mountain) and in its South it comprises a cuesta landscape ending in Saharan zones (Haaken 2008).
The Drâa river has cut its path into this geologic structure south of the central Anti Atlas, and marks the beginning of the Middle Drâa Valley (Fig. 1.2): the Drâa River crosses the Anti Atlas between *jbel* Siroua and *jbel* Saghro at 2500 m a.s.l., followed by the beginning of the first oasis and ending at each oases with a cuesta, that functions like a hydrological barrier, while the less resistant schist form depression zones called *feija*. These barriers distinguish each oasis as separate groundwater basins (Klose et al. 2008). The first oasis is Mezguita, enclosing the town of Agdez, followed by Tinzouline, the oasis wherein the research was conducted, after that follows the oasis of Ternata, with the provincial city Zagora, and then follows the oasis of Fezouata. The Middle Drâa Valley ends with the oasis of M'hamid at 450 m a.s.l, whereas the Drâa River continues through Lac Iriqi southwest of M'hamid and discharges into the Atlantic Ocean. However, since the construction of the reservoir Al Mansour Eddahbi, the Drâa never reached the ocean again (Busche 2008).

Soils, Vegetation and Land Use

The elevation gradually decreases from the *jbel* Bani towards the Pre-Sahara in the South of the Drâa Valley and along with the characteristic topography aridity increases. This affects soils and vegetation. While typical desert soils are prevailing in the whole Valley, there are localized differences. The *feija* are characterized by sandy soils with high skeleton contents, whereas the slopes comprise of shallow soils, with high contents of skeleton. The soils in the oases are influenced by loamy and loess-like river sediments, rather sandy and silty and almost free of skeleton (Klose et al. 2008).

Accordingly, the vegetation can be differentiated into three types. The Hamada steppe is dominating most of the Middle Drâa Valley, with interspersed dwarf-shrub Saharan rock communities. Acacia trees grow along periodical discharge beds and *Tamarix amplexicaule* grow at the oasis' and dunes margins (Finck and Staudinger 2002). Vegetation is rather sparse and degraded, also due to human activities: Not only is the broad denudation through wind and water a determinant of arid climate, but also the soil degradation due to deforestation, overgrazing and agriculture (Benbrahim et al. 2004, Benabid 1996).

Both pastoralism and irrigation agriculture constitute major land uses in the Valley. Pastoralism, which has dominated the land use of the *feija*, is subsequently marginalized from expanding agricultural land use onto these rather poor soils. While in the rain-fed agriculture of western Morocco this expansion through irrigation schemes has been possible without serious degradation, in the irrigation agriculture of south-eastern Morocco the cultivation of unfertile land outside of the oases is unsustainable, owing to high water needs but low productivity (Müller-Hohenstein and Popp 1990: 116ff). Furthermore, the increasing cultivation of water intensive cultures on the *feija* and in the oases accelerates land degradation. Whereas the typical three storey cultivation in the Middle Drâa Valley – consisting of date trees, fruit trees and lower growing plants (e.g. henna or beets) – has lost significance[10] (Pletsch 1971: 113ff), the focus on cereal cultivation has significantly increased (ibid.: 119). As a result of recurrent droughts, the agriculture of the Valley is nowadays highly dependent not only on surface water (e.g. through releases by the reservoir Al Mansour Eddahbi), but also on groundwater provided by privately owned motor pumps[11]. But thanks to low groundwater tables (2.1.1), it has been possible to expand production in the last decades, despite increasing aridity (see 2.2.2 and Benbrahim et al. 2004).

2.1.1. Hydro(geo)logy

The climate, geological structures and vegetation of the Middle Drâa Valley are thus reinforced, and impact themselves on environmental change in a complex net of mutual

[10] The loss of significance of this levelled system is also due to a fungus disease affecting date trees, called *bayoud*, which in the 1980s has caused the loss of many date palms. The loss of the covering level of the storeys has subsequently ceased productivity of the lower levels (Ouhajou 1996: 87f).

[11] Overall, in the six oases of the Middle Drâa Valley 26 000 ha are irrigated (Schulz 2007), and according to Ouhajou (1996: 164f) in 1977 there were already 2001 motor pumps, which were employed during the periods when the reservoir did not release water.

ascendancies that are closely linked to the hydrology of the region. The aim of the following section is to complete the geographical picture of the research area.

Morocco is the North African country with most water resources, and the Atlas Mountains play a major role in nourishing the country's many rivers. Besides this, water originating from snow constitutes a considerable additional source of water for the Drâa from spring to early summer (Schulz 2007).

The surface of the Middle Drâa Valley covers 15 000 km² (Klose et al. 2008: 180) and is since 1972 mostly controlled by the Al Mansour Eddahbi reservoir on the northern edge of the Valley. Therefore, the water discharge of the main tributary rivers Dadès, M'Goun and Ouarzazate is subject to management decisions and the Drâa River ceased to flood the Valley naturally. Ideally, an average total of 35 Mm³ water was to be released throughout five to seven releases a year from September to April (Busche 2008). But since the early 1980s this quantity was steadily declining due to long droughts in the Mid-1980s and 1990s, but also due to gradual sedimentation of the reservoir. Evidently, this led to a diminishing yearly number of controlled releases (*lâchers*) (Ouhajou 1996: 155f). In the summer, the riverbed remains empty, except for the part until Agdez, which marks the limit of the perennial fraction of the river and the beginning of the ephemeral flow. The surface water of the Wadi thus contributes to groundwater recharge only during the limited winter months, which for the whole oasis of Tinzouline approximates 950 000 m³ per lâcher (Haaken 2008: 72).

Water for household use is withdrawn solely from groundwater and thus depends on groundwater availability. Apart from surface water infiltration lateral afflux – depending on rainfall – from the southern mountain ranges contributes to groundwater recharge. However, a case study in the oasis of Tinzouline by IMPETUS staff showed that groundwater levels react sensitive to the usage of groundwater pumps for agricultural water use, which run every three to four days for two to four hours (Haaken 2008: 69). In irrigated areas the groundwater levels fall thus significantly and in direct relation to extraction rates of pumps, contrary to non-irrigated land or land outside the oasis (*kudya*).

Furthermore, as we have already seen in the introductory section, the geology of the Valley marks six different sub-catchments coinciding with the six oases (Fig. 1.2), in each oasis constituting similar hydrologic conditions. Each sub-catchment comprises a subjacent alluvial aquifer (Fig. 2.2), divided by quartzite tectonic limits forming gorges called *foum* (en.: mouth). The hydraulic conductivity of the aquifer is depending on the age of sediments: The permeability of the topmost sediments ranges between very high, high and medium, with a reduced hydraulic conductivity in the older layers. Weathered Ordovician schist are directly underlying the aquifers, featuring moderate to high permeability, which towards the fringes gradually loose permeability. The subsequent layer is comprised of unweathered bedrock, which is locally referred to as *sikh* (en.: hard rock). This layer is deepest under the oasis owing to the weathering capacity of water and gradually rises towards the mountain range. The hydraulic conductivity hence decreases towards the mountains formed by resistant sandstone and quartzite.

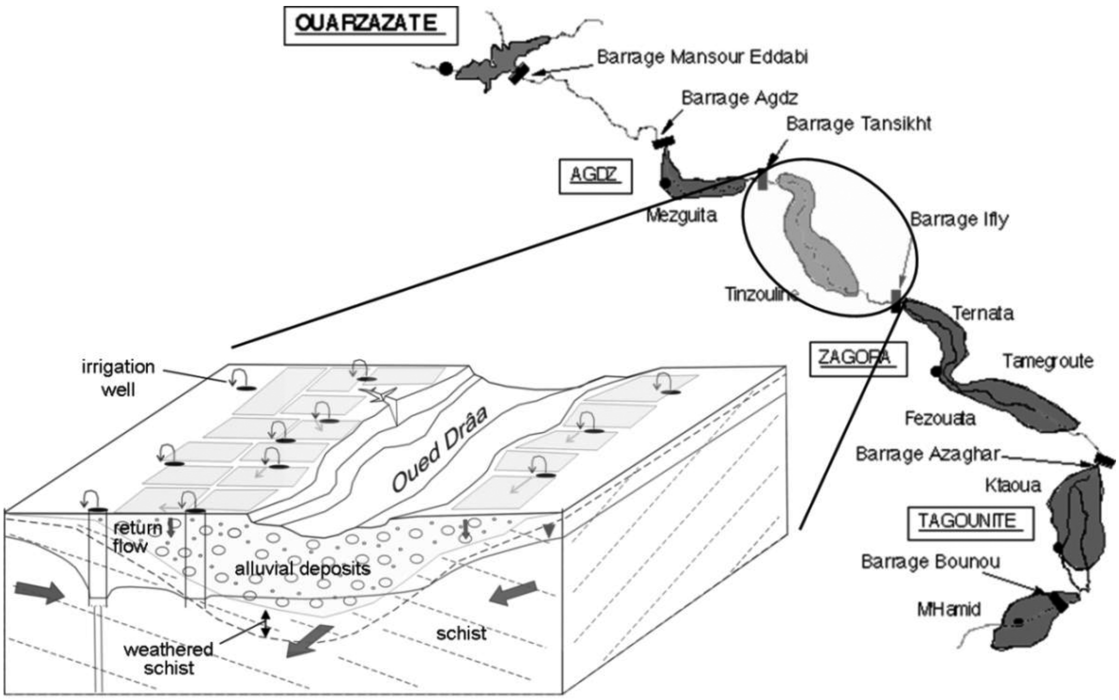

Figure 2.2: A Close-up of the Alluvial Aquifer of the Sub-catchment of the Oasis Tinzouline
(modified according to Klose et al. 2008: 183)

These sub-catchments are then connected in a cascade-like aquifer system, where the groundwater underflow follows the topographical gradient (Klose et al. 2008). As generally groundwater aquifers are shallow – on average not exceeding 10 m (Pletsch 1971: 43) – the withdrawal of groundwater through pumps is facilitated and impacts on this system by a negative groundwater recharge.

Another determining factor of groundwater use is the salinity, which constitutes another domain covered by IMPETUS research. The groundwater of the subsequent of the oases is hardly potable. But with increasing depth from the oasis surface the salinity of water decreased (cp. Haaken 2008). Even if the connections between hydrology and salinity are complex, it can be assumed that it causes a structural instability of the soils, leading to reduced yields and opening a vicious cycle of continuous salinization that has increased since its documentation began (Klose 2008: 37). Salinity gradually increases from the upper to the lower reaches of the Drâa (on average per oasis from 1.5 to 5 g/l) (Pletsch 1971: 45). The degree of salinity fluctuates widely with seasonal dominance of the tributary flows, the intensity of motor pump use or the alternation of *lâchers* and dry spells. In sum, the hydrology and hydrogeology of the Middle Drâa Valley are both shaping and being shaped by environmental change. Human action is closely linked to this process. By leaving the region of the Drâa Valley for a moment, the following section now elaborates the process of global environmental change.

2.1.2 Water Scarcity in the Light of Global Environmental Change

At least since the UN Summit in Rio de Janeiro in 1992, the discourse of global environmental change is supranational and determines the environmental debate. While the whole globe is influenced by very diverse effects of this change, it is especially the arid regions of the world which feel the negative impact most. With very high likelihood the Mediterranean region is going to be influenced by rising temperatures, decreasing rainfall and changes in runoff and water availability (Boko et al. 2007). In Morocco, water scarcity is coupled with fast population growth, and hence results in a total yearly water abstraction 50% above of the recharge rate of long-term freshwater resources (Boko et al. 2007: 441). Global environmental change has several effects on the Moroccan environment, of which the tendency towards warmer and dryer climate is probably the most severe (cp. Born et al 2008b).

This section provides a short overview of projections of future climate variability and its impact on water availability. It does not claim to be comprehensive, as outstanding studies are available on a global and regional scale (e.g. Parry et al. 2007, Hulme et al. 2001).

Inter-annual Climate Variability

The Intergovernmental Panel on Climate Change (IPCC) and many other studies have expounded the problems of complexity and uncertainty evolving from global environmental change, impinging on sensitive global climate circulation systems, such as ENSO or the North Atlantic Oscillation (NOA). These global changes will have effects on regional level as well, but the downscaling of environmental change has proved a particular challenge (cp. Hulme et al. 2001). Nonetheless, several attempts have been made, among others by IMPETUS, to project future climate variability for marginal regions. In this section, I describe possible changes impacting on the research area.

The aforementioned sections have already pointed at the impact of intra-annual climate variability, due to a bimodal rainfall distribution and high temperature amplitudes. But climate variability is significant also throughout several years, as the following two figures display. Inter-annual climate variability has always played a significant role in Morocco: wet years are followed by dry years in a rather unpredictable succession, which the

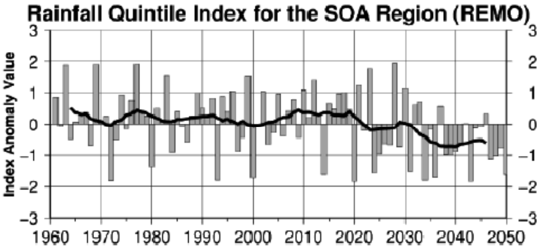

Figure 2.3: Rainfall Quintile Index, South of the Atlas (SOA), 1960-2050 (Born et al. 2008a: 40)

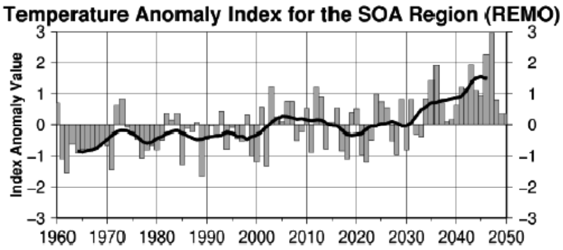

Figure 2.4: Temperature Anomaly Index, South of the Atlas, 1960-2050 (ibid.: 43)

occurrence of droughts in the 20th century shows: 1913-18; 1927-31; 1933-39; 1945-47; 1955-57; 1973-76; 1979-84; 1987; 1993-95 and from the beginning of 2000 until 2007 (Martin 2006: 51). Hence, the variability of climate is a familiar phenomenon in Morocco. Nonetheless, uncertainty about possible changes of climate variability is very high, especially south of the Atlas Mountains, due to the lack of complete long term data. Since 2000, the work of IMPETUS provided more reliable data for the region of the Drâa catchment and the resulting scenarios indicate a shift towards a yet dryer and hotter climate (Born et al. 2008a, Schulz and Judex 2008): Growing amplitudes of temperature and precipitation will very likely increase the occurrence of extreme weather events (e.g. droughts, heavy precipitation), while their predictability decreases. Figure 2.3 provides a good long-term perspective and projection of this tendency: precipitation reaches higher variability and then steadily declines from 2020 onwards. Figure 2.4 shows that temperatures rise from 2030 onwards, while their variability decreases.

Water Scarcity

The sections above showed that not only the future, but already the present is marked by water scarcity, which in an arid desert climate such as that of the Middle Drâa Valley determines rural households in most of their subsistence activities, throughout most of the year. In the following section I want to depict the possible effects of global environmental change on the water household in Morocco and the Drâa Valley in particular.

The total usable water resources (renewable and easily mobilised) in Morocco amount to 20 km³ per year, which is significant in comparison to other North African countries (cp.

chapter 1). The yearly total demand of water resources amounted to over 12 km³, which is considerably high (UNESCO 2004: 32). Concerning the per head withdrawal of water, Moroccans withdrew a total of 427 m³ freshwater in 2002 (ibid.), which is much higher than a 1995 estimate suggested for the year 2000 (381 m³ per year and head) (ibid.). However, most of these water resources are used by agriculture, especially for irrigation. IMPETUS research for the Middle Drâa Valley showed that agricultural water use amounts to more than 97%, while domestic water use ranges between only 1.5 and 2.5%. Industrial water use plays no significant role in the Valley (Klose, forthcoming).

To allow for a sustainable development of water and health infrastructure, it is essential to project future water availability. Arnell (1999) has made an attempt to project global hydrological regimes and water resources:

- decrease of 0 to 25 mm/year in average annual runoff by 2050
- widening magnitude, from -50 to -25%, of monthly and annual runoff (of a 10-year return period)
- most of Morocco will experience a decrease in low flows (more than 10% reduction)
- a shift from being a medium to being a highly water-stressed country by 2025

Bennani (2001, cited in Chaponnière and Smakhtin 2006) even projects a decrease of 10 to 15% in surface and groundwater availability.

These figures, however, are only projections and the uncertainty of coupling effects further complicates resource management. Given the high sensitivity of the resource to natural climate variability, environmental change will very likely have a strong impact on Morocco and decrease the amount of usable water. Pairing this change with the aforementioned impact of demographical and societal change in Morocco is subject of the following sections.

2.2. Society and Change

When such a fragile system encounters societal change it faces a great challenge. In order to allow for an understanding of the processes of societal change, it is indispensable to describe first the general demography of the Valley and the evolution of social and ethnic grouping in a historical perspective.

2.2.1. Blad al-Makhzan versus Blad as-Siba

Morocco is a fast growing country, with an estimated 34.8 M inhabitants in 2009 and a yearly growth rate of approximately 1.5% (CIA 2009). In comparison, in 1925 the country had only 12 M inhabitants (Pletsch 1971: 58). Today, over 99% of the population is Arab-Berber and 98.7% is Muslim, belonging to the branch of the Maliki within Sunni Islam. In 2004 more than half of the population was illiterate, of which 60.4% were women; rural areas being more affected than urban areas. Though Arabic is the official language (French being only the language of the educated urban population, of diplomacy and administration), 40% of the population speaks *amazigh*[12]. Since 1972 the country is a constitutional monarchy, and since 1999 it is governed by the hereditary king Mohammed VI together with an elected prime minister (El Fassi for the 2007-2011 legislature). The territory is divided into 15 administrative divisions; the Middle Drâa Valley is part of the Souss-Massa-Drâa division (DGH 2009).

Though the urban population constitutes half of the total population (56% in 2008; CIA 2009), the rural Middle Drâa Valley is overpopulated (Ouhajou 1996: 70ff). Its population more than doubled from 122 291 inhabitants in 1971 to 283 368 in 2004; the density in the oases reaches over 8 inhabitants per irrigated ha (ibid., Croisier 2009). This growth is typically explained with the intensification and extensification of the agricultural sector, the main economic revenue of the Valley.

There is a long historic division of the Moroccan state into *blad al-makhzan* and *blad as-siba* (en.: the government controlled land of the urban centres vs. the land of abandonment and dissidence of the mountainous areas and desert plains), which before the Protectorate also designated the border between tax-payers and non-tax-payers (Hart 2000: 9). Owing to this division, the rural populations have since independence been only slowly integrated into national development policies. This neglect of rural regions (including the Drâa Valley) is visible: in 2001 at least 25% of all rural households lived below the poverty[13] line, compared to only 12% in urban regions (Müller-Hohenstein/Popp 1990, Lanjouw 2004, World Bank 2001). Nonetheless, this 'abandoned' part of the country, which during the French Protectorate was also named *Maroc inutile*, because it could not provide the French settlers with spacious, empty land (Liebelt 2003: 23), has been contested for nearly

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[12] *Amazigh* is the umbrella term for three distinct Berber dialects, which exist in Morocco: *tarifit*, *tamazigh* and *tashelhit* (Müller-Hohenstein and Popp 1990: 57). According to Hart (2000), Berber is considered the aboriginal language of Morocco, though it reached a formal status as a taught language only recently, after the rise of a Berber linguistic and cultural movement since the 1990s.

[13] Poverty is defined by the World Bank as the minimum level of income necessary to meet one's daily needs. Nowadays, the poverty line is defined as 1.25 $ or 2 $ a day (World Bank 2009).

a millennium. While it was long inhabited by Berber-speaking tribal confederations that were semi-nomadic and maintained extensive trade on the fringes of the Sahara as well as irrigated agriculture in the six oases, the transitional character of the Valley attracted the central powers in the West. Without going back to the long history of the Valley (the first historic accounts begin in the 11th century), the influence of what Hammoudi (1985: 30) calls "the three-sided battle" (from the 17th until the 20th century) between the *Alawite* dynasty (centralized power), the alliance of the *marabouts* (Islamic influence) and the nomads (tribal confederations), has significantly shaped the Valley's society and its outcomes are felt until now. Since then the Islamization was complete (Herzog 1979) and a strong ethnical division and hierarchy developed, dividing until today the Valley's inhabitants into five clearly different strata.

The most prestigious group, the *shurafā'*, are the descendants of religious figures, closely followed by the *mrabtīn*, another group with religious ancestors. The *ḥrar* (free men), former nomads but since long sedentary and agriculturally active, make up the third stratum. All three have subordinated the *ḥaratīn*, the autochthonous black population of the Drâa Valley, and the *'abid*, the lowest group in this social hierarchy, designating slaves that were brought to Morocco from Sub-Saharan Africa through caravan trade (Hammoudi 1985: 31). The structure of the villages still shows evidence of these social groupings: the members of one group usually live in close vicinity within a rural settlement; some villages even consist of only one ethnic group (Pletsch 1971: 82ff).

Language provides further evidence of the diversity of social and ethnic groupings in the Valley. Nowadays, there are some exclusively Arab-speaking villages, others where two of the three Moroccan Berber dialects (*tamazigh* and *tashelhit*) are spoken, but in the majority of villages both Arab and one of the aforementioned Berber dialects are employed. Educated people, mostly in urban settlements, often speak French as well.

The Valley is thus in many respects a socio-ethnic melting pot in an area of Morocco that, though contested, was not at the centre of economic and developmental interest during the last century.

2.2.2. Linking Social and Environmental Change

In this section, the linkages between societal and environmental changes since the 1960s and 1970s are depicted. Though the Valley has always been changing and adapting to new political dominance, it was, according to Pletsch (1971: 196), the acceleration of the process of change that was significant.

In the beginning of the section I showed that the Valley was a contested passage way for trade, but when the French pacified Morocco, the Valley proved of no interest as a settling region (Müller-Hohenstein and Popp 1990: 94f). Even after independence, the Moroccan government concentrated on developing the West rather than rural dwellings in the South-east. The western agricultural plains (Gharb, Doukkala, Chaouia etc.) were extended and production intensified to serve domestic and even foreign demand (although food was scarce in the country's own periphery). Early structural adjustment programmes were conducted to integrate Morocco into international markets (Oubalkace 2007: 3), yet until the 1970s, the rural areas south of the Atlas Mountains were economically neglected and experienced hardly any development at all.[14] Only with the construction of the Al Mansour Eddahbi reservoir a first attempt was made to integrate and control the Drâa Valley. At the same time, internal changes in the Valley led to new economic and social constellations. With the sedentarization of the nomads by the 1950s (Pletsch 1971: 196f) and an agricultural intensification through motorized groundwater pumps from the 1960s onwards, the setting for the massive population growth within the oases was created (Ouhajou 1996).

When, during the early 1970s, the intensification and extensification of agriculture in the Drâa Valley began, (at last) aided by national agricultural programmes (e.g. the creation of ORMVA offices, see Croisier 2009 for further reading), production aimed at satisfying the growing alimentation needs: more land was cultivated, goat and sheep herds grew bigger and irrigation agriculture expanded. But this development was not adapted to local constraints in the South (Müller-Hohenstein and Popp 1990), the limited natural conditions were not allowing increased production and the social hierarchies were not ready to accept new forms of organization. Hence, these attempts mainly resulted in:

- the use of fertilizer and pesticides that impact negatively on groundwater quality
- an irrigation leading to the salinization of soils and the deterioration of groundwater quality and quantity
- overgrazing, causing the loss of vegetation cover and thus erosion

Aridity hence increased due to anthropogenic influence. This, and many other natural and anthropogenic factors (cp. Benbrahim et al. 2004, Müller-Hohenstein and Popp 1990,

[14] Müller-Hohenstein and Popp (1990: 114f, (emphasis in orig.) also speak of the 'modern' and the 'traditional' agricultural sector, which equals the division of *Maroc utile* and *Maroc inutile* made by the French. Modern farms are designed for market production and export, whereas traditional farms are small enterprises for subsistence, following Islamic ownership rights and use traditional tools (e.g. mule ploughs). By not integrating the latter areas in national development projects such as large irrigation schemes, the marginalization of the rural regions south of the Atlas was reinforced.

Swearingen and Bencherifa 1996) resulted in the increased degradation of the Valley's resources. The now faster successions of droughts further damage the environment. The loss of the means of subsistence by many households who relied on agriculture has caused the doubling of labour migration at the beginning of the 1990s[15] and led to the emptying of villages. Because of the semi-abandonment of plots[16] as well as the complicated land and water rights (cp. Hvezda 2007), traditional irrigation water management could not be maintained properly and the remaining farmers face further difficulties (Ouhajou 1996: 74ff). Moreover, the loss of young male adults to migration implies also the loss of the group which would, according to the new national strategy since the 1990s, be the leading figures of the participative development approach in rural areas. Their remaining wives have, beyond the usual 12 to 14 hours of work and the additional burden of childcare, no time and often lack the education to do engage actively in development projects (Aït Hamza 1997: 85, Pletsch 1971: 221).

Societal and environmental changes are thus highly intertwined and have mutually reinforced each other (cp. also Casciarri 2008). It was only in the mid-1990s that first attempts to develop infrastructure (health, education, water and sanitation) have been made in these shrinking villages (Bzioui 2004), e.g. through national drinking water supply programmes (i.e. PAGER in 1995, chapter 3).

2.3. The Research Sites

The two villages of 'Àfra and Qsbat al-Ghamàd which constitute the empirical basis for this work are situated in the second oasis of the Middle Drâa Valley, Tinzouline. Beginning at the *foum* Tansikht and ending at the *foum* Azlag, the oasis stretches for 48 km on a strip no wider than 3 km, making it the longest of the six Drâa oases (Ouhajou 1996: 20). According to Ouhajou (ibid.: 68ff), in 1982 there were 28 922 inhabitants living in the oasis of Tinzouline, distributed over 3 473 households and 71 villages (*diour*). The main town of the oasis, Rbat Tinzouline, accounts for half of the population (15 452 inhabitants). Because most of the population lives along the thin strips on the riverbanks of the Drâa, there are high densities per irrigated ha. In Tinzouline this means 7.9 inhabitants

[15] The out-migration of the Valley is closely linked to the socioeconomic weakening of rural households. Though labour migration has been practised since Independence by men of the Drâa Valley to gain an additional income for the remaining family through (mostly unskilled) labour in Moroccan cities, new migration accounted for only 15 to 30% from 1960 to 1989 compared to almost 70% new migrants from 1990 onwards (Rademacher 2008).

[16] According to Pletsch (1971: 220) the plots were not abandoned in the proper term, because if a plot is not cultivated for seven consecutive years, the ownership is lost. Most migrants rely thus mostly on the remaining families to maintain the property, but in recent years, also owing to the fungus disease *bayoud*, more plots are actually abandoned and more *whole* families migrate out of the Valley (Aït Hamza 1997).

live on one irrigated ha (in 1982), which constitutes the second largest density in the Drâa Valley after Mezguita. The average household size was of eight people in 1982, and each village had on average 407 inhabitants (ibid.).

The two villages of ‘Àfra and Qsbat al-Ghamàd are two out of eight *diour* in which Arab is the only spoken language, the others being the Ka'āba villages of Timkshad, Zaouite al-Fagouss, Ouled Ahmed ben Ali, Zaouite ben Talib, Ouled Yaoub and Taghzout, beginning 35 km north and ending 24 km north of Zagora[17]. In 2007, the Ka'āba had 4 656 inhabitants living in 486 households (Province de Zagora 2007). They constitute an administrative unit within the *Commune Rurale* (CR) of Tinzouline (*qiyāda*) and therein are the dominant ethnic group. Most households are closely interwoven by descent.

The history of the Ka'āba villages has many versions, but according to Rademacher (2010), who cites the local *shaykh* Abdellah Amine, the Ka'āba are a fraction of the Arab tribe of the *ouled* Yahia, one of the biggest tribes which is still present in the Drâa Valley. Four centuries ago, the nomad tribe of the *ouled* Yahia came from the Anti Atlas to the Drâa Valley and arranged guard contracts with the local farmers, which resulted in the fraction's sedentarization in 1916 (Rademacher 2010) (on guard contracts cp. also Pletsch 1971: 71). The autochthonous (Berber or Arab) *drawa*[18] have remained in the villages despite the installation of the Ka'āba and people still refer to their distinct origins and traditional social divisions (2.2.1). Until the 20th century, the identification with one of the groups was reason for conflicts over land and water, which dominated the political life of villages. Today only minor conflicts arise, as the affiliation with specific ethnic or social groups has slowly faded.

2.3.1. ‘Àfra

‘Àfra, formerly also called Ouled as-Soultan, lies 30 km northwest of Zagora, adjacent to the main road of the Drâa Valley, in the South of the oasis of Tinzouline (N 30°28.505, W 6°02.279; 790 m a.s.l.). The village has a compact structure (cp. Appendix C1) and most houses feature the typical dried clay and straw construction, some compounds have also elements of cement. There is no green (trees, bushes etc.) within the small village and there is also no central square or meeting place except for the mosque, which is still under

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[17] The exact location of villages in Morocco is done by marking the km on the asphalt road until the next bigger administration or city.

[18] The term *drawa* refers in different literature to either the black *ḥaratīn* or to the autochthonous inhabitants of the Drâa Valley. With Rademacher (2010), in this work *drawa* designates the autochthonous farmers of the Drâa Valley without necessarily referring to *ḥaratīn*. Nonetheless, in ‘Àfra some inhabitants called themselves both *drawa* and *ḥaratīn*.

construction and had no roof until my last visit in May 2009. There is no shop for daily needs in ‘Àfra itself. Most people practice some irrigation farming and further rely on one of the markets in the bigger settlements (e.g. Rbat Tinzouline). The agricultural land of the village lies within the oasis in the North and borders the Drâa River on the left riverbank.
According to a census by the Province of Zagora (2007), ‘Àfra has 277 inhabitants living in 31 households (according to my own data, in 2008/2009 there are 30 households and 288 inhabitants). The main source of income is irrigated agriculture (mostly barley, wheat and dates) and husbandry. The empirical data I collected in 2008 and 2009 revealed that those households who own land, own on average 6.5 plots.[19] However, six households do not own any land, but work as labourers (*khammās*) on rented plots or do not work in agriculture at all. According to the 2007 census of the Province of Zagora, 39.7% of the population is illiterate, of which 71.8% are females[20]. ‘Àfra is connected to the electricity grid and has a tap water system (*Système d'Alimentation en Eau Potable*, SAEP) since October 2008, which is managed together with the neighbouring Ka'āba villages of Ouled Ahmed ben Ali and Zaouite ben Talib by an association called *Association d'Usagers* (AU, en.: User Association).
According to my own data there are several ethnic groups in ‘Àfra. 16 households are Arab of six different lineages, ten are *drawa,* and four households, belonging to the same lineage, are Arab-speaking Berber. In the South, typically several households are grouped in one lineage and have their origins in a same village as well. In ‘Àfra there are three households that are from another Ka'āba village and belong to non-local lineages. The political representative chosen by the *qiyāda* of Tinzouline, the *muqaddim*[21], who represents both ‘Àfra and Qsbat al-Ghamàd, lives in ‘Àfra. Despite the influence of the state since administrative reforms in the 1960s (see also 3.3), local politics are still represented through traditional interest groups (*firaq, sg. firqa*) and their representatives (*mu'ayyanīn*) in a village council (*jma'a*). Though this institution lost significance since then, its four members still take important political positions. In the future, however, these representatives might find no successors, as labour migration drains the village: 19 households have at least one male member who migrated to a Moroccan city or abroad.

[19] Owing to local land right customs the *number* of plots is a more valuable information then the plot size (on average smaller than 1 ha, one farm owns in on average 1.6 ha; Heidecke and Schmidt 2008).
[20] During both field trips there was a one year alphabetisation class taking place, which was visited by most women of the village. But it was followed sincerely only by the younger women.
[21] The position of the *muqaddim* is typically given to a local person of higher economic status and independency through the nearby *qiyāda*. He deals with disturbances and small crimes and serves as organ of the government in the village. This institution exists since Independence and results from the desire of the government to control the remote rural areas. Nonetheless, the traditional political organisation of the village council (*jma'a*) is still active (Rademacher 2010).

2.3.2. Qsbat al-Ghamàd

Qsbat al-Ghamàd lies 32 km northwest of Zagora in the South of the oasis Tinzouline (N 30°28.425, W 6°03.985; 780 m a.s.l.) and is visibly divided from the neighbouring Zaouite al-Fagouss – also a Ka'āba village – only through the main road and a central square between the two villages (cp. Appendix C2). In contrast to 'Àfra, Qsbat al-Ghamàd is not compact but compounds spread over several hundreds of meters across the rocky plain, south of the road. Like in 'Àfra, most compounds are constructed of clay and straw, but there are visibly some richer households next to the street, which are completely built in cement. The cultivated plots lie on the other side of the street, north of Zaouite al-Fagouss. The two adjacent villages share a mosque in Zaouite al-Fagouss and there is a small shop for daily needs in Qsbat al-Ghamàd itself. The Monday market of Tinzouline is 5 km northwest of the village.

According to my empirical data, there are 261 inhabitants living in Qsbat al-Ghamàd, in 33 households of an average size of 7.9 members. The 2007 census[22] indicates that the main source of income is husbandry and agriculture, barley and dates being the staple products. On average farmers own three plots – only half as many as those of 'Àfra – and there are nine households who either rent a plot or do not farm at all. According to the 2007 census, illiteracy amounts to 30.3%, of which 70.4% are women. Qsbat al-Ghamàd is connected to the electricity grid and since 2001 it has a tap water system, managed by an AU that is also composed of members from Zaouite al-Fagouss and Timkshad – another Ka'āba village on the other side of the Drâa River.

The results from the two field trips in 2008 and 2009 point out that Qsbat al-Ghamàd is ethnically homogenous: all inhabitants are *ḥrar* (s. 2.2.1) and originally belonged to the Arab *ouled* Yahia.[23] The results also indicate that there are three major lineages and several smaller lineages, as well as some newcomers without any family ties in the village. Politically, there are four representatives of the *firqa*, which still take local leadership roles, for instance in water management. But in this village migration is also changing the social organization; one member is not permanently living in Qsbat al-Ghamàd anymore. Migration affects 27 households, leaving only six households not affected.

[22] The 2007 census by the Province of Zagora considere Qsbat al-Ghamàd and Zaouite al-Fagouss as one village, the census data are thus the avergage of the two villages.

[23] Interestingly, the adjacent Zaouite al-Fagouss is mainly inhabited by *shurafā'*, descendants from the prophet Muhammed.

2.4. Conclusion: Rural Household Water Now and Then

This chapter showed that the diversity of climate, environment and society at large add to an accelerating process of change, causing new challenges from the national to the local level. As rural household water management involves all aforementioned elements and is constantly confronting their implications, I end this chapter by shortly introducing the management of household water.

Rural households in the arid South-east of Morocco have always been facing water scarcity, but for centuries the inhabitants were able to provide themselves with sufficient water for survival. Typically, the supply is guaranteed through draw wells in the vicinity of several households. Women and young girls manage the water storage and usage, as well as its actual procurement. Much time and physical effort is devoted to providing the household with water for cooking, drinking, cleaning and washing. Seasonal variability in water availability greatly influences water management. As a result of these struggles, rural people established adequate ways to deal with unpredictable natural conditions, and manage and sustain the scarce resource. Since some decades, however, these mechanisms are challenged by numerous external and internal changes, including a steady resource degradation, fast population growth, agricultural intensification and national policies, which all call for the renewal of these systems and their institutions.

3. Institutional Constraints

Against such background, the installation of tap water only a few years ago appears not as the beginning of access to potable water, but rather as an improvement of water facilities (cp. Eguavoen 2008). Conversely, in most instances, the quality of the resource has changed only slightly. It is rather the ease of access to water that has improved. Furthermore, no complete replacement of the wells in favour of tap water has taken place; instead, a mixture of both facilities dominates. But with improved access water withdrawal often rises, despite decreasing water availability, and water institutions in 'Àfra and Qsbat al-Ghamàd seem unable to respond adequately to these changes.

The present chapter illustrates the institutional constraints which influence the inhabitants' actions in the domain of drinking water. The relevant institutions are depicted according to their implementation levels, ranging from the national to the local level. The chapter begins with an introduction of Moroccan water policy (3.1). In the following section, I illustrate how the new national approach is implemented in the drinking water supply programme PAGER (section 3.2). I present the local level of water management and its organization by shortly depicting the User Association (section 3.3). The conclusion of this chapter evokes the critical role and deficiencies of institutions in the villages (3.4).

3.1. National Drinking Water Policy

As was stressed in section 1.3.1, institutions have to be seen in their historical evolution and hence I begin this section with a historical overview of national water management (3.1.1). After that, a presentation of recent drinking water laws (3.1.2) and future national water demand estimates follow (3.1.3).

3.1.1. Historical Perspective on Water Management

Household water management is closely linked to the evolution of agricultural water management, and the latter has constituted a major element of agricultural reform since the early Protectorate (see also chapter 2). As a consequence of failed wheat growth in the 'useful' western plains of Morocco (fr.: *Maroc utile*) during the 1920s, the French settlers tried to improve agricultural production through large scale irrigation (Müller-Hohenstein and Popp 1990). Due to this new policy, large scale irrigation became a major topic in the French administration in the 1940s and started what Ouhajou (1996: 136) calls *la politique des grands barrages* (en.: politics of large scale reservoirs). Due to fast population growth but slow agricultural output growth in the subsequent years, particularly in the peripheral regions of Morocco, emerging hunger crises resulted in the migration from rural to urban regions or even abroad. Nonetheless, the Moroccan water policy continued this strategy after Independence (1956), when 14 large dams had already been constructed by the French. For long, the focus of this strategy was solely the West of the country and it was only at the end of the 1960s that socially motivated reservoir construction replaced economically motivated construction, reacting to the demographic pressures resulting from migration and population growth at last (ibid.: 140). This pressure further increased, when water availability severely decreased also in western cities such as Casablanca and Rabat during the 1960s (Hajji 2006). At that time, King Hassan II personally took interest in water management, and since 1969 the King is president of what is now called the *Conseil Supérieur de l'Eau et du Climat* (CSEC)[24] thus effectively promoting national water management (Liebelt 2003: 17; Hajji 2006: 69). The construction of a reservoir supplying the Drâa Valley, named Al Mansour Eddahbi, was an attempt to fulfil the social aspirations of the *politique des grands barrages*, while concomitantly the creation of the *Offices Regionaux de Mise en Valeur Agricole* (ORMVA) throughout the country aimed at enhancing state control in the regional agricultural sector (Ouhajou 1996). At the same time (1972), in the domain of drinking water, the creation of the *Office National de l'Eau Potable* (ONEP) was a first step towards acknowledging the need to manage potable water (Hajji 2006).

While in urban areas the ONEP improved access to safe drinking water during the following 30 years, connecting 85% of all urban households (ibid.: 61), there was no improvement in drinking water infrastructure in the 'useless' rural Morocco until the 1990s; quite the contrary, poverty and hunger even increased when droughts ravaged the whole country (ibid.: 70). The *politique des grands barrages* had failed and people remained left to their own resources.

3.1.2. Current Institutions of Drinking Water Management

Not only did Moroccan policies fail to achieve ample access to water and sanitation: Even on a global scale the 1980s were an unsuccessful decade in improving the access to water for marginal and poor regions. Consequently, during the UN Conference on Environment and Development in Rio de Janeiro in 1992, the global scientific community called for sustainable but fair resource management. In the water sector, the Integrated Water

[24] It is not clear when exactly the CSEC has been created, as all available documents state a different year, ranging from 1969 to 1995. I assume that the CSEC has existed since 1969 and since then experienced several shifts of meaning and structure. Its present role was most likely defined in 1995, with the promulgation of the new water law (cp. Ouhajou 1996; Hajji 2005; Martin 2006; Croisier 2009).

Resource Management (IWRM) approach proved to be a viable way to sustainably couple water management with socioeconomic development (Doukkali 2005).[25] The IWRM approach is based on four principles, called the Dublin principles (GWP 2000: 12f):

(1) Freshwater is a finite and vulnerable resource

(2) Water management should base on a participatory approach

(3) Women are central in managing water

(4) Water has an economic value

The IWRM approach promotes a demand-led water management by focussing on the specific needs of a region, instead of a supply-led approach, dominant until then (Cleaver and Lomas 1996).

It is against this background that one has to view the promulgation of the new water law in 1995 (fr.: *Loi N°10-95 sur l'Eau)*, which redefined the functions of different water organizations and created new ones along with the four Dublin principles. The Moroccan government recognized that water is a main element of socioeconomic development, health and education[26] and reacted to the worsening situation in the periphery with a new policy (Royaume du Maroc 1995; Hajji 2006). In the domain of drinking water, the *Loi N°10-95 sur l'Eau* aimed at integrating all water users in separate units of hydraulic basins supervised by autonomous *Agences des Bassins Hydrauliques* (ABH) (Royaume du Maroc 1995: 637f; see below). Water was therein declared a public good (fr.: *domanialité publique*) as Islamic law prescribes it[27], and its public use became subject to the administration on national level. Moreover, the distribution at the communal level according to a rational demand-led approach was introduced. In this law, the role of potable water for human development is mainly expatiated with reference to water quality, e.g. through declaring protection zones around water facilities (Royaume du Maroc 1995: 650). According to several authors (Bzioui 2004, Doukkali 2005), the new water law represents an overall progress for the Moroccan water sector, mainly through decentralizing its management, which is apparent from the organization of water management at various levels.

[25] For a detailed account of goals and scopes of the IWRM approach see GWP 2000; and Loucks et al. (2005) for the evolution, methods and application of this approach.

[26] Though schools have existed in rural regions since Independence, it was mostly boys attending classes, while girls of the same age were occupied with fetching drinking water. Before the installation of tap water, this was a time consuming duty and consequently, most girls had no time to go to school (World Bank 1997).

[27] However, water which before the new law was in private ownership remains so after the promulgation of the law. This responds to traditional water law and accounts for the complex water rights, which are still persistent in the irrigation management of the Middle Drâa Valley (Croisier 2009: 62; Hvezda 2007).

National Institutions

Since the decentralization of water management, there are several institutions that have become less relevant for national water management (cp. SEMIDE Maroc 2009 for further institutions). I present only those organizations that still play a major role; these can all be conceived as "specified institutions", or organizations, according to Hodgson (2006).

Within the frame given by the *Loi N°10-95 sur l'Eau*, the drinking water sector is headed by the *Conseil Supérieur de l'Eau et du Climat* (CSEC) which acts like an advising council for national, regional and local institutions (Fig. 3.1). Water as a natural resource is just one of the CSEC's domains; the body also engages in other environmental issues such as climate, desertification and agriculture.

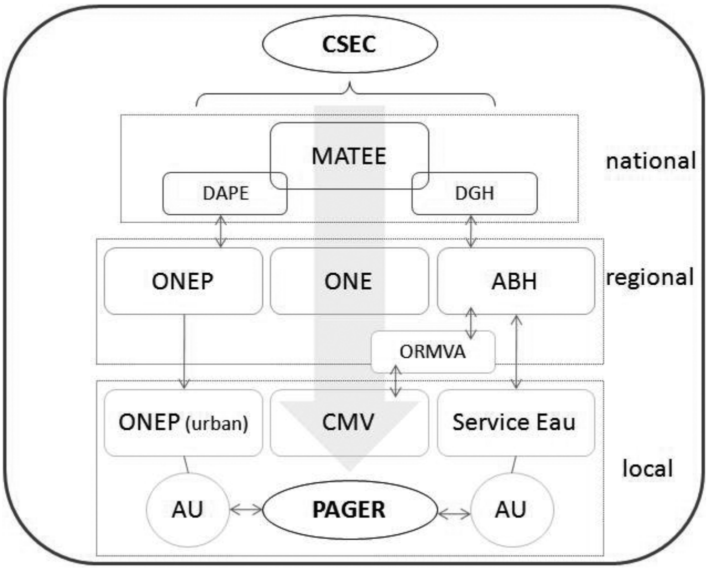

Figure 3.1: Environmental Institutions in Morocco

At the national level there are three institutions represented in the CSEC: the government is represented through the *Ministère d'Aménagement du Territoire, des Eaux et de l'Environnement* (MATEE) – in Morocco often referred to as the *Ministère de l'Interieur et de l'Equipement* (MIE), because the latter is heading the MATEE; the environmental early-warning system (*Dispositif d'Alerte Précoce Environnement*, DAPE) and the *Direction Générale Hydraulique* (DGH). The latter two organizations exert significant control through general management plans and technical guidelines and are thus of more direct importance for water management than the CSEC.

Regional Institutions

The main regional institutions are the *Agences des Bassins Hydrauliques* (ABHs) – the Middle Drâa Valley belongs to the ABH Souss Massa – the *Office National de l'Eau*

Potable (ONEP) and the *Office National d'Electricité* (ONE). Each of these organizations is financially autonomous and accountable to the MATEE. ONEP was created in 1972 and remains an important regional and even local actor (see below). The 16 ABHs in Morocco are the result of the 1995 reform, which are coordinated through the DGH. The main function of the ABHs and the ONEP is to plan and implement water management projects; and in the case of the ABHs also to evaluate their proceedings through a *Plan Directeur d'Aménagement Intégré des Ressources en Eau* (PDAIRE) which is issued separately by each ABH.
In the domain of agricultural water management – still the largest branch of water management – there are the aforementioned regional agricultural offices (ORMVA), with their local branches (see below). They act between the regional and local level and their role is to sustainably manage irrigation water and increase agricultural production (SEMIDE Maroc 2009).

Local Institutions

At the local level there are three institutions which are accountable to their regional counterparts: the local offices of the ONEP (mostly in urban settlements), the *Centres de Mise en Valeur* (CMV) of the ORMVAs for agricultural matters, and the *Service Eau*, which works essentially in rural settlements, but has an office only in Ouarzazate.
The truly local organizations are the *Associations d'Usagers* (en.: User Associations, AU) which are associations formed by villagers managing a tap water system installed through the water supply programme (PAGER). The role of these local institutions is picked up later in this chapter (3.2 and 3.3).

3.1.3. National Estimates of Future Water Demand

The current national water management and policies rely on the projection of future water demand according to the IWRM approach. Herein, all projections clearly differentiate between urban and rural milieus: There is an estimated absolute increase in water demand in urban settlements, including larger towns in the more remote regions of the country (fr.: *Centres Chefs Lieux de Communes Rurales*, CLCR), and a decrease in those areas that are expected to lose inhabitants due to migration, mainly the rural peripheries.

Table 3.1: Estimated Water Withdrawal, Urban Settlements (in Mm^3 per year; Hajji 2006: 73, my translation)

Years	2000	2010	2020
Large cities	705	901	1165
Medium cities	135	160	166
Small cities	60	61	58
Total	900	1122	1389

Table 3.2: Estimated Water Withdrawal, Rural Settlements (in Mm^3 per year; ibid.: 74, my translation)

Years	2000	2010	2020
CLCR	40	41	48
Dispersed villages	361	346	324
Total	401	387	372

As shown in tables 3.1 and 3.2, in large cities ('large' was not further specified) water demand was 705 Mm^3 in 2000 and is projected to rise to 1165 Mm^3 in 2020, while in small cities demand is expected to slightly decrease from 60 Mm^3 in 2000 to an estimated 58 Mm^3 per year in 2020. The same bias between large and small settlements holds true for the rural milieu: administrative centres (CLCR) withdrew 40 Mm^3 in 2000 and are projected to increase demand to 48 Mm^3 per year by 2020, whereas dispersed villages (*diour*) withdrew 361 Mm^3 water in 2000 and are expected to withdraw only 324 Mm^3 per year in 2020. These figures highlight the problem of distribution at the national level as well as the urban-rural disparity, discussed in chapter two; both issues remain pressing and unsolved even after the reform attempts of 1995.

Other national sources (DRPE 1998b: 18) suggest for the year 2010 an average daily water demand of 25 l per head and day by rural households for human needs, and for livestock additional 6 l per head[28] and day. Interestingly, 25 l represent the minimal daily need of water per person, which the World Health Organisation (WHO) claimed necessary to maintain a sustainable livelihood, which is only 5 l more than what the WHO considers necessary for human survival (UN Water 2006: 35).

Yet other sources suggest much higher demand of water, varying widely across the existing facilities (i.e. draw well, water point or domestic tap). For the Middle Drâa Valley it was calculated that in 1995 rural households withdrew 17 to 23 l per head and day if only access to water through draw wells was available and 20 to 38 l per head and day in villages that disposed of a SAEP (Martin 2006: 97, citing SOGREAH). In comparison,

[28] The term 'per head' is not specified and can thus not be easily translated into a standard taxonomy. It is most likely based on small livestock like goat or sheep, the main livestock in rural areas. In this study I work with the TLU (Tropical Livestock Unit). 1 TLU = 250 kg livestock (cp. Pallas 1986).

urban households in Zagora that have access to tap water provided by the SAEP, were estimated to withdraw 60 l per head and day in 2005. These numbers essentially reflect the demographic changes in the Drâa Valley that I have presented in chapter two. Needless to say that there is a correlation between tap water facilities provided by the SAEP and rising water withdrawal (cp. chapter 4).

In sum, these numbers give an idea to what extent there is great confusion on actual water demand for rural areas and especially national water policy lack appropriate data, thus resulting in wrong demand estimates: Water supply programmes in fact base their project plans on an estimated rural water demand of 25 l per head and day (World Bank 1997).

3.2. PAGER

Above I explained that the ONEP and the 16 ABHs are the main regional actors in the institutional setting and both carry out drinking water projects in rural areas. They operate thus as intermediate organs between the national and the local water institutions. Their tasks include the provision of potable water throughout the Kingdom, and where communities request it, but also the coordination of all potable water projects and regular pollution controls. The ONEP reached financial autonomy in 1995 and has by then been able to provide a stable water supply to the urban and peri-urban areas throughout the country. The rural areas, however, were still insufficiently equipped with safe access to water (Bzioui 2004: 50f; World Bank 2009). The ABHs, in contrast, are active in the whole water sector.

In line with the new water policy and the recognized need to supply water to rural populations as well, the *Programme d'Approvisionnement Groupé en Eau Potables en Zones Rurales* (fr.; short PAGER) – a national master plan for the installation of tap water systems (*Systèmes d'Alimentation en Eau Potable*, SAEP) – was launched in 1995.[29] Whereas in 1992, before the implementation of PAGER, only 14% of all rural households had safe access to water, in 2001 already 48% disposed of a safe access provided by PAGER; in the Province of Zagora the percentage was 59%, above the national average of rural tap connections (DGH 2009).

In the 1990s, PAGER was the only rural water supply project and it still remains the biggest national programme to supply rural regions with potable water. PAGER is financed

[29] The landscape of water supply projects is wide and nowadays there are several other strategiers providing drinking water to rural populations, e.g. through output-based aid approaches (see Chauvot de Beauchene 2009 and AfDB 2006). But they do not concern the Middle Drâa Valley in particular and hence will not be mentioned further in this study.

by national funds in collaboration with several international donor organizations, including the World Bank. It was implemented during a first phase from 1995 to 2001 and a second phase beginning 2002 countrywide and ending 2004. However, the PAGER projects in the southern provinces (including the Province of Zagora), which were mostly financed through Luxemburg and Belgium, were subject to a third phase from 2004 until the end of June 2009 (Lux-Development 2009). The general secretary of the MATEE coordinates the programme, while the executing institutions at the local level are embodied in the Service Eau and the ONEP (DGH 2009).

PAGER focuses on different water facility structures, such as public or domestic tap water points, and water is either supplied by local water towers or by water towers from nearby villages, according to the best available quality and quantity (Martin 2006). Wells that supply these central water towers are generally equipped with electric, thermal or fuelled motors. Due to the falling groundwater tables throughout the Valley, the groundwater availability decreased significantly in the last four to six years (ibid.: 95). Many newly installed SAEPs can only few years after their installation not satisfy the demand.

The project relies on three implementation strategies (World Bank 1997) which adhere to the IWRM approach:

(1) Participative rural appraisal

(2) Cost-effectiveness

(3) Local institutions such as User Associations

Through (1) PAGER attempts to include all inhabitants of a *douār* in the whole process, from planning to actual water exploitation, and thus aims at the creation and empowerment of local institutions. This manifests itself in that project requests have to be made by the village (or a representative) itself. This approach is widely accepted in development programmes, as it allows for a more direct interaction of local actors with external institutions (for further reading see Chambers 2007, Krüger and Lohnert 1996). The economic approach envisaged in (2) is implemented through a division of expenses, including local participation: yearly international contributions amount to 2 B DH[30], the Moroccan state invests 250 M DH, the rural administration – usually the *Communes Rurales* (fr.; CR; e.g. CR of Tinzouline) – contribute with 15% of the costs of one SAEP and 5% are paid by the participating *douār* itself (World Bank 1997). Strategy (3) aims at creating local institutions to manage the SAEP: During the implementation phase there are professionals from either the ABH or the ONEP supporting the process, but five years after

[30] At the time of my research, one Moroccan Dirham (DH) equalled approximately 0.09 Euro (Source: http://www.oanda.com/convert/fxhistory (04/10/09).

the inauguration the SAEP is handed over to local AUs. The professionals also help in founding the AU and in building up the required management and technical skills among its members (DGH 2009; see Appendix A1 for PAGER project implementation sequence). PAGER thus implements the national objective of decentralizing water management in creating local water institutions.

3.3. Local Water Management

In 'Àfra and Qsbat al-Ghamàd there are several institutions structuring the village life and to some extent coordinating social behaviour. Before introducing the local User Associations (fr.: *Associations d'Usagers*, AU) as a particular water institution, I present and interpret some of the major institutional settings that shape the politics of rural settlements in Morocco and affect local water practices.

General Institutional Setting

In chapter two (section 2.3.1) I demonstrated that the local political setting is influenced by the central government through a regional *qāid*, a *shaykh* and an appointed *muqaddim* (in descending order). The village's politics were a purely local matter of the village council (ar.: *jma'a*) (Venema and Mguild 2002) until the reorganization of the administration in the new national constitution of 1962 eroded many aspects of local governance and made the *jma'a* accountable to the state (Ilahiane 2001: 386). According to Gellner (1972), with the installation of the government through its representing officials in the provincial *qiyāda* and the role of the *muqaddim*, the old dualism between external and internal politics came to an end:

> "A district no longer had an official, representing central power, facing tribal leaders, representing the local groups: there was only *one* administrative hierarchy, which [...] consists of appointed, non-local professional officials, and which below that level consists of local, non-professional, part-time headman [ar.: muqaddim]." (Gellner 1972: 370f, emphasis by author)

The role of the *muqaddim* is centrally appointed and there is no longer a possibility for local actors to participate in formal politics. Since the implementation of these administrative institutions throughout the country in the 1960s, external factors seem to determine local action and political behaviour to quite some extent.

However, Venema and Mguild (2002), using the example of a Middle Atlas village, illustrate that local institutions such as the *jma'a* are still active in many ways and continue to have legitimacy within the village. The study of the village Tiraf in the South of the Drâa Valley by Casciarri (2008) confirms the continuous relevance of local, traditional institutions, especially in the domain of natural resource management. In section 2.3 I have made this point already: while in ‘Àfra migration does not affect the members (ar.: *mu’ayyanīn*) of the *jma’a,* which still controls village politics, in Qsbat al-Ghamàd only three of the four *mu’ayyanīn* are active due to the higher migration rates in this village and the ageing of its members. These local institutions mostly act in informal spaces, which the *qāid* of Tinzouline or the *muqaddim* of ‘Àfra do not control formally. This contradicts Gellner’s (1972) theory that the old dualism is gone. In fact, a new and more complex dualism has emerged and local politics are the result of internal and external institutions that do not have clearly defined frames, but rather coexist and continuously reorganize their influence.

According to Cleaver (2001a) (cp. section 1.3), this form of institutionalization can be described as a process of institutional bricolage: informal institutions exist next to formal ones, and together they shape an institutional setting which Mehta et al. (1999) call the “messy middle”. Local actors have rearranged themselves in the new institutional setting and found a way to cope with both external and internal institutions. The domain of water institutions, however, seems to constitute an exception to this approach.

Local User Associations

The introduction of a national participative strategy in development practices in the 1990s was crucial in its promotion of active participation by local actors – who had formerly only experienced top-down approaches – to the creation of new institutions such as the AUs. In section 1.3 I noted that the participative approach is in general criticised for not adapting to existing local institutions. I illustrate to what extent this holds true also for my research by presenting the drinking water management organization AU.

Both in ‘Àfra and in Qsbat al-Ghamàd there are local AUs managing a drinking water system (SAEP) at the village level. Just as it applies to general politics described above, an AU is neither a local nor a non-local institution, but something in between. AUs are created and assisted by external technicians from the ABH or the ONEP for every PAGER project, but each AU is operated exclusively by local members.

In theory, the creation of an AU adheres to the national strategy maintained in PAGER: the process of the installation of a SAEP should be participative and cost-effective, and thus local actors are supposed to actively take part in the planning, construction and inauguration of the SAEP. The PAGER prepares for the usage and management of a SAEP by raising local actors’ awareness of hygiene, sanitation and water scarcity in order to ensure a healthy and sustainable usage of water. Financial management is also taught to all members of the AU and a plan for water pricing is worked out in cooperation with a professional from either the ABH or ONEP. After the inauguration there is a five year phasing-out programme which aims at assisting the handing over of the SAEP to the local AU. A social technician travelling from Ouarzazate is regularly visiting the locality for this purpose. After that period, local actors manage the SAEP themselves (Sabib 2006).

Locals make the request for a SAEP to either the Service Eau or any other of the aforementioned water institutions. In principal, every AU should have more than five male members and connect more than 50% of the households at the first stage. The tasks that the AU performs include the general organization of its members, the financial and technical management as well as the daily operation of the SAEP. Each member is assigned one specific task and there are members who act as general consultants. These tasks are redistributed every four years. Only the reparations and the technical maintenance are undertaken by a trained plumber, who is paid for this job and cannot be a member of the AU, whose members typically work on a voluntary basis. None of the AU members is required to have a specific education, but the majority of them should be able to read and write in order to issue payment bills and keep records. Members are usually elected and often coincide with the *mu'ayyanīn* of the *jma'a*, a reality that is criticized by external professionals who fear the overlapping of tasks and institutions. The financial management is another important aspect of local water management and the AU is in charge of this. The minimal water tariffs that PAGER professionals advise are 2 DH per m^3. This constitutes the minimal tarification which covers the maintenance costs. To this a tax for the water meter is added, which ranges from 8 to 12 DH in the two villages and is to be paid by every connected household for every month. This tax is collected by the AU to fulfill the contract which includes a 5% share in the installation costs of the SAEP (see above); it is not feeding into the financial management. The payment bills can be issued on a monthly basis or up to only twice a year, the decision remains to the AUs themselves. 'Àfra is collecting the payments monthly, while Qsbat al-Ghamàd charges on a trimester basis. As a result of opting for the lowest water tariff, the income of both AUs is just enough to pay the electricity or fuel for the SAEP pumps.

The guardian is the most important figure in the AU and the one who assures the functioning of the SAEP. He takes care of the water tower and the well, is in charge of running the pump to fill the tower with water daily. Additionally, he is supposed to purify the water with chlorine regularly, which is available free of charge from the health post in Tinzouline.

The AU of ‘Àfra includes two other villages and has six members in total (two from ‘Àfra: the treasurer who issues payment bills and collects the money, and a consultant). At the time of my first visit in November 2008 164 households were connected to the SAEP (82% of all households in the three villages). The guardian for ‘Àfra and the two other villages – who is at the same time president of the AU – lives in the neighbouring village Ouled Ahmed ben Ali and does not receive money for the job, which requires more than two hours every day.

The AU of Qsbat al-Ghamàd and its two other member villages has nine members in total, three of whom are from Qsbat al-Ghamàd itself. Here, more than 80 households are connected to the SAEP with a domestic tap (52.5% of all households in the three villages). The water tower is located in the South of the village, close to the compound of the guardian, who has been chosen for his vicinity to the tower. He switches the electric pump on and off twice a day and monthly receives 200 DH for this job. Though the specific roles of members of the AU should change every four years, the Guardian of the SAEP of Qsbat al-Ghamàd has been in charge since the inauguration of the SAEP in 2001 and has been unable to find a man to replace him.

The Reality of Local Water Institutions

In reality, local water management is based on fragile grounds. Not only is the resource increasingly scarce due to decreasing groundwater tables, but there are also deficits in water management. The deficits on the local level are mostly concerning the participation of local actors. Out of all registered members often only one or two are active. This holds true in ‘Àfra, where it is only one active member, the guardian and at the same time president of the AU. Other members do help if needed, i.e. when payment bills are collected every month, but with the lowest investment of time and effort. In Qsbat al-Ghamàd it is only the guardian who maintains the SAEP and every four months the treasurer[31] collects the payment bills. According to professionals working for the ABH and Service Eau, many villages lack social resources, i.e. social capital, due to low education rates or other factors such as migration.[32] The functioning of the SAEP is in fact depending on one man only. What is more, drinking water management is a female domain, but since

[31] The third of the three villages belonging to this SAEP has its own treasurer.

[32] The lack of social capital is often named as a major reason for failing development projects. According to Cleaver (2001b), who criticises participatory approaches used without recognition of local politics, there is no lack of social capital, but rather lack of suiting social capital for an external project.

the installation of tap water, men interfere in several ways. This manifests itself in the composition of the Aus, in both villages they have only male members. One woman from ‘Àfra told me she would have liked to be part of the AU, because she has time and is interested in water management. However, due to the opposition of most AU members but also the PAGER professional in charge this was impossible.

In both villages, the financial management is based on the lowest recommended water tarification, which results in missing possibilities to invest into the improvement of water infrastructure, e.g. the deepening of the main well. However, locals assured that if there is a problem with the SAEP and it does not provide water, they will pay whatever is in their possibilities. The guardian confirmed this and seems to rely on this promise. On the lowest institutional level the close relations between the villagers are providing a frame of trust and accountability: the guardian trusts the help of the villagers and they trust in his capability to provide water.

On the non-local level (i.e. PAGER) the situation is different from the *ideal* project as well. While in ‘Àfra there was only once a professional sent to organise a meeting to teach hygienic and financial management, in Qsbat al-Ghamàd none of the interviewed persons knew of sensitising courses or meetings at all. Moreover, the exchange with neighbouring AUs was not supported by PAGER. Quite the contrary, the PAGER professionals do not foster an exchange of knowledge or experience between different villages that take part in a PAGER project. This, they say, would critically affect the management performance and deflect the members from their tasks. Additionally, the drinking water management promoted by PAGER does not integrate other sectoral issues, e.g. agricultural water management, for the same reason that it distracts the AU members.

Apart from technical assistance and financial inputs during the construction of the SAEP in Qsbat al-Ghamàd, there were no external professionals helping the AU. After the SAEP had been inaugurated in 2001, the guidance so promoted by PAGER was not provided and consequently there was no phasing-out programme. The participation of local actors was taken for granted and the AU was from the start fully accountable for its drinking water management, without knowing more than how to switch the pump on and off. The SAEP in ‘Àfra, Ouled Ahmed ben Ali and Zaouite ben Talib is considerably new and has not been officially handed over to the local AU yet. This means that once a month a professional from Ouarzazate visits the AU and controls the management efficiency, mostly in the domain of financial subsistence. But according to one such professional, not all members attend these meetings, though they are asked to show up. On the other hand, due to a small number of such professionals facing a growing number of AUs, these visits are not undertaken regularly.

Research during both field visits revealed the absence of external assistance in both villages and showed to what extent the AUs are left to their own resources, with an organization that was introduced and determined by non-local actors. The participatory approach brought them an institution that was manufactured at the national level and has to function in a local setting.

3.4. Conclusion: Dysfuntional Water Management

The historical perspective clearly demonstrated that the provision of drinking water particularly in the rural regions has not been included in national development attempts and it is only since a decade that the state acknowledges this deficit by promulgating a new water law that provides a national formal framework. National water management is since then strongly determined by a strategy of decentralization and is thus subject to a conversion from top-down to bottom-up management. Though this transformation helped to end what Gellner (1972) called a political dualism of external versus internal political actors, it created a new, more complex dualism, the dualism of institutions: traditional and local institutions versus modern and global institutions. On the local level, this means that existing institutions and the actors see themselves excluded from development strategies but are at the same time asked to participate in the creation of new local institutions. The results are a dysfunctional drinking water management and rising water withdrawal in a context of water scarcity.

4. Patterns of Water Withdrawal

The preceding chapter illustrated that access to drinking water in both 'Àfra and Qsbat al-Ghamàd is constrained by non-local institutions. This means that it is determined by new institutions that were *created* to manage access to potable water. Instead of dwelling upon an abstract concept of institutions, in this chapter I look deeper into the local setting and provide a more detailed picture of the actors concerned and their patterns of action in response to these constraints. I accompany the description of my empirical data with a tentative interpretation of them. The main problem is to understand the patterns of water withdrawal at the household level resulting from the described institutional constraints.

Access to water in rural households is ensured by two facilities: conventional draw wells and the domestic tap water connection to a local water supply system (fr.: *Système d'Alimentation en Eau Potable*, SAEP). In both cases, water is withdrawn exclusively from groundwater aquifers. Whereas in 'Àfra most households rely mainly on tap water provided by a SAEP, in Qsbat al-Ghamàd household water is withdrawn from both well and tap. The main determinants of these patterns lie in the problems the villagers face due to water scarcity and dysfunctional drinking water institutions.

In order to understand how these two different options translate into a specific behaviour, it is necessary to look at the empirical data and compare the findings. The chapter opens with a general introduction of water infrastructure in South Morocco followed by a description of the methodology employed. The empirical findings are first discussed for 'Àfra (4.1.) and then for Qsbat al-Ghamàd (4.2.): Both sections describe the access to water according to the facility, the patterns of action according to the source of water and end with a portrayal of the water withdrawal in each village according to the type of usage and facility. Though livestock water withdrawal is part of household water management, it is dealt with separately in each section. The findings from both villages are interpreted in a concluding comparison, which also draws on existent IMPETUS research (4.3.).

Water Infrastructure

Conventional Draw Wells

In South Morocco there are two main types of conventional wells[33] currently in use, distinguishable by their purpose: wells with a fuel or electric pump for *agricultural use*

[33] The term *conventional well* refers, in this work, to those wells that are not connected to modern SAEPs, which of course are also served by wells. This term serves as a distinction between the (conventional) wells and the (modern) tap system. Private drinking water wells, which are sometimes equipped with an electrical pump, are conventional wells as well. If not further specified, the term *well* designates thus a conventional well.

(which have replaced the old balanced wells (ar.[m.]: *l'gnina*) and donkey pulled wells (ar.[m.]: *aghrour*)) (Ouhajou 1996: 113, 164), and draw wells for *household use*. In the context of my research, only the second kind of well is of interest (Fig. 4.1), which is sometimes also equipped with an electric pump (Fig. 4.2). The typical draw well (Fig. 4.1) has a bucket (mostly of black rubber), with a capacity of approximately five litres. Attached to a cord, the buckets are thrown into the wells, which in the two villages are on average between 24.4 m and 31.7 m deep (Tab. 4.1 and 4.5). Once the bucket is full of water, it is pulled up using the attached cord. Typically only one person pulls up the bucket – mostly women or girls – and then fills the water into five litre bottles (ar.: *bidu*) or ten litre buckets (ar. [m.]: *stol*) (cp. Appendix B1). The type of container is chosen according to the task the water is needed for (see below).
The structure of most drinking water wells is similar: they are circular and about 1 m wide, with a fortified edge ca. 1 m above the ground. On the sides of the well there are two poles that serve as a support for a bar – mostly wooden –to which the cord and bucket are attached on a winch, approximately 1.8 m above the ground. The wells are typically built with either a combination of compacted dry clay and straw or a mixture of cement and stones. In most cases there is also a compacted surface around them, to prevent the surrounding ground from developing mud. In both villages the draw wells are not covered as long as they are used, whereas those that are out of use are covered with palm trunks.

Tap Water

I described in chapter three how drinking water in rural areas is provided by a SAEP; the system is managed by a local institution – a User Association (fr.: *Association d'Usagers*, AU) – where one or several villages have their representatives. Here I want to outline some technical details of the SAEP.
Tap water is usually provided to any household requesting a domestic connection. Poor households are regularly assisted by anonymous people who pay their water bills. The location of the tap within the compound is the same in most rural households: if there is only one tap, it will be in the central court, which is accessible from most areas of the compound. If there is a second tap, it will most likely be in the toilet, a separate little room on the outer side of the compound. A third tap, which was rare among the households that took part in the research (1 out of 15 households in Qsbat al-Ghamàd and 3 out of 15 households in 'Àfra), would then either be in a shower room or in another court. Due to the

low pressure of the system, households with properties located on higher ground cannot be provided with a domestic connection but have a tap in the vicinity of their compound.[34]

The SAEP is supplied by one main well with a pump filling a water tower through the main pipe system; from here the water is then distributed to the households through smaller pipes. Each household is equipped with a water meter to allow individual billing. Whereas the general infrastructure remains the same throughout most of rural Morocco, specific local conditions account for varying functional effectiveness.

Methodology: Withdrawal Measurements

In section 1.2 I provided a general scheme of the different methods that were employed in this research. In order to place the following data, I now give a more detailed account of the measurement of water withdrawal.

My assistants and I undertook this data collection twice and simultaneously in each village in November 2008 (21st-28th) and May 2009 (7th-14th) to permit a comparison not only of the two villages but also of the seasonal variance. This was important so as to work under the same weather conditions and their effect on different withdrawal patterns in both villages. The basis of this method is a questionnaire which differentiates between the usage of water within the household and the facility it has been taken from (cp. Appendix A3). It is based on daily withdrawal in the participating households, for which we additionally asked the household size, ownership of a private well and number of taps. The questionnaire was given to 50% of the households[35] of each village, based on voluntary cooperation. Due to this dependency of their cooperation, it was a steady number of households willing to participate, which we tried to alternate as much as possible during the two periods of measurement to achieve a representative sample.[36] Another precondition determining the choice of households was the availability of at least one literate person in either the same or a neighbouring household, to assure the correct completion of the questionnaire.[37] It was written in Arabic including as many words in the Moroccan dialect as possible. For the measurements, each household was equipped with such a paper for

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34 When the connection was inaugurated in Qsbat al-Ghamàd, which has a slightly hilly terrain, households located on the hills were equipped with a domestic water tap. Soon, however, those households got no water when pressure was low (mostly during the summer) and hence decided to move their taps to lower areas.

35 In Qsbat al-Ghamàd, which has in total 33 households, it can be noticed that the second round of measurement has not delivered 50%, which owes to the fact that a marriage has taken place. This has not only increased the water withdrawal beyond average means, but also impaired the adequacy of the observed water withdrawal. The data from these households was thus not used.

36 However, a welcome effect of this was that most of the participant households were eager to help and deliver valid questionnaires.

37 These persons proved to be mainly girls with a basic schooling education, who after finishing the primary school, typically help their mothers in daily household chores, of which fetching water is an essential part.

each of the seven days. Every day this questionnaire had to be completed with the quantity of water used from either well or tap according to usage.
Both seasons the distribution of the questionnaire was assisted in each village by my two key informants. While distributing the questionnaire, my assistants (both times women) took as much time as was needed until an understanding of the task was achieved in every household. Since women of neighbouring families tend to spend some time of the day together, this task was accelerated by explaining it to several women of different households at once. After having distributed the questionnaire, we assured that those villagers who still had questions could always reach us in the house of our key informants.
The quantity was measured with standardized containers of either five or ten litres; typically *bidu* of five litres serve for water for cooking and drinking and *stol* of ten litres serve for washing, showering and toilet water. In case of the draw wells, this poses no additional effort, since the women use either of these containers anyways to carry and store water. In order to count the water from the tap, however, we had to ask the women to use a container before the actual usage of the water. In 'Àfra, this caused the participating households some effort, whereas in Qsbat al-Ghamàd, where everyone stores the water from the tap in reservoirs (section 4.2.2), this was a fairly easy task. The literate person had the task to add the used containers and write it down each day, according to facility and one of the five possible usages (see below).
During the collection of the questionnaire we were able to ask more questions in order to verify the correctness of each sheet. Except for one of the resulting four datasets (Footn. 44), three of them had just one invalid case, which resulted in a sample size of n = 15 three times and n = 17 once. The total sample is N = 30 in 'Àfra and N = 33 in Qsbat al-Ghamàd.[38] The presented findings stem from a descriptive analysis of the datasets.

4.1. 'Àfra

'Àfra is connected to its own SAEP since the end of October 2008, and most wells were abandoned after that date. Within only half a year, a clear divide between well and tap usage had developed. Before asking the reasons for this development, I depict the household's possibilities to access drinking water.

[38] In 'Àfra there are 30 households and both times 15 households participated, while Qsbat al-Ghamàd comprises of 33 households, of which once 15 and once 17 were participating.

4.1.1. Access to Water and Water Infrastructure

Figure 4.1: Typical Draw Well, ‘Àfra

Figure 4.2: Well with Electric Pump, ‘Àfra

Conventional Wells

‘Àfra has 30 households with an average size of 9.6 members and there are 11 wells – six of which currently unused (Tab. 4.1, cp. Appendix C1). Although the inhabitants of ‘Àfra don’t make a real distinction between communal and private wells, both types are present. Private wells are within the compounds, typically placed near the kitchen facilities and the animals’ stables. Two communal wells are located on communal land, accessible to everyone. The small number of wells should not lead to think that households without a private well have to resort to communal wells; it has rather been custom to share a well within the wider lineage. To access water, women and children can enter the house of their neighbours without asking permission. Since several neighbouring households typically belong to the same lineage, a truly private well exists only in families that are of a different lineage.

Table 4.1: General Information on Drinking Water Infrastructure, ‘Àfra (EC = Electric Conductivity)

	Population	Draw Wells	SAEP	SAEP Well	SAEP Tower
‘Àfra	Households: 30	11	Since 26/10/08	Location: oasis	Location: south of village
N30°28.505 W6°02.279	ø Size: 9,6	Out of Use: 6	Management: AU	N30°28.372 W6°01.835	N30°28.118 W6°02.376
790 m a.s.l.	Inhabitants: 288	ø Depth: 31,7 m	EC: 2750 µS/cm	Depth: 24 m	Storage capacity: 125 m³
		ø EC: 2234 µS/cm		792 m a.s.l.	785 m a.s.l.
				Fuel pump, uncovered	

An exception to these general water arrangements occurs during the dry summer period: From July to September many wells run dry and the households then depend on water from the irrigated fields in the oasis north of the village. Nowadays, all farmers either use or own a groundwater pump for farming their land, and access to water for irrigation is thus guaranteed throughout the whole year; villagers are allowed to fetch water from these wells when their wells run dry.

To better understand the issue of access to water, each well is considered individually briefly, as their usage and function change over time. In November 2008, shortly after the connection of the whole village to its own SAEP, one of the two communal wells was out of use, because it fell dry during the summer. According to the local people, it had not had water during the summer and just in November began to recharge. In contrast, during the second visit in May 2009, some households living in vicinity of this well were again using it regularly for washing their clothes (section 4.1.3). The second communal well was constructed three years ago by an inhabitant of 'Àfra providing the material, with the voluntary labour contribution of male villagers. Before the inauguration of the SAEP, this well was used by most households in addition to their private wells. Since it is a well equipped with a pump and a tap (Fig. 4.3), its water is easily accessible. After the installation of the SAEP, however, this well has lost its importance, but is still being used by households living nearby.

Figure 4.3: Communal Well with Pump, 'Àfra

Apart from these two communal wells, there are another nine private wells in 'Àfra. Three of them were in continuous use until the second field trip in May 2009 and are planned to be maintained[39] in the future, whereas the remaining six wells were unused in May.

Tap Water

Tap water is very popular among 'Àfra's inhabitants. Due to the novelty of this infrastructure, in the first month people used much more water than usual (based on results of AU in 4.1.3 and my own findings), although in November it was relatively wet and cold. By my second visit, the water withdrawal had stabilized (section 4.1.3).

The SAEP of 'Àfra is not only serving this village but also the two adjacent villages of Ouled Ahmed ben Ali and Zaouite ben Talib. Local water management is undertaken jointly by the representatives of these villages (as explained in section 3.3). Almost the entire village of 'Àfra was connected to the SAEP by the end of October 2008 (82% of all households), and only those compounds located further away from the main pipes were connected one or two months later, when the missing pipes became available. As the

[39] The maintenance of a well necessitates regular cleansing (ca. every month) and due to falling water tables it is sometimes necessary to deepen the well (often more than once a decade).

village is rather densely populated – compared to the dispersed layout of Qsbat al-Ghamàd – it was fairly easy to connect all households. By May 2009 all households in 'Àfra were connected, except for two households sharing one tap connection. The water tower has a capacity of 125 m³ and is located south of the village (Tab. 4.1). The tower is supplied by a 24 m deep well with a motor pump and is located in the oasis, where water availability is highest. Whereas the pump is enclosed in a cement building, the well itself is only covered by a plastic bag (cp. Appendix B4). The distance between the well and the tower is 985 m.
Since its inauguration at the beginning of fall 2008 and until the beginning of the dry season in May 2009 the SAEP of 'Àfra always supplied enough water to satisfy demand. Minor problems caused some interruptions of up to twelve hours, but overall the tower disposed of enough water to supply the three villages. No household expressed dissatisfaction with the SAEP and no one doubted its ability to supply water during the upcoming dry summer months.

Quality and Constraints

In southern Morocco, and particularly in the Middle Drâa Valley where agriculture is practiced extensively, the combination of arid climate and irrigation has caused the salinization of soils (cp. section 2.1). Consequently, well water in the oases is of bad quality due to the salinity of the groundwater. Moreover, well water in the villages is polluted by infiltrations of human sewage water from latrines.
The electric conductivities (EC), indicating the salinity, of 'Àfra's draw wells display a gradual increase of EC towards the oasis, ranging from 1835 to 2740 µS/cm. According to national water quality standards, these wells range from medium to bad quality.[40] Nonetheless, according to my own findings, salinity played only a minor role in the abandonment of wells. Rather, as all wells in 'Àfra display high salinity, its different degree isn't of too much significance in deciding whether to keep or abandon the wells. Another major factor is the location of wells within the compounds, in direct vicinity (less than 10 m) to the stables, thus violating the guidelines of the *Loi N°10-95 sur l'Eau* (see 3.1.2). Therefore, the wells are likely to be polluted by faecal infiltrations and potability cannot be guaranteed. Nonetheless, people are aware of the fact that their water resources are highly saline in comparison to other nearby water resources (i.e. those of Qsbat al-Ghamàd, section 4.2.1). Some individuals are willing to travel several km in order to get

[40] The Secretary of Water of the MATEE measures water quality by means of salinity: medium water quality = 1300-2700 µS/cm; bad quality = 2700-3000 µS/cm; above 3000 µS/cm the water quality is very bad and undrinkable for humans (Sécretariat d'Etat Chargé de l'Eau 2003: 17).

fresh and sweet water. There is also a family maintaining a private well mostly for its better taste (see below). Despite these exceptions, the convenience of using a tap to access water clearly outweighs its poor quality and taste. To guarantee the water availability throughout the year, the SAEP well was constructed inside of the oasis. This location was chosen despite its water showing the highest EC (2750 µS/cm) of all measured wells in ‘Àfra. Other determinants were more important: the availability of communal land and the yet greater danger of sewage water infiltrations from latrines within the settlements.
Another constraint to water access is the clear divide between households *with* and *without* a private well. Six wells have been abandoned and only three private wells remain. In case of future difficulties with the SAEP, it is thus doubtful whether the remaining two communal wells can provide drinking water for those 25 households which no longer maintain a private well.

4.1.2. Patterns of Action

Before looking at the quantities of drinking water withdrawn, I describe the patterns of action involved in getting water. In ‘Àfra we find different patterns and perceptions of drinking water availability according to household size and wealth.

Access to Water

Most women prefer to use tap water for its fast availability and easy access. To be prepared for unexpected problems, quite rare in the case of ‘Àfra, most households fill some containers every morning with tap water. This is a widespread practice to prevent household water shortages in the arid areas of rural South Morocco. But different from Qsbat al-Ghamàd, these reserves never amount to more than five or six *bidu* and mostly serve as movable water resources within the house, e.g. for tea preparation or hand washing.
To assess the willingness to pay for water, I conducted interviews asking about the monetary meaning of tap water, but it seemed that most households chose the facility because of its convenience. In fact, all interviewees considered the tap water tariffs (2 DH[41] for 1 m^3, section 3.3) rather as a contribution to maintenance costs[42], which are in the long term lower than maintenance costs for wells. Here, women’s opinions differ from men’s, the latter – being the ones who pay the bills – keeping an eye on monthly

[41] At the time of my research, one Moroccan Dirham (DH) equaled approximately 0.09 Euro (Source: http://www.oanda.com/convert/fxhistory (04/10/09).
[42] The maintenance costs are mainly costs for electricity to run the pump. If reparation was needed, the money collected from the households based on their withdrawal would not suffice.

withdrawal and arguing for minimal tap water use. But since it is women who actually manage household water, most husbands have no real say in the way water is managed.[43] The AU decided to charge for the withdrawn water on a monthly basis, and all villagers indicated that the amounts are never too high to pay for (see also 3.3). Access to water therefore seems to be mainly determined by practicality, and only secondarily by economic considerations. Interestingly, economic aspects do become more relevant when considering the maintenance costs of private wells, which require higher and concentrated investments rather than regular but relatively small payments; the difference in wealth does play a role in determining patterns of access to water insofar as only wealthy households can afford to both maintain a well and pay the monthly tap water charges. Consequently, the three above-mentioned households that still exploit their wells differ from the average household[44]: the first family owns an electric pump to draw water from the 32 m deep well and since eight years also has a private tap installed in the house, even supplying a shower. This well also serves the neighbouring household, which is at the same time part of the wider family (the two households combined have 16 members). A second family has a well equipped with a bucket, and with its 30 m the well is deep enough to be used almost all year round. This household consists of 18 members, all agreeing that the water from the well is noticeably better-tasting than that from the tap. The third family maintaining a well consists of two households of 22 and 14 members, respectively. The *mūl ad-dār* of the bigger household has three wives, which is exceptional in ʻÀfra and explains why the household consists of many women and children. This is due to the fact that the *mūl ad-dār* is the village's *muqaddim* and has considerable political and economic power (see also 2.3, 3.3). The two households are related by descent, live in close vicinity and use a common well equipped with a rubber bucket and located within the bigger household's compound. To summarize, these three households (plus two related households) differ from the other households of ʻÀfra mostly in their size[45] and wealth (cp. Footn. 40), which allows them to make investments in a private well.

[43] In fact, before the installation of tap connections, management of household water was a purely female matter, whereas now men are necessarily involved. Power relations are thus changing, seriously threatening the independence of women. Only female-headed households (due to the labour migration of their husbands) are able to pay charges themselves and maintain their independent position in water management.
[44] Average households have been defined on the basis of a shortened index, based on the following indicators: household size and number of migrated members (providing extra income through remittances), number of cattle and size of goat and sheep herd. Wealthy households are additionally identified by their ownership of items such as cars, water pumps or by the political position.
[45] On average these three wealthy households have 14 members, compared to only eight members in the households defined as average.

The remaining six wells in ‘Àfra were unused at the time of my latest visit in May 2009, though the precipitation of the winter 2008/09 recharged the groundwater basins and all wells were, despite their abandonment, in good physical condition. In the household survey which I conducted in November 2008, seven out of ten households[46] clearly stated to prefer using tap water, because the other option consists in getting water from the well, which is physically more challenging. Especially women stressed the fact that their life has improved in many respects since they no longer spend much time in fetching drinking water from the wells. Smaller households (cp. Footn. 41) abandoned their wells, apparent in that they do not clean them anymore, untied the buckets and covered them with palm trunks.

The average households in ‘Àfra prefer to solely use tap water and believe that they will no longer need to use the wells, which are considered a burden. The three exceptions to this are bigger and wealthier households, which can afford to invest in maintaining their wells and paying the SAEP charges at the same time. Their patterns of action are considered in the following section, as they constitute a combination of facilities.

Combination of Facilities

In ‘Àfra, it is mostly the wealthy households which base their withdrawal on two facilities. Whereas the first family uses two facilities because they have the possibility to invest in their own well with an electric pump as well as into the installation of a tap from the SAEP in their house, the second family distinguishes clearly between the different tastes and qualities of the sources. Depending on the chore, the women of this household use the well for fetching tea water, whereas for water intense activities, when taste does not matter (like washing the laundry, watering animals, showering and cooking) they use the tap of the SAEP. From this combination of facilities it can be deduced the price of water from the tap has no impact on the choice of facility. A member of this family affirms: “We just want to have water, no matter the price”. Contrary to this pattern, the third family uses their two sources of drinking water according to the amounts of water needed, which then determine the costs: water intensive activities like washing the laundry and watering the animals and plants are done with well water, whereas water for tea and cooking is withdrawn from the tap. This is an active attempt to reduce costs, which is an exception in ‘Àfra. But since there are many women and children in this household, there is also enough labour force to use the time consuming well instead of the time effective, but costly water tap.

[46] Out of these ten households, two belonged to the three families which still maintain a draw well.

Most other households claimed to presently depend only on the tap water from the SAEP (9 of 15 in November 2008, 10 of 15 in May 2009) and for the future intend to exclude the usage of wells. Nevertheless, particularly those families that live in vicinity of the two communal wells use these at least for washing the laundry (section 4.1.3). The old communal well, which belongs to the whole village (*qabīla*) is, since its reuse after November 2008, maintained by two families living nearby, which are as well the only ones using it. The other communal well, which was constructed by one household for the whole village, was during both of my field trips used daily for washing clothes, but also for other water consuming tasks by the nearby households or by the whole village for special needs, e.g. a marriage or for construction.

4.1.3. Water Withdrawal

The water withdrawal in both villages is determined mainly by five different usages of water for household chores and activities (Tab. 4.2 and 4.3). Though water is used by all members of a household, it is typically the women who access the water and make it available for the men, be it in form of prepared food, washed laundry or filled buckets in separate rooms for showers or toilets.

Withdrawal Patterns

Above I showed that in ‘Àfra a preference for tap water is prevailing, while the data suggests that for some tasks well water is still used (Tab. 4.2 and 4.3). The mission of this section is to detangle the usage and withdrawal according to the facility. In the following tables the percentage of households using tap and well water and the respective quantities withdrawn are given according to the specific usage. As was shown before, the usage of one facility does not exclude the usage of the other; the tables hence illustrate a general pattern of action. The data shows that the overall withdrawal is clearly determined by tap water: In November 100% of the measured households used tap water, compared to 27% of households using the draw well additionally. With some minor variance, this holds true for both seasons. To distinguish between the differences in withdrawal in November and May, one has to remember the seasonal climatic variability in South Morocco (section 2.1).

November

In the wet season, the average withdrawal of household water (excluding livestock) in ‘Àfra was 23.6 l per head and day (Tab. 4.2). This rather low quantity can be explained, among other things, by the rainfall that the whole of Morocco received in 2008, which was largely above the average of a 35 year time series (Narcis 2009) and by November, people already perceived the period as a very wet one. Resulting from this, villagers said, people use much less water, because they drink and shower less. From the well an average of 11.2 l/h/d was taken, whereas the bigger quantity (18.2 l/h/d) was withdrawn from the tap.[47] Almost all households have access to tap water through their domestic connection and most households also have the possibility to access wells. Patterns of action are expressed in the uses of water for specific tasks in the household.

Table 4.2: Water Withdrawal According to Water Facility and Type of Usage in November 2008, 'Àfra (average in litres per head and day)

Usage	Well	Tap	Average
Kitchen	27%	100%	
quantity	2 l	4 l	
Drinking water	20%	93%	
quantity	2 l	2.3 l	
Washing (clothes)	53%	73%	
quantity	8.6 l	13.6 l	
Shower	40%	93%	
quantity	3.8 l	5.2 l	
Toilet	33%	87%	
quantity	3.5 l	4.5 l	
Overall Withdrawal			23.6 l
	60%	100%	
	11.2 l	18.2 l	

There are four households (27%) in 'Àfra which accessed water for the kitchen (e.g. cooking, dish washing etc.) through a conventional well, in contrast to all 15 surveyed households using the tap water. The former households used thus two facilities to access drinking water. Water from the well for tea preparation (or washing hands etc.) accounted for only three households (20%), whereas tap water was used by 14 households (93%) for this usage. In both cases the amount of withdrawn water was minimal, being somewhat higher from the tap (2 to 4 l/h/d). The highest water withdrawal is that used for washing the laundry, a water intensive task, which women generally perform every second or third day. Here, more than half of the cases (53%) used the well to access the water, on average having withdrawn 8.6 l/h/d. Both water and time needed for washing the laundry are plenty and by using the tap not much more time can be saved anyhow. Nonetheless, eleven cases

[47] The number of cases varies slightly in each village and in each season and thus causes the overall withdrawal to be not simply the sum of the well and the tap withdrawal.

(73%) took advantage of the tap water and used on average 13.6 l/h/d. Showering and water for sanitation[48] were other usages which six (40%), respectively five cases (33%) used their water for, compared to 14 (93%) respectively 13 cases (87%) having used the tap. Withdrawal from the well was low (3.8 and 3.5 l/h/d), compared to 5.2 respectively 4.5 l/h/d from the tap. According to interviewees, in the wet season the amount of taking showers is relatively low, because the low evening temperatures make a shower after work less compelling for the farmers.

May

As a result of less rainfall and higher daily temperatures the water withdrawal in May (Tab. 4.3) differed radically from that in November. The overall withdrawal was 33.7 l/h/d, with an increased span between well and tap water: Whereas in November the withdrawal of tap water was not much higher than of the well, in May 29.6 l/h/d were withdrawn from the SAEP compared to 16 l/h/d from the wells. However, the number of cases having used the well has changed only slightly: seven of 15 surveyed households (47%) indicated to use the well and 14 households used the tap (93%).

Table 4.3: Water Withdrawal According to Water Facility and Type of Usage in May 2009, 'Àfra (average in litres per head and day)

Usage	Well	Tap	Average
Kitchen	27%	93%	
quantity	5.7 l	5.8 l	
Drinking water	33%	93%	
quantity	3.8 l	3 l	
Washing (clothes)	40%	87%	
quantity	9.6 l	20.5 l	
Shower	27%	93%	
quantity	4.9 l	6.7 l	
Toilet	20%	87%	
quantity	7.5 l	4.5 l	
Overall Withdrawal			33.7 l
	47%	93%	
	16 l	29.6 l	

In a detailed picture again four cases (27%) used the well for kitchen water, on average 5.7 l/h/d, compared to 14 cases (93%) having used an average of 5.8 l/h/d tap water. In May, more households than in November took water for drinking from the well (33%).

48 All interviewed households have a toilet and shower room with a sewage channel, but only few households own a real shower. The term shower thus refers to the usage of buckets in a small room, often the toilet room.

According to locals and verified by own measurements, this was due to the fact that the tap water disposed of higher salinity after the agricultural term (since November five reservoir releases took place) and to the intensive irrigation of the oasis, which alters the taste of water significantly. Inverse to the overall trend, there was thus slightly more water used from the well (3.8 l/h/d) than from the tap (3 l/h/d). As for the usage of water for washing the laundry six out of 15 cases (40%) used the well (9.6 l/h/d), whereas since November more households (87%) preferred the tap water (20.5 l/h/d). Water withdrawal for showering has for both facilities increased in comparison to November (4.9 respectively 6.7 l/h/d), whereas fewer cases used water from the well (27%). The same holds true for toilet water: Instead of five cases (33%) in November it was only three cases (20%) that used the well for the toilet, though the quantity rose to 7.5 l/h/d. An amount double as high as in November seems not plausible, as toilet water should be a stable variable, notwithstanding the season. The only explanation for this could be an error in measuring quantities within one or several households. Contrary to that, the number of cases using tap water and the withdrawal of this for toilets has remained stable.

Water Withdrawal for Livestock

The withdrawal of drinking water typically it includes livestock as well, because the same drinking water facilities are used. The water use for livestock is thus also an integral part of household water management, but is considered separately and rather for reasons of completeness. The results were also gathered with the aforementioned questionnaire.

Table 4.4: Comparative Water Withdrawal of Livestock According to Water Facility, ‘Àfra and Qsbat al-Ghamàd (in m³ per TLU and year; HH = household)

/TLU per HH	Well	Tap	Total
‘Àfra			
Nov 08 / 2.4	2.62	7.45	10.07
Mai 09 / 2.1	1.89	9.95	11.83
/ ø 2.25	2.26	8.69	10.95
Qsbat al-Ghamàd			
Nov 08 / 1.5	3.84	5.18	9.02
Mai 09 / 1.3	6.45	12	18.41
/ ø 1.4	5.14	8.57	13.72
Average Mean	3.7	8.64	12.33

In ‘Àfra the livestock is composed of cattle, donkey, sheep, goat, chicken[49] and one mule. Table 4.4 shows that on average each household has livestock of 2.25 TLU[50], which is

[49] Chicken were not separately accounted in the livestock water use, because their exact number is unknown and they use the same water containers than the other livestock.
[50] TLU = Tropical Livestock Unit; 1 TLU = 250 kg livestock (Pallas 1986).

considerably more than in Qsbat al-Ghamàd. The average yearly water use of one TLU in ‘Àfra was 10.95 m^3, thus on the scale of one household this signifies a yearly withdrawal that is 2.25 higher than the average withdrawal per TLU, amounting to 24.63 m^3 per head and year. This is eleven times higher than national estimations suggest for livestock (see 3.1.3); the latter assume the water demand of livestock for the year 2010 to be 6 l per head and day, i.e. 2.19 m^3 per head and year (DRPE 1998b). According to the interpretation of the choice of a facility that I made above, the livestock is mostly supplied by tap water (8.69 m^3/TLU/y) and only marginally by well water (2.26 m^3/TLU/y).

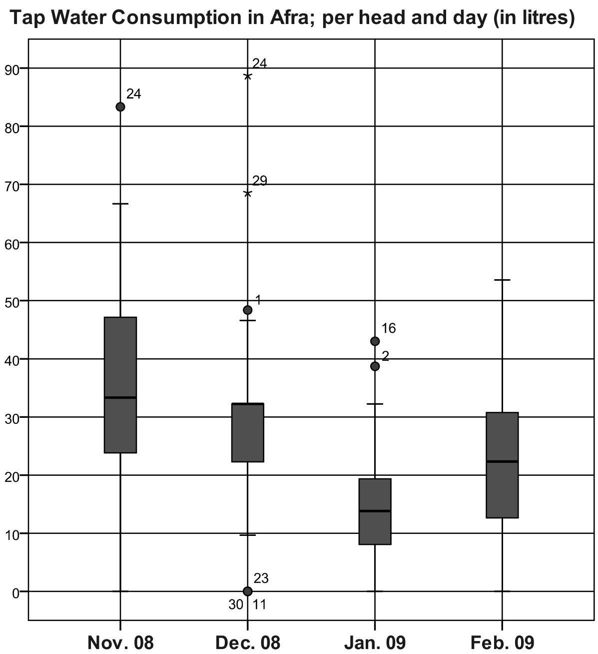

Figure 4.4: Tap Water Withdrawal from Nov. 08 to Feb. 09, ‘Àfra (User Association ‘Àfra)

Results from Association d’Usagers

Since the connection to the tap system on 26th October 2008, the AU of ‘Àfra kept detailed record of withdrawal and payments of each connected household. The data, which I obtained from the AU of ‘Àfra (Fig. 4.4), is shortly discussed in this section. They constitute a validation of the household measurements from November 2008[51] as they are read from the water meters in each household end of each month.[52] As has already been mentioned above, November 2008 was the first month of connection to the SAEP and the households enjoyed the novelty of the tap water by withdrawing extensively. The average withdrawal per head and day was then 35.1 l, despite high precipitation and low temperatures. During the following months, which were also considerably wet and cold, the withdrawal slowly dropped from 29.6 l/h/d in December[53] to 14.7 l/h/d in January. By February 2009, the withdrawal had reached a stable 23.8 l/h/d, which steadily increased

[51] Unfortunately, the months between February and the second field trip beginning of May were not registered, because originally it was planned to undertake that second field trip already in March, hence the president of the AU, who keeps record, did not continue to note it down in French. When I arrived two months later, he did not have the data for those two months at hand.
[52] Whereas the quantity indicated by the water meters is in m^3, I employ the daily use per head in litres, to make this data comparable to my own datasets.
[53] One of the most important Islamic feasts, *‘id al-kabir*, took place in December and all those family members that migrated to other Moroccan cities visit their home village for this occasion, therefore the water withdrawal rises significantly during one week in most households.

until May due to rising temperatures. The overall withdrawal of tap water during these months had thus been 25.8 l/h/d, which is nearby the average mean of my own measurements in November 2008 and May 2009 (Tab. 4.9). The results from my own measurements from the end of November differ considerably from the AU results for that month. This, the AU president told me on enquiry, relates to the fact that end of November, when we undertook the measurements, the quantities have dropped already, compared to the high withdrawal beginning of the month.

4.2. Qsbat al-Ghamàd

In Qsbat al-Ghamàd, different from ‘Àfra, the SAEP does not play a greater role for water withdrawal than the wells, though it is widely accepted. Since 2001 the village is connected to a SAEP that already after three years proved to be insufficient in supplying water to itself and the neighbouring villages Zaouite al-Fagouss and Timkshad. I first give a general introduction into the water infrastructure and then show to what extent this deficiency influences the patterns of water withdrawal.

4.2.1. Access to Water and Water Infrastructure

Conventional Wells

In Qsbat al-Ghamàd there are 20 conventional wells supplying 33 households of an average size of 7.9 members; five of these wells are out of use (Tab. 4.5, cp. Appendix C2). Whereas in the latter there is a distinction between communal and private wells, in Qsbat al-Ghamàd this distinction is not made. Except for a few wells, most are located outside of the compounds, which belong to certain families living nearby, who maintain them. The only well that has always belonged to the whole village (*qabīla*) was out of use since two years. Everyone can access every well without entering another compound as it is the case in ‘Àfra. Since households of the same lineage typically live close to one another, the organisation of access is influenced by the affiliation with a lineage like in ‘Àfra. There are many more wells than in ‘Àfra however and access to drinking water from wells is fairly easy in Qsbat al-Ghamàd. There is one household further away from the actual village which uses a motor pump to access water, but every other well is equipped with a rubber bucket and a cord. Locals agree that pulling up the bucket is quite unproblematic, because wells are shallow (on average 24 m; Tab. 4.5).

Table 4.5: General Information on Drinking Water Infrastructure, Qsbat al-Ghamàd (EC = Electric Conductivity)

	Population	Conv. Wells	SAEP	SAEP Well	SAEP Tower
Qsbat al-Ghamàd	Households: 33	20	Since: March 2001	Location: south of village	Location: west of village
N 30°28.427 W 6°03.985	⌀ Size: 7,9	Out of Use: 5	Management: AU	N 30°28.276 W 6°04.144	N 30°28.482 W 6°04.480
780 m a.s.l.	Inhabitants: 261	⌀ Depth: 24,4 m	EC: 427 µS/cm	Depth: 35 m	Storage capacity: 80 m³
		⌀ EC: 707 µS/cm		809 m a.s.l.	820 m a.s.l.
				Electric pump, covered	

Those five abandoned wells are either old – like the *qabīla* well (no one can recall knowing the year of its construction) and an investment for deepening these would be required – others have never been finished, once the village was connected to the SAEP. Added to this, three out of these five wells have belonged to households that migrated permanently to the urban western Morocco and no longer take care of their compound. Overall, each household has access to a well in vicinity and most make use of that.

Another aspect differing from 'Àfra is the fact that during the dry months there are four to five wells which continuously supply water to the whole village and all inhabitants use these remaining wells. This is due to a lateral afflux trench in the schist zone from the southern *jbel* to the Wadi Drâa, above which the village is located (Fig. 2.2, chapter 2). Thus, in normal summers there is no need for the villagers to enter the oasis for fetching household water. Consequently, there are different patterns of action than in 'Àfra (section 4.2.2).

Water Tap

The AU of the village manages its own SAEP since eight years jointly with Zaouite al-Fagouss and Timkshad, the first being on the other side of the street and the second on the other side of the oasis. Since five years this SAEP has reached its capacity limits and does not satisfy demand.

Whereas the water tower is located on an elevation next to the road leading to Zagora, the well that supplies it lies south of the oasis and the road, in vicinity of Qsbat al-Ghamàd (cp. Appendix C2). An electric pump is installed and both the pump and the well are protected from unauthorized access by a cement building. The distance from the 34 m deep well to the tower is 660 m. According to an informant and my own observations, the well lies within the groundwater stream that provides water year round, except for extremely dry summer periods. Nonetheless, due to the high withdrawal of water, the well cannot provide enough water for the three villages, and the tower (storage capacity: 80 m^3) exhausts daily, even in the wet period.

While in ‘Àfra all households have a tap connection, in Qsbat al-Ghamàd there are many households which decided not to get connected (47.5% of all households of Qsbat al-Ghamàd and Zaouite al-Fagouss). These households are located further away from the village centre and own a well which supplies enough water year round. The costs for connection pipes and the material to provide an access were exceeding the benefits, according to the *mūl ad-dār* of each of these households. Those families that own a tap consider it an advantage, but are comparatively less enthusiastic about it than ‘Àfra’s inhabitants. The dissatisfaction stems, according to the guardian of the pump, from the following reasons: First, the well is not deep enough to guarantee water the whole day and after two to three hours of pumping it is empty. Second, the pipes between the well and the tower are smaller than the pipes inside of the well and, as a matter of fact, there is less volume pumped to the tower in the same time that is pumped from the well. Third, the demand on village level exceeds the supplies in the tower and thus after two to three hours after the pump is switched off the tower is emptied. Forth, the electricity costs are too high to allow for continuous pumping (monthly ca. 2000 DH). Another limitation is that the guardian of the well is at the same time a full-time farmer. The result are limited hours of pumping, from approximately five to seven in the morning and from four to six in the evening. Since the details of this deficient management are discussed elsewhere (chapters 3 and 5), it should here only be concluded that the demand cannot be met and locals understandably question the reliability of the SAEP.

Quality and Constraints

Due to the geographic position of Qsbat al-Ghamàd between the cuestas and the oasis basin, the groundwater stream from the mountains to the oasis supplies this village with fresh water. The electric conductivity of the draw wells lies within 490 and 990µS/cm and the main well that supplies the SAEP had only 427µS/cm in May 2009. This is almost as low as the electric conductivity of Moroccan bottled water and locals confirm: “it’s like Oulmès”[54]. Also, there are no major pollutions to be expected, since there is no impact of fertilizer and pesticides and no animal stables nearby, as wells lie outside of the

[54] Oulmès is a Moroccan brand of bottled water, known for its good taste and quality.

compounds and far from other possible sources of pollution (e.g. latrines).[55] In general, the water quality in Qsbat al-Ghamàd is good and even famous throughout the Valley. As the water quality of all wells is fine, the access to water is determined by the constraint of water availability from the SAEP, which results in specific patterns of action.

4.2.2. Patterns of Action

Access to Water

The access to conventional wells is guaranteed throughout the whole of Qsbat al-Ghamàd and though the SAEP exceeds its capacity every day, there is no shortage of water itself. In fact, people have established quite a unique way of accessing water through both means: In the morning, when there is running water, people open their tap and fill several containers (up to 20) of both five and ten litres until the water runs no more or until they have enough, in case of small households. Typically, this takes about two hours in dry periods and three hours in wet periods and including Zaouite al-Fagouss and Timkshad, over 100 households withdraw water in those hours. The same repeats itself in the evening, when there is again water in the tower (see 4.1.1). Thus, in order to have enough water to manage it within one day, households fill reservoirs each day. The average volume of such a household reservoir is 104 litres for one day.[56] If there is need for more water, e.g. for washing clothes or the house, the well will be used. Since in normal conditions average sized households (eight members) wash every second day and in the days in between have other water intensive chores, there is almost constantly a need to complement with water from the well. In the household survey undertaken in November 2008, seven out of eight cases (families with a tap connection) said to regularly use both facilities. But this does not account for smaller households, whose daily water reservoir provides enough water for all tasks in the house. Added to that, in case of special events, such as a marriage or a religious feast, the guardian can be contacted and runs the pump to fill the tower for the specific event.

Combination of Facility

In Qsbat al-Ghamàd there is also a different proportion of the facilities in terms of usage. This signifies that according to the water intensity of a task, people choose the facility. Households prefer to use the tap water, if only it was constantly available and a reliable

[55] Those households that own a well within their compound are excluded from this generalization.
[56] In order to guarantee a good water quality, the containers are ordered according to the time of withdrawal: the freshest water is last in line. This way, the 'oldest' water is always used first.

source. According to several interviewees (both sexes) especially women would always use the tap water first and only if needed the well. But as the access to tap water is limited to some hours daily, the storage activities add to this limitation by excessively withdrawing water in those hours. This particular situation reflects itself in the seasonal usage of water, too. A limited amount of water is available from the tap the entire year except for very dry periods. It is rather weekly fluctuations that determine the recharge of the well and the quantity that can be pumped into the water tower. The withdrawal measurements indicate that there is a combination of facilities in half of the cases (53% in November, 47% in May). The same holds true for the household survey drawing on statements of women, who confirm using both facilities equally often.

Though in Qsbat al-Ghamàd the payment bills are issued on a trimester basis, there is no household, except for one, which tries to save tap water to cut costs. It is generally perceived to be a fair deal to pay for maintenance of the SAEP (electricity, remuneration of the guardian) in order to take advantage of it. 55% of the averagely wealthy households say tap water is cheap and see no reason to save on its use.

It seems there is a correlation between the usage of the well and the amount of water that can be withdrawn from the tap: the more tap water there is available, the less the well is used. The locals have established a pattern of water usage that is adjusted to the limited availability of tap water, which according to several interviewees, has declined since 2001. These findings contrast with those from ‘Àfra, where there is a divide between wealthier, big households – which combine facilities like the villagers of Qsbat al-Ghamàd – and rather average sized families – which prefer to use only the tap water and resort to the well, only if needed.

4.2.3. Water Withdrawal

The water withdrawal per head and day in Qsbat al-Ghamàd varies significantly from that in ‘Àfra (Tab. 4.6 and 4.7). Not only is its quantity much higher, but also the usage of well and tap water seems to be more equal.

Withdrawal According to Usage

The following two sections describe the withdrawal during one week in November and one in May, according to usage and facility. The results show that the proportion of households using either facility varies significantly along with fluctuations in water availability.

November

The overall withdrawal in Qsbat al-Ghamàd in November 2008 was 24.5 l/h/d (Tab. 4.6), thus more than 10 l higher than in ʻÀfra. The distribution between well and tap was quite even: on average 15.8 l/h/d were withdrawn from the well and 19.9 l/h/d from the tap. The number of cases having used the well (71%) approached those using the tap (82%), indicating an equal usage of both facilities.

Table 4.6: Water Withdrawal According to Water Facility and Type of Usage in November 2008, Qsbat al-Ghamàd (average in litres per head and day)

Usage	Well	Tap	Average
Kitchen	59%	76%	
quantity	5.8 l	5 l	
Drinking water	35%	82%	
quantity	4.2 l	3.2 l	
Washing (clothes)	59%	71%	
quantity	10.5 l	10.9 l	
Shower	41%	65%	
quantity	3.6 l	5.5 l	
Toilet	53%	71%	
quantity	4 l	6.8 l	
Overall Withdrawal			24.5 l
	71%	82%	
	15.8 l	19.9 l	

For kitchen water there were ten households (59%) using the well and 13 (75%) using the tap, whereas the quantity of water withdrawn from the well for this purpose exceeded the tap by almost a litre (5.8 respectively 5 l/h/d). The same holds true for water used for tea preparation and drinking, 4.2 l/h/d were withdrawn by six cases (35%) from the well, contrary to 14 cases (82%) withdrawing 3.2 l/h/d from the tap. Many women explained to prefer keeping the reservoir (i.e. tap water) for unexpected cases and rather go to one of the nearby wells to withdraw more water, if necessary. In comparison to ʻÀfra, there is a high density of wells in Qsbat al-Ghamàd and the areas around them are still lively places, where one meets neighbours and chats a bit. Added to this, in November, the wells provided warmer water than the main well and since end of that month it was rather cold for Moroccan standards, this was a welcome feature of the well water. The well is thus still a good option for accessing drinking water. The water used for washing added up to 10.5 l/h/d from the well (59%) and 10.9 l/h/d from the tap (71%). Only the water for showering and the toilet was withdrawn in higher quantities from the tap than from the well, 5.5 l/h/d was withdrawn from the tap and 3.6 l/h/d from the well for showering. Water withdrawal for the toilet added up to 6.8 l/h/d from the tap compared to 4 l/h/d from the well. The number of cases having used the tap water is slightly higher (65%, respectively 71% compared to 41%, respectively 53%). There is a simple interpretation for this: In Qsbat al-Ghamàd many households mostly own more than one tap (on average 1.54) inside their compound and at least one of them is located in the water closet. Instead of using well water to carry it in buckets to the closet, women opted for the installation of taps directly in the toilet. Since typically the shower room is identical to the room for the toilet in most rural households, because it has a hole and a drainpipe and is constructed with cement, that tap can be used for the two usages.

May

While in November there is an almost equal usage of both facilities, the situation was different beginning of May (Tab. 4.7). The overall withdrawal has doubled to 46.9 l/h/d. The tap withdrawal is on average 42.1 l/h/d compared to only 19.5 l/h/d average withdrawal from the well. There is also a clear sign of preference for the tap: whereas only 53% of households said to use the well, 93% of them used the tap.

Table 4.7: Water Withdrawal According to Water Facility and Type of Usage in May 2009, Qsbat al-Ghamàd (average in litres per head and day)

Usage	Well	Tap	Average
Kitchen	33%	93%	
quantity	7.7 l	9.5 l	
Drinking water	20%	93%	
quantity	4.1 l	9.3 l	
Washing (clothes)	33%	87%	
quantity	11.7 l	14.1 l	
Shower	47%	87%	
quantity	5.8 l	10.1 l	
Toilet	40%	87%	
quantity	5.6 l	10.6 l	
Overall Withdrawal			46.9 l
	53%	93%	
	19.5 l	42.1 l	

The kitchen water withdrawal from the well amounted to 7.7 l/h/d, but only five households (33%) used this facility, in contrast to 14 households (93%) having used the tap, withdrawing 9.5 l/h/d. This finding holds true also for tea and washing water: only three (20%), respectively five cases (33%) indicated to use the well, with average withdrawals of 4.1 and 11.7 l/h/d respectively. Tap water withdrawal was much higher for these usages (9.3 and 14.1 l/h/d) with 14 (93%), respectively 13 cases (87%) having used it. For the shower and toilet the results shifted slightly in favour of the well. Seven households (47%) withdrew 5.8 l/h/d from the well for showering and six households (40%) withdrew 5.6 l/h/d of water from the well for the toilet. Concerning the tap, in both cases there were 13 households (87%) withdrawing 10.1 l/h/d for showering and 10.6 l/h/d for the toilet. The much higher withdrawal from the tap can again be explained by the fact that most households have a tap connection in the toilet.

These results seem exorbitantly high, both in comparison to the withdrawal in 'Àfra in the same period and compared to the results from the AU for the year before (see below). However, in the course of several interviews, of which some with the guardian of the well, it can be concluded that due to the intense rainfalls throughout the winter period, which were above average, the groundwater basins in the whole Valley reached higher levels. The villagers observed a rise of the water level in each of their wells and the SAEP well provided more than it used to in the preceding years. Therefore, more water was available and as the villagers prefer the tap water, they use more of it. And contrary to the preference in November for warmer water from the wells, the tap water is colder and thus suits the higher temperatures of May. The wells are nonetheless maintained in case of the usual shortages from the tap, which are so typical for this deficient system.

Water Withdrawal for Livestock

In Qsbat al-Ghamàd the livestock is composed of cattle, donkey, sheep and goat. Table 4.4 shows that the size of herds is much smaller than in 'Àfra: the average TLU per household is only 1.4. Per year 5.14 m³ are withdrawn from the well and 8.57 m³ from the SAEP. The yearly average water use per TLU is 13.72 m³ and thus even higher than in 'Àfra. Per households this equals 19.2 m³ of water per year used for livestock.

Results from Association d'Usagers

In this part, I present data which I received from the AU of Qsbat al-Ghamàd. Though the village has been endowed with a SAEP since 2001, there is data available only since September 2007.[57] Nevertheless, one whole year is covered by the data (Fig. 4.5) and serves as calibration for the results of my own measurements in November 2008 and May 2009. As the reading and billing, based on domestic water meters, is undertaken on a

[57] During my first research trip I met one villager who owned a personal computer and had the data since September 2007 digitalized. Unfortunately, I did not meet him again during the second field trip, which is why I could not get access to the data from August 2008 until April 2009.

trimester basis, the datasets are available only on that scale and for that reason the withdrawal is indicated as average mean per head and day.

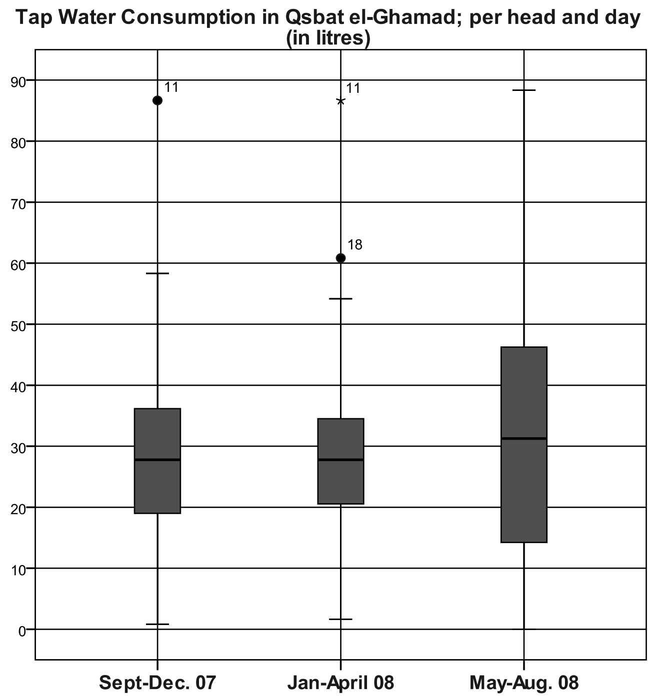

Figure 4.5: Tap Water Withdrawal from Sept. 07 to Aug. 08, Qsbat al-Ghamàd (User Association Qsbat al-Ghamàd)

In the autumn period from September to December 2007, as well as in the winter/spring period from January to April 2008, there has been the same average withdrawal of 29.7 l/h/d in Qsbat al-Ghamàd. In contrast, the water quantity during the dry summer months from May to August has increased to an average of 32.1 l/h/d. Thus, the average withdrawal throughout the whole year is 30.5 l/h/d. These results are fairly stable, owing to the trimester based billing. The average tap water withdrawal resulting from my own measurements in November and May (31 l/h/d, see Tab. 4.9) shows a close relation to the AU results during the one-year-period.

4.3. Conclusion: Comparison of Adaptive Management Patterns

The presentation and interpretation of the results of quantitative measurements and a household survey in this chapter confirmed that there are different patterns of action to access water according to different local settings. After resuming with a short comparison of the previous sections, I conclude with an illustration of the average withdrawal of both ‘Àfra and Qsbat al-Ghamàd. An analysis of the findings presented in this and the preceding chapter will then be undertaken in chapter five.

According to the functional capacity of the SAEPs in both villages, different patterns of water withdrawal have evolved in the households of each village. In ‘Àfra, there is a difference between rather big, wealthy families and those households, which are of average size and economic situation. Whereas the first group actively takes advantage of both well and tap water, the second group relies solely on tap water since the recently inaugurated SAEP. The villagers of Qsbat al-Ghamàd, who have in the years since the inauguration in 2001 experienced the unreliability of their own SAEP, didn’t abandon their wells, but maintain and use them. The cost and effort of maintaining a well has not been named an obstacle to its continuous usage, though the household's economic situation is comparable to the average households in 'Àfra. However, in the latter village, people complained about the high maintenance costs of wells and name this a reason for their abandon. There are many more maintained wells in Qsbat al-Ghamàd: 15 compared to five in 'Àfra. In fact, in 'Àfra the dependence on tap water is much higher, given that all households are connected. Despite the system being newly installed in 'Àfra, people were eager to abandon their wells for the sake of convenience. Contrary to that, the households of Qsbat al-Ghamàd who have a domestic tap (52.5%), rely on two facilities for securing their drinking water resources. While most favour the tap, these households still use their well.

Owing to the different reliability of the SAEP, different patterns of using them have emerged. Except for the three families in 'Àfra, no combination of facilities takes place in this village, though washing the laundry it one domain where some women still resort to the well. In Qsbat al-Ghamàd, and valid also for the aforementioned three families in 'Àfra, a combination of the two facilities dominates. In case of the three families one can conclude that it is not only their relative wealth that allows for the usage of two water facilities, but also the fact of valuing the well for its reliability and its better taste. In case of two families it is also their size that eases the usage of the time intensive well. In case of Qsbat al-Ghamàd's households, the combination takes place not just because there is the option, but because there is the need to combine both tap and well: As soon as the tap water is insufficient for household water management the well has to be used. In consequence, it is necessary to maintain the wells. Though most households prefer to use the tap water, its water availability and/or its management do not allow for the continuous use of this facility. In the light of good water availability due to reliable groundwater recharge in most wells of Qsbat al-Ghamàd, the deficiency of the SAEP well seems almost paradox.

The findings of the water quality suggest a disparity between the villages (Tab. 4.1, 4.5), too, but interestingly the salinity of water in 'Àfra does not generate adapted patterns of usage. A possible interpretation could be that as *within* the village the salinity is rather homogenous, the households do not have a real choice unless they want to travel to Qsbat al-Ghamàd to fetch fresh water, which only few have time to do.

Whereas the households in 'Àfra withdrew on average 28.67 l/h/d (November and May), the household water withdrawal in Qsbat al-Ghamàd is with 35 l/h/d much higher than in

‘Àfra. In detail this means that in ‘Àfra 13 l/h/d was withdrawn from the well, compared to 17.2 l/h/d in Qsbat al-Ghamàd. This results in an average withdrawal of 15.4 l/h/d from the conventional wells. Contrary to that, 25.3 l/h/d tap water have been withdrawn in ‘Àfra and 31 l/h/d in Qsbat al-Ghamàd, resulting in an average withdrawal of 27.3 l/h/d from the SAEP. Therefore, the quantitative results display the different usage of the facilities in both villages. If beyond that, the average of both villages is calculated, it can be concluded that on average 32 l/h/d of water are withdrawn in all households under scrutiny.

Table 4.8: Comparison of Water Withdrawal According to Water Facility (average in litres per head and day)

	Well	**Tap**	**Average**
‘Àfra (Nov. 08)	11.2	18.2	23.6
‘Àfra (May 09)	16	29.6	33.7
Overall	13	25.3	28.7
Qsbat al-Ghamàd (Nov. 08)	15.8	19.9	24.5
Qsbat al-Ghamàd (May 09)	19.5	42.1	46.9
Overall	17.2	31	35
Average mean (both villages)	15.4	27.3	32

Table 4.9 shows the total water withdrawal per head[58] and year in ‘Àfra is 25.1 m³ and in Qsbat al-Ghamàd 31.3 m³. The average for both villages is 28.22 m³/h/y. The preference for tap water is evident: 19 m³/h/y is on average used from the tap, compared to only 9.2 m³/h/y from the well. The absolute withdrawal per village is astonishingly even – assuming that the measurements of two weeks also represent the remaining 50 weeks of the year.[59] ‘Àfra withdraws 241.2 m³ water per year and Qsbat al-Ghamàd 247.4 m³ per year.

Table 4.9: Human and Total Water Withdrawal According to Water Facility in 3 Villages (columns 1-3: in m³ per head/TLU and per year; column 4: in m³ per year)

	Well	**Tap**	**Total (m³/h/y)**	**Total (m³/y)**
‘Àfra (human water use)	4.7	9.2	10.5	100.5
‘Àfra (total)	7	18.1	25.1	241.1
Qsbat al-Ghamàd (human)	6.3	11.3	12.8	100.9
Qsbat al-Ghamàd (total)	11.4	19.9	31.3	247.4
Average Mean	9.2	19	28.2	--
Ouled Yaoub[60]	8.1	--	8.1	8100

58 Here, head also refers to livestock; one human = 1 TLU. A distinction between quantities of water use by adults and infants has not been made in the data analysis, as the lower infant water use for drinking and showering is evened out by the higher water need for washing clothes.

59 This assumption is based on the fact that more water is used in the summer months and less water in the winter months. The two contrasting quantities are thus evened out through one year, as the results from the AU of Qsbat al-Ghamàd also show.

60 For 2005 an estimated 1000 inhabitants lived in Ouled Yaoub. The data was extracted from IMPETUS 2007: 250 and from Rademacher (2010): 75. Livestock water use is not included.

This comparison of absolute water withdrawal illustrates a higher per head withdrawal in Qsbat al-Ghamàd and shows to what extent the tap water use increases water demand. The comparison of the village's water withdrawal is evidence of the correlation between a tap water connection and rising water withdrawal. This assumption is confirmed by other IMPETUS-findings on household water withdrawal in Ouled Yaoub (Tab 4.9), where no SAEP existed at the time of measurements. In Ouled Yaoub, the drinking water withdrawal (excluding livestock) per head and year is only 8.1 m³ (in 2005, IMPETUS 2007: 250) or 22.2 l per head and day. This is considerably lower than the average withdrawal of an inhabitant of 'Àfra or even more so, of Qsbat al-Ghamàd.[61]

The presented results indicate a different evolution of water demand in rural areas than was estimated by the Moroccan Government and PAGER described in section 3.1.3. My measurements from November and May show that on average rural households *withdraw* 7 l/h/d more than the 25 l/h/d the Moroccan Government predicted to be the average human *demand* of drinking water in rural areas in 2010. What is more, PAGER presumes a water demand that is 13 l/h/d below the presented results. This has direct impacts on the performance of national water policy and programmes (chapter 5).

In conclusion of this chapter, it can be assumed that one determining factor for the distinctive patterns of water withdrawal and management is the everyday experience with the SAEP. Qsbat al-Ghamàd is connected since eight years and all households have a similar pattern of action, which is stable in that it is adaptive to fluctuating water availability from the SAEP. However, in 'Àfra, people still have to see how reliable their SAEP is and with time will be able to react according to the options the system allows for, while now the these villagers abandon the conventional wells.

[61] A comparison with agricultural water use could not be made due to high uncertainties associated with the agricultural use of groundwater. This is, amongst others, a result of the employment of motor pumps, which make an estimation of total water use for agriculture impossible.

5. Options for Action

With the creation of local water institutions to access safe drinking water, rural water demand is now on the national agenda of water policy. As a consequence of improved access, water withdrawal is rising, while water availability decreases. Both the institutional as well as the natural constraints were described in the precedent chapters and demonstrated that water management is ineffective, from an economic and sustainable point of view. From the local and emic perspective, the situation is perceived differently: The experience with rural drinking water supply systems in Qsbat al-Ghamàd showed that there problems concerning its functioning emerged soon after its inauguration eight years ago. Not only do organisational problems cause the unreliability of the SAEP (fr.: *Système d'Alimentation en Eau Potable*), but the resource is increasingly scarce due to lowering groundwater tables. Nonetheless, there *is* access to tap water. In 'Àfra the SAEP is popular and provides tap water without major interruptions, and since its recent inauguration most villagers abandoned their draw wells. These households now rely mainly on tap water, although experience made in other villages proves the SAEP not to be reliable. From a local standpoint, it is thus the reliability of the SAEP that is judged.

In the course of this study I presented the context within which local water management takes place and showed that water withdrawal rises with the access to tap water, despite increasing water scarcity in the region. National water policies impact on rural households in that water supply programmes for rural settlements such as PAGER promote the creation of prefabricated institutions of User Associations (fr.: *Associations d'Usagers*, AU) to manage drinking water locally. But the empirical data showed that drinking water management is actually undertaken on a different institutional level: the household. In response to the unreliability of the SAEP, flexible and adaptive management patterns have evolved in Qsbat al-Ghamàd, while 'Àfra's inhabitants embraced the new water facility without doubting its capacity.

The relation of water withdrawal and management with environmental and institutional constraints should thus be apparent. But the underlying problem of the study is with this diagnosis only partly answered and the question remains of *why* the formal management is ineffective? In the course of this chapter, I try to answer this question by analysing the institutional constraints (5.1) and evaluating the performance of rural drinking water management (5.2). This way, I want to explore the options local actors have in managing the scarce resource, and by taking up three storylines developed by IMPETUS I delineate future options for local action (5.3).

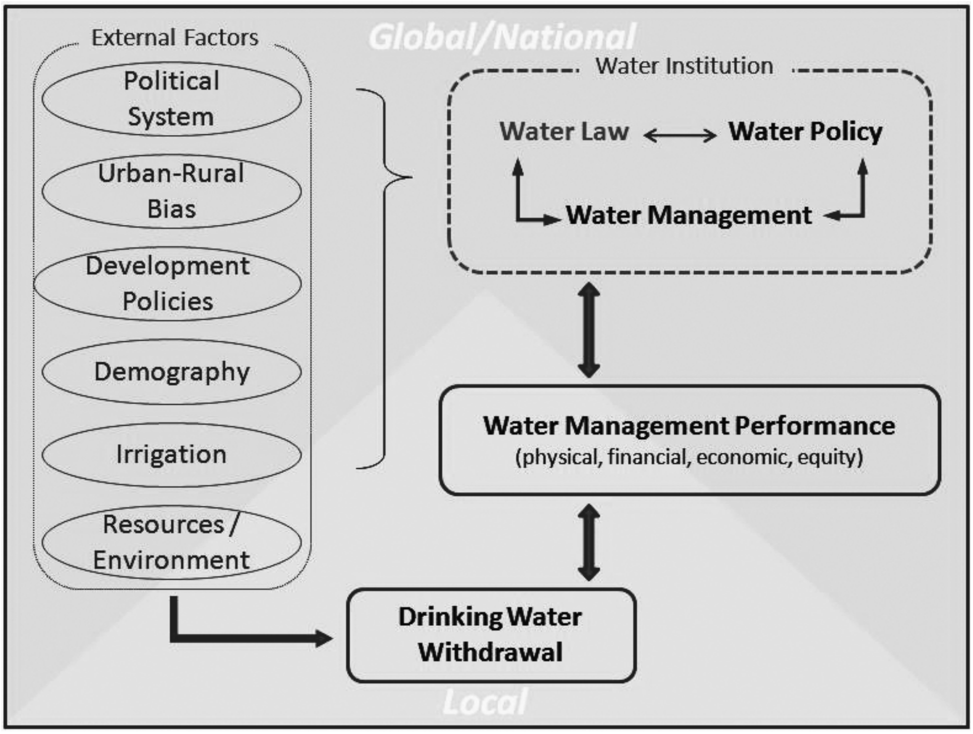

Figure 5.1: Analytical Framework (modified according to Saleth and Dinar 1999)

5.1. Water Management in the Light of Resource Scarcity and Institutional Constraints

The aim of this section is to analyse the aforementioned constraints in the light of water management. In so doing, I first resume with the main external factors that determine the access to drinking water. I then outline the relevant institutional components and decompose these to show how the institutional aspects and their linkages impinge on water withdrawal and management.

External Factors

Let me sum up the most relevant external factors. These range from global and national to local phenomena and are arranged accordingly in figure 5.1. While socio-political factors are rather general phenomena, valid for the whole of Morocco, demographical and environmental factors have a more direct negative relevance to rural livelihoods. I explained through a historical lens in how far the Moroccan political system has been subject to power struggles between the urbanized West and the rural South-east. This urban-rural bias evolved between Islamized central powers and their attempts to control the territories of the tribal federations in the Atlas Mountains and south of them. Meanwhile, these areas established their own political systems based on village councils. Centuries of clashes between these groups have translated into an ongoing struggle of self-determination in these settlements in what is now the 'periphery' of Morocco. When the agro-economic development of the country during the Franco-Spanish Protectorate was initiated beginning of the 20th century, it based on this bias, pragmatically distinguishing *Maroc utile* and *Maroc inutile*; the area of my research belonging to the latter. Development policies after Independence continued this strategy and fostered economic and agrarian development solely in the West. The South-east remained neglected. As a consequence of the economic growth in the urbanized areas and an ongoing population growth since the 1950s, labour migration from the less developed rural regions to the striving West became a national phenomenon. These demographical changes further aggravated geographical disparities, bolstered only by the remittances from labour migrants and their investment in the home region. The result of these dispersed investments was and still is the promotion of irrigation agriculture through access to groundwater resources with private motor pumps. This caused a groundwater discharge rate above recharge and thus constitutes one major explanation for the degradation of water resources in most arid regions of Morocco, where agriculture is the main source of income. Whilst other anthropogenic factors add to this factor of resource degradation, the natural conditions change as well. Chapter two illustrated to what extent global environmental change impacts on climate variability in the South of Morocco, thus accelerating the process of environmental degradation in the Drâa Valley and impacting on rural household water withdrawal and management strategies.

Decomposing Water Institutions

Additional to external constraints impinging on local action, there are also institutional constraints inherent to the problem of non-functioning water management. As can be seen in figure 5.1, a water institution is composed of three components, of which two were subject of this study: water policy and water management. This division has been proposed by Saleth and Dinar (1999), who developed an analytical toolbox for analysing the institutional aspects of water management and its performance. The following analysis of water institutions in the Middle Drâa Valley is based on this toolbox.

In chapter three I showed which relevant water institutions there are in Morocco, ranging from national institutions such as the *Conseil Superieur de l'Environnement et du Climat* (CSEC) to the local User Association (AU). And a closer look at the box of the ideal water institution in figure 5.1 shows its affinity with figure 3.1 in chapter three. Hypothetically, water institutions transcend all levels from national to local and include both national and local actors. However, figure 5.1 suggests that water institutions are a global or national phenomenon. This paradox is due to what I call institutional prefabrication and what I turn to after the following decomposition.

By assuming that a functional water institution is constructed of three components which are composed of six elements each, according to Saleth and Dinar (1999: 5f), it is possible to see in how far the concerned institutions in the context of this study are functional or not. First, the component of water policy is decomposed, as it is concerned with *national* institutions. Its decomposition in table 5.1 shows that of the four aspects which were tackled in this study, only one responds in part positively. The findings indicate that the remaining three aspects are not fulfilled in the case of Qsbat al-Ghamàd and ‘Àfra:

Table 5.1: Institutional Aspects of Water Policy (according to Saleth and Dinar 1999: 5)

(I) Institutional Aspects of Water Policy	Fulfilled?
(a) Project Selection Criteria	Partly
(b) Pricing and Cost Recovery	--
(c) Inter-regional/Sectoral Water Transfer	No
(d) Private Sector Participation	--
(e) User Participation	No
(f) Linkages with other Economic Policies	No

- According to my data, the project selection criteria (Ia) were partly fulfilled: dispersed rural settlements (*diour*) are the focus of the programme PAGER, the main criterion for the project selection as it attempts to eliminate urban-rural disparities. Another aim of national water policy is partly (see below) achieved since the demand for a SAEP is formulated by the interested village itself, thus fostering local participation. However, though PAGER promotes the access to potable water, in the case of ‘Àfra the well supplying the SAEP is located inside of the oasis and subject to high salinity. The groundwater is thus of bad quality. The criterion of water availability seems to have outweighed that of water quality, though both are claimed as equally important selection criteria.
- The aspect of pricing and cost recovery within water policy (Ib) was hardly tackled in the present study and can therefore not be answered comprehensively.
- Concerning the inter-regional or sectoral water transfer (Ic) there are several features indicating this aspect is not fulfilled: PAGER intentionally excludes the cooperation with other formal local associations, such as education or religious associations. The professionals claim this separation necessary to guarantee the AUs focus on the domain of drinking water. Additionally, sharing of knowledge

and/or experience with the SAEP is not promoted between different villages but rather inhibited, though most of these work with PAGER and are geographically close (e.g. the distance between ‘Àfra and Qsbat al-Ghamàd is only 5 km). Nonetheless, there is informal exchange of knowledge and experience taking place between the villages as they are tied through kinship.

- The private sector participation (Id) was not part of this study and is not addressed.
- The aspect of user participation (Ie) is not fulfilled, notwithstanding its strong promotion in national water policy: in both villages many members of the AUs are not actively participating in managing the water institution, manifested in their absence in meetings with PAGER professionals. What is more, the women who actually manage household water are not included in capacity building and training. Instead, the female domain is now influenced by the husband, as the latter are in charge of the payment of water charges and thus gain a new power in the household. Participation as a national strategy is thus far from local realities.
- Linkages with other economic policies (If) are non-existent: First, linkages with other local institutions are not promoted by PAGER (see above) and second, drinking water is considered to be a separate entity from agricultural water management, its direct competitor over the resource. Hence, whilst both are subsidiary to the same national institution (Fig 3.1) and manage the same resource, they act separately and – in case of droughts – are in conflict with one another.

This analysis shows to what extent many institutional aspects of Moroccan water policy, through being legally established in the *Loi N°10-95 sur l’Eau*, show evidence of the lack of a broad institutional basis for local water management.

The local manifestation of water policies are the institutional aspects of water management, directly impacting on rural livelihoods. Hypothetically, these are the elements the AU should be composed of. The four aspects examined in this study were – if at all – only partly fulfilled (Tab. 5.2):

Table 5.2: Institutional Aspects of Water Management (according to Saleth and Dinar 1999: 5)

(II) Institutional Aspects of Water Management	**Fulfilled?**
(a) Spatial Organization	--
(b) Organizational Features	Partly
(c) Functional Capacity	No
(d) Pricing and Finance	Partly
(e) Regulatory and Accountability Mechanisms	Partly
(f) Information and Technological Capabilities	Partly

- The spatial organization (IIa) was not part of this study and is not analysed.
- The aspect of organizational features (IIb) is probably the most apparent of all aspects of a water institution as it includes not only the distinction between members and non-members, but also the emergence of principles of sovereignty, task appointment and chains of command within an institution. Though not all AU members are actively participating in neither of the villages, they are distinguishable from non-members. There are no principles of sovereignty either, but that would not make sense anyways, since it is in reality only one man managing the SAEP: the guardian. The same applies to the responsibilities within the organisation. The AUs are thus not exactly what PAGER had in mind when creating it, but it delivers the one service villagers ask for: the supply with water.
- The functional capacity (IIc) of the SAEP in 'Àfra differs from the one in Qsbat al-Ghamàd. While in 'Àfra there have been no deficits in the functioning of the SAEP and water was available continuously, in Qsbat al-Ghamàd the water availability is reduced to four hours daily. Several reasons account for this management deficit: the SAEP well is not deep enough, the pipes are of different size or else the costs of electricity are too high. Another reason for functional problems is the reduced participation of the other members (see above), thus increasing the responsibility of the guardian.
- The pricing and finance of the water management (IId) is a complex issue, of which tarification is the most important. Both AUs charge the minimal water tariff proposed by PAGER professionals. Due to the high social integration in each village, the AU – being composed of locals only – does not dare to charge more than absolutely necessary. In local perception, the SAEPs are meant to supply water to every household at the price of maintenance. The AU can thus not make long term financial plans, i.e. investments beyond electricity or fuel. However, if there is dire need (i.e. there is no tap water), the households pay on command and affirm their willingness to do so. But the results of this deficit financial management of the AU become obvious in the long run as the example of Qsbat al-Ghamàd shows: it is not able to satisfy demand since years, as it lacks the financial resource to improve the water infrastructure. As long as there is tap water, villagers do not want to pay more.
- Formal regulatory and accountability mechanisms (IIe) are absent in formal water institutions, but exist informally. Though being an integral part of the strategy of

PAGER, the AU is left to its own resources after its creation and no regulation takes place (e.g. the exchange of members after four years of duty). The AU is accountable to PAGER, but since in fact no monitoring or evaluation takes place in most villages, there is no way to control accountability. This has the negative consequence that many of the aforementioned institutional aspects will continue to be absent and the AU is likely to remain in the hand of one or two active persons. However, the guardian is accountable to all villagers, which is a typical phenomenon of strong social integration. The AU is thus socially accountable rather than formally.

- Information and technological capabilities (IIf) are another institutional aspect which is partly fulfilled. Above I have mentioned that formal meetings of the AU do not take place regularly, but there are other means of distributing information: mainly through mouth-to-mouth. In rural settlements news and information are usually disseminated orally and do not always have the formalised shape of a meeting. This local means of information dissemination is thus functional enough to represent an informal institutional aspect. Concerning technological capabilities, however, the situation is less promising: I encountered one villager and member of the AU in Qsbat al-Ghamàd who owned a personal computer. He is not often in the village, as he is one of the many labour migrants. Consequently, his capabilities to take record of water withdrawal and maintain a database are reduced. Additionally, most other AU members are older and do not know how to operate a computer. The local technical capabilities are thus constrained by a lack of skill to use it.[62]

The decomposition of the institutional aspects of water management depicts a lack of most of these and casts doubt on whether formal institutions of water management exist at all.

Drinking Water Withdrawal

This analysis illustrates which institutional aspects are necessary to manage water in the light of external determinants and institutional constraints and allows understanding why the patterns of water withdrawal depicted in chapter four are such as they are. Tables 5.1 and 5.2 indicate that some institutional aspects are fulfilled, while others are not. However, for an institution to be judged functional, the fulfilment of all aspects is required. But in

[62] Or the lack of will; which is according to Rademacher (2010) a source for conflicts between representatives of existing village institutions and representatives of new ones.

‘Àfra and Qsbat al-Ghamàd water is supplied despite the lack of these aspects; quite the contrary, withdrawal is rising.

The decomposition showed that in some cases there are local responses to the non-functioning of the AU or the SAEP (see Tab. 5.2); these were thoroughly discussed in chapter four and constitute specific adaptive patterns of action. In the case of Qsbat al-Ghamàd, which has a longer experience with its SAEP, locals adopted flexible mechanisms in accessing water and resort to a combination of facilities. The traditional draw well is thus still in use and constitutes a main access to drinking water in case the SAEP is not supplying enough water. While the locals prefer the easier access to water from the tap, the draw well remains a backup solution. In ‘Àfra the situation is different, the new SAEP is popular and caused most households to abandon the draw well and rely on tap water. Water withdrawal has increased as well, but did not yet reach the same quantity as in Qsbat al-Ghamàd. Nonetheless, the analytical decomposition illustrated that institutional constraints are identical to those in Qsbat al-Ghamàd and thus raise doubt as to whether the management of the SAEP through the AU in ‘Àfra will remain reliable in the near future.

In conclusion, in both villages locals responds to changing circumstances – be it by abandoning the draw well in favour of the SAEP or by relying on both facilities, with water withdrawal rising. What is particularly interesting in the case of local institutional aspects of water management is the fact that three of five aspects are partly fulfilled and do exist in both villages in a reduced way. They certainly are not formal, but *informal* arrangements, which evolve as a response to the non-functional *formal* aspects of the water management. The following section evaluates these findings and then points out in how far this institutional dualism impacts on rural drinking water management.

5.2. Institutional Prefabrication versus Institutional Bricolage

The analytical decomposition of the institutional aspects of water institutions proved the deficits of national water management to frame local water management and raises doubts about the effectiveness of a nationally promoted process of institutionalisation through the *Loi N°10-95 sur l’Eau*, the national water policy and PAGER. In fact, these institutions constitute restrictions to local action in that they introduce a form of non-local institution that has inherently different forms of organisation (e.g. participation of men only, water tarification, election of AU members or distribution of tasks). The limited capacity of PAGER professionals to help establish a formalised institution such as the AU results in a local institution that is not familiar with an organisation according to formal aspects. I call this non-local concept ‘institutional prefabrication’, delineating a process of institutional creation which does *not* build on social and cultural arrangements of a concerned locality, but has been shaped by global or national concepts of institutionalisation. These prefabricated institutions are not only unable to respond to the needs of rural households; the process of formal institutionalisation is constraining local action.

In fact, the decomposition of water policy illustrated to what extent these prefabricated institutions are in a local context not even real institutions and, opposite to the defining traits of an institution, do *not* constitute social structures that provide cohesion and coordinate practices. With three of four institutional aspects of water policy being unfulfilled (Tab. 5.1), hardly any aspects remain that are worthy being called *institutional*. Rather, looking at the institutional aspects of water management (Tab. 5.2), it is in part the locals who react to the lack of cohesion and coordination by PAGER in creating adaptive mechanisms such as the combination of facilities. Instead of a process of institutionalisation according to national water policy, these local mechanisms evolve in the need and desire to provide access to tap water.

By evaluating the management performance of formal institutional aspects against local arrangements (Tab. 5.3), I now explore in how far it is possible to refer to the concept of institutional bricolage presented in section 1.3 (Cleaver 2001a: 26): Is it possible to refer to “a process by which people [...] draw on existing social and cultural arrangements to shape institutions in response to changing situations” or do the constraints of institutional prefabrication outweigh local action?

The decomposition does not claim to be complete and leaves many aspects to subjective interpretation. Nonetheless, it allows for an evaluation, which is summarized in table 5.3, based on four elements:

Table 5.3: Management Performance of Formal and Informal Institutional Aspects (modified according to Saleth and Dinar 1999: 7)

Management Performance	**Institutional Aspects**	
	formal	**informal**
(1) Physical: water availability, quality	Bad	Bad
(2) Financial (actual vs. required)	Bad	Medium
(3) Economic Efficiency (incentive gap)	Bad	--
(4) Equity between Regions/Sectors/Groups	Bad	Medium

- The physical performance (1) is judged based on aspects of water availability and water quality and the performance herein is bad in both formal and informal institutional aspects: the water infrastructure of Qsbat al-Ghamàd as it was planned and constructed by PAGER does not cover the rising demand. Additionally, the AU does not have enough financial possibilities to run the electric pump continuously and thus reduces water availability to some hours a day. In ‘Àfra the SAEP well provides enough water, thanks to its location in the oasis. However, the water availability comes at the cost of reduced water quality owing to high salinity. Though the AU guardian is treating the SAEP well with chlorine, the pollution of water remains a constant threat.

- The financial performance (2) is bad from a formal institutional point of view, but not so bad from an informal point of view. Though the PAGER professionals teach the AU members in financial management, they did not consider problems the AUs meet in their villages: the people do not accept tariffs above the maintenance costs, because they consider water a public good. Furthermore, the AU does not have the bargaining power to charge more than the maintenance costs. Villagers trust in the financial performance and the AU trusts in the villager’s cooperation: if there is dire need, households will pay. Nonetheless, this system proved suboptimal, as so far investments in the improvement of the SAEP (of Qsbat al-Ghamàd) did not take place. In the long run, the financial management is unsustainable not just according to formal aspects promoted by PAGER (and western concept of financial management in general).
- The economic performance (3) is bad from any point of view. According to resource management economics, in the both villages there is an incentive gap due to low water tarification and one way of assuring the sustainable use of a scarce resource would be higher water tariffs. In case of water scarce regions, prices should be higher and would thus contribute to more conscious use. In reality, however, water is a public good, declared by the *Loi N°10-95 sur l’Eau*, and the villagers are quite aware of this. As a matter of fact, locals are willing to pay the amount that is needed to run the SAEP, but they are not willing to pay for water itself. This difference in water tariffs is clear and particularly the inhabitants of the arid Drâa Valley are willing to fight for this right. On the side of informal institutional aspects, the perspective of locals differs from that of non-local professionals. And since the concept of economic performance is again a western concept that is not easily applicable to local conditions, it cannot be evaluated from an informal perspective. Water constitutes a main element of local livelihoods and

neither the AU nor the households care about a good economic performance, as long as they have access to water.

- The equity between regions, sectors or groups (4) is bad, evaluated from the results of the analytical decomposition in section 5.1. Neither experience sharing nor knowledge transfer between villagers or AUs is taking place or being fostered by PAGER. Informal institutional aspects, however, showed that local action is attempting to balance between sectors. This means, for instance, the possibility of free water withdrawal from agricultural wells in dry periods. Equity between groups is reached by helping poor households in paying SAEP water bills anonymously. Furthermore, ‘Àfra reacted to complaints of villagers in Qsbat al-Ghamàd about high water bills and is now billing on a monthly basis instead of a trimester basis. This way, the payments are smaller and allow for the locals to better keep track of their withdrawal.

This performance evaluation shows why the institutional prefabrication causes ineffective water management in Qsbat al-Ghamàd, and hints at likely problems in ‘Àfra in the near future. There are some informal arrangements which react to these deficits. The notion of efficiency, however, seems to be different from the local perspective, which is judging management not based on the notion of efficiency, as long as the SAEP provides tap water, but rather judges its reliability. In case of Qsbat al-Ghamàd there are some problems in providing water around the clock, but the locals know that they can get tap water, if it is needed. They can always call upon the guardian and they trust his management. On the other hand, the system is not reliable and forces the villagers of Qsbat al-Ghamàd to maintain draw wells nonetheless.

This evaluation, with Cleaver, accounts for a process of institutional bricolage in which the locals adapt to non-local institutions, drawing on existing social arrangements in response to changing situations. Local drinking water management is thus based on other assumptions than the presented non-local concepts of a ‘good’ performance. Locals rely on structures such as trust and social accountability in order to access what they all need. Knowing that there are physical constraints such as reduced water availability, local actors do not ask for efficient water institutions, they ask for water. The actual drinking water management is thus undertaken on household level, it is here that locals are adapting to institutional prefabrication in using draw wells additionally. The fact that tap water was brought to the villagers, is honoured through its wide acceptance, but rural households always dealt with uncertainty and keep doing so in establishing flexible patterns of water use and management. The formal drinking water management performs badly (not only from an economic perspective), but as long as there is water, there is one institution that is able to cope with all other constraints: Households create forms of water management that respond to prefabricated institutions and allow for the use of tap water despite its unreliability. Therefore, institutional bricolage *does* take place in that it occupies those gaps in water management performance which matter to local actors.

5.3. Conclusion: Which Options will Local Actors have in the Future?

Against the background of institutional prefabrication but rising water withdrawal one remains wondering which local options for action remain in the future. This section aims at displaying possible future constraints and tries to answer this question by employing three IMPETUS storylines.

In comparing those villages which do not yet have access to tap water with villages which have tap water, the correlation between domestic tap connections and rising water withdrawal becomes evident. As research on household withdrawal in another Ka'āba village showed (chapter 4), the quantity of withdrawn water remains low when the only access to water constitutes the draw well (IMPETUS 2007: 250). These latter results indicate congruence with national estimations on water demand (chapter 3): the households of Ouled Yaoub used on average 22 l per head and day (excluding livestock). This equals a water quantity of 8.1 m³ per head and year, which is considerably lower than water withdrawal in 'Àfra and Qsbat al-Ghamàd (excluding livestock: 10.5 m³/h/y respectively 12.8 m³/h/y). The lower quantities of 'Àfra owe to the fact that its SAEP is only one year old, while the SAEP of Qsbat al-Ghamàd is more than eight years old and withdrawal has risen since. The evolution of water withdrawal and management as it happened in Qsbat al-Ghamàd can thus be of interest to those villages, which – like 'Àfra – are just beginning to change their household water management.

By taking up three storylines developed by IMPETUS in 2005, I demonstrate three possible developments in water withdrawal and management. The scenario M1 assumes a further marginalisation of the Drâa region due to a lack of development aid, scenario M2 assumes rural development in the Drâa region through regional programmes and scenario M3 assumes business as usual. While the storylines are developed on several traits of development, I draw only on those relevant for water policy and management. I illustrate each scenario with its relevant storyline and conclude with a future development in water management according to the appointed scenario:

Scenario M1

Herein, the Drâa region remains mostly neglected by economic development projects and is further marginalised; industry and tourism remain negligible branches, while the agrarian sector continuous to be dominant. Development programmes are significantly reduced, while at the same time traditional mechanisms of decision-making reach new local influence. Migration drains the villages and decreases livelihoods. Local conflicts increase due to increasing individualisation in economic and household management. The privatisation of drinking water supply projects causes rising water tariffs, thus excluding economically weak households. Energy prices rise as well, causing the increased usage of natural resources for energy.

The water withdrawal is likely to increase according to the economic standing of households and individualisation will further this development towards a biased society: Those households, who can afford it, will steadily increase their water withdrawal, while economically weaker households return to draw wells for most of their usages. The increasing water prices will result in two very different patterns of water withdrawal and different household water management strategies. The combined effect will then cause a stagnation of water demand, also due to decreasing population caused by increasing migration. The water quality will remain a local issue according to given natural conditions. Hygienic standards will not improve due to lacking sensitisation. Overall, the drinking water management will be subject to individual adaptations, which range from the use of a draw well only to the use of tap water only.

Scenario M2

In this scenario, development programmes which foster self-help gain importance and the tourism is reinforced in the Drâa region. The agrarian sector remains dominant. According to the claims of national strategies, development programmes are extended and enhance local administrative institutions. Migration is decreasing and causes population growth in the Drâa region, while overall livelihoods improve. Infrastructure, such as drinking water supply systems, is further developed by drawing on local structures. Local institutions are thus stabilised and formalised and the access to safe potable water gains new priority in national water policy. Additionally, the usage of renewable energy is fostered and contributes to a sustainable resource management. Energy prices rise.

M2 assumes a rather positive development for drinking water supply in the Drâa region, mostly owing to the fact that development programmes are successful in consolidating local institutions. The new awareness of local capabilities fosters local involvement and raises local self-consciousness, thereby increasing the participation of local actors. In this scenario, all informal institutions, particularly drinking water management in households, experience a new valuation and receive tailored assistance. This way, the institutionalisation will take place on the real level of drinking water management and new powers will be given especially to women. The increased priority of drinking water in water policy will increase the access to safe potable water and increase its quality and a hygienic handling of the resource. Though sustainable use of the resource is advocated and greatly enhanced in the energy sector, water withdrawal will greatly increase with a parallel population growth. The positive effects of better resource management will be outweighed by a fast increase in groundwater withdrawal. However, in a long-term perspective, the more powerful local institutions will help to establish a sustainable water management thanks to the new self-awareness of the local actors. Generally, household drinking water management will first increase, due to the increased efficiency of the drinking water supply, but at one point local actors will respond to the growing water scarcity by keeping water withdrawal at a sustainable level. New patterns of withdrawal evolve that take into consideration resource scarcity, thus contributing to a stable water management.

Scenario M3

The business as usual scenario assumes a slow process of industrialisation of the Drâa region. The tourism is reduced to a few attractive areas and the only sector that receives aid. The agrarian sector remains dominant. Societal transformation continuous towards individualisation and the dualism of national and local administration is reinforced. High migration rates are compensated by high population growth. The increasing water scarcity reduces agricultural land and reduces income, while energy prices rise. Development programmes remain active in easily accessible areas of the Drâa region and improve access to potable water in these parts while further neglecting remote areas.

Assuming this scenario, it would by most easy to draw on experiences from Qsbat al-Ghamàd in order to project the development of water withdrawal and management in ‘Àfra. The usage of tap water will increase as long as the SAEP is reliable. Due to rising water demand, however, and the decreasing water availability of groundwater aquifers, the

SAEP will reach its capacity limits and locals will not be able to access tap water regularly. Consequently, households will resort to draw wells and a pattern of withdrawal similar to that in Qsbat al-Ghamàd evolves. The combination of access will allow the satisfaction of drinking water demand and hence withdrawal will increase steadily. After a decade, the situation will change further: the groundwater aquifers will be significantly reduced – also due to continuous agricultural usage of groundwater – and water availability will decrease as well. Consequently, irrigation agriculture will have to be reduced and thus income and livelihoods will decrease, followed by reduced availability of drinking water. At the same time, water quality will worsen owing to higher concentrations of salt in smaller water quantities. The household drinking water management will thus be forced to adapt through reducing withdrawal, which is possible thanks to the institutional flexibility. The process of institutional bricolage will finally end in the creation of highly adaptive water institutions. In the long term, drinking water management will stabilise in reacting flexibly to uncertainty.

The display of these three scenarios shows that in all cases the adaptive capacity of the local actors is of crucial importance. Local actions can fill the gaps where external determinants are inactive, but the effectiveness of water management depends on the options created through national programmes. While local patterns of water withdrawal account for the given possibilities and constraints by being flexible, the key to increasing local options lies within institutions. The three storylines describe to what extent the empowerment of local water institutions can increase management efficiency and the reliability of tap water systems. They also show that national water policy has to take into consideration existing social arrangements, to foster a process of institutional bricolage adapted to local conditions. This might lead to the sustainable use of the scarce resource without halting rural development.

6. Concluding Remarks

In a context of both natural and man-made water scarcity the supply of drinking water is becoming increasingly difficult, and global environmental change might soon rise its toll. The prefabrication of water institutions for local drinking water management by national water supply programmes further impinges on water availability and is rather constraining local action than enabling it. As a result, water management is ineffective or, in local terms, unreliable. Despite these limitations, rural households in the Middle Drâa Valley are increasing their withdrawal of the scarce resource. Thus, water demand is rising, while groundwater availability is decreasing.

It is this linkage between water withdrawal and management against a background of resource scarcity and institutional constraints that constitutes the topic of the present work. It aimed at showing the extent to which these parameters affect one another. From a western view on management, the analysis of this linkage highlighted that rural drinking water management in the villages 'Àfra and Qsbat al-Ghamàd is ineffective. Adopting an actor-oriented perspective during both the research and the analysis of the data, however, allowed approaching water withdrawal also from an emic perspective. Moreover, by coupling the theoretical approaches of New Institutionalism and Natural Resource Management, hydrological and social-anthropological ideas were integrated. In summarizing the multiple perspectives below, a distinction is made between management taking place at the household level and at the village level through the User Association.

Adaptive Household Water Management

While from both an etic and an emic perspective the negative correlation between water withdrawal and groundwater availability holds true for both villages, different evaluations of the management performance must be made. As shown in chapter four, clear differences in water withdrawal and the patterns of its usage in both villages remain. And while the first is quite similar in both villages, the latter displays a marked disparity.

In Qsbat al-Ghamàd, which has a tap water system since more than eight years, an average of 35 l is withdrawn per head and day (excluding livestock). In 'Àfra the average withdrawal per head and day is of almost 29 l. Relating these results with the findings of another IMPETUS research project, it can be inferred that the installation of tap water, and thus the combination of two facilities, causes water demand to rise.

But in terms of management performance and reliability of the SAEP, the two villages fare quite differently. In 'Àfra the water supply system has the same underlying constraints (e.g. low water tarification and unsustainable financial management, participation of men only or inactive AU members) and the water management is, from an institutional point of view, ineffective. However, the SAEP is considered reliable in that it provides ‘Àfra with water despite these constraints. The expectations of locals are satisfied and most draw wells have been abandoned since its inauguration in October 2008. Household water management, to be distinguished from local water management through the AU, is thus adapting to the reliability of the tap water by relying on this facility – and if affordable, on both facilities.

In Qsbat al-Ghamàd, water is withdrawn from the tap water system as well, but the patterns of withdrawal are different. The system was inaugurated in 2001 and has soon after not been able to satisfy the water demand of Qsbat al-Ghamàd. As a consequence, local households still resort to draw wells to meet their growing water demand and integrated this bias into their patterns of action. The findings in chapter four showed that it is particularly the institution represented by the household which is flexible in its response to changing situations. If there is tap water available, it will be preferred to draw wells.

It can thus be concluded that with the combined access to draw wells and domestic tap water, household water demand is rising, in contrast to villages which use only draw wells. This rise is manifested in the both villages by a flexible and adapted household water management.

Ineffective Local Water Institutions

Formal drinking water management, on the other hand, displays a much more reduced institutional capacity of its physical, functional, organisational and financial components, and is therefore judged ineffective in the evaluation made in chapter five. The presentation of water institutions from the national to the local level illustrated that despite an attempt to decentralize water management, this strategy was not implemented effectively: Participation is not enforced strongly enough and the process of a formal institutionalisation of local User Associations is not taking place. Water policy and water management, the two components of water institutions I analysed, did not take into account local arrangements. To name just one of such arrangements: at the household level it is the women who manage drinking water, and yet it is the men who are asked to participate in creating a formal local water institution, namely the AU.

The analytical decomposition in chapter five demonstrated that, as a consequence, local water institutions are ineffective and compensated by adaptive patterns of withdrawal that take the unreliability of the SAEP into account. While the findings presented in chapter four indicate this unreliability clearly for the village of Qsbat al-Ghamàd, only the analysis of the institutional aspects suggests that the same holds true for ‘Àfra, where the demand of households is still satisfied and judged reliable by merely quantitative standards. Furthermore, formal local water management does not take into account the correlation between rural development and rising water demand, adding yet another source of ineffectiveness.

Institutional Prefabrication constrains Institutional Bricolage

In this context, the presentation of the process of institutional bricolage discussed by Cleaver (2001a) helped explain how institutions can evolve against a changing background and thus avoid ineffectiveness: By forming a sort of conglomerate integrating both old and new institutional elements, institutions become flexible and can adapt to new situations or needs.

Conversely, this research showed that new institutions such as the AU were prefabricated at the national and regional level, and though meant to operate in a local setting, they did not account for existing social and cultural arrangements within the realities of Qsbat al-Ghamàd and ‘Àfra. The study demonstrated that local institutional settings, e.g. the role of women in water management, were not taken into account. The result is an institutional dualism between prefabricated water institutions on one hand and local adaptations to their unreliability on the other, with the non-local ideal of organization rather constraining local options for action. Despite this set of prefabricated institutions, rural households draw on existing social arrangements and manage drinking water. Institutional bricolage is thus taking place nonetheless, allowing a degree of flexibility in a changing natural environment with rising uncertainties.

This study illustrated that local drinking water management is ineffective and unsustainable in the longer run. Projected into the future, this means that if institutional bricolage and local empowerment are not further promoted, the options for local action will be increasingly constrained. Water withdrawal will increase and water scarcity will threaten rural livelihoods ever more in an arid environment such as the Middle Drâa Valley.

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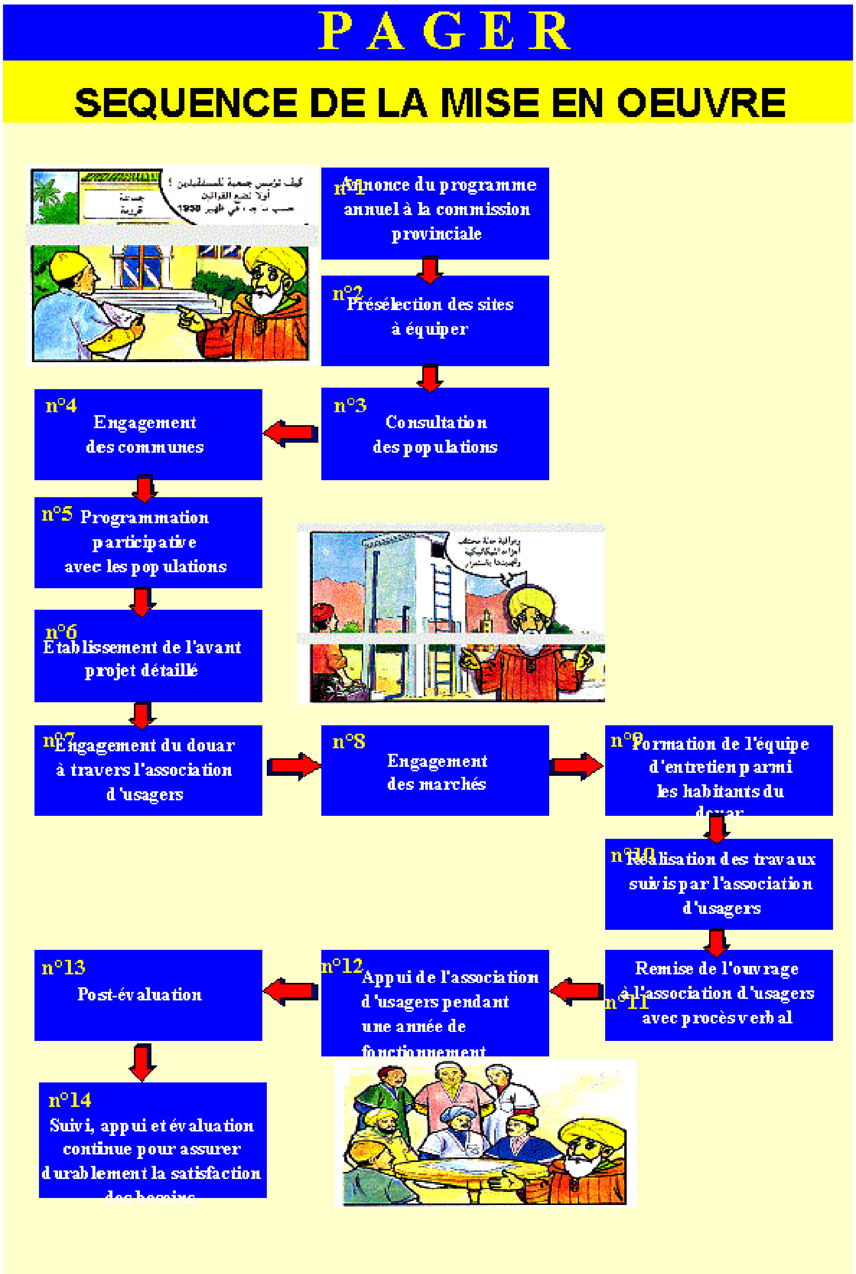
8. Appendix

(A) Figures and Tables

(B) Pictures

(C) Satellite Images

The satellite images C1 and C2 are taken from Google Earth, based on a WGS84 projection with 1 m resolution. Both images are oriented. I have identified draw wells and, if in vicinity of the village, also the SAEP well and water tower. The given ID numbers correspond with the results from the mapping depicted in A3.



(A1) Sequence of Project Implementation by PAGER (DGH 2009)

(A2) Employed Methods*

Method	Quantity	Target Group	Topic	Language
Mapping	2	--	spatial organisation of water access and infrastructure	--
Withdrawal Measurements	n = 32 in Nov., n = 30 in May (N =63)	households (women)	water withdrawal according to facility, type of usage	Arabic
Pre-Survey	2 for N = 63	households	total population	Arabic
Household Survey	n = 20 (N = 63)	household head	patterns of withdrawal, general water management	Arabic
Expert Interview	Villages: 4, Ozz: 2, Zagora: 2	experts (local, external)	role and function of PAGER, ONEP, AU; water institutions	French, Arabic
Semi-Struct. Interview	6	villagers	water management	Arabic
Informal Interview	5	villagers	general	Arabic
Venn Diagram	8	men	institutions relevant for access to water	Arabic
Daily Activity Schedule	2	women	assess daily tasks of HH water management	Arabic
Time Line	3	elderly people	history of conventional wells	Arabic
Free-Listing	10	villagers	validating information, spot gaps	Arabic

* Employed methods during two field trips (November 2008, May 2009), their quantity (N = basic population, n = sample size), target groups, topic of investigation (HH = household) and the language of method

(A3) Findings of Well Mapping in ʻÀfra and Qsbat al-Ghamàd

ID	Ort	Name	GPS	Alter	Brunnen	Bedeckt	Pumpe	Pumpenart	Tiefe (m)	EC (in µS/m)	Geschmack	Leitungsanschluss	Betrieb	führt Wasser	Nutzung < 10
38	Q	SAEP	Z-Brunnen	8	öff.	ja	ja	elektr.	35		süß				
1	Q	Qabila	Z1		öff.	nein	nein				süß		nein	nein	keine
2	Q	El Beshi, Mahjoub	Z2		priv.	nein	nein		25	990	salzig	ja	ja	ja	keine
3	Q	El Wadi, Tahar	Z3		priv.	nein	nein				süß	ja	nein	nein	keine
4	Q	Hamedi	Z4		priv.	nein	nein		25		süß	ja	nein	ja	keine
5	Q		Z5		priv.	nein	nein		26	490	süß		ja	ja	Garten
6	Q		Z6		priv.	nein	nein		20	510	süß		ja	ja	keine
7	Q	Hameri, Hajmi	Z7	14	priv.	nein	nein		30	500	süß	ja	ja	ja	Garten
8	Q		ohne GPS		priv.	nein	nein							ja	keine
9	Q	Gsiggs	Z9		priv.	nein	nein		27		süß		nein	ja	keine
10	Q	Benjoui	Z10	20	priv.	nein	nein		26	610	süß	nein	ja	ja	keine
11	Q	´Adimi	Z11		priv.	ja	ja	Diesel	26	600	süß	ja	ja	ja	Garten
12	Q	´Adimi	Z12	3	priv.	ja	ja	Diesel	22	600	süß	ja	ja	ja	keine
13	Q	Sreri	Z13	11	priv.	nein	nein		15	1640	süß	nein	ja	ja	keine
14	Q	Mazouz	Z14	36	priv.	nein	nein		30	590	salzig	nein	ja	ja	keine
15	Q	Belkehir	Z15		priv.	nein	nein		22		süß	ja	ja	ja	keine
16	Q	Idemi	Z16		priv.	nein	nein		22		süß	ja	ja	nein	keine
17	Q	Kaylie, Muhamed	Z17	18	priv.	nein	nein		26	540	süß	nein	ja	ja	keine
18	Q	Kaylie, Muhamed	Z18	18	priv.	nein	nein				süß	nein	nein	ja	Garten
37	Q	Kaylie, Mohamed	Z19	40	priv.	nein	nein		20		süß	ja	ja	ja	im Haus
35	Q	Jouidie, Lakhcen	ohne GPS	7	priv.	nein	nein		25		süß	ja	ja	ja	im Haus
34	A	SAEP	A-Brunnen	1	öff.		ja	Diesel	24	2750	salzig				Oase
20	A	Qabila	A1	40	öff.	nein	nein		22	1835	salzig		ja	ja	keine
24	A	Dadae, Faraji	A4		priv.	nein	nein		30		süß	1	nein	nein	keine
25	A	Shilahi, Abdelkader	A5	20	priv.	nein	nein		40	2740	salzig	1	nein	ja	im Haus
26	A	El Barkawi, Zohra	A6	30	priv.	ja	nein		35		salzig	1	nein	ja	im Haus
27	A	´Alami, Abdellah	A2	2	öff.	ja	ja	Diesel		1550	süß	1	ja	ja	keine
28	A	´Alami, Abdurahma	A3	30	priv.	nein	nein		28		salzig	1	nein	ja	im Haus
29	A	Benjijou, Mohamm	A7	34	priv.	nein	nein		25	2600	salzig	1	ja	ja	im Haus
30	A	Kaylie, Lakhcen	A8	20	priv.	nein	nein		45		salzig	1	nein	nein	im Haus
31	A	Faraji, Abdurahman	A9	20	priv.	nein	nein		30	1940	salzig	1	ja	ja	im Haus
32	A	Khalifi, Abdurahma	A10	6	priv.	nein	ja		32	2340	süß	1	ja	ja	im Haus
33	A	Atmani	A11	22	priv.	nein	nein		30		salzig	1	nein	nein	im Haus

(B1) Typical Water Containers: *bidu* of 5 l (orange), *stol* of 10 l (brown), *gulla* of 15 l

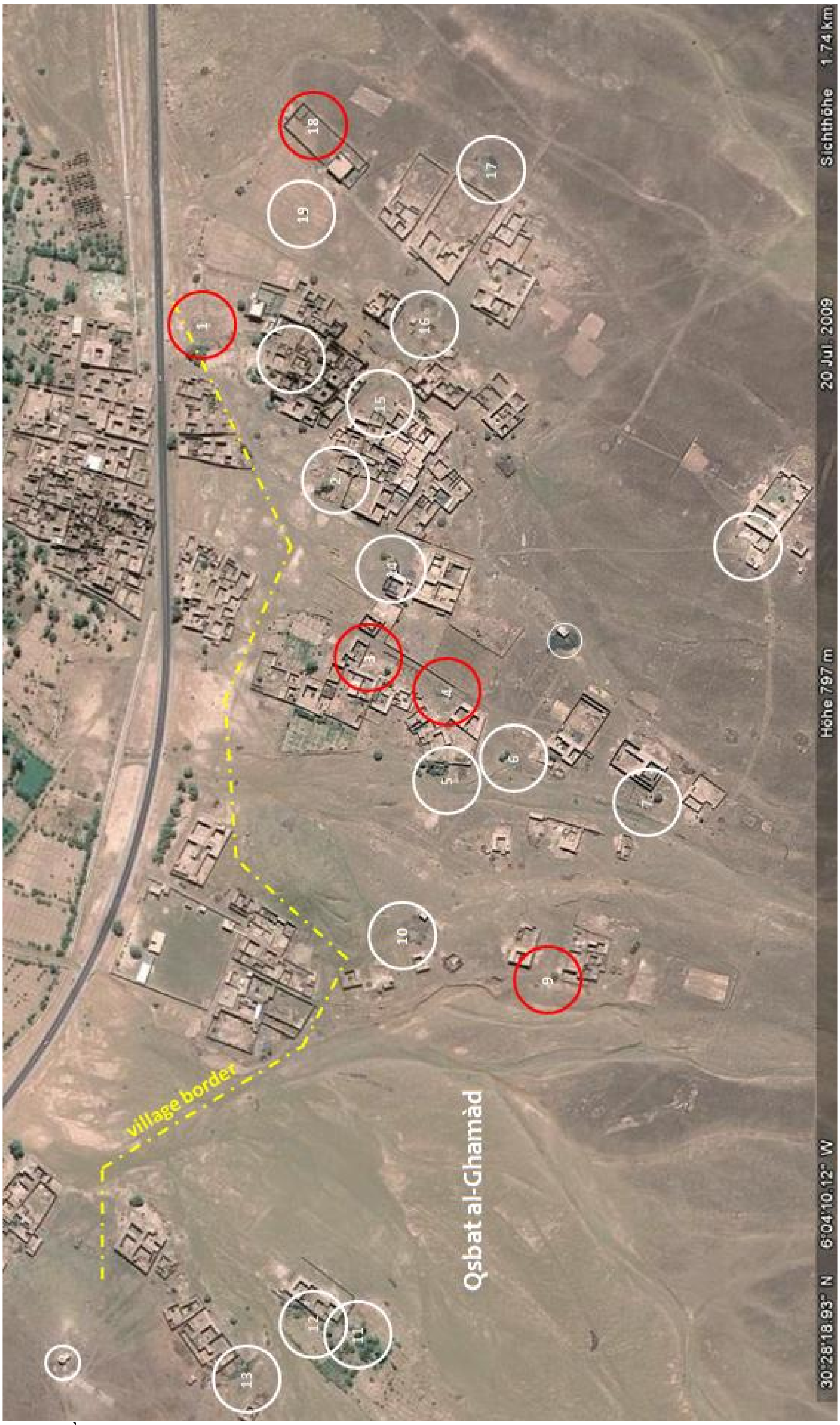
(B2) SAEP Water Tower of Àfra, Ouled Ahmed ben Ali and Zaouite ben Talib

(B3) SAEP Motor Pump in a Cement Building in the Oasis of ‘Àfra

(B4) SAEP Well behind the Cement Building in the Oasis of ‘Àfra

(B5) SAEP Water Tower of Qsbat al-Ghamàd, Zaouite al-Fagouss and Timkshad

(B6) SAEP Electric Pump and Well in Cement Building in Qsbat al-Ghamàd



(C1) ‘Àfra from an Eye Level of 1.74 km (ID numbers, white circle = used draw well, red circle = abandoned draw well)

(C2) Qsbat al-Ghamàd from an Eye Level of 1.74 km (ID numbers, no number = without GPS-ID, white circles = used draw wells, red circles = abandoned draw well, small circles = SAEP well and SAEP tower)