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# *When the Spate is Your Fate*

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# Part I.

# Introduction

The location is *Wadi Al Jawf* in the *Al Jawf* governorate in the North-Western mountains of the Yemen. It is an afternoon in late August sometime in the 1980s. You are farmer and landowner Hamdi Al Attas from the village *Al Khalaq* in the lower part of the *wadi*. You and your fellow villagers are desperately waiting for the rain to come flowing through the earthen irrigation channels to soak your fields, as every year around this time - but not this year.

This year, things are not the same. You are aware of what the rules should be - the rules about who gets what share of the water the spate is going to carry down the riverbed. You know about the basic Islamic legal principle of watering the higher fields before the lower fields - the Prophet himself had delivered this rule. But you also know about the embankments that the traditional tribal rulings and the *Shari'a*, the Islamic law, have attached to this principle in order to protect your community from unfair actions of upstream users. That these embankments limit the number and size of barrages that a community can build, limit the time of water appropriation and limit the time upstream users may water their fields before they must allow the flow to pass on. You know they did so for centuries - but not this year.

As you heard from other villagers, the people from the upstream village *As Sawda* replaced the cultivation of sorghum for the sake of water-intensive banana trees. With the new concrete diversions the men from the central government in Sana'a built in the valley in the course of their constructing a big dam in the hinterland of the wadi, the people of *As Sawda* are now able to divert the required excess quantities of water. With the traditional earthen barrages this would not have been possible. The peaking flood would have flushed them away naturally and carried the water downstream - but not this year.

The village elders and the chief of your tribe are in outrage. All attempts to convince the people of *As Sawda* not to divert these huge amounts of water were lost upon. Even the talks with *Shaykh Hamyd Umar* of the tribe *Hamdan* - to which most of the people of *As Sawda* belong - remained unsuccessful: and since there is no mutually respected higher authority they could resort to with this problem, the elders of *Al Khalaq* consult among each other. Actually, they know exactly what they have to do as a last resort. Their forefathers had always done so. The sanction is inevitable - one of the sons of the tribe *Hamdan* has to be killed in order to restore justice. Now here you are, standing in front of your desiccated fields, wallowing in anger: and there is only one thing you know for sure - the people of tribe *Hamdan* will not allow the killing to stop at one.

# 1. The Paradoxon

The above is a stylized account of the typical story that has happened over and over again in the rural areas of the Yemen since the 1970s. Thus, it would seem to be quite obvious that there *are* conflicts over water.

> *The wars of the next century will be over water.*

The notion of water as *the* conflict-generating factor of the next century - as Ismail Serageldin of the World Bank famously purported in 1995 - seems to have become commonsense knowledge (Ohlsson 1995*a*, p. 1). Yet, it has been barely justified with too many unknowns remaining. This project tries to move a step forward toward a more elaborate analysis of the relation between water and conflict for the case of the Yemen. In particular, international disputes between upstream and downstream countries over the use of shared river discharge have been prominent topics for political scientists (Schulz 1995, p. 105).

However, in light of the increasing importance of intrastate warfare since the end of the Cold War as well as the results of my preliminary research in the Yemen, this work will focus on the outbreak of local violent conflict. Prominent quantitative studies on water conflicts find no relation between water-scarcity anomalies and the outbreak of armed conflict - see for example Allan (1997) and Levy et al. (2005). At the same time, news agencies continuously report about water-related disputes. As a study by the Civic Democratic Initiatives Support Foundation (CDISF) in Sana'a, Yemen, declares, as much as 80 percent of local disputes leading to fighting and revenge attacks in the Yemen are caused by disputes over water (YemenTimes 2006). The analysis at hand will thus be twofold.

A first research question asks whether a correlation between freshwater availability anomalies and the occurrence of local violent conflict in the Yemen is on display - slightly remodeling an already existing global quantitative model by Levy et al. (2005).

> *Is there a correlation between negative freshwater availability anomalies and the outbreak of local violent conflict in the Yemen?*

The second part will try to qualitatively trace the underlying mechanisms between irrigation water allocation and the outbreak of local violent conflict on the basis of qualitative data from the Yemen. Hence the second research question.

> *What are the underlying mechanisms between irrigation water allocation and the outbreak of local violent conflict?*

These two questions will be the focus of this thesis which has been composed as follows. In a first step, an overview of the literature since the 1980s is provided which leads to the current state of research. Therewith, 15 postulates to sum up the existing research will be developed and put in order. In the second and third parts, the theoretical framework, methodology and analysis of both a quantitative as well as a qualitative analysis based on a case study of the Yemen are presented.

However, the relevance of this project must first be highlighted first in the following Chapter 2 in order to justify the efforts behind conducting this research.

# 2. Relevance

When discussing the relevance of a research project, the benefit for its very subject matter (i.e. the polity and policy concerned) ought to be considered first and foremost. Second, a rationale for the geographical focus is required if a certain area is chosen to be analyzed. Last but not least, a thesis can also be of benefit for the discipline of political science. How these criteria are met within this thesis will be explained in the next three paragraphs.

**Relevance of the Subject Matter** Especially in so-called 'weak states' regional feuds can pose a serious threat to a country's and even a region's stability. If a government cannot maintain law and order in the hinterland, small-scale tribal feuds and thereby regional turmoil can develop and gain momentum in areas where religious, ethnic and tribal cleavages already destabilize the social fabric. Hence, more insights about conflicts emerging at the non-state level need to be gathered.

Thomasson (2006, p. 12) emphasizes that very small conflicts between, for example, pastoralists and/or agriculturalists can even spill over national borders and thereby bear a potential to exert contagious effects. These effects pose a high risk toward the stability of entire regions. Examples of this dangerous mechanism have been evident in, for instance, the Great Lakes Region or West Africa during the period after the Cold War (Buhaug & Gleditsch 2005). Thus, research about small-scale conflicts is certainly of great importance.

But not only the outcome of certain conflict mechanisms need to be considered. The input level is important as well. According to Thomasson (2006) it is also important to know how to augment positive outcomes of investments in the water sector, which are an integral part of the Millennium Development Goals. However, he argues that there is much evidence of conflicts that arise from such water interventions.

**Relevance of the Yemen** The Middle East, and especially the Arabian Peninsula, is one of the most arid regions in the World (Unicef 2003, p. 36). In a recommendation paper for the United Nations Environment Program, Levy & Meier (2004) argue that for a more efficient management of freshwater resources, we need to have knowledge about the areas with great potential for conflict over this resource. This problem is of urgent importance to the Yemen, which experiences several types of conflict over this resource on a regular basis. Hence, the Yemen represents a case in point for the study of conflicts related to water-scarcity and an early example of what could soon become the problem elsewhere. Hence, an inquiry into these problems in the Yemen is of utmost importance.

In addition, as mentioned above, the outcome of development help efforts implemented

during the second half of the 20th century has not been analyzed sufficiently yet. During the last 50 years, the Yemen received large-scale development help in the water sector - with highly ambivalent outcomes: and because some of these investments even resulted in conflictive situations (See Part IV), further knowledge about these effects is required.

**Benefits for Political Science** Paralyzed by the lack of relevant baseline data, researchers are not able to support quantitatively oriented research in order to guide decision-making procedures. Matthew et al. (2004) therefore call for an expansion of methodological tools to inquire into relationship between environmental factors and conflict. They recommend the use of new visualization technologies offered by Geographic Information Systems (GIS). The quantitative part of this thesis tries to display how far statistical analysis can move in such a direction. The analysis is able to assess what hydrological data is available with the example of the Yemen - one of the most poorly recorded areas in terms of gauged hydrological data.[1]

It is also important to know how far the available data allows to 'go down' towards the level of single catchment areas in order to differentiate between miscellaneous localities. The conflicts in question are often too small to be captured by traditional conflict data gathering (Thomasson 2006, p. 12). The coding efforts of the Armed Conflict Location and Event Dataset (ACLED) group indicate the need for disaggregated conflict data (Raleigh et al. 2005). The study at hand adds value in terms of systematic subnational conflict data through a fine-grained event data set that was created within these research efforts.

Last but not least, Matthew et al. (2004) also urge the combination of large-N studies with fine-grained micro-level case analysis in order to clarify the precise nature of the inter-variable relationships. Hence, not only shall correlations be detected - even more important are the underlying mechanisms between variables of interest in order to discover the toeholds where actual intervention can start. The qualitative part of this thesis attempts to uncover these links and variables.

**Overview** To sum up, this project is relevant in several respects, in light of its subject-matter. First, to gain more knowledge about conflicts emerging at the local level is crucial for guiding policy in so-called weak states where the central government struggles to keep law and order in the hinterland. Second, knowledge about low-level conflicts may also offer insights about potential spill-over effects, which are not yet fully researched. Third, the input side, i.e. how scarcity is dealt with and to what extent water interventions lead to positive or negative outcomes, needs further study. The outcome of this research might offer a glimpse at situations and mechanisms that will occur much more often in the medium-term future.

In addition, there are three reasons for selecting the Yemen as a case study for this research. Firstly, being one of the most arid countries in the World, it struggles with water scarcity and hence has more potential for conflict in this regard than most other

[1] Insights from personal correspondence with Peter Molnar of the Hydrology Group at the Department for Environmental Engineering, ETH Zurich.

regions. Secondly, the Yemen at the same time has experienced a host of infrastructural projects in the water sector, the outcome of which has not been sufficiently studied to date. Thirdly, the Yemeni state is extremely docile as opposed to its tribes, and hence is a typical example of a weak state prone to conflict at the regional and local levels.

Many recommendations on methods mentioned in recent political science literature are being followed and hence tested in reality. First, the possibilities offered by new visualization technologies are weighed up and a new set of baseline data is being compiled. This dataset may serve as a test for appliance of geographical information software within the social sciences and as a template for further studies in other regions of the World.

Second, this research venture gathers knowledge about how far the available quantitative data allows us to zoom-in to the micro-level of analysis, where an actor-centred approach fits in and to what extent further data production is required.

Finally, the methodological approach of combining large-N studies with fine-grained micro-level analysis is further tested and hopefully enhanced.

# Part II.

# Literature and Research

So far, the subject-matter of this thesis has been introduced and its relevance highlighted. The following chapter elaborates the most important currents in the literature on the rather general topic of 'environmental security', as well as the more focused work on the relationship between freshwater availability and violent conflict. Postulates of possible use for my analysis are extracted throughout. In this way, the subject of this thesis is approached gradually, so as to be able to commence quantitative and qualitative analysis from a position of awareness of what the state of the art is.

# 3. Literature - Postulates

Since the literature on 'environmental security' is vast, its history will be wrapped-up as briefly as possible and important differentiations in this field of research dealt with more extensively - especially the topic of 'resource scarcity'. Following this, the literature on 'water conflicts' will be presented, narrowing its focus from the international to the intrastate and even the local level.

## 3.1. The Environment and Security

> *"Future wars will be those of communal survival, aggravated or, in many cases, caused by environmental scarcity. These wars will be subnational, meaning that it will be hard for states and local governments to protect their own citizens physically. This is how many states will ultimately die."*

This vigorous sentence marks one of the highlights in the dramaturgy of journalist Robert D. Kaplan's (1994, p. 23) renowned article 'The coming anarchy'. Ignited by population growth, tribalization and resource depletion, the World's social fabric - according to Kaplan - is headed south. The infamous journalist's evil tidings came at the height of a first wave of scholarly engagement in the study of what till now has been referred to as 'environmental conflict'. According to Ronnfeldt (1997), the first generation of this literature deals with the debate on whether and how environmental issues should be incorporated into security concerns at all. Thereby, the debate also hosts approaches independent from violent conflict between social entities, but in light of questions about sustainability and more exogenous threats toward human beings. Levy (1995), for example, argues that only direct physical threats such as the ozone hole and climate change may be considered 'environmental' factors relevant for U.S. national security.

Yet existentialist arguments, such as that of Myers (1998) on environmental degradation and the consequent undermining of humanity's natural support systems, are also often based on too blunt a concept of 'environment' to be able to effectively advise policy. Thus, according to Dokken & Graeger (1995) they are often launched more as sort of 'political slogans' rather than 'analytical tools': and as Graeger (1996) argues, research projects need to focus on *one* environmental factor rather than all-embracing variables with a plethora of notions. Or, as Gleditsch (1998) simply puts it, no one ever tried to look for an all-embracing 'human'-factor to explain a specific outcome.

Libiszewski & Spillmann (1995), for example, opt for a more narrow understanding of 'environment' in light of ecological equilibria, the disruption of which can lead to a

chain of disequilibria, destabilizing not only the environmental system, but also existing social-economic and political equilibria. Thus, it is "the human-made disturbance of the natural resource's normal regeneration rate"(Libiszewski & Spillmann 1995, p. 3f) through overuse or pollution that constitutes the 'environmental' factor. Yet, there is a problem of accountability. Since a lot of degradation problems originated from bad resource governance, the causal mechanism is wholly man-made rather than to be blamed on an environmental factor (De Soysa 2002, p. 11).

A second differentiation is needed on the dependent variable. The notion of security is considered too broad a concept as well. Research should rather focus on conflict to narrow the scope. Similarly to Libiszewski & Spillmann (1995), the figurehead of the second generation of 'environmental security' research - the 'Toronto Group' lead by Thomas Homer-Dixon - tried to pinpoint links between environmental change and acute intra-state and international violent conflict. Environmental change may shift the balance of power between nations, warmer temperatures could lead to contention over new ice-free sea lanes in the Arctic or land stress may produce waves of environmental refugees. Using process mapping, the Toronto Group tried to pinpoint possible causes and effects of different environmental changes on different social outcomes. The outcomes as well as factors of environmental change mutually influence each other, which makes the theoretical models of this first batch of the Toronto Group's work rather incomprehensible (Homer-Dixon 1991). Anecdotal evidence certainly helps to locate underlying mechanisms, but the conceptions remain largely abstract and hard to test empirically (Diehl & Gleditsch 2001, p.5). Nevertheless, this second generation of research on 'environmental conflict' formed the starting point of a development toward a stricter focus on scrutinizing single aspects of environmental factors.

Accordingly, the focus of this discussion shall be narrowed to the study of the relation between natural resources and conflict in Section 3.2.

## 3.2. Natural Resources and Conflict - Honey Pot or Shrinking Pie?

In 1986, Arthur Westing compiled a list of important wars from the World Wars to imperial and secessionist wars, wherein the competition for natural resources such as minerals, fish stocks and of course, territory was central (Westing 1986). McMichael (1995, p. 143) even believed that "the end-stage of unequal power relations and economic exploitation in the world will be tension and struggle over life sustaining resources." Homer-Dixon (1994) shows through 'evidence from cases' - collected through an international multi-case study - that environmental scarcity causes violent conflict. These conflicts tend to be persistent, diffuse and on a sub-national level. Furthermore, scarcities of cropland, forests, fish and water are of most immediate concern. However, three important differentiations are connected to scarcity, the debates on which are here discussed in light of the two research questions of this thesis.

**People VS. Malthus** This debate discusses whether high population density together with the relative scarcity of a resource within a certain geographical area really constitutes a conflict-generating factor. Gurr (1985) has pointed towards a conflict-intensifying effect of increases in scarcity and the creation of greater material inequalities. Later, Homer-Dixon (1994) identified population growth as an important source or catalyst of scarcity and thereby conflict. On the opposite side of this neo-Malthusian argument, 'cornucopian' resource optimists concede that agricultural land scarcity caused by high population growth may be a driving factor of economic development. Lomborg (2001) holds that most debated resources are not really scarce. 'Endogenous-growth' theorists argue that people are able to adapt to scarcities and that they could even be the key to development (Boserup & Schultz 1990) and finally end wars (Simon 1989). Yet, Homer-Dixon (1995) finds that ingenuity and institutions are crucial for the ability of a society to adapt to such problems: and that we will see an increasing bifurcation of the world into societies that can maintain an adequate supply of ingenuity and those that cannot (For more on the topic and a definition of ingenuity see Section 5.3 in Chapter 5). Urdal (2005) finds no strong quantitative support for either perspective. Even if the evidence for neither of the arguments is convincing, an important differentiation from this debate can be derived for this analysis: the availability of ingenuity and institutional structures to react to scarcities need to be considered when the link between water use and conflict is analyzed.

Table 3.1.: Postulates - People VS. Malthus

| No. | Postulate |
|---|---|
| 1. | A lack of ingenuity hinders societies to react to scarcities that can lead to violent conflict. |
| 2. | A lack of institutional structures to react to scarcities can lead to violent conflict. |

**Honey Pot or Shrinking Pie** The second differentiation can be drawn between greed and grievance. This debate is at least to a certain degree linked with the neo-Malthusian arguments, because it discusses whether the scarcity or rather the *abundance* of certain resources contains more conflict-generating potential (De Soysa 2002) - i.e. whether people fight over a shrinking pie or a honey pot. The so-called 'resource-curse' theory links resource wealth to negative economic and political conditions such as slow growth, poor governance, weak institutions and political instability (Gleditsch 2004). However, that abundance rather than scarcity leads to conflict is most likely the case where easily lootable high-income resources such as gems, tropical timber, cash crops and drugs offer incentives to monopolize the resource. Collier (2000) finds ample evidence for this. On the other hand, grievance theories by neo-Malthusians prefer to emphasize resources that are essential to food production and thereby to the basic survival of human beings. Homer-Dixon & Blitt (1998) argue that four key resources are of central interest especially in developing countries: cropland, forests, fisheries and fresh water.

Thus, the literature alludes to two fundamentally different types of resources. Collier & Hoeffler (2002) integrate the two theories and locate grievance (or motivation) and greed (or opportunity) as the two main explanations of civil war. After quantitative testing, they conclude that greed has more explanatory power than grievance. De Soysa (2002) also finds strong evidence for the 'honey pot' thesis. However, there *are* conflicts over a scarce resource - namely water. But then, what explains these different findings? Maybe water can be subject to stockpiling as well, even if it is a scarce and renewable resource. At least, this needs to be scrutinized - and therefore considered in the analysis.

Table 3.2.: Postulate - Honey Pot or Shrinking Pie

| No. | Postulate |
|---|---|
| 3. | Life-essential resources such as water can be related to both conflict motives, greed and grievance. |

**Disaggregation** As far as studies on scarcity are concerned, the levels of analysis are international, national, sub-national and even local. Studies based on 'resource-curse' theories mainly focus on the sub-national level and therewith rebel movements as opposed to the central power of a state. According to Theisen (2006), rational-choice and resource-mobilization theories tell us that the cost of fighting a government army is considerable: and since deprived groups are expected to be too weak to fight with state forces, we could expect that conflicts over environmental scarcities are to a greater extent found at the sub-state level. Since this study will focus on intrastate violent conflict, the international realm will mostly be left out. Furthermore, the results of the preliminary research in the Yemen - as shown within the stylized story in the introduction - indicate intra-national water conflicts to erupt even at the very local level, i.e. at the level of a single *wadi* which accommodates the community of water users of the same river basin.

Table 3.3.: Postulate - Disaggregation

| No. | Postulate |
|---|---|
| 4. | Formation of intrastate conflict over scarce resources happens at the local level of resource-systems. |

## 3.3. Water and International Conflict

The literature on international water-conflicts is far too sweeping to be fully covered. Some central works will be referred to without any claim for completeness. Basic research on water issues was initiated by UNESCO in the 1960s, leading to the world water conference (1977) in Mar del Plata, which itself produced the first body of international law on the subject, *inter alia* the Athens Resolution on the Pollution of Rivers and Lakes (Ohlsson 1997, p. 25). However, one crucial lawless condition has prevailed up until the

present day. Upper riparians can always insist upon their territorial sovereignty when redirecting or damming the water-courses crossing their territory (Libiszewski 1999). Gleick (1993) lists numerous factors linking water and international conflict in a rather anecdotal-inductive manner. Water can thus be a geopolitically strategic military goal - think of the River Jordan on the eve of the Arab-Israeli War in 1967 (Wolf 1995); water can also be an instrument of war - hydroelectric dams, for example, were bombed during World War II; and conflicts can arise over issues of maldistribution. Libiszewski (1999) provides a typology of conflicts over water pollution as well as absolute and relative water distribution, i.e. over definite consumption of the resource and over the manipulation of water courses which effect alterations in the seasonal pattern of water discharge. The volume *Hydropolitics* edited by Leif Ohlsson (1995*b*), presents several case studies of international water disputes and thereby shows how they already *have* been a major contributing cause of war. Because none of the world's major rivers is contained within a single state, classic riparian problems can be observed almost everywhere. Most prominent have been issues over siltation, diversions of water-flow and dam projects. Falkenmark & Lundqvist (1995) attest to a general predicament of low awareness, weak institutions and arbitrary water allocations at the same time. The only published large-N study of water and international conflict, by Toset, Gleditsch & Hegre (2000), shows that sharing a river increases the probability of militarized interstate dispute. Interestingly for this thesis, even these international studies refer mainly to low-level conflict and are not pointing to impending 'water wars'. Hence, the focus has to be reset toward the sub-state level in the following Section 3.4.

Table 3.4.: Postulates - Water and International Conflict

| No. | Postulate |
|---|---|
| 5. | Conflicts can arise over the absolute distribution, i.e. consumption of water. |
| 6. | Conflicts can arise over the relative distribution, i.e. alteration of seasonal water-discharge patterns. |

## 3.4. Water and Intrastate Conflict

To introduce the discussion about water and intrastate conflict, a study shall be quickly referred to that exemplifies the urgency to expand the focus to mechanisms on the sub-national level. Beaumont (1997) argues that neither absolute amounts of water nor the need to pursue food security are causes or catalysts to conflict over water in the Middle East. The otherwise key argument of food security he rebuts with the refutation that the countries in the region were able to offset this need through food imports. Therefore, conflict most likely occurs as an upstream-downstream issue along transboundary rivers. Had he incorporated sub-national conflict in his study, he would possibly not have come to the same conclusion. Thus, the next two subsections will treat the research on the

general correlation as well as the underlying mechanisms of intrastate conflicts over water.

**Research on the General Correlation** In probably the first large-N study on the correlation between different measures of environmental scarcity and 'internal' conflict, Hauge & Ellingsen (1998) hold that, even though with less power than economic and social factors, water stress increases the likelihood of the incidence of conflict - yet, water stress does not necessarily act as a catalyst. As Thomasson (2006, p. 7) argues, though, research on conflict is normally geared toward international and major intra-state conflict: and even if intra-state conflicts are integrated in these datasets, they often require that the government is one of the actors (Eck 2005). This is also one of the main drawbacks of the study by Levy et al. (2005). The study draws on the PRIO/Uppsala Conflict Database (Gleditsch et al. 2000). Conflict centroids in Levy et al. (2005) are geo-referenced according to longitude and latitude given in the dataset and thus organized by grid-year plus intensity as an additional attribute. Thereby, vast territories within a country are coded as one and the same conflict, even if the centroid comprises many different riverbeds and irrigation-systems which can account for very different mechanisms of conflict-evolution. Thus, they somehow violate their own presumption that such conflicts start at the very local level (For an illustration hereof, see Figure 5.1 in Section 5.1, Chapter 5).

Furthermore, these conflict datasets require certain thresholds, for example 25 battle-related deaths in the Uppsala dataset or even 999 deaths in the Correlates of War dataset (Thomasson 2005). Mostly, the types of conflicts that are related to water issues obviously do not qualify for inclusion therein. However, this is by far the best available model - and it is the first study able to exploit the rich explanatory potential found in spatially explicit environmental data sources instead of relying on gross national averages. There have been approaches in the development of geospatial indicators of emerging water stress in environmental sciences (Voeroesmarty et al. 2005). Levy et al. (2005), though, were the first to link these to conflict explanations. More about their variables, measures and how these shall be improved follows in Part III.

**Research on the Underlying Mechanisms** Underlying mechanisms will remain obscure without knowledge about agency as well as conditions and opportunities for certain actors to cause conflict with regards to water. Hence, the point is to disentangle political, institutional, economic and social determinants from often irrevocable physical sources of constraint. Gleditsch (2004) thus urges to answer the question of how resource conflicts - whether driven by scarcity or abundance - are mediated by political and economic factors. The first differentiation concerns the actors involved. One important point is the water use by category and sector. Household water withdrawals are estimated at only 5-10 percent of total societal withdrawal. A benchmark figure for industrial withdrawals is 20-25 percent. By far the largest water user is agriculture with about 65-70 percent (Postel et al. 1996). Depending on the degree of industrialization of a country, agriculture can have even more relevance. Therefore, one ought to concentrate on water

used for agriculture.

In the case of the Yemen, the state in terms of the central government seems to play a rather small role - that is the allocation of financial resources and the planning of large-scale dam and concrete water-diversion projects. Not even officials in the respective governorates seem to play an important role in the conflicts.[1] Yet, as Kahl (1998) argues in his work on state-sponsored violence, there are types of scarcity-induced conflict in which government elites capitalize on environmentally induced scarcities. For example, they actively ignite inter-group violence in order to crush political opponents. However, the evidence collected on site shows the conflicting actors to be found at the very local level, i.e. village communities or tribes and tribal federations respectively.

Besides degradation, depletion and increased consumption of renewable resources, scarcity can as also evolve through human-induced inequitable distribution which could lead to violent conflict (Homer-Dixon & Percival 1996). Or put differently, there is absolute physical scarcity from supply through rainfall, demand-induced scarcity as with population pressure, and, also structural scarcity arising from distributional changes. It is this that is interesting for political science since it is induced by human agency and hence is subject to political deliberation.

Ohlsson (1997) adds to this model the dimension of 'second order' risks. Thereby he describes negative consequences arising out of a failing capacity of the state to adapt to these scarcities. Ohlsson depicts this 'social resource' in terms of the tolerance level or price a society is willing to pay for certain government-induced changes, or better yet, hold-ups, in respective reforms and adaptive measures. An ebbing of this social resource can finally lead to social friction and failing state legitimacy.

Table 3.5.: Postulates - Underlying Mechanisms I

| No. | Postulate |
|---|---|
| 7. | Central governments mainly play a role in local conflicts through superimposing of infrastructural projects. |
| 8. | It is possible that governments deliberately ignite conflicts based on scarcity-arguments. |
| 9. | Conflicting actors in scarcity conflicts are to be found at the local non-state level. |
| 10. | Second-order conflict can arise from failing adaptive capacity of the central state or governorate. |

Ohlsson (1997) concludes that the driving force for conflicts within countries is the attempt to increase supply, resulting in competition between different sectors and groups. In practice, this might mean that one community draws off water from another community's assets and removes it to their own lands using trucks. Yet, this assumption is only realistic up to a certain level, and does not hold for the huge amounts of irrigation water required for agriculture. Top to bottom, such a reallocation can nevertheless

[1] Conversation with Dr. Kahled Al Attas, Head of the Project Implementation Unit of the Irrigation Improvement Project, Al Jarrahi, Wadi Zabid, Yemen, 20th February 2007.

happen if water is withdrawn from rural to urban areas in order to meet the growing demand of urban settlements. Padrutt (1997) gives an example of this mechanism from the Southern Yemeni town of *Ta'iz*.

On the other hand, there is the famous 'upstream-downstream' problem, which this thesis will focus on. Mason et al. (2007) argue, that all stakeholders within a river basin are somehow related to each other in an upstream-downstream relationship as they are dependent on the same water that flows from the source downstream. This brings about the question of conditions and opportunities for actors upstream and downstream. As the theoretical literature shows, the main opportunity for (upstream) actors to alter the discharge regime is via the distribution, i.e. the water abstracted. Yet, such actions mostly require the technology to be able to do so.

Table 3.6.: Postulates - Underlying Mechanisms II

| No. | Postulate |
|---|---|
| 11. | Conflicting actors coexist in an upstream-downstream relationship. |
| 12. | Upstream actors cheat via changes in the distributional patterns. |
| 13. | Technological means may give upstream actors the opportunity to alter distributional patterns. |

And what is there to say about the downstream actors? Homer-Dixon (1999) argues that if the political structure fails to give these groups the opportunity to peacefully express their grievances, they could resort to violence. This has already been put forward by Baechler (1998). He argues that in some marginalized regions the central state has not succeeded as an administrative and law-enforcing apparatus: and if regulatory mechanisms are not missing altogether from the start, they can become ineffective or malfunctioning over time. Homer-Dixon (1999) adds that for conflict the aggrieved individuals need to participate in some sort of ethnic, religious, or class-based collective that is capable of violent action.

Table 3.7.: Postulates - Underlying Mechanisms III

| No. | Postulate |
|---|---|
| 14. | In order to act violently, aggrieved individuals need to participate in groups. |
| 15. | Where regulatory mechanisms are missing, aggrieved groups will resort to violence. |

## 3.5. Postulates - Summary

From the theoretical discussion 15 postulates have been derived. These mirror the most important conclusions of the literature in this field, thus they are not in any way binding

for the theoretical framework mapped in the context of the quantitative and qualitative analyses in Parts III and IV.

Table 3.8.: Postulates - Summary

| No. | Postulate |
|---|---|
| 1. | A lack of ingenuity hinders societies to react to scarcities that can lead to violent conflict. |
| 2. | A lack of institutional structures to react to scarcities can lead to violent conflict. |
| 3. | Life-essential resources such as water can be related to both conflict motives, greed and grievance. |
| 4. | Formation of intrastate conflict over scarce resources happens at the local level of resource-systems. |
| 5. | Conflicts can arise over the absolute distribution, i.e. consumption of water. |
| 6. | Conflicts can arise over the relative distribution, i.e. alteration of seasonal water-discharge patterns. |
| 7. | Central governments mainly play a role through superimposing of infrastructural projects. |
| 8. | It is possible that governments deliberately ignite conflicts based on scarcity-arguments. |
| 9. | Conflicting actors in scarcity conflicts are to be found at the local non-state level. |
| 10. | Second-order conflict can arise from failing adaptive capacity of the central state or governorate. |
| 11. | Conflicting actors coexist in an upstream-downstream relationship. |
| 12. | Upstream actors cheat via changes in the distributional patterns. |
| 13. | Technological means may give upstream actors the opportunity to alter distributional patterns. |
| 14. | In order to act violently, aggrieved individuals need to participate in groups. |
| 15. | Where regulatory mechanisms are missing, aggrieved groups will resort to violence. |

# 4. Research Outline

After having set the current state of research within the topic of discussion, the thesis shall now proceed to its core - the twofold analysis on the relation between water and conflict in the Yemen.

In order not to simply counter an existing quantitative study (Levy et al. 2005) with a qualitative study, this thesis preliminarily shows in Part III that a statistical correlation between negative freshwater availability anomalies and the occurrence of local violent conflict in the Yemen is on display. This is done by means of geographic information systems and a new dataset is derived from this. The statistical correlation between the two variables beyond coincidence can partially rebut the findings of Levy et al. (2005).

In Part IV, the underlying mechanisms between the above mentioned variables is elaborated on a theoretical level and traced on the basis of qualitative data from interviews with several tribal *shaykhs* from rural areas in the Yemen. This is particularly important in light of the variables of historical narratives before and in-between the independent and dependent variables. This is to avert Coleman's synecdochic fallacy (Berry & Martin 1974) and to make sure that contextual factors (which are not possible to cover quantitatively) are incorporated in a resulting theoretical framework.

Theoretical frameworks as well as working hypotheses will be developed within each analysis separately and based in large part on the insights gained from the literature. Both parts follow an appropriate methodology and entail slightly different conclusions consistent with their respective research question, data and methodology.

# Part III.

# A General Correlation - Quantitative GIS Analysis

*To readers interested in the qualitative mechanisms of conflict formation and process tracing it is recommended to skip this part and to proceed directly to Part IV.*

So far, the subject matter has been converged from a general view on the notion of 'environmental' conflicts in general toward a set of tangible precondition and interaction paradigms as suggested by the literature in this respect. Fifteen essential paradigms related to what is contained in the notion of conflicts over water have been discussed and listed in Chapter 3. A selection of these will be used as a guideline to set up the theoretical framework required to quantitatively test for a correlation between freshwater availability anomalies and the outbreak of conflict.

The sole aim of the following large-N inquiry is to verify a dynamic beyond coincidence between freshwater availability anomalies and the outbreak of violent conflict. To find a general correlation between these variables, a framework by Levy et al. (2005) will roughly be followed, complemented by knowledge deriven from the postulates listed in Chapter 3. Levy et al.'s (2005) innovative study gave the initial impetus to conduct this thesis. After briefly summing up their study, the main shortcomings to be tackled shall be discussed. This is followed by the theoretical framework, methodology and a discussion of the results.

# 5. Theory for a General Correlation

When compiling a theoretical framework that ought to be tested by means of quantitative large-N methods, the framework building is almost always bound to develop along the limitations of indicator availability. The following study is no exception. While being able to operationalize certain constructs in a satisfying way, other theoretical elements have been left out since they are untraceable in quantitative terms. Nevertheless, such studies offer valuable insights about the factors under scrutiny. Thus, they are very much necessary.

Within the theoretical models themselves lies another problem - the problem of aggregation: i.e. variables not being operationalized on the appropriate level of analysis. The discussion of the study by Levy et al. (2005) in Section 5.1 reveals this very problem. Their main problem lies in the 'raddy conflict data', which will be discussed next.

## 5.1. The Raddy Conflict Data

The study by Levy et al. (2005) is the only quantitative study that attempts to trace a correlation between freshwater availability anomalies and the outbreak of *internal* war. By creating a harmonized spatial time-series database on a subnational global grid of internal war, renewable freshwater surface-water resources, rainfall deviations and population, they are not able to find a significant correlation between the water variable and low-intensity internal wars. Their model is composed of the following variables.

Table 5.1.: Model by Levy et al.

| Variable | Description |
|---|---|
| Y | internal war outbreak |
| X1 | rainfall deviations |
| X2 | average surface freshwater in the form of runoff |
| X3 | population density |
| C1 | infant mortality |
| C2 | political institutions |
| C3 | trade openness |

Much more interesting than the variables is the operationalization thereof. The rainfall deviations data as well as the runoff data are highly sophisticated as they are deriven from the geographically referenced Water Balance and Transport Model by Voeroesmarty

et al. (1998) in collaboration with the Water Systems Analysis Group at the University of New Hampshire. The runoff and deviation data at a stretch allow for differences in runoff quantity upstream and downstream of certain river catchments. While such data certainly allows for a sound zoom to the local level the conflict data does not.

Falling back on the PRIO/Uppsala Conflict Database (Gleditsch et al. 2000) the authors are constricted to information about latitude and longitude of a conflict's center plus an estimate of the conflict's geographic extent in the form of radius-length. The conflict center is fixed, so as to represent the geographic center of all significant battle-zones during a conflict (Strand et al. 2003, p. 12). The country-border clipped conflict centroids resulting from the PRIO data in (Levy et al. 2005) thereby cover vast territories within a country. This is illustrated in Figure 5.1 - a clip from Levy et al. (2005). These centroids cover large territories, even if they comprise many different types of riverbeds and irrigation systems which can account for different mechanisms of conflict evolution.

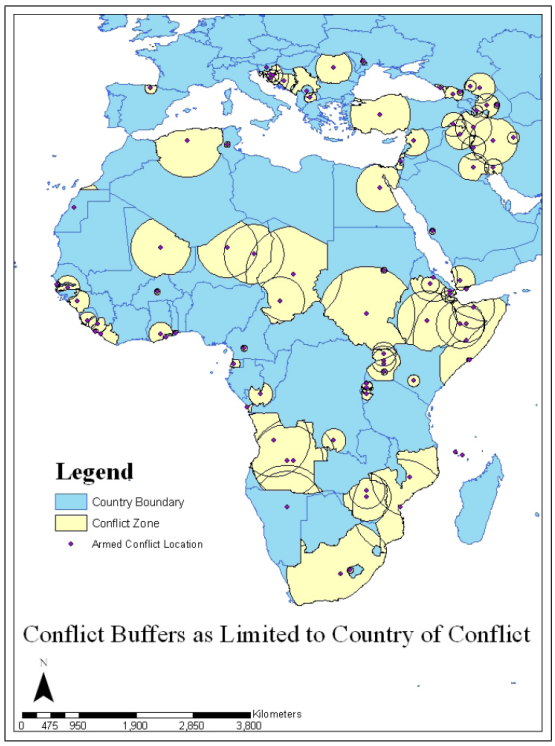


Figure 5.1.: Conflict Centroids by Levy et al. 2005

However, if we are to study the *outbreak* of a conflict, we have to look for a specific place where a first clash has occurred and not the nearest point between all the subsequent clashes. The PRIO/Uppsala conflict data surely makes sense within long time-series analyses. Yet, for geo-referenced studies focusing on the micro-level it does not. This is the main shortfall in Levy et al.

This ought to be tackled by geo-referenced subnational conflict data within this study. Data points have been coded by hand from news archives. Hence the dataset to be

compiled is constrained to one country, the Yemen. As a first step, the hypothesis and a theoretical framework will be compiled in the next two sections.

## 5.2. Hypothesis - General Correlation

In order to build a hypothesis, the exact focus of the study has to be envisioned. First, only temporary *anomalies* rather than absolute values of water availability will be analyzed. It is assumed that social entities in regions with a constantly low level of absolute water availability have rather learned to cope with this scarcity over time. Therefore, absolute scarcity is assumed not to be perceived as a pestering scarcity able to generate conflictive behavior - hence the focus on temporary scarcity alone. This temporary scarcity in the form of freshwater availability anomalies is the main independent variable. The violent conflict incidents - as seen in Chapter 3 - ought to take place at the very local level, hence local violent conflict constitutes the dependent variable. The following research question and hypothesis (Figure 5.2) will be put up against quantitative evidence:

> *Is there a correlation between negative freshwater availability anomalies and the outbreak of local violent conflict in the Yemen?*

Table 5.2.: Hypothesis for Quantitative Analysis - General Correlation

| No. | Hypothesis |
|---|---|
| H1 | If there are negative anomalies in freshwater availability in a certain region, the probability of the outbreak of local violent conflict in this region increases. |

The two concepts within this quantitative hypothesis need to be specified. First, by 'negative anomalies in freshwater availability', deviations from long-time precipitation means within a certain region are meant that go *beyond* repeatedly occurring 'normal' deviations within that region. This is the main difference between deviations and actual anomalies.

Second, the term 'probability of the outbreak of local violent conflict' delineates conflicts at the very local, i.e. the inter-tribal or inter-village level, as well as at the very bottom level of violence. That is, even single shootings, bomb attacks and kidnappings shall be included in this term. However, it is not intended to include in this concept political manifestations that are legitimate according to Western standards of freedom of speech, such as demonstrations or public rallies. Only if the action is pro-actively and violently directed towards a counterpart will it be incorporated in this term.

A significant correlation between the two variables is expected to be on display. This would strongly support the claim that - with the adequate conflict data - the original

supposition by Levy et al. (2005) can be affirmed. However, it is also possible that there is no correlation on display at all. If the null hypothesis cannot be disproved, possible theoretical failures would have to be coped with and additional variables fed into the model - missing intervening variables, for example. Furthermore, poor data could pose a serious constraint to the validity of the outcome. If such is the case, alternative proxies would have to be tested in order to find *ersatz* indicators.

However, the expected result is a significant correlation between negative anomalies in freshwater availability and an increasing probability of the outbreak of local violent conflict in a specified area. In order to be able to test for this result, the two variables of interest need to be weaved into a theoretical environment that allows a trade-off between alternative explanatory factors, i.e. control variables. This will be elaborated in Section 5.3.

## 5.3. Theoretical Framework - General Correlation

After having set independent and dependent variables, control variables shall be considered to complement the theoretical model. When it comes to control variables, one has to regard the vast array of possible explanations suggested by the conflict literature. To control for all of these would blur the results of any quantitative analysis. Therefore, only the most important variables ought to be treated. Certain variables in this framework may not be used due to data constraints or lack of intra-variable variance. Nevertheless, the theoretical framework will encompass even these variables for the time being.

Theoretical outcome of existing research purports the urge to control for possibly conflictive (group) identities. Often embraced by the notion of 'ethnicity' in the literature, group cohesion will only render violence if groups experience a collective grievance and group-members can hope for personal gain (Kaufmann 2005) - which can be assumed in the case of water conflict. As a matter of fact, this variable is perceived to be of utmost importance when it comes to alternative explanations for intra-state conflicts. Thus, a control for different identities able to weld individuals together is required. Therefore 'identity' is added as the main control variable - an aggregated factor consisting of religious schisms, ethnic and tribal affiliations.

Cederman et al. (2007) identify ethno-nationalist insurgencies as an important non-materialistic explanatory factor for intra-state war. However, the role of ethnic identities in this respect is seen from a center-periphery perspective and nationalist insurgencies are by definition connected to the central state. Water conflicts, by contrast, are assumed to happen at the very local and inter-group level without imperative state involvement. Therefore, the inclusion of any form of nationalist explanations in the model is abstained from.

A further possible explaining factor is 'water dependence'. Water is usually put in four categories. Drinking water and water for sanitary use circumscribe the very personal occupancies of people and represent the first two categories. In addition, water for the agricultural and industrial sectors as categories three and four represent the indirect use

of water. Even if it is a net-importer of agricultural goods, the Yemeni population largely depends on agriculture as a generator of self-supply and labor (Wehner & Arvidsson 2001). In 1990 for example, 92 percent of total water withdrawal was used for agricultural purposes, while just 6.9 percent was withdrawn for domestic (i.e. personal) use and only 1.1 percent for industrial use (World Bank 1993.). Therefore, water dependency needs to be controlled for.

As Homer-Dixon (1999) argues, population pressure and ingenuity gaps usually add to the severity of scarcities. Population pressure is seen as catalyzing scarcities. The concept of ingenuity entails a notion of innovation potential and stems from Romer's (1993) economic development theories that relate ideas and innovation to economic growth. "Ideas [and hence ingenuity]," Romer writes, "are the instructions that let us combine limited physical resources in arrangements that are ever more valuable"(Romer 1993, p. 64). Hence, ingenuity describes the level at which the potential for innovation within a social entity is able to cope with scarcities. In the same sense, Homer-Dixon applies this concept to the ability of societies and groups to cope with *conflicts* arising from (resource) scarcities. Therefore, it has to be assumed that population pressure and ingenuity ought to be controlled for.

Indeed, the Middle East is famous for its abundant oil reserves - so are parts of the Yemen. Yet oil cannot be classified as a 'lootable' abundant resource such as timber or gemstones. Therefore, the thesis by Collier & Hoeffler (2005) would suggest oil not to be of importance here. However, this debate is still ongoing: and as Fearon (2005) argues, high oil-exporting countries are more prone to civil war, since they do often have a weak state. However, Yemen is just a minor net exporter of oil figuring even behind Azerbaijan, Qatar and Oman (Al Zayer 2005). Nevertheless, competition for drill licenses and revenue allocation is certainly possible where there are not many alternative sources of income - as is the case in the Yemen. To make sure that this is not missed, primary commodity-resource availability will be controlled for.

Civilian rate of small arms ownership in the Middle East varies on a high level. While in Jordan 'only' ten out of a hundred persons own a small firearm, 37 do so in the Yemen, officially. The estimated number of unreported firearms may be significantly higher (SmallArmsSurvey 2005). Small arms ownership rate at the intra-state level has to be controlled for.

Chiozza (2002) purports that if possible conflict dyads are from the same civilization' - in terms of Huntington's (1993) lean bipolar division - there is a negative relationship between modernization and the probability of conflict. The concept of modernization as a control in this realm is understood as the conflict potential of societal frictions arising out of deep-notching social and economical changes in a given society. Even if Chiozza's (2002) study is on interstate warfare, the argument can be accepted for this subnational model', and therefore modernization excluded as a control variable.

Another prominent topic of discussion within today's conflict research literature is contagion effects. These effects can have subnational, trans-boundary and even inter-regional proportions, and describe the mutual inducement of different regions and groups when it comes to the outbreak and spread of conflicts. Buhaug & Gleditsch (2005) find risk for conflict through contagion effects only for separatist conflict to be clear. The

conflicts in this study are neither separatist nor fully-fledged civil wars. Whether scarcity conflicts spread - from upstream to downstream actors, for example - is not clear. Instead of a control variable, a certain spatial threshold will be used when mapping conflicts in GIS. Thereby it should be possible to control for conflict clusters.

Finally, it is planned to control for the occurrence of earlier conflicts in the same region, which somehow resembles the control mentioned above. As the case of the Yemen shows, conflict certainly fosters further conflict: and as always when observations temporally follow each other, the problem of dependence between the residuals occurs.

These considerations result in the following model as shown in Table 5.3.

Table 5.3.: Model - Quantitative Analysis

| Variable | Description |
|---|---|
| Y | occurrence of violent conflict |
| X | water availability anomaly |
| C1 | identities |
| C2 | water dependence |
| C3 | population pressure |
| C4 | capital of ingenuity |
| C5 | primary commodity resource availability |
| C6 | small arms |
| C7 | earlier conflict |

This model will be put up against real-life observations. Therefore, an appropriate method is elaborated in Chapter 6. An adequate measure has to be accredited to each of the nine constructs in the model. Therefore, possible indicators are discussed and compared. In a second step, possible statistical procedures will come under scrutiny; and thirdly, the final method will be applied.

# 6. Methodology - General Correlation

The first thing to consider when trading off different methods against each other is: what data is required to measure the variables? Which real life indicators appropriately mirror the reality of these abstract concepts in the theoretical framework? Only when these questions are treated, can different methods to actually measure a potential correlation be discussed.

## 6.1. Operationalization

In order to operationalize the variables with adequate indicators, one has to pinpoint what information is needed to measure the variable. Furthermore, it has to be clarified whether three attributes are met by each indicator in question: first, one has to check whether the respective data is accessible: second, it has to be checked whether there is enough variance within the respective data: and third, the quality of the data has to be discussed. This is done for each construct in the following.

**Occurrence of Violent Conflict** As specified in Section 5.2, by 'occurrence of violent conflict' every violent conflict, even at the local level will be included in the dataset. The aim is to go as far down the levels as possible. Therefore, a very low threshold concerning battle deaths will be applied. Every killing or even minor violent pro-active aggression towards an other group needs to be incorporated in a given dataset. It would be of great advantage to know the actors involved in the conflict, yet it is not at all necessary. The temporal domain should cover the time after unification of the two Yemen in 1995, until the time where most datasets are still reasonably updated, which is around 2002. More about the temporal domain of this research can be found later in the study. Last and most important, the data points need to have geo-referenced information, i.e. provide longitude/latitude or other geographical coordinate references such as a name of a village.

There are some existing datasets trying to cover intra-state conflicts. Eck (2005) provides a comprehensive directory of conflict data. However, almost all of these datasets lack geographical information that goes beyond the state-level and are thus out of question for this analysis. This problem mostly stems from a high threshold, which is located at the state-level. Hence, geographical information stays at that level. And since the literature clearly points toward the local level as *the* important ground where conflicts around water evolve, these datasets are not suitable for this study.

The only data program to be considered would be the Uppsala Conflict Data Program (UCDP). Within this program, three datasets are to be considered. The PRIO dataset - as mentioned above - does not provide the exact locations where violent incidents happen. Furthermore, its threshold is set to at least 25 battle-related deaths which disqualifies the dataset for this study. The 'UCDP Non-State Conflict Data' would meet the demand for conflicts without state-involvement. However, the temporal domain only covers 2002 and onwards. Finally, the 'UCDP One-Sided Violence Data' would satisfy the desire for data on violent assaults, but the temporal domain is 2002 onwards - and although it has recently been backdated to 1992, the data is not yet available to the public. Based on Eck's (2005) overview, the UCDP data for now cannot be included in this study.

However, a very promising recent venture to collect subnational geo-referenced data is the Armed Conflict and Location Event Database (ACLED), of the Center for the Study of Civil War at PRIO (Raleigh et al. 2005). Regarding different conflict categories and intensity levels, violent events are being referenced geographically with exact coordinates - suitable for the use with geo-processing software such as ArcGIS. Unfortunately, only central African countries as well as some Asian states have been covered to date. Up to now, there is no data for countries in the Middle East, including the Yemen. Hence this auspicious dataset cannot be harnessed.

It becomes clear that there is no given data for the aim of this study. Thus a dataset needs to be assembled. The original idea, therefore, was to gather the event data through the automatic event coding of Reuters news bulletins from the Middle East. Through dictionaries containing verbs, phrases, actors and - most important - locations, events might be machine-coded. However, Reuters data on the Middle East is of very poor quality. Different trials ensured that even with a good programming of the TABARI software (Schrodt 2006) its application to the large Reuters databases could not render data anywhere near acceptable. While many conflicts did not show up in the Reuters databases, location names were almost never accurate. This is because the location of the Reuters office in a given country is mostly the only available geographical information. Hence, while the quality is extremely poor, access to a reasonable fraction of the total of all conflicts was not given at all. Consequently, this trial had to be aborted.

The only residual method for compiling a useful dataset is coding by hand. This is also the main reason, why the quantitative analysis is limited to one country. Even for a single country, coding these conflicts by hand is extremely time-consuming. Fortunately, the Yemen has two English newspapers edited by Yemeni journalists with complemented archives that go back as far as 1995. In a coding effort lasting several days, a conflict dataset of about 230 conflict reports for the period of 1995 until 2002 was compiled. Each report consists of the following information: title, lead, date, exact location. Subsequently, every event was geo-referenced, i.e. pin-pointed to an exact coordinate (longitude/latitude). This had to be done by comparing village-name lists as a layer in a GIS project with the locations given by the newspaper reports. Even research on the location of different tribes had to be done in order to geo-reference events without information about location. Descriptive statistics within GIS show a satisfying spatial variance of the graph. Since the data was coded by hand, it was already

possible to control for certain events that should not be included in the dataset: first, suicide incidents were not included: second, jailbreaks and support of jailbreaks were excluded since these incidents do not match the requirement of an intended pro-active action toward an antagonist (jailbreaks are more of a defensive character); third, religiously motivated assaults against *Western* institutions were not incorporated. These events are considered to be of exclusive and temporary character, detached from any intra-state conflict mechanisms. On the other hand, violent events were included even if there were no casualties or where there were no actors and motivations specified. In six cases, the coordinates had to be determined by computing the geographical center of the governorate because the governorate was the only geographical reference in the report. The geographical distribution of the conflicts is mapped in Figure 6.1.

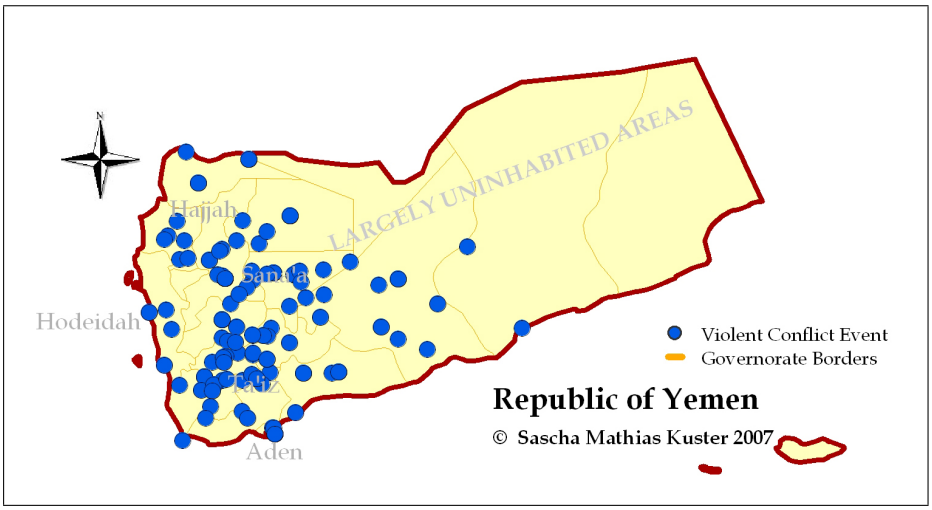


Figure 6.1.: Violent Events 1995-2002

**Water Availability Anomaly** An anomaly can be understood as a deviation from accustomed scarcities, hence as a rather unexpected deviation from normal. It is important to bear in mind that over the years tribal and Islamic societies developed highly sophisticated allocation regimes to cope with scarcities - especially with regards to water. The undisputed right for drinking water as well as different allocation rules are repeatedly mentioned in the Qur'an as well as emphasized in numerous *Hadiths* of the Prophet Mohammad.[1] This is why only clear anomalies are expected to induce violent conflictive behavior. The data to measure this construct needs to fulfill four requirements. Besides being available at all, the data needs to cover the period from 1995 until 2002: and since the Yemen is one of the most poorly covered areas when it comes to gauged precipitation data, the data needs to be intra-polated and scaled with satellite-observation data and climate modeling (so called re-analysis), in order to fully cover the whole span of the

[1] Insights from private conversations with Islamic scholar Al Habib Ali Al Jifri, Tarim, Yemen, August 2006.

Yemen in a fine-grained spatial resolution. Third, the 1990s are known to have been an exceptionally warm period.[2] Therefore, data on anomalies has to be time-critical, i.e. such trends as the 'hot' nineties have to be controlled for. In other words, anomalies should not be computed from a long-year mean of deviations and absolute precipitation amounts, but should be computed from recent means, because anomalies are perceived in light of recent experience and empirical value. Of course, how far back empirical value remains relevant and whether old or young experience is key remains a contentious issue. However, a time-critical approach is opted for. Fourth, the data must be available in fine-grained time intervals - monthly data at best.

Levy et al. (2005) were requested to provide a clip from their hydro-climatic dataset for this study. Their Weighted Anomaly Standardized Precipitation index (WASP) measures on a monthly basis and on a 2.5 degree grid the difference between observed rainfall totals and persistent averages. Unfortunately, this data is not open to the public.

Another promising approach is the Subnational Basins Indicators simulated with Water Balance Models provided by the Food and Agriculture Organization of the United Nations (FAO). This would have been especially useful, since they measure natural as well as actual outflow and inflow into subnational river basins while considering potential evapo-transpiration, soil properties and irrigation losses. Furthermore, the data is provided on a high resolution of 10 km on 10 km per grid cell.[3] Such data would be perfect to compute a sound measure for freshwater availability anomalies at the level of single river basins. Unfortunately, the data is provided on a yearly basis only.

By far the best available precipitation data is the Global Precipitation Analysis Product by the Global Precipitation Climatology Centre (GPCC), collected by the Deutscher Wetterdienst (DWD) (Fuchs et al. 2007). Through free access, its monthly gridded precipitation datasets are publicly available for download. The Full Data Product contains quality-controlled gauged data from up to 43000 stations worldwide, intrapolated through time and scaled with satellite observation data and climate modeling. Therefore, it is possible to provide absolute precipitation data for the Yemen at a 1.0 degree grid scale on a monthly basis for the whole period required (1995-2002). The data is provided in millimeters of rainfall for each grid-month in ASCII-format, which was imported into the geographical information system. Furthermore, the GPCC provides data on precipitation anomalies along the same perimeters.

However, the anomaly data is not time-critical. Therefore, an indicator for anomalies had to be computed from the absolute precipitation values. The eight-year mean (1995-2002) for each grid month was subtracted from the actual observation for the respective grid month. The resulting difference was then divided through the standard deviation for the respective grid *season*. In this way, grids with high values (and high deviations for this reason) and grids with low values (and low deviations respectively) can still be compared. Because for dry grids, small deviations can add up to huge anomalies with

[2] Insights from a meeting with Wolfgang Ruf, Expert for hydrodynamic flow modelling at the Department of Environmental Sciences at the Federal Institute of Technology, ETH, in Zürich, Switzerland, 7th November 2006.

[3] Information available online: http://www.fao.org/ag/agl/aglw/aquastat/irrigationmap/index.stm (11/24/06).

respect to their usual amount of precipitation while the same deviations are perceived to be of minor importance in 'wet' grids. Hence the equation to compute freshwater availability anomalies.

$$\frac{GMobservation - GMmean}{GSstandarddeviation} = GMprecipitationanomaly$$

The reason why a grid season (as opposed to grid month) format is used for the grid's standard deviation is as follows. The Yemen has two main seasons: rainy and dry. There are two rainy seasons for most of the Yemen. These are March and April as well as July and August. All the other months are more or less dry. At the intersection of these 'four' seasons as well as within the seasons, there are no large systematic deviations at regular intervals. This is very important, because perceived expectations are considered to refer to the level of a season and not to each month. A farmer usually expects certain rainfall patterns in the time periods over which they occur, rather than splitting them up into months. On the other hand, anomalies are still felt at the monthly level.

To be correct, the concept of 'water availability' ought to encompass well water and spring water in addition to mere precipitation. Even if spring water only occurs in mountainous regions, well water is often used as a backup method to counter dry periods. However, there are not enough resources or any data necessary to control for this. Therefore, a certain risk of somehow skewed results has to be taken into account.

**Identities** When it comes to the coding of identities in a certain spatial area, one question comes to the fore. Which societal identification features shall be included in such an identity indicator? Are we looking for religious schisms only? Or do we want to track ethnic divisions such as 'Arab' and 'Africans'? And what exactly *is* an 'Arab'? Ask a Syrian baker whether he considers the Moroccan King Mohammed VI an 'Arab', and he will say no. Moroccans are Maghribians, Berbers, North Africans. On the other hand, Yemenis like to see the Lebanese as their fellow 'Arabs', while most Lebanese prefer to see themselves as Phoenicians. It is obvious that 'identity' is a very blurred and only temporary construct most of the times. It is heavily dependent on time and context.

Therefore the data required has to contain adequate identity features for the period of investigation in unified Yemen. As far as religious schisms are concerned, there is mainly one cleavage that is known to have generated conflicts since the unification. This is the divide between the large *Sunni* majority and the *Zaydi Shia'i* minority that is clustered in the mountainous North of the country.

Regarding language or cultural customs, there seems to be no conflictive potential within the Yemen. Pertaining to phenotypical group features, there is only a diminutive 'black' fraction of Somali, Djibouti and Eritrea people living mainly in the urban areas

of the country. This group is considered to be irrelevant. By far the vast majority is of Arabian Peninsula origin. Therefore ethno-somatic group features shall not be included in the concept of identity.

One of the major cleavages beside the religious schism derives from tribal origin. As Manea (1998) describes, in Yemen "tribes and the state are disengaged and function in separate spheres: the state in the center and the tribes at the periphery" (Manea 1998, p. 9). It has to be said that in the former South Yemen (i.e. the Peoples's Democratic Republic of Yemen (P.D.R.Y.)) fertile grounds and thereby agriculture helped to dissolve tribal roots around the *Himiar* and *Madhhij* tribal confederations toward semi-feudal entities. This weakened the individual power of the tribes. In the British colonized port of Aden, the tribes where virtually non-existent. Alternating Emirates and Sultanates paved the way for today's state-run character of South Yemen (Manea 1998, p. 4). Following this, the Communist era in the P.D.R.Y. as well as British rule influenced Southern educational norms away from tribal systems.[4] Therefore, tribal divisions are not considered for the former South Yemen. However, in the North things are quite the opposite. Here the tribes always continued to exist as entities independent from the state, led by their *shaykhs*. The *Hashid* and *Bakil* confederations are of greatest importance in this respect (Manea 1998, p. 3). An indicator should definitely cover the division lines between these two tribes, even if such a division is hardly possible to draw in urban areas where members of both sides intertwine. To observe further and more fine-grained tribal divisions is almost impossible without local tribal expertise. This would demand coding almost every other village, because tribal descent can split into very fine-grained lineages. Hence, at least the cleavage lines between the *Hashid* and *Bakil* strongholds need to be covered by a possible indicator. Furthermore, the data needs to contain spatial information about where the identity-cleavages are to be located, i.e. which grid cells are divided by such cleavages. Since this investigation period starts after the unification of the two Yemen, there is not much variance expected between 1995 and 2002 in regard to identity shifts. Therefore a temporal variance within the data is not necessary.

There are no existing datasets comprising the spatial information demanded in this case. Fortunately, an indicator compiled in line with the Geo-Referencing of Ethnic Groups II (GREG II) project is applied. GREG II is a joint-venture between the ETH Zurich in Switzerland, UCLA and the Department of Geography at the University of Trondheim, Norway.[5] This GIS-layer comprises both of the above specified cleavages. The cleavage lines are drawn according to GREG II in Figure 6.2.

[4] Insights from conversations with Shaykh Abdullah Aydrus Al Saqaaf, Al Qaryat Al Waht, Lahj Governorate, Yemen, February 2007.

[5] By the time of print, the geo-referencing task of the group lists compiled within the ESEG and GREG projects was still in its take-off phase. The geo-data employed in this study was a pilot for the geo-referencing of Yemeni groups within GREG II.

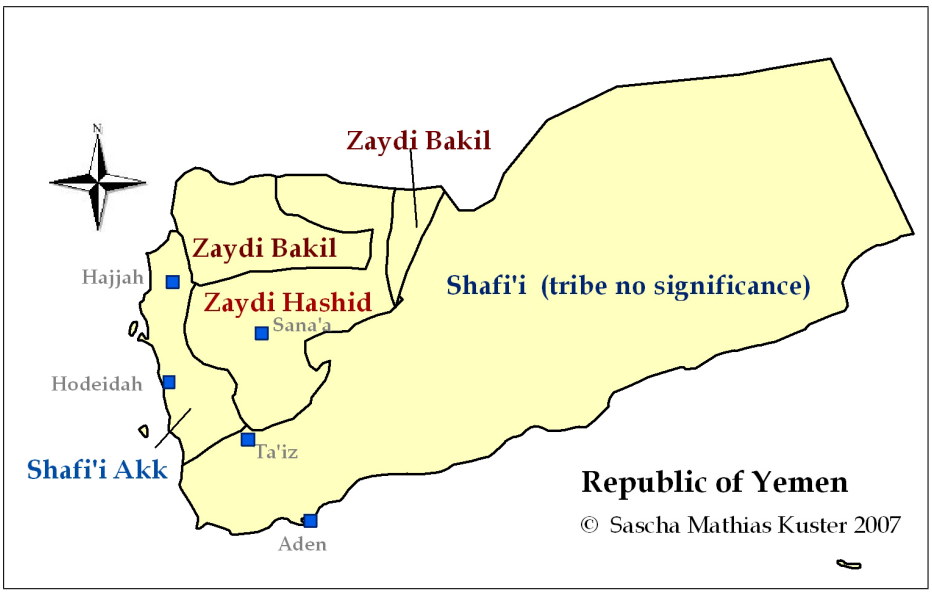


Figure 6.2.: Identities Yemen

**Water Dependence** The concept of water dependence may be considered from two perspectives. First, water today is 'mobile' in the form of virtual water - as, for example, in imported vegetables or processed food. Therefore provision water can be compensated for - given the monetary potential of a social entity to purchase such goods. On the other hand, water is very much necessary for almost all branches of industry, and even more in agriculture. In the Yemen, small social entities have nowhere near enough monetary potential to resort to virtual water when necessary. Further, as shown above, the vast majority of the Yemeni people depend on agriculture as a means of self-supply as well as to generate a marginal income. An industry or service sector as alternatives are almost non existent. 92 percent of all water withdrawal is used for agriculture. Therefore, there is considerable water dependence throughout the Yemen.

However, water dependence is an indicator which hardly varies within the country as far as the spatial as well as the temporal dimensions are concerned. Because of this lack of variance, this variable is intrinsically no variable but rather a constant within the Yemen. Therefore, it cannot be employed within any method considered in Section 6.2.

**Population Pressure** If more entities are competing for a constantly scarce resource, the possible allotment for each entity decreases. From this it follows that in regions with a higher population density, a given scarcity is more acutely perceived. A possible indicator to measure population pressure has to provide information about the relative pressure at a given time associated with a spatial reference.

Unfortunately, to the author's knowledge there is no suitable dataset to cover these requirements. The only dataset[6] available is limited to an ArcGIS *shape* file, the attribute

[6] Available online:www.met.gov.na/publications/Databases/MetaDB/DRFN/Population/20Pressure.htm (07/03/07).

data of which does not entail spatial coordinates, which prevents its incorporation in this dataset, so far as alignment with other spatial information is concerned. This, of course, is a cogent prerequisite. Due to limited resources, it was decided against an unreasonably complex calculation of these coordinates within the scope of this thesis.

However, if one takes a look at the shape file in Figure 6.3, some uncertainty can be wiped off. On the one hand, there are five clusters with outstanding population peaks which are easy to explain. Two of them represent the large port cities of *Aden* and *Hodeidah*. The largest cluster represents the industrial and urban center of the country around *Ta'iz* and *Ibb*. The last two clusters represent the capital *Sana'a* as well as the urban region around *Amran* and *Hajjah* in the North. Therefore, these peaks can be written off as urban areas. All the other populated parts of the country (mainly in the Western third of the territory plus the Hadramawt Region in the East) can largely be considered agricultural regions.

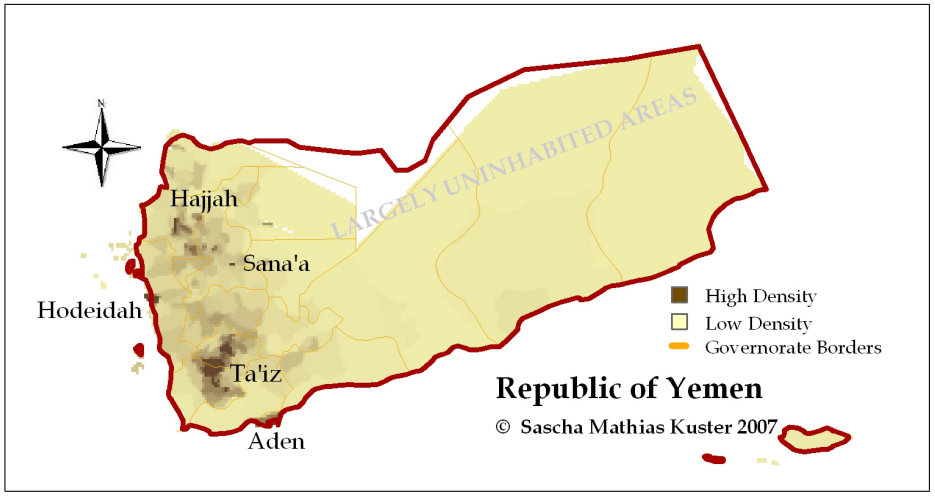


Figure 6.3.: Population Density 2000

If the layer 'percentage of land irrigated' in Figure 6.4 is compared with the layer for 'population pressure' in ArcGIS, it becomes obvious that in most cases a higher population pressure runs congruent with a higher percentage of irrigated land. Hence, a higher percentage of irrigated land offsets a high population density and thereby decreases the pressure.

Of course, enlargement in the percentage of irrigated land may occur in ignorance of the actually available water in the same location. Hence, the balancing could also *add* to the structural scarcity. Yet, this would require further computing - an unreasonable effort within the scope of this thesis. Hence, population pressure is not controlled for when it comes to possible regressions or probability distribution tests.

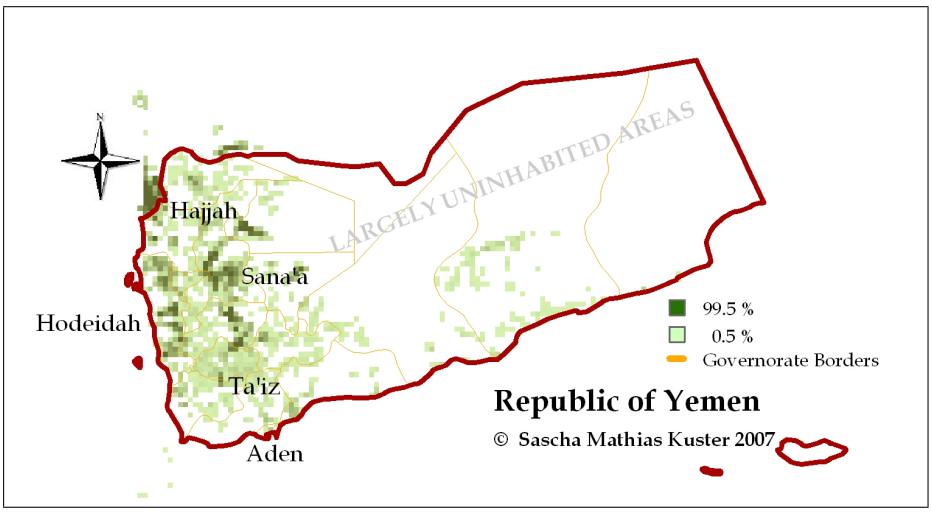


Figure 6.4.: Percentage of Irrigated Land 1999

**Capital of Ingenuity** The capital of ingenuity in light of the conflict literature is commonly described as the potential of a social entity to cope with scarcities of all forms. The question of how to measure quantity and quality of 'ingenuity' available within a society is key but very tricky. Thomas Homer-Dixon, father of the 'Ingenuity-Gap' Theory, dedicates whole essays to this topic.[7] An indicator should at least have spatial variance at the subnational level. One of the most practicable indicators so far is an index compiled by Bocchi et al. (2005). They merge the value of the Human Development Index and the GDP by the UNDP. Unfortunately, this index is obviously at the state level and thus lacks subnational variance. Hence, this variable has to be dismissed because there is no measure available.

**Primary Commodity Resource Availability** Primary commodity exports are measured at the state-level. Data about primary commodity production at the subnational level is not available. Thus there is no subnational variance. Hence, this variable has to be dismissed as well.

**Small Arms** There is no measure for small arms distribution at the subnational level. Thus there is no subnational variance. Hence, this variable has to be dismissed as well. Nevertheless, the high small arms ownership rate in the Yemen has to be kept in mind when drawing conclusions.

**Earlier Conflict** Conflict, of course, has to be assumed to beget conflict. Yet earlier conflict cannot be considered a control variable alone. Furthermore this concept implies the element of time, which will be discussed more elaborately in the next chapter on statistical methods. Actually, one would try to control for time through statistical methods. However, whether certain conflict can be explained by deduction from a previous

[7] Essays available online: http://www.homerdixon.com/ingenuitygap/theory.html (07/24/07).

incident or argument depends largely on the involvement of the same or related actors within both conflicts. Therefore our ideal case of violent conflict would contain information about the actors involved - better yet, about aggressor and receptor. Unfortunately, this information is not given in 98 percent of the conflict cases. Therefore the only way to ascertain whether time-contiguous events have an actual real-life relation too, is by analyzing geographic proximity. The aim is to identify relevant conflict clusters. The respective grid months can subsequently be marked by a dummy variable relating to whether the grid month belongs to a cluster (1) or can be seen as a separate entity (0). Therefore, all the conflicts were looked through. Wherever two conflicts within a two-month period occurred in the same or neighboring grids, only the first grid-month event was given a 0. The subsequent related events where marked as 1.

## 6.2. Statistical Method - The Problems with Time and Space

Now that adequate measures for the theoretical constructs have been determined, statistical methods have to be weighted up against each other. The first thing to consider when thinking about which statistical method to apply is the character of the dependent variable. In this case, the conflict variable is dichotomous and thereby qualitative - i.e. the dependent variable can only take two values (0 or 1). Influences on such variables cannot be analyzed with ordinary least squares (OLS) analysis, because several necessary conditions in light of inferential statistics are not given. A minimization of the sum of all squared errors is not possible. Furthermore, potential predictions above 1 and below 0 breach the dichotomous character of the data.

One solution could be a logistic transformation of our dependent variable, working with the probability of our dependent variable to reach value 1. Maximum likelihood estimates would help to iteratively approach the coefficients. This could be done by means of Logit or Probit models.

However, our data also comprises the factor of discrete time - i.e. the data contains observations made within discrete time intervals only (Conflict in December 1997 etc.), and so the dichotomous dependent variable is time-dependent. However, simple Logit (or Probit) models though eliminate time dependency by presumption. Possible solutions could be the following: adding another dependent variable counting for 'time' within a risk set analogous to the Weibull model; or a dichotomous variable for each time period (Beck et al. 1998, p. 179ff). However, both of these solutions - especially the second one - would cause a serious problem through an increase of the degrees of freedom. Another problem with the data is its huge sample size. Almost 10,000 cases (i.e. grid months) are very likely to produce significant results by virtue of their own frequency (Hug 2006).

When discussing the operationalization of the 'earlier conflict' variable, spatial dependency was mentioned. Again, problems with spatial dimensions cohere with presumptions toward the theoretical errors within the classical linear regression model. In this case, in contrast to the time factor, the theoretical error is marked by a spatial unit.

Can we assure a constant variance of all theoretical errors?

Hence, if one wants to combine time series with a quite large amount of units given by the spatial grids, the problems of these two combine as well. It would be necessary to control for autocorrelation in the temporal *as well as* the spatial dimension. The spatial dimension furthermore begets a heteroscedasticity, as mentioned above. If the dataset were to contain 'simple' panel data, one could fall back on Parks Estimate and ascertain the standard errors of the estimated coefficients (Hug 2006). However, given the large N in this study, a variance-covariance matrix necessary for such a computation is hardly possible.

It has become clear that even sophisticated statistical models face serious problems in light of the idiosyncratic characteristics of this specific data. Thus, even if pretty detailed data is available - the utilization of which is quite alluring - it is considered inappropriate to utilize regression analysis to harness it. Yet, as Gary King (1996, p. 160) argues, "...political geographers should try as hard as possible to make context *not* count." Of course, to work a theoretical model until (at least) the spatial dimension does not act a part anymore would be a fine solution. However, research and the theoretical state of the art are far from allowing such a strategy to be realized within this thesis.

Taken these points into consideration, a clear-cut cross-table analysis using Chi-square measures, in order to identify whether any correlation between the variables of interest is on display, was opted for. This method is considered to be sufficiently elaborate since the original aim was to simply identify whether there is a correlation at all. The results of this Chi-square analysis are presented in Chapter 7.

# 7. Statistical Analysis- General Correlation

As a first step, the main variables - Freshwater Availability Anomalies and Violent Conflict - are confronted directly. The anomaly-variable has been re-coded into a dichotomous variable in order to use it within a cross-table. It was decided to conduct this analysis with two codings of the anomaly variable in order to check for its robustness. First, all cases are coded as anomaly (attribute: 'Anomaly') where the deviation computed is equal or higher than 25 percent of the highest possible deviation of the grid month (derived from its eight-year mean). All the cases below this value are coded as normal (attribute: 'Normal'). Second, all grid months are coded as anomaly that have a deviation equal or higher than 75 percent of their highest possible deviation. The latter adds up to a decrease in negative-anomaly cases. Therefore, the former version of the variable is much more likely to generate a result in favor of the hypothesis.

## 7.1. A Plain Correlation

A look at Table 7.1 shows that 1.9 percent of the anomaly cases coincide with a conflict, whereas only 1.3 percent of grid-months with normal rainfall do so.

Table 7.1.: Anomalies > 25 Percent of Max. Possible Negative Deviation

| Confict | Count | Normal | Anomaly | Total |
|---|---|---|---|---|
| 0 | actual | 3053 | 6768 | 9821 |
| | expected | 3039.4 | 6781.6 | 9821.0 |
| | Percent of Anomaly | 98.7 | 98.1 | 98.3 |
| 1 | actual | 39 | 131 | 170 |
| | expected | 52.6 | 117.4 | 170.0 |
| | Percent of Anomaly | 1.3 | 1.9 | 1.7 |
| Total | actual | 3092 | 6899 | 9991 |
| | expected | 3092.0 | 6899.0 | 9991.0 |
| | Percent of Anomaly | 100.0 | 100.0 | 100.0 |

This results in a high Chi-Square value at a .024 level in Table 7.2. According to this, one could rebut the null-hypothesis at an error margin lower than 2.5 percent.

However, the distribution in light of the second variable coding must also be analyzed. Here, only those cases are considered anomalies where the deviation reaches at least 75

Table 7.2.: Anomalies (25 Percent) - Chi-Square Test

| Measure | Value | df | Exact Significance |
|---|---|---|---|
| Pearson's Chi-Square | 5.188 | 1 | .024 |
| Number of Cases | 9954 | | |

percent of the highest possible deviation. The difference is even more definite. 2.1 percent of negative freshwater availability anomalies coincide with conflicts in contrast to only 1.3 percent of normal rainfall grid-months (See Table 7.3).

Table 7.3.: Anomalies > 75 Percent of Max. Possible Negative Deviation

| Confict | Count | Normal | Anomaly | Total |
|---|---|---|---|---|
| 0 | actual | 4591 | 5230 | 9821 |
| | expected | 4571.9 | 5249.1 | 9821.0 |
| | Percent of Anomaly | 98.7 | 97.9 | 98.3 |
| 1 | actual | 60 | 110 | 170 |
| | expected | 79.1 | 90.9 | 170.0 |
| | Percent of Anomaly | 1.3 | 2.1 | 1.7 |
| Total | actual | 4651 | 5340 | 9991 |
| | expected | 4651.0 | 5340.0 | 9991.0 |
| | Percent of Anomaly | 100.0 | 100.0 | 100.0 |

The Chi-Square value for this setting is even higher and allows rebuttal of the Null-hypothesis at an error rate of less than one percent (See Table 7.4).

Table 7.4.: Anomalies (75 Percent) - Chi-Square Test

| Measure | Value | df | Exact Significance |
|---|---|---|---|
| Pearson's Chi-Square | 8.809 | 1 | .003 |
| Number of Cases | 9991 | | |

## 7.2. Control for Earlier Conflict

Even if the above results may look encouraging, the hard test against the two control variables has yet to be passed before any conclusions can be drawn. In a primary step, earlier conflict was controlled for.

Beginning with the 25-percent variable again in Table 7.5, the distribution of cases points toward a strong effect exerted by earlier conflicts. If there are no earlier conflicts, 1.6 percent of the respective anomaly cases appear together with conflicts while only 1.3

percent of normal rainfall cases do so. Yet, as soon as an earlier conflict comes into play, only 74.1 percent of anomaly cases face 90.0 percent of normal rainfall cases in line with a new conflict.

Table 7.5.: Earlier Conflict Controlled (25 Percent)

| EarlCon | Conflict | Count | Normal | Anomaly | Total |
|---|---|---|---|---|---|
| 0 | 0 | actual | 3052 | 6761 | 9813 |
| | | expected | 3038.3 | 6774.7 | 9813.0 |
| | | Percent of Anomaly | 99.0 | 98.4 | 98.6 |
| | 1 | actual | 30 | 111 | 141 |
| | | expected | 43.7 | 97.3 | 141.0 |
| | | Percent of Anomaly | 1.0 | 1.6 | 1.4 |
| | Total | actual | 3082 | 6872 | 9954 |
| | | expected | 3082.0 | 6872.0 | 9954.0 |
| | | Percent of Anomaly | 100.0 | 100.0 | 100.0 |
| 1 | 0 | actual | 1 | 7 | 8 |
| | | expected | 2.2 | 5.8 | 8.0 |
| | | Percent of Anomaly | 10.0 | 25.9 | 21.6 |
| | 1 | actual | 9 | 20 | 29 |
| | | expected | 7.8 | 21.2 | 29.0 |
| | | Percent of Anomaly | 90.0 | 74.1 | 78.4 |
| | Total | actual | 10 | 27 | 37 |
| | | expected | 10.0 | 27.0 | 37.0 |
| | | Percent of Anomaly | 100.0 | 100.0 | 100.0 |

Consequently, a look at Table 7.6 is due. As expected, the Chi-Square results are not convincing. If no earlier conflict has taken place, the results are significant, i.e. the Null-hypothesis can be rebutted. If however, there has been an earlier conflict this correlation disappears and the Null-hypothesis cannot be declined at a significant level.

Table 7.6.: EarlCon (25 Percent) - Chi-Square Test

| EarlCon | Measure | Value | df | Exact Significance |
|---|---|---|---|---|
| 0 | Pearson's Chi-Square | 6.277 | 1 | .013 |
| | Number of Cases | 9954 | | |
| 1 | Pearson's Chi-Square | 1.092 | 1 | .404 |
| | Number of Cases | 37 | | |

The relevant proportional distributions in Table 7.7 approximately equal the results from Table 7.5. As soon as an earlier conflict precedes a case, a mere 68.2 percent of anomaly cases face 93.3 percent of normal rainfall cases in the event of a new conflict.

Table 7.7.: Earlier Conflict Controlled (75 Percent)

| EarlCon | Conflict | Count | Normal | Anomaly | Total |
|---|---|---|---|---|---|
| 0 | 0 | actual | 4590 | 5223 | 9813 |
| | | expected | 4570.3 | 5242.7 | 9813.0 |
| | | Percent of Anomaly | 99.0 | 98.2 | 98.6 |
| | 1 | actual | 46 | 95 | 141 |
| | | expected | 65.7 | 75.3 | 141.0 |
| | | Percent of Anomaly | 1.0 | 1.8 | 1.4 |
| | Total | actual | 4636 | 5318 | 9954 |
| | | expected | 4636.0 | 5318.0 | 9954.0 |
| | | Percent of Anomaly | 100.0 | 100.0 | 100.0 |
| 1 | 0 | actual | 1 | 7 | 8 |
| | | expected | 3.2 | 4.8 | 8.0 |
| | | Percent of Anomaly | 6.7 | 31.8 | 21.6 |
| | 1 | actual | 14 | 15 | 29 |
| | | expected | 11.8 | 17.2 | 29.0 |
| | | Percent of Anomaly | 93.3 | 68.2 | 78.4 |
| | Total | actual | 15 | 22 | 37 |
| | | expected | 15.0 | 22.0 | 37.0 |
| | | Percent of Anomaly | 100.0 | 100.0 | 100.0 |

However, the Chi-Square value in Table 7.8 is far better than in the case of the 25-percent variable. This could be explained by the fact that the anomaly cases in this arrangement represent the concept of anomaly more lucidly than the 25-percent coding does. However, the result in the case of earlier conflict is not sufficiently significant.

Table 7.8.: EarlCon (75 Percent) - Chi-Square Test

| EarlCon | Measure | Value | df | Exact Significance |
|---|---|---|---|---|
| 0 | Pearson's Chi-Square | 11.186 | 1 | .001 |
| | Number of Cases | 9954 | | |
| 1 | Pearson's Chi-Square | 3.329 | 1 | .108 |
| | Number of Cases | 37 | | |

## 7.3. Control for Identity

Apart from the results above, the Identity control variable will now be scrutinized. Whereas an effect of earlier conflict can be anticipated quite easily, there is much more uncertainty about the influence of Identity on the outbreak of conflict. The number of

conflicts that have taken place in grids with tribal and/or religious cleavage (77 conflicts) almost equals the number of 'cleavage-free' conflicts (93 conflicts).

In Table 7.9 it becomes obvious that the percentage of anomaly cases equal the percentage of normal rainfall cases when it comes to conflict without any identity cleavage. However, as soon as an identity cleavage comes into play, the percentage of anomaly grid-months in case of conflict (4.4 percent) highly outnumbers the grid-months with normal rainfall (1.6 percent only).

Table 7.9.: Identity Controlled (25 Percent)

| Identity | Conflict | Count | Normal | Anomaly | Total |
|---|---|---|---|---|---|
| 0 | 0 | actual | 2302 | 5365 | 7667 |
| | | expected | 2301.1 | 5365.9 | 7667.0 |
| | | Percent of Anomaly | 98.8 | 98.8 | 98.8 |
| | 1 | actual | 27 | 66 | 93 |
| | | expected | 27.9 | 65.1 | 93.0 |
| | | Percent of Anomaly | 1.2 | 1.2 | 1.2 |
| | Total | actual | 2329 | 5431 | 7760 |
| | | expected | 2329.0 | 5431.0 | 7760.0 |
| | | Percent of Anomaly | 100.0 | 100.0 | 100.0 |
| 1 | 0 | actual | 751 | 1403 | 2154 |
| | | expected | 736.7 | 1417.3 | 2154.0 |
| | | Percent of Anomaly | 98.4 | 95.6 | 96.5 |
| | 1 | actual | 12 | 65 | 77 |
| | | expected | 26.3 | 50.7 | 77.0 |
| | | Percent of Anomaly | 1.6 | 4.4 | 3.5 |
| | Total | actual | 763 | 1468 | 2231 |
| | | expected | 763.0 | 1468.0 | 2231.0 |
| | | Percent of Anomaly | 100.0 | 100.0 | 100.0 |

The above findings are confirmed by the statistical measures. When there is no identity cleavage, Pearson's Chi-Square is not significant. As soon as Identity comes into play the results are highly significant (See Table 7.10).

Table 7.10.: Identity (25 Percent) - Chi-Square Test

| Identity | Measure | Value | df | Exact Significance |
|---|---|---|---|---|
| 0 | Pearson's Chi-Square | .043 | 1 | .910 |
| | Number of Cases | 7760 | | |
| 1 | Pearson's Chi-Square | 12.281 | 1 | .000 |
| | Number of Cases | 2231 | | |

Given an identity cleavage, the distribution of anomaly and normal rainfall cases in the event of conflict is even more pronounced in Table 7.11.

Table 7.11.: Identity Controlled (75 Percent)

| Identity | Conflict | Count | Normal | Anomaly | Total |
|---|---|---|---|---|---|
| 0 | 0 | actual | 3482 | 4185 | 7667 |
| | | expected | 3477.8 | 4189.2 | 7667.0 |
| | | Percent of Anomaly | 98.9 | 98.7 | 98.8 |
| | 1 | actual | 38 | 55 | 93 |
| | | expected | 42.2 | 50.8 | 93.0 |
| | | Percent of Anomaly | 1.1 | 1.3 | 1.2 |
| | Total | actual | 3520 | 4240 | 7760 |
| | | expected | 3520.0 | 4240.0 | 7760.0 |
| | | Percent of Anomaly | 100.0 | 100.0 | 100.0 |
| 1 | 0 | actual | 1109 | 1045 | 2154 |
| | | expected | 1092.0 | 1062.0 | 2154.0 |
| | | Percent of Anomaly | 98.1 | 95.0 | 96.5 |
| | 1 | actual | 22 | 55 | 77 |
| | | expected | 39.0 | 38.0 | 77.0 |
| | | Percent of Anomaly | 1.9 | 5.0 | 3.5 |
| | Total | actual | 1131 | 1100 | 2231 |
| | | expected | 1131.0 | 1100.0 | 2231.0 |
| | | Percent of Anomaly | 100.0 | 100.0 | 100.0 |

Thus, as Table 7.12 shows, the effect of Identity together with Anomaly even aggravates as opposed to the case of the 25-percent coding. Pearson's Chi-Square is amplified to a highly significant value.

Table 7.12.: Identity (75 Percent) - Chi-Square Test

| Identity | Measure | Value | df | Exact Significance |
|---|---|---|---|---|
| 0 | Pearson's Chi-Square | .769 | 1 | .403 |
| | Number of Cases | 7760 | | |
| 1 | Pearson's Chi-Square | 15.617 | 1 | .000 |
| | Number of Cases | 2231 | | |

## 7.4. Conclusion - General Correlation

Before drawing any conclusions, two preconditions need to be mentioned in order to call attention to the limitations of these results. First, the study is on the Yemen. Thus,

the results are to be seen as holding for the Yemen only instead of their having a global claim. Second, the operationalization was bound to the fact that certain variables do not show any (sub-national) variance in order to be usefully measured. Hence, certain antecedent factors, i.e. control variables were not included.

Nevertheless, three conclusions can be drawn from the results above. First of all, if examined in isolation, the two main variables show a very strong correlation. In light of these results, the invalidity of a Null-hypothesis has to be assumed.

Second, earlier conflicts act as a clear inhibition upon a correlation between freshwater availability anomalies and the occurrence of violent conflict at the local level, i.e. conflict most likely beget further conflict.

Last and most important, identity cleavages cannot corrode the correlation as presumed. If a correlation only occurs between the identity cleavages and conflict occurrence, freshwater availability anomalies would not make a difference. Yet, as seen in Tables 7.9 and 7.11, it clearly does make a difference. This result presumably points to an interaction between the independent and the control variable. Hence, freshwater availability anomalies could be a motivator, whereas identity cleavages may act more as a mechanism for mobilization with regards to subsequent violent conflicts.

# Part IV.

# The Underlying Mechanism - Qualitative Analysis

After having compiled the state of the research on the subject of scarcity, water and conflict by means of a set of paradigms about preconditions and interaction mechanisms, a correlation between freshwater availability anomalies and the outbreak of conflict in the Yemen has been tested for.

Therefore, a theoretical framework has been set up and operationalized through adequate measures. Furthermore, a conflict dataset has been compiled so as to be able to zoom in to the very local level of non-state agency. By means of geographic information systems software (ArcGIS), a large set of grid months with multilayer attribute data about freshwater availability anomalies, conflict occurrence (including earlier conflict occurrence) and identity cleavages has been computed. This resulted in a large-N dataset of roughly 10,000 grid month cases, each attributed with the relevant data measuring the variables in the theoretical model.

The correlation between the different variables was then statistically analyzed using cross-table Chi-square analysis. This test revealed a significant correlation between freshwater availability anomalies and the outbreak of local violent conflict. However, the results of the statistical analysis have shown that earlier conflict and identity cleavages act a part in this relationship. While earlier conflict accounts for an alleviative effect on the correlation's significance, identity cleavages are not able to corrode the correlation. The result rather points to an interaction between freshwater availability scarcities and the identity control variable.

Hence, the finding by Levy et al. (2005) that there is no correlation between freshwater availability anomalies and the outbreak of local violent conflict may be questioned. It has been shown that a correlation is obviously on display in the Yemen, albeit with a certain degree of interference from the two control variables. But how, when and why do these controls act a part in the mechanism of conflict evolution? And - are there other influencing factors shaping underlying mechanisms between the two variables of interest?

In order to find out about these antecedent factors that might influence the conflict mechanism, the spectrum will be opened up again: i.e. alternative factors (variables) allowed for that could not be measured and included in the quantitative study because of data constraints. Thus the aim of the following qualitative analysis is to trace how conflicts over water emerge, evolve and eventually escalate.

Part IV is composed as follows. First, the argumentation for the Yemen as a relevant study case suitable to provide insights into the subject matter in demand is brought forward in Section 8.1. Second, a typology of different types of intra-state water conflicts is elaborated and the focus of this study set to intra-catchment conflicts about irrigation water between actors upstream and downstream (Section 8.2). This is followed by a discussion on 'Governing the Commons' and a look at the principles of self-government in light of common resources, as well as one actual example of a functioning self-governed common pool resource (Section 8.3). Fourth and fifth, the peculiar characteristics of the Yemeni case regarding its water allocation systems (Section 8.4), as well as its Islamic, traditional and tribal legal systems (Section 8.5) are elaborated. In Section 8.6, an actor-centered theoretical framework is then compiled by means of harnessing Dessler's (1994) Rational Actor Model. This framework is composed of a sequence of decision-making

boxes that are illustrated alongside concomitant factors within a flow process chart.

Chapter 9 elaborates the methodological procedure. First, a set of case-study methods are discussed along with the method of process tracing selected in Section 9.1. Second and third, a 'focused interview' technique is chosen from a discussion of different interview types, followed by building up a set of instructions for the actual interview situation (Sections 9.2 and 9.3). Furthermore, the methodological discussion is secluded by the elaboration of a set of working hypotheses and the operationalization thereof, as well as the case selection of three catchments to be analyzed in Sections 9.4 and 9.5.

Finally, the three cases of intra-catchment upstream-downstream settings are analyzed in Chapter 10. The results of the case studies - i.e. the three field visits in *Wadi Tuban*, *Wadi Zabid* and *Wadi Al Jawf* - are all presented following the same pattern. Each case is introduced by a historical and institutional overview, followed by the presentation of the interview outcome and a small in-case conclusion. This process-tracing part is concluded by re-introducing the findings in the initially set up theoretical framework (Section 10.4).

In the final Chapter 11 the findings from both the quantitative and qualitative analysis are put in relation to each other and integrated back into the literature as discussed in Part II.

# 8. Theoretical Framework - Underlying Mechanism

After advocating the study case of the Yemen in the following, the selection of the conflict type of intra-catchment water conflict will be established, followed by the composition of the theoretical framework.

## 8.1. The Study Case: Yemen

This process-tracing study in search of insights about the underlying conflict mechanism between freshwater-availability anomalies and the occurrence of local violent conflict is based on the case of the Yemen, at the utmost Southern offshoot of the Arabian Peninsula. The Yemen serves as an excellent study case mainly because of four reasons.

First, the Yemen ranks among the most arid regions in the World (Unicef 2003, p. 36). Even if called *Arabia Felix* (Happy Arabia) by the Romans because of its rather fertile mountain range as opposed to the mostly deserted remainder of the Arabian Peninsula, the coastal and inland plains repeatedly face serious water shortages. In addition to unsteady rainfall occurrence, groundwater depletion proceeds at a dramatic pace (World Bank 1993.).

At the same time, the Yemeni population depends for the most part on agriculture. This economic branch not only serves as a generator for labor. Much more importantly, for a large part of the population agriculture serves as an essential source for self supply (Wehner & Arvidsson 2001). Agriculture requires a constant supply of freshwater in addition to drilled well water in order to yield a harvest on a regular basis. Furthermore, there are no sufficient financial resources to cover this supply by means of food imports (Wehner & Arvidsson 2001). In 1990, 92 percent of total water withdrawal in Yemen was used for agricultural, i.e. irrigation, purposes (World Bank 1993.). Hence, there is ample potential for conflict over this sought-after resource in the Yemen.

Third, a host of large-scale infrastructural development projects were implemented in the country during the second half of the 20th century, largely ignoring existing traditional resource governing regimes. As a consequence, many functioning regimes within the *wadi* courses drifted into a loose set of disorder and arbitrariness when it came to the allocation of freshwater among its riparians (Al Askari 2005, p. 13). This ignited several inter-communal and inter-tribal conflicts that dragged themselves on over the time.[1]

[1] Insights from private talks with Dr. Mohammed Barakat, Institutional Engineer within the Irrigation Improvement Project, Ministry of Agriculture and Irrigation, Sana'a, Yemen, August 2006.

Fourth, and colluding with point three, the political system in the Yemen is characterized by a weak central state and a highly independent and at times even disobedient periphery made up of long-established kinship and tribal communities and federations (Manea 1996). These peripheral entities are at times powerful and heavily armed to such an extent that the central government is not able to protect the people in the periphery and to restore order in case of local and regional conflicts (Katz 1992, p. 120f.). Furthermore, the Yemeni tribal system still follows the rule of vendetta and blood feuds. Therefore, once ignited inter-tribal and inter-communal violent conflicts can drag on over months and years, causing numerous casualties and serious regional instability - even if they started as small-scale fights over a scarce resource (YemenTimes 2006).

Hence, the Yemen is an important case with a great potential for insights into the research question on the underlying mechanisms between freshwater availability anomalies and the occurrence of local violent conflict. In order to narrow the focus of this study to a workable dimension, different conflict types are discussed following Thomasson's (2005, p. 15) conflict categorization in the following Section 8.2 and one appropriate conflict-type opted for.

## 8.2. Thomasson's Conflict Categorization

In order to locate this study in the research and to set its focus, a discussion about different types of conflict in relation to water is given in the following. According to Thomasson (2005), there are roughly seven categories of local, i.e. intra-state water conflicts (See Table 8.1).

First, the disposal of wastewater generates considerable problems worldwide. Yet, most of these conflicts evolve in line with industrial use and sanitation rather than water supply. Such conflicts over pollution and water quality tend to be far more common in richer and more environmentally conscious countries, which is definitely not the case in the Yemen.

Secondly, large infrastructural projects - especially dams - have captured quite a large part of the discussion on water conflicts. However, these discussions center more on population displacement issues rather than the actual water.

Third, economic sectors are often competing for the same resource. Given a water-intensive industry such as the textiles, this can account for severe competition among industrial sectors. The Yemen, however, is by no means an industrial society, since only 1.1 percent of water is withdrawn for industrial use while as much as 92 percent account for agricultural use (World Bank 1993.).

Another highly publicized root of conflict is privatization. Mostly present in urban areas, private contractors get entrusted with management and delivery of water. This formalization of the water distribution often leads to the exclusion of marginalized groups. Since this study also emphasizes the tribal element within water conflicts, rural settings are supposed to give more insight in that direction rather than urban phenomena in that regard.

Fifth, a very interesting conflict arrangement derives from reallocating water from

rural to urban areas - as shown, for example, by Padrutt (1997). Water is piped or loaded in tankers and transferred from rural areas to urban centers with water shortages. Water that has originally been used for irrigation is withdrawn to meet the ever increasing water demands of growing urban areas. However, this form of water theft and resource transfer between urban and rural areas is a topic in its own right. This category will not be considered in this analysis.

Last but not least, Thomasson differentiates between *inter*- and *intra*-catchment conflicts of water allocation. Allocation conflicts between different catchment areas strongly resemble the last category mentioned, i.e. the reallocation from rural to urban areas: and they are mostly in fact identical. It is assumed that across-catchment transfers require at least one party that is wealthy enough to set-up such a cost-intensive transfer-mechanism. Hence, this type of conflict is possibly not very frequent. Allocation conflicts within a single catchment, on the other hand, are assumed to be far more numerous, since such offences can be performed by means of water diversion at the micro level.

To sum up, Table 8.1 provides an overview of the seven types of water conflict according to Thomasson (2005).

Table 8.1.: Local Water Conflicts - Typology by Thomasson 2005

| Source of Conflict | Description |
|---|---|
| 1. Water Quality | Conflicts can arise due to water-pollution - more common in industrialized countries. |
| 2. Infrastructure Projects | Possible civil strife afflicting large infrastructural projects, particularly dams. |
| 3. Competing Sectors | Economic sectors can compete for the scarce resource water. |
| 4. Privatization | Exclusion of poor people due to formalization of water market. |
| 5. Reallocation | Water is piped or transported from rural to urban areas. |
| 6. Inter-Catchment | Water from one catchment is transferred to another. |
| 7. Intra-Catchment | Maldistribution between actors upstream and downstream. |

Yet, of what relevance are these different conflict types for the Yemen? Will certain types offer more adequate insights about the relationship between freshwater scarcities and conflict in the Yemen? This will be discussed in the following.

First, conflicts over water-quality due to pollution issues will not be considered because the Yemen has no large-scale industry, as the figures for water withdrawal by economic sector show. For the same reason, conflicts arising out of competition over water between different economic sectors shall be ignored.

Third, the construction of large infrastructure projects renders more problems of people displacement. Hence, the conflicts around this factor do not center on the actual water, rather than the issue of displacement - and shall therefore not be considered either.

Fourth, conflicts over the privatization of water raise economic and legal questions rather than questions about political interaction between individuals at the local level. Furthermore, privatization mostly happens in urban areas while this study rather aims at highlighting the role of the tribal element within water conflicts. Therefore, rural settings may offer more insights about the subject matter.

Fifth, inter-catchment conflicts of unequal distribution and reallocation between rural and urban areas will be excluded, since these are generally large-scale undertakings and to only a lesser extent happening on a daily basis.

Although analysis of all of these conflict types is important, they do not seem to be the most prevalent causes of conflict in the Yemen. Hence, instead of these the analysis uncovers the underlying mechanisms in intra-catchment conflicts related to irrigation water between actors upstream (UA) and downstream (DA) - be it village communities, tribal communities etcetera. The local factor is crucial here, since abutting owners of the same catchment inevitably interact with each other.

Analytical models, collective action theories, preliminary research and game theoretical considerations will direct discussion and formulation of the framework of analysis set out in Section 8.6. To build these hypotheses, a very simple causal relationship, such as the one presented in the quantitative analysis, is taken as a starting point: if water becomes scarce, the likelihood of violent conflict increases.

But what do the literature and preliminary evidence say about this hypothesized causal relationship? As will become obvious in the next four sections, the mechanism is not a direct one. In fact, several contextual preconditions shape the opportunity and preference structure of actors upstream and downstream. However, in order to understand the conflict mechanism, as a first step knowledge is required about the narratives, where there are *no* conflicts despite very similar settings as those existing in the Yemen - where common pool resources are governed without conflict and sustainably by the users themselves. Therefore, an example of how the commons shall and can be governed is given in the following section.

## 8.3. Governing the Famous Commons

Finding or gradually developing mutual agreements - whether official or tacit - about how to govern, or better yet allocate, scarce common resources among players having equal rights is key to conflict prevention. When "everybody's property is nobody's property" (Ostrom 1990, p. 1) individual welfare has to be sacrificed for joint welfare in order to prevent the destruction of the common good, as well as the stability within the relationship among its users. How do communities reach such a state, where the amount of joint welfare can compensate for a deliberate renunciation of individual welfare?

**Principles of Self-Government** Elinor Ostrom (1990) grandly laid out the principles of how the commons ought to be governed in avoidance of exploitation and conflict. After evincing the two traditional tenets about how institution building has to come about - by Leviathanish centralized control mechanisms or direct privatization - Ostrom argues that "the capacity of individuals to extricate themselves from various types of dilemma situations varies from situation to situation" (Ostrom 1990, p. 14). By analyzing different successful self-governing systems (from high-mountain meadows to fishing grounds), Ostrom lists several characteristics that repeatedly appear in these common pool resource settings. Central to these characteristics is the ability of people to commit *themselves* to a cooperative strategy. Therefore, they use several practices.

> *"(...) a frequent practice is to use a private arbitrator rather than a civil court as the mechanism to achieve enforcement." (Ostrom 1990, p. 16)*

According to Ostrom, this arbitrator helps the parties find methods to resolve disputes. Being one of them himself, motivation to keep the cooperation running is inherent in his strategy. In case of a tribal-based social structure, as in the Yemen, this private arbitrator would be the village eldest (*shaykh*).

Furthermore, the contracts are designed by the participants themselves - through deliberation and mutual agreement.

> *"The self-interest of those who negotiated the contract will lead them to monitor each other and to report observed infractions so that the contract is enforced." (Ostrom 1990, p. 17)*

This, again, very much resembles the self-governing characteristics of rural tribal communities in the Yemen - where no central state staffs the local authority or where "it is difficult for a central authority to have sufficient time-and-place information to estimate accurately both the carrying capacity of a common pool resource and the appropriate fines to induce cooperative behavior" (Ostrom 1990, p. 21).

To illustrate these successful methods of self-governance, Ostrom outlines a range of institutions that "have broken the shackle of a commons dilemma" (Ostrom 1990, p. 21). In order to explain their success, Ostrom urges us to look for factors external, as well as factors *internal*, to a certain group: and, along the same lines as the current study intends to choose its cases, Ostrom's entire focus lies on small-scale common-pool resource settings, where the common-pool resource is located within one country and the numbers of individuals affected varies from 50 to 15,000 people that are heavily dependent on the resource - i.e. gain a major part of their economic return from the resource (Ostrom 1990, p. 26). Ostrom's poster child for self-government of a water resource is a set of irrigation institutions in Andalusia in the South of Spain.

**Huerta Irrigation Institutions** The main characteristic within all the catchments in the Huerta region is the limited quantity of rainfall throughout the region as well as an extreme variation in rainfall. All face uncertain and complex environments due to erratic rainfalls. All of these preconditions result in a very high potential for conflict. However, despite this conflict potential,

> *"(...)the institutions devised many centuries ago for governing the use of water from these rivers have proved adequate for resolving conflicts, allocating water predictability, and ensuring stability in a region not normally associated with high levels of stability." (Ostrom 1990, p. 70)*

The regulations within these institutional regimes specified who had the rights to water and how the water would be shared in years of drought. Hence, they explicitly regulate the handling of allocation in light of freshwater availability anomalies.

Of course, the rules within different catchment areas (Olson analyzes four of them) contain different shades according to their local peculiarities. However, all do have some rules in common. First of all, the right to water inheres in the land itself - each piece of land is entitled to a quantity of canal water or a fixed time period during which water may be withdrawn. Second, the irrigators within the catchment or parts of the catchment are organized in syndicate-like irrigation communities with a respective chief executive. As will emerge in the following, these features are actually of highly Islamic character.

> *"The many Islamic features of its [the Irrigation Community's] traditions have led scholars to argue that the court evolved during the period of Islamic rule." (Ostrom 1990, p. 71)*

According to Eckert (2000), up to 80 percent of the Arab troops invading the Iberian Peninsula during the course of the Islamic expansion were Yemeni soldiers. In service to the then ruling Arabian Peninsula based *Umajiad* Dynasty, three Yemeni commanders led the armies into Iberia crossing the narrows of Gibraltar. According to Daghfous (1995), the Yemeni groups mostly colonized the undeveloped mountainous regions introducing ancient Yemeni techniques of irrigation and cultivation. This is further justified by Eckert (2000) by the fact that many village and meadow names, as well as irrigational and agricultural terms, in Andalusia can still be traced back to local Yemeni dialects. Hence, there is a strong connection between Ostrom's (1990) cases and the case of the Yemen.

However, the catchments in Andalusia addressed by Ostrom are all more or less of spring-flow character. A spring flow is a constant flow of water that is not only fed by rain, but also by water stored in the surface layers of, and the snow up on, the mountains where its wellsprings originate from. Hence, these catchments are not subject to long periods of drought and therefore do not render long-term scarcity.

Thus, this is the point where the focus has to be shifted to the country under scrutiny in order to clarify why there *are* conflicts over irrigation water in the Yemen as opposed to Al Andalus. Therefore, an important distinction between two types of water-allocation systems within different river catchments will be discussed in the following Section 8.4.

## 8.4. Sayl and Ghayl - Spate and Spring

A 1983 article by Daniel Martin Varisco of the University of Pennsylvania (Varisco 1983) serves as a key eye-opener explaining why the two major types of water-allocation sys-

tems in the Yemen entail different levels of conflict risk. In his article, Varisco compares these two major systems in the Yemen: the seasonal flood (*sayl*) and the highland spring flow (*ghayl*).

Varisco mainly argues that tribal political organization offered an adequate adaptive response to spring-flow allocation, whereas it was not able to regulate competition for water within coastal flood systems that transcend tribal boundaries. In order to comprehend this difference, the characteristics and the consequential preconditions and problems for political organization inherent in the two systems are discussed below.

**Ghayl - Highland Spring Flow** Springs are the prevalent source of irrigation in the Yemeni highlands, most of which are located in the North-Western part of the country. The central feature of spring flows are their perpetual stream of water due to storage of rainwater inside the mountains. Access to water is here linked with land ownership (Varisco 1983, p. 369). This link cannot be alienated through sale of water and land rights.

These two constants given, the water allocation within spring flow irrigation systems can be organized by means of exact appropriation cycles. There are rotation cycles of turns where each plot of land (i.e. farmer) has the right to withdraw following temporal measures of hours or quantitative measures of hand widths (Varisco 1983, p. 372). Since appropriation rights are defined to such a fine-grained degree, there is not even a need for any official to oversee the process.

> *"The distinctive character of spring flow distribution in al-Ahjur [a mountain valley in Northern Yemen] is that everything is in the hands of the irrigator himself who is responsible for appropriating the water at the cistern. He is not dependent on simultaneous activities by any other individual, nor is he directed by an irrigation official." (Varisco 1983, p. 373)*

Relatively few disputes over water rights occur: and if they do, these local disputes can easily be handled by the respective village elders (*shaykhs*). It has further to be said that spring-flow systems are usually limited to small valleys where strong kinship and economic ties guarantee a certain quality within the social fabric. Nevertheless, spring flow systems are thus environments in which the rights to water are clearly defined and protected - without any external influence. This, of course, very much resembles the Andalusian systems described by Ostrom and can thus explain the absence of conflicts therein to a certain extent.

**Sayl - Seasonal Spate Torrent** Several of the constants mentioned above are not given in spate-torrent flood systems. How these systems differ from spring flow settings influences their tendency to conflict. The word *sayl* is used in the Yemeni Arabic dialect for spate or seasonal flood. Apart from rare spring flows in the high mountains, there are no permanent rivers in any part of the Yemen. Therefore, the spates that descend

the major dry river courses (*wadis*[2]) after the rains in spring and late summer have great importance attached.

Flood irrigation accounts for most Yemeni agriculture (Varisco 1983). Flood flow is traditionally diverted by means of earthen barrages that lead parts of the flow into off-take channels. These barrages are constructed as temporary structures and must often be breached in order to let the water flow through towards downstream irrigators with rights. Many of these earthen banks are also repeatedly destroyed by violent floods during the rainy seasons. This ensures provision for downstream actors (Mehari et al. 2005, p. 6f).

All in all, the spate flows in the Yemeni *wadis* are characterized by a great deal of uncertainty. First, there is an overall uncertainty about whether any water will leave the catchment area at all. Second, ample irregularities in flow intensity are inherent in the very nature of the spate flood. Hence, it is especially difficult to establish regulations that consolidate themselves within the local societies on a long term basis: and even if established law bodies come into being over the years, these sets of rules are far more complicated than are their spring flow counterparts. Hence, the risk of conflict in spate flood systems is much higher (Varisco 1983, p. 368-371).

As shown above, in a highland spring system there is little need for active supervision in day-to-day activities. Due to the sheer proximity between the actors adjacent to the spring flow, opportunities to 'cheat' - i.e. to withdraw more water than the regime allocates - are very much limited. Furthermore, the flow is almost completely predictable which allows more routine in long-repeated regulations. In the coastal spate-flood systems, by contrast, there is a cogent need for supervisory actors in the allocation process in order to coordinate the distribution of water - especially when the flood is low and not strong enough to naturally destroy the earthen barriers and flow downstream. Hence, the question how intra-catchment conflicts over irrigation water evolve can be analyzed with regards to spate-flood irrigation schemes in large *wadis* in the Yemen.

However, not only topological features such as rainfall and the rhythmicity of the spate-flood torrent account for the sum of preconditions influencing the governing and allocation of the spate water within an allocation regime. Furthermore, ancestral legal regulations stemming from tribal rulings, tradition and Islamic law form the structure, and hence codetermine the functioning of, an irrigation-water allocation regime within a *wadi* system. Therefore, legal aspects regarding water allocation are discussed in Section 8.5.

## 8.5. Legal Aspects - The Tribe, Tradition and Islam

Two social and legal systems mainly influence the build-up of a *corpus iuris* within irrigation systems in the Yemen: tribal traditions and Islamic law (*Shari'a*). Apart from national water laws that are usually not very much adhered to, customary water

[2]The Arabic term *wadi* traditionally describes a valley. In some cases, it can also refer to a dry riverbed that contains water only in form of spate floods during periods of heavy rain. This is also the definition followed in this thesis.

rights and the Islamic law are the main pillars of regulation when it comes to water allocation.[3] The importance and characteristics of these legal realms are discussed by first taking a look at the role of the tribe, and then the rules from customary law and Islamic law.

**The Role of the Tribe** According to Varisco (1983, p. 379), the tribe in Yemen "has more of a geographical than a genealogical meaning." The primary unit in the highlands is the patriarchal household (*bayt*). Further up, there is the lineage grouping called *lahm* which basically means 'flesh' and describes the segment that defines the pool for cross-cousin marriage. Two or more *lahm*-groupings usually make up a village, which has an elected village elder. Several village elders in turn elect regional *shayks*. These regional elders are of authoritative importance. Yet they do not have binding jurisdiction over local resource allocation (Varisco 1983, p. 379).

Varisco argues that local political mechanisms - especially the role of a village or family elder - are usually sufficient for mediating water disputes (Varisco 1983, p. 379). Yet, this effect is only of small reach. This is no problem in the highlands. Seasonal flood systems however, invariably extend across tribal boundaries, and as just mentioned, regional *shaykhs* do not have the power to *enforce* allocation among tribal segments as soon as a dispute crosses tribal boundaries. Hence, the tribal system does not offer a firm polity in this regard.

Furthermore, in the coastal areas where flood schemes are the main irrigation system, both communities belonging to tribal federations and communities without such affiliations live along the major water courses. Therefore, the conflict potential between upstream and downstream communities is significantly larger than in the highlands (Varisco 1983, p. 380).

Hence, because of this polity gap in a mixed environment of tribal-affiliated and independent social entities, supra-communal political mechanisms to arbitrate between independent communities are required. Varisco (1983) reports, that one regularly practiced solution to this problem was to look for mediators outside the tribal system, i.e. Islamic judges and scholars of Islamic law. These again were guided by the regulations given from Tradition and Islamic law. The characteristics and potential of these two norm-generating factors are discussed in the following.

**Tradition and Islamic Law** There are two legal systems in the Yemen accounting for the legislation of law. The first of which is nearly irrelevant: the Draft National Water Law, drafted by the Yemeni Government in 2002 (Saleh 2002). Being still contested and discussed, this law body has not had any impact so far. That the Yemeni state is not regarded by its citizens as ensuring a common good but rather as an actor with vested interests, adds to this (Kohler 2000, p. 170). Hence, the state constitutes no relevant source of legal norms so far.

[3] Insights from private talks with Dr. Mohammed Barakat, Institutional Engineer within the Irrigation Improvement Project, Ministry of Agriculture and Irrigation, Sana'a, Yemen, August 2006.

On the other hand, there are customary water rights that have considerably more authority. Customary water rights are composed of norms from Islamic law and traditional customary law. According to the Yemeni Constitution, the Islamic law is the basis of all legislation. The *Shari'a* consists of what is said in the Holy Qur'an and is handed down as traditions relating to the words and deeds of the Prophet Mohammed (*Hadiths*) (Kohler 2000, p. 170).

In addition to the Islamic elements, the non-state law corpus also entails a regionally differing set of traditional customary laws (*'urf*).

> *"While the Shari'a governs water rules countrywide, the 'urf has many regional specifications." (Kohler 2000, p. 172)*

Hence, the *corpi iuri* in different allocation systems can be arranged in quite different ways. Nevertheless, despite these regional specifications, there is a body of 70 traditional customary rules that are accepted by most of the tribes (*qaua'id ul-saba'ayn*). Yet, out of these 70 rules only two deal directly with water, both concerned with the regulation of well construction and protection.

According to Kohler (2000, p. 172), the Islamic law was often overemphasized in the literature, because rules governing irrigation water can only indirectly be derived from the norms conveyed in the Qur'an and the *Hadiths*. Nevertheless, there are some important principles written in these collections. These are principles of economic use and equal access, as well as relating to water ownership.

Water ownership is only possible in the following cases. First, water contained in wells belongs to those who dug the well. Second, surface water can be possessed as soon as contained, e.g in a pond. However, any water price is considered only a price for lifting and transporting - never for the water itself (Kohler 2000, p. 172). Third and most important for the purpose of this study, Islamic law rules that surface water that is not contained is *res nullius*, i.e. belonging to nobody.

> *"In general, one can say that, according to customary law, water abstraction from the wadi is restricted whenever it can cause damage to users in the lower part of the wadi." (Kohler 2000, p. 173)*

Hence, actors downstream would seem to be fairly protected by means of the rulings in Islamic law.

Yet interestingly, one rule seems to completely contradict these protective precautions. This is the most cited traditional water rule on the Arabian Peninsula: *Al a'la fa al a'la*, which means 'the upper to the upper'. This rule gives priority to upstream users. It is an extremely important rule concerning water conflicts in spate irrigation schemes. In itself, this rule appears to discriminate actors downstream. Yet, the rule has to be examined within the actual system where it was and is applied.[4]

In light of traditional diversion techniques, where dams and bounds are built of gravel, sand and mud, this rule makes complete sense. As already mentioned, dams and bounds

[4]Insights from private talks with Dr. Mohammed Barakat, Institutional Engineer within the Irrigation Improvement Project, Ministry of Agriculture and Irrigation, Sana'a, Yemen, August 2006.

were usually washed away repeatedly by the torrent in times of heavy rainfall. This allowed the floods to reach the canals and fields further down the stream.

Where this was not the case (in the event of weak floods), accompanying measures mostly ensured the lower riparians a degree of protection. That is, riparians downstream were usually ensured fixed (even if very short) periods of appropriation time. During these periods, the upper riparians were urged to open their sluices (Kohler 2000, p. 171). This regulatory mechanism worked until new technological means altered the opportunity structure of actors upstream.

> *"Once technology and organization was introduced to build a permanent dam, diverting all the water during the entire rainy season, traditional water rights lost their functionality (...) and the consequences for downstream farmers can be detrimental." (Kohler 2000, p. 173-174)*

This is exactly the turning point mentioned in the stylized story at the very beginning of this thesis. A narrative that was told over and over during the preliminary research for this thesis in the Yemen during August 2006.

> *"In all the wadis, we had traditional sets of rules since often more than 600 years. They were established around the time when Islam and its legal scholars from the now Saudi-Arabian Hijaz embraced and domesticated the Yemen. Yet, during the last 30 years, the change to a modern system of efficient agriculture - facilitated through international development aid - disrupted these highly sophisticated law-bodies. Since then, the conflicts started."(Mohammed Barakat, Sana'a, August 2006)*

Since the dams were built, the rules did not work anymore. Concrete dams and diversion structures were almost entirely financed by international development aid (e.g. the World Bank), in order to improve the local agriculture. Before that, upstream communities were restricted to grow water-saving crops only, because the high floods naturally destroyed the earthen diversion structures. Therefore, continuous watering with high quantities of water was not assured. Thus, upstream users did not cultivate water-intensive cash crops such as water melons or bananas. In view of the new possibilities the concrete structures offered to them, the cultivation of cash crops suddenly became feasible.[5]

However, the question remains why upstream actors actually *did* start to refrain from such long-established rules of water appropriation. Even if earnings from cash crops provide a good incentive to cheat, the risk of conflict and unrest within the wadi is very high. These motivation effects and mechanisms may be traced following Dessler's (1994) Rational Actor Model in the following chapter, resulting in a theoretical framework that is testable through interview-narratives with community leaders on-site in the Yemen.

[5]Insights from private talks with Dr. Mohammed Barakat, Institutional Engineer within the Irrigation Improvement Project, Ministry of Agriculture and Irrigation, Sana'a, Yemen, August 2006.

## 8.6. The Conflict Mechanism - Theoretical Framework

As became obvious, the route from water scarcity to an actual incidence of violent conflict is not a direct one. In fact, there are several contextual preconditions shaping the opportunity and preference structure of UA and DA.

According to Dessler's (1994) Rational Actor Model, every actor - whether this is an individual, a group or an organization - has to be considered a decision-making unit (DMU) at different key points in time. The outcome of each DMU - i.e. the decisions each DMU reaches are influenced by internal and external factors in the past, present and the perceived future. Dessler (1994) disaggregates the DMU and its environment into four components, each of which influences the action resulting from the DMU. These four components of the DMU are illustrated in Table 8.2.

Table 8.2.: Dessler's Rational Actor Model

| Influence Factor | Description |
|---|---|
| 1. Opportunity Structure | An external and objective set of constraints, pressures and opportunities appoint a set of feasible actions to the DMU. |
| 2. Endogenous Perception | The DMU's cognitive processes and circumstantional factors in the DMU's close environment influence the perceptual salience of opportunities and obstacles in its environment. |
| 3. Beliefs on Consequences | The DMU has certain beliefs about the casual consequences of its various possible actions. |
| 4. Preference Order | The DMU has absolute or temporal preferences regarding the various outcomes that it believes will arise from the action chosen. |

Every conflict is a matter of action and reaction: and the mechanism analyzed in this study represents the steps from a conflict-free situation to a conflictive situation, where action and reaction may cause violence. The initially presented stylized story as well as the details in Chapter 8.5 would indicate the following DMU for the UA in a conflict-free initiatory position (Table 8.3).

Table 8.3.: Upstream Actor Initiatory Motivation Model

| Influence Factor | Description |
|---|---|
| 1. Opportunity Structure | The UA is only to a very limited degree in possession of necessary technical means to increase structural scarcity, i.e. to disadvantage the DA. |
| 2. Endogenous Perception | Tribal and Islamic rulings as well as traditional handling from a notion of what should be the norm. Furthermore, lack of technical opportunities or even knowledge about such opportunities shape UA's perception thereof - so far that cheating is not taken into consideration. |
| 3. Beliefs on Consequences | Besides not having the means to cheat, jeopardizing the already vulnerable harvest is perceived too high a risk to try cheating. The perception of these consequences of possible options let UA abstain from cheating. |
| 4. Preference Order | UA prefers a secured harvest for self-supply instead of trying to cheat. Cheating is perceived to be provoking violent reaction which itself could even worsen the own situation. |

As shown in Chapter 3.4, there are three forms of scarcity. First, there is an absolute physical freshwater scarcity from supply through rainfall. Second, demand-induced scarcity results from population pressure. Third, there is *structural scarcity* (Homer-Dixon & Percival 1996). Since the former two are very hard to keep tabs on, structural scarcity is the interesting one for political science, and hence for the mechanisms traced in this analysis. In game-theoretical terms, a payoff matrix of the situation free of conflict can be drawn where no structural scarcity is produced (Table 8.4). The UA here has no means to render structural scarcity for the DA.

Table 8.4.: Payoff Matrix - Conflict Free Situation

| | UA cooperative | UA conflictual |
|---|---|---|
| DA cooperative | (++) Remain with traditional water-saving crop in order to yield guaranteed harvest. | (- -) No means to securely achieve profit outcome by defecting from traditional rules. |
| DA conflictual | (- - -) No reason. | (- - -) No reason. |

However, if the opportunity structure for the UA changes - as with the new possibilities given by the concrete diversion structures built - the other three dimensions of his DMU II will alter as well. In the same tenor, the DMU of the DA changes. Both altered DMU complexes will cause the final decision of each actor in favor of conflictive action. These two motivational structures are illustrated in Table 8.5.

Table 8.5.: Upstream Actor and Downstream Actor - Conflictive

| Influence Factor | Description |
|---|---|
| 1. Opportunity Structure | The UA gets the means to cheat and thereby to provoke structural scarcity. In this way, the situation for the DA worsens. At the same time, there could be a lack of conflict-resolving institutions at hand for the DA. |
| 2. Endogenous Perception | Prospect of enhancing the own harvest by the new means may be convincing for UA. Circumstantial factors such as a fall in revenue from original product can influence UA's perception in favor of opportunity given. Same circumstantial factors may influence DA's perception in a negative direction, since his situation worsens even more. |
| 3. Beliefs on Consequences | UA's DMU may know about lack of conflict-resolving authorities and might expect being able to bear reaction of DA. In situation of structural scarcity, DA expects his situation to advance, even through violent action. |
| 4. Preference Order | UA may prefer to cheat, since positive outcome expected from cheating outweighs expected outcome of countermeasures by DA. The preference order of DA is clear. Justice has to be restored by any means, since the life-essential harvest is at risk. |

In Table 8.5 the UA renders structural scarcity by abstracting more water because of his perceiving his agricultural opportunities and ability to cope with DA's reaction in favor for a shift to the cultivation of water-intensive crops.

At the same time, the situation for the DA worsens without any conflict resolving institution to resort to. Hence, the DA's beliefs about his detrimental consequences direct his preference order toward the option of restoring justice even by violent means.

This again can be visualized within a game theoretical payoff matrix in order to exemplify the preference order of actions to take by the two actors. The combined payoff matrix of the conflicting interaction is illustrated in Table 8.6. Table 8.6 clearly

Table 8.6.: Payoff Matrix - Conflict

| | UA cooperative | UA conflictual |
|---|---|---|
| DA cooperative | UA: (++)<br>Remain with traditional water-saving crop in order to yeld guaranteed harvest. | UA: (++++)<br>Means to divert water and secure water-intensive cash crops.<br>DA: (- - - -)<br>No water. |
| DA conflictual | | UA: (+++)<br>Accepts risk of DA reaction.<br>DA: (+)<br>Because no functioning polity of conflict-mediating mechanisms. |

shows the uneven distribution of possibilities to choose from between UA and DA. While for the UA conflictive behavior is perceived as feasible and profitable even with a violent reaction from the DA, the latter has no choice but to act in a conflictive fashion as well.

As we have seen, one variable does not produce the effect. In highly complex systems such as ecological-political systems, multiple factors account for a specific outcome. Therefore, the analytical framework is plotted through a flow process chart in Figure 8.1. The empirical data shall thus supply the information whether the flow-process chart ought to be amended with additional elements.

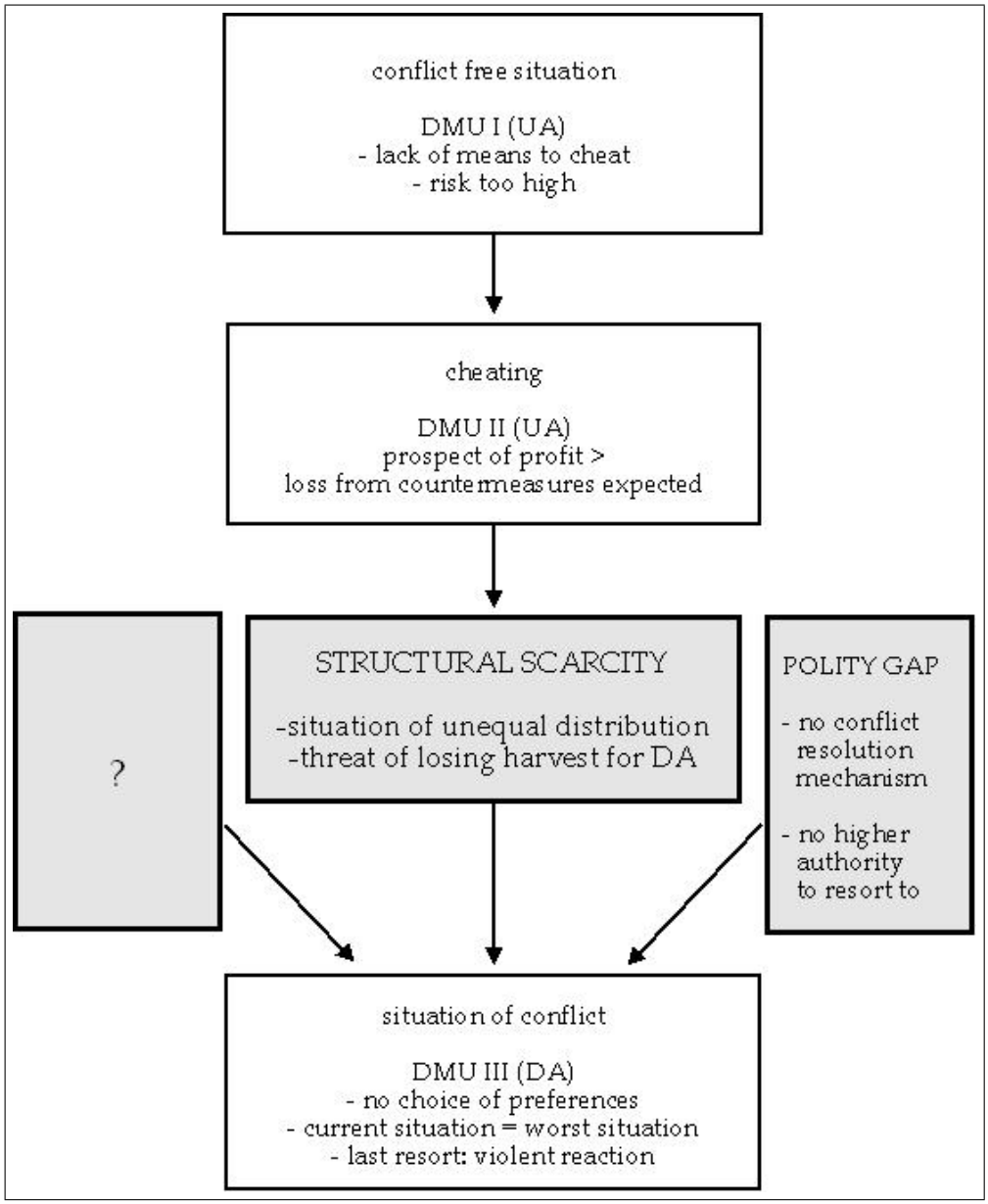


Figure 8.1.: Conflict Mechanism Proposed - Flow Process Chart

This mechanism of conflict evolution can be summed up and formalized within the following two multi-dimensional hypotheses in Table 8.7.

Table 8.7.: Hypotheses for Underlying Mechanism

| Nr. | Hypothesis |
|---|---|
| H 1 | If the UA gets the means to cheat he will cheat - if the following conditions hold: expectation to increase gain; absence of effective higher authority. |
| H 2 | If structural scarcity is imposed on the DA by the UA and there is no functioning polity for conflict mediation, the DA will resort to violent reaction. |

In order to test whether these hypotheses, as well as the composition of the flow process chart, represent the conflict mechanism in real life, empirical evidence has been collected in order to trace, verify and eventually amend the process. This will be discussed in Chapter 10.

However, the methodological means need to be elaborated first in Chapter 9, so as to be able to test for this theoretical framework in real life. Therefore, the right methodological procedure to trace the theoretical process will be selected in Section 9.1. Second, the task of collecting empirical data by means of interviews is discussed (Section 9.2) and a set of guidelines composed (Section 9.3). Third, the working hypotheses need to be developed and operationalized through actual interview questions in Section 9.4. Finally, appropriate cases for analysis will be selected in Section 9.5.

# 9. Methodology - Underlying Mechanism

The proposed conflict mechanism, in line with the two qualitative hypotheses, needs to be put up against empirical evidence. Therefore, the selection of an adequate method, as well as the design thereof, will be discussed in the following three sections. Sections 9.4 and 9.5 then deal with the operationalization of a set of working hypotheses, as well as the case selection.

## 9.1. Case Studies and Process Tracing

Van Evera (1997, p. 27) mentions two different manners through which to test theories - experimentation and observation. Of course, an experimental setting is not feasible at all for this study, since facts have to be analyzed *ex-post facto*. Observational tests can be classified in large-N quantitative and small-N case studies. A large-N study has been presented in Part III. In order to test the hypotheses arrived at, a small-N process-tracing case study design will be employed.

> *"Case Study Analysis: The analyst explores a small number of cases (as few as one) in detail to see whether events unfold in the manner predicted and (if the subject involves human behavior) whether the actors speak and act as the theory predicts." (Van Evera 1997, p.29)*

George & Bennet (2005) argue that case studies allow the investigator to reach high levels of concept validity: and that researchers must try to look for analytically equivalent phenomena across different contexts, i.e. to conduct a so-called 'contextualized comparison'.

However, there are voices speaking against inference derived from case studies. One of the most frequent critiques alludes to the 'selection bias', since case-study designers often deliberately choose cases that share particular outcomes and hence a purported mechanism is at hand from the outset (George & Bennet 2005).

The cases chosen for this study share certain preconditions and setting patterns, but do not all have identical outcomes. If the flow process chart in Figure 8.1 illustrates the complete conflict mechanism, the outcomes would have to be all identical. This means that there must be additional factors that have not been thought of yet - i.e. that are responsible for producing these differing outcomes from supposedly 'identical' cases. In order to be able to explore such additional factors, the proposed mechanism will thus

be tested in light of cases where the outcome expected has happened, and cases where it explicitly did not.

George & Bennet (2005) further discuss whether a researcher's foreknowledge of values and case variables biases the theory design in favor of particular hypotheses.

> *"Selection with some preliminary knowledge of cases, however, allows much stronger research designs; (...) cases can be selected with a view toward whether they are crucial for a theory, making the process tracing test of a theory more severe." (George & Bennet 2005, p. 24)*

Hence, they argue (p. 19) that preliminary knowledge about cases allows the identification of indicators that best represent the theoretical concepts intended for measurement.

Another critique relates to 'underdetermination' in case studies. From a statistician's point of view, the setting of this study has zero if not negative degrees of freedom, since a high number of independent factors are tested with such a small N as a mere three cases. However, as King, Keohane & Verba (1994, p. 119-120) acknowledge, generating process-tracing observation can mitigate this problem of indeterminacy. This, they say, is because defining and observing the crucial steps along a hypothesized causal mechanism could lead to a "plethora of new observable implications for theory" and thereby circumvent the problem with degrees of freedom (King, Keohane & Verba 1994, p. 225).

Furthermore, a lack of representativeness is held against the case study method, since it often lacks theoretical parsimony. However, George & Bennet (2005, p. 34) argue that case study designs always involve "a trade off among the goals of attaining theoretical parsimony, establishing explanatory richness, and keeping the number of cases to be studied manageable." And therefore, the theories tested in case-studies usually apply to well-defined types or subtypes of cases only - in the case of this thesis to local violent conflicts stemming from unjust allocation of irrigation water in spate flood irrigation systems. Accordingly, King, Keohane & Verba (1994, p. 20) admit that parsimony cannot be the single worthwhile goal and hence, "theory should be just as complicated as all our evidence suggests."

According to Van Evera (1997, p. 56ff), there are three case study methods for testing theories (or hypotheses in the case of this analysis). First, in a *controlled comparison* paired observations of two or more cases are explored with regards to whether the values on the pairs are congruent with the theory's predictions or not. Cases are selected according to John Stuart Mill's methods of 'difference' or 'agreement' (Mill 1973, pp. 388-406). However, this method has much more of a theory-testing rather than an explorative purpose. The analysis at hand seeks exploration of alternative and additional factors to complement the mechanism proposed, though. Therefore, this method has to be dismissed.

Second, there are *congruence procedures* in which a case is explored looking for congruence or incongruence between paired values of independent and dependent variables observed in the case, and values predicted by the hypotheses. A particular case can be compared to respective values 'typical' in most other cases, or to respective values of the same variables across a range of circumstances within a case. However, finding 'typical'

values for the variables in my model is hardly feasible. The second case, a within-case comparison, has already taken place to a certain extent by building-up the model for the mechanism proposed. Independent and dependent variables have been observed across a range of differing circumstances within a case, i.e. a *wadi* (Van Evera 1997, pp. 58-63). To extend such a comparison over a longer time period would require much more resources, so as to allow for a long-term field study. Such resources are not available - hence this method is not feasible either.

Instead, the third type of case-study method, *process tracing*, will be applied in this analysis. A chain of events in the decision-making process is explored and initial case conditions are followed to case outcomes. According to Van Evera (1997, p. 64), "the cause-effect link that connects independent variable and outcome is unwrapped and divided into smaller steps" in order to establish a framework of analysis. This has been done with the flow chart in Section 8.6. The investigator then looks for observable evidence for each step. Even if Van Evera (1997) purports that a thorough process-trace of one single case can provide a strong test of a theory, testing hypotheses is only of partial importance here. Additional cases will also be used in order to discover antecedent conditions that might interfere with our narrow framework. "Evidence that a given stimulus caused a given response can be sought in the [sheer] sequence and structure of events and/or in the testimony of actors explaining why they acted as they did" (Van Evera 1997, p. 65).

Hence, testimony of the relevant actors explaining their circumstantial setting and motivational structure is crucial in tracing and adjusting the processes put forward in the proposal for an underlying mechanism. In such an *ex-post facto* design, data could be collected along two methods: non-reactive and reactive data-collection (Diekmann 2005, p. 371ff).

Observation would be the most obvious choice for a non-reactive method in line with the research question at hand. However, observation requires long-term field studies in order to put the mechanism up against different settings and points in time within the same case. The behavior of actors in a certain *wadi* ought to be observed during a long period of several months, if not years. This is certainly out of the question, given the limited resources of this project.

Qualitative content analysis or historical research are other non-reactive methods to trace actions and processes by the actors in question (Diekmann 2005, pp. 456-540). However, water conflicts and especially their underlying mechanisms are only poorly handed down, if documented at all. Hence, these secondary data-collecting methods are not feasible either.

In this analysis, the method of qualitative interviews will be applied. While in quantitative social sciences the utmost possible interview standardization is favored, this is perceived as a severe limitation in qualitative social sciences. Any social phenomenon outside of the response options will not get captured (Diekmann 2005, p. 444). Since the conflict mechanism at hand should not only be tested against the evidence but also extended with additional influencing factors, a reactive method has to be employed in order to be able to trace processes. Hence, data collection within this analysis will be conducted by deliberately deploying reactive interview techniques. A discussion about

different types of interviews and the rules and guidelines to follow when collecting testimony in such a way will be pursued in the following two Sections 9.2 and 9.3.

## 9.2. The Right Type of Interview

When considering what interview technique to follow, two topics need to be discussed first - the type of interview to be employed and its inherent characteristics, as well as the practical guidelines concerning dramaturgy and access to interviewees. This section examines four different types of interviews and vindicates the choice made for this analysis. The next section will then provide the guidelines necessary within the interview situation itself.

The literature usually differentiates between roughly two types of interview designs - *structured* (also: formal or standardized) and *unstructured* (also: informal or unstandardized) interviews. A further median category may be added - the *semi-structured* (also: semi-standardized) interview (Berg 1995, p. 31) which itself may be divided into problem-centered and focused interview method. The above mentioned standardized formal interview is usually employed in large-N surveys and the like, and hence is not adequate for this analysis. Therefore, this method will not be discussed any further.

**Narrative Interviews** Completely unstandardized interviews are also called narrative interviews. After an initial stimulus in form of a question or a single topic, the interviewer is required to abstain from engaging any further while the narrator proceeds. Only in the end, when the phase of narration peters out, the interviewer may clarify any ambiguities or trigger new narrative strands (Diekmann 2005, pp. 449f.). Because a wide array of detailed questions need to be answered in order to trace the many episodes that make up the process in this analysis, a completely unstructured narrative interview would run the risk of information gaps. Depending on the discipline of targeted interviewees, this could pose a real threat to obtaining the information required.

**Problem-Centered Interview** A somewhat more structured technique is the problem-centered interview. Since 'narrative competence' cannot be assumed with anyo interviewee, in this strategy the investigator plays an active role during the narrative phase. He relies on a compendium of relevant questions or narrative triggers. Which questions to ask at what point during the interview is left to the interviewer's discretion (Diekmann 2005, pp. 450ff.).

**Focused Interview** Very similar to the problem-centered approach is the focused interview, although slightly more structured. A focused interview generally proceeds along the following four steps. First, as a precondition the interviewees are chosen because they all have experienced a similar event or series of events. From these preliminary narratives, the investigator then draws a set of working hypotheses. Third, this situation analysis leads to an interview compendium. This compendium covers all the important aspects and questions required by the analysis. The central aim of the interview is

then to test the working hypotheses. However, the interview stays open for unexpected reactions, answers and viewpoints at all times.

The compendium's sole purpose is to make sure that all the relevant questions are answered properly (Diekmann 2005, pp. 446ff.). Narration, deliberation and discussions in the Yemen usually take place during the long afternoon break in the living and assembly room for the men (*mafraj*). More often than not, the stimulating drug *qat* is consumed during these daily social gatherings: and since such gatherings can amount for up to 20 people, following a disciplined interview and discussion structure is rather difficult. Hence, a proper compendium is of utmost importance. On the basis of these considerations, a focused interview will be conducted in this analysis.

## 9.3. The Interview Situation

Given the rather delicate topic of violent conflict, harnessing every trick of wording and dramaturgy within an interview is key to success, and hence the information required to test and develop the proposed conflict mechanism. Foddy (1993, p. 2) lists five principal causes of error in the gathering of verbal data through interviews. First, respondents can fail to understand the questions as intended. Second, a lack of interest or effort on the part of the respondents can lead to insufficient answers. Third, respondents can also be unwilling to admit to certain attitudes and behaviors - a factor very important in light of this study. Fourth, the respondents memory and ability to comprehend are constricted due to interview stress. And finally, the interviewer can fail in many different ways: inappropriate wording, inept dramaturgy or simply finding no access to and confidence from the respondent. The following paragraphs shall discuss countermeasures to some of these.

**Wording and Questions** First of all, questions have to be worded in such a manner as to motivate answers. Motivation can be restricted by provocation, misunderstanding or retreat due to a lack of understanding, which possibly arouses a sense of shame on the side of the respondent.

In addition to this, a vocabulary of special language has to be put together (Berg 1995, p. 41). This has been done before the field-trip by compiling a list of Yemeni terms related to agriculture, irrigation and tribal *Lokalpolitik*.

Furthermore, four types of questions should be included in a proper interview according to Berg (1995, pp. 37ff). *Essential questions* aim at the central focus of the study. These can be clustered together or scattered throughout the interview. Depending on the level of delicateness, they may be scattered in order to alternate them with *throw-away questions* that can be used to cool out a delicate subject. These questions may also be used to develop rapport between interviewer and subject. Some *extra questions* are kept in stock in case an essential question is not answered properly. Extra questions basically ask the same as essential questions but in a different manner. Last but not least, *probing questions* allow the interviewer to dig deeper into a certain subject (e.g.

"Could you tell me more about this?"), "to elaborate on what [the respondents] have already answered" (Berg 1995, p. 38).

**Dramaturgy** When it comes to dramaturgy, several preconditions have to be decided upon before the actual course of the interview can be discussed.

First and foremost, it has to be clear what the respondents are all about in terms of ancestry, social status, beliefs, bias and the like. This is the basis from where to decide about language (i.e. personal etiquette) and where to seek personal leverage. Concerning language and personal etiquette, a discreet and deferent manner was employed throughout all the interviews. Either a relationship to a group's 'gate-keeper' (in Yemeni villages mostly the village elder, i.e. the *shaykh*) is established, or an ally can supply moral legitimacy in order to find access to the respondents required (Berg 1995, pp. 47ff). Through the translator for this study, who is an Islamic student in one of the most respected *Sufi* orders in South Yemen, sufficient moral legitimacy could be implied.

Second, the interviewer himself has to decide upon questions of *role-taking*. This role-taking, according to Gorden (1987, p. 213), is "a conscious selection from among one's actual role repertoire, of the role thought most appropriate to display to a particular respondent at the moment." The fact that the author has a rural and Roman Catholic Christian background allowed for adding these elements intentionally to his character projection when deemed necessary. Especially the Catholic factor is of great importance to most of the *shaykhs*, since many Muslims consider the Catholic branch of Christianity as closest to their own beliefs and ethics.[1] Furthermore, the author's personal relationship with then Minister of Agriculture and Irrigation, Dr. Jalal Ibrahim Faqira, added further leverage in favor of the interviewer. However, this relationship was only disclosed to interviewees in the position of downstream actors who would have profited from a potential 'denunciation' of their statements to the Minister after the interviews.

Third, the degree to which the study's goal is communicated has to be defined (Foddy 1993, p. 21). It was decided that all cards should be played 'face up' and to disclose the whole purpose and aim of this study. This has been done by reason of the author's ethical creed - with the positive 'side effect' of being able to "present a natural front" as Berg (1995, p. 57) recommends doing.

After these preconditions have been clarified, a proper introduction to start the interview has to be envisioned. Both Berg and Foddy agree on the directive never to start an interview cold. While Berg (1995, p. 57) proposes chatting and small talk with the respondent, Foddy's (1993, p. 21) bag of tricks suggests providing information about the researcher himself. This has been done by underlining the author's interest in the subject matter, as well as his considering the knowledge transfer from the Middle East to Europe as very important. Thereby, class-details can also be levelled-out through narratives about the problems of Swiss farmers and rural areas.

Foddy (1993, p. 73) then urges to literally *teach* the respondents the theoretical framework to get them to answer in terms of this framework. It has been decided that

[1] These are insights stemming from the author's experience from numerous discussions and talks with Yemeni friends and scholars about the mutual perception of each other.

this step will only be taken if necessary. That is, as long as a short description of the study's aim is sufficient, there is no need to explain the whole framework. Yet if answers are not given as required, further explanations will be given instantly.

Such explanations can also be used to highlight the respondent's role as an indispensable bearer of knowledge - another way to strengthen the respondent's motivation (Foddy 1993, p. 73).

A rather difficult question concerns possible fears on the side of the respondent, that the information given could be used against him. Therefore, "any information concerning the researcher's goals that is (...) given to respondents is likely to condition their willingness to cooperate" (Foddy 1993, p. 74).

After an atmosphere of mutual trust has been established, it is suggested to sequence the questions in terms of their levels of generality - i.e. to start with the most general questions and then gradually increase the level of complexity. Furthermore, threatening questions should be put at the end and/or allotted throughout the interview and subsequently cooled-out by throw-away questions. Last but not least, every interview should be ended by a proper debriefing and some *hush time* after the recorder has been turned off. The respondent might be needed for additional interviews at a different point in time. Therefore, a harmonious completion ought to be envisioned.

However, in order to conduct these interviews, a set of interview questions ought to be compiled. Therefore, the DMUs within the flow process chart in Section 8.6 have been split up into working hypotheses. Each working hypothesis is then issued with one or more questions that ought to render answers in order to confirm or negate the working hypothesis. This operationalization is discussed in the following section.

## 9.4. Operationalization of Working Hypotheses

In order to apply the above techniques, three steps have to be taken. First, the mechanism put forth in Figure 8.1 has to be disaggregated into working hypotheses to which concrete questions can be issued. Second and concurrent, appropriate questions have to be formulated that can be checked for in interviews with UA's and DA's *in situ*. In a third step, these *essential questions* need to be arranged within a compendium that embraces all of the above-mentioned question types and dramaturgical means. However, this last step is not listed within the thesis itself.

The breaking down of hypotheses and the formulation of the essential questions are ordered along the different DMUs in Chapter 8.6 and will run in a chronological order guided by the flow chart. The operationalization of the first DMU is illustrated in Table 9.1.

Table 9.1.: Operationalization - DMU I

| Nr. | Hypothesis |
|---|---|
| **H 1.1.** | ***Opportunity Structure.*** **If the opportunity structure for the UA to secure a harvest of more water-intensive crop is not given, then the UA will not cheat.** |
| Q 1.1.a | What did the people of your village cultivate before the concrete diversion structures were built: water-intensive or water-saving crops? Name them! |
| Q 1.1.b | Would it have been possible to grow more water-intensive crop under the same distribution regime? |
| **H 1.2.** | ***Endogenous Perception.*** **If the UA's environment is depending on a secure harvest to survive, then the UA will not cheat.** |
| Q 1.2.a | Do you generally have a stock of crops for periods of drought or crop failure - in order to secure the survival of family and village people? Or could you have switched to an alternative strategy like wage-labor and purchased food-supplies? |
| **H 1.3.** | ***Beliefs on Consequences.*** **If the UA believes that a transfer to more water-intensive crop could jeopardize his crop, then the UA will not cheat.** |
| Q 1.3.a | Was a transition towards water-intensive crop perceived as too much a risk at that time or even perceived as not feasible at the time before concrete dams? |
| **H 1.4.** | ***Preference Order.*** **If the UA's preference order favors a secure harvest of low profitable crop over water-intensive cash crop, then the UA will not cheat.** |
| Q 1.4.a | So, did the you/your community prefer a secure harvest of low profitable crop over water-intensive cash crop? |
| Q 1.4.b | Were there situations of deviations from normal water allocation policy during the period before the concrete diversions, i.e. did you vary from diverting the amount officially appropriated as through traditional custom and law? |

The first working hypothesis in Table 9.1 concerns the situation free of conflict. Hence, the starting position of the UA has to be checked for. In DMU I his opportunity structure as well as his beliefs about the feasibility of a shift toward water-intensive crops are very limited. Hence, his preference order ought to be clearly favoring a secure harvest of water-saving crops. Therefore, it has to be verified if water-saving crops were really cultivated before the dams were built and whether a shift was perceived as not feasible - also in terms of having financial backing in case of crop-failure. Lastly, it has to be approved that there were no major deviations from normal water-allocation policy during this precedent period. This of course has to be asked in a general manner in Q 1.4b - pointing towards all the people in the *wadi* rather than the respective person or community itself.

Next, DMU II is directed towards the UA as well. The operationalization of this is illustrated in Table 9.2. The decision for conflictive behavior of the UA after being confronted with new possibilities of water control needs to be verified. Therefore, the actual cultivation of water-intensive crops and the UA's perception of feasibility thereof in the period after the dams were built have to be ascertained. H 2.2. is especially delicate to trace, since perception about relative gains and considering to cheat are clearly statements of an accusing character. Hence a verification has to be approached by first asking about whether "the people in the *wadi* were *talking* about this possibility" and only then concentrating on UA's community directly in Q 2.2.b and c. UA's beliefs about consequences can be verified in a much more straight-forward fashion, since the delicate subject matter is - at least indirectly - established by now. The last working hypothesis about the UA only cheating if this behavior is actually assessed as being profitable has to be simplified in order to trace it. Therefore, the profitability is questioned in Q 2.4.b in light of the already accomplished fact of switching to water-intensive crops.

Table 9.2.: Operationalization - DMU II

| Nr. | Hypothesis |
|---|---|
| **H 2.1.** | ***Opportunity Structure.*** **If the opportunity structure for the UA to secure a harvest of more water-intensive crop is given, then the UA will more likely be tempted to cheat.** |
| Q 2.1.a | What did the people of your village cultivate after the concrete diversion structures were built: Water-intensive or water-saving crops? Name them! |
| Q 2.1.b | Did the new distribution channels, i.e. concrete diversion structures open up the possibility to withdraw more water from the spate? |
| **H 2.2.** | ***Endogenous Perception.*** **If the UA perceives the relative gains of water-saving crops to decrease, then the UA will consider cheating.** |
| Q 2.2.a | Did you hear about people in the *wadi* talk about this new possibility? |
| Q 2.2.b | (If Q 2.2.a, yes) Did the people in your community talk about this new possibility? |
| Q 2.2.c | Were there people consider actually doing this? |
| **H 2.3.** | ***Beliefs on Consequences.*** **If the prospect of countermeasures expected is uncertain or perceived as minor, the UA will cheat.** |
| Q 2.3.a | Did you have to consider the reaction of the people in the lower *wadi*? |
| Q 2.3.b | If yes, how did you expect the people in the lower *wadi* would react? |
| Q 2.3.c | Was there a feeling of threat stemming from the reaction expected? |
| Q 2.3.d | When you and your community decided to discharge more (than assigned by custom): Was the profit expected higher than the risk of countermeasures by the people down the *wadi*? |
| **H 2.4.** | ***Preference Order.*** **If the prospect of profit through water-intensive cash-crops outstrips the loss from countermeasures expected, the UA will cheat.** |
| Q 2.4.a | Did you always stick to the custom rules of water appropriation? |
| Q 2.4.b | When you appropriated more water: was it profitable? |

In a next step, the proposed interaction factors of structural scarcity and the polity gap will be operationalized by means of two interaction-hypotheses with regards to the DA in Table 9.3.

In order to verify these interaction factors, the situation prior to the building of dams as well as the two interaction factors themselves ought to be traced. For a sound check of the preconditions, it has to be ensured that there were no major conflicts before the concrete diversion structures were built. And if there were minor disputes between the communities and families, how these were dealt with. Finally, if water was sufficiently available - i.e. no scarcity was at hand at that time. To trace the situation of structural scarcity, the DA's own coping capacity in terms of crop stock and wage-labor possibilities are questioned, as well as the actual water scarcity verified in Q.inter 1.a to c. In addition, the polity situation is followed by asking about the DA's own efforts, as well as to what extent the DA is not able to rely on state institutions.

Table 9.3.: Operationalization - Interaction Proposed

| Nr. | Hypothesis |
|---|---|
| **H.inter** | ***Preconditions*** |
| Q.inter.a | Can you recount any conflicts over water before the dams and concrete diversion structures were built? |
| Q.inter.b | How were disputes between the communities and families handled? Who mediated between them? Were the mediators people among the communities? |
| Q.inter.c | Was water sufficiently available in order to secure food for the families in your community? |
| **H.inter 1** | ***Opportunity Structure.*** **If the UA abstracts more water than designated by the traditional regime, this results in a structural scarcity of irrigation-water for the DA.** |
| Q.inter 1.a | Do you generally have a stock of crops or financial means for periods of drought or crop failure (In order to secure the survival of family and village people)? |
| Q.inter 1.b | Can you switch to an alternative income (working in urban centers or abroad) to purchase food supplies? |
| Q.inter 1.c | Did the water at your disposal once become scarce because communities upstream discharged more water than usually? |
| **H.inter 2** | ***Polity Gap.*** **The exhaustion of inter-actor conflict-resolving potential together with the absence of a higher authority (provided by the central state), result in a gap of polity to provide means for peaceful conflict resolution.** |
| Q.inter 2.a | What was the reaction of the people in your community? What steps did your 'officials' (*shaykhs*) take in order to reinstall the order as supplied before? |
| Q.inter 2.b | Were there any government officials or institutions you could resort to? |

Finally, DMU III again concerns the DA and breaks up his decision linkage whether to react violently to the threat posed by UA action in DMU II. DMU III is operationalized in Table 9.4.

For DMU III, it has to be verified that a pestering structural scarcity as well as a polity gap are actually at hand in light of the DA in the given situation. Furthermore, the role of the water dispute as being the only dissent-motivating conflictive behavior of the DA has to be ascertained. To establish a common ground of understanding, the interviewer's knowledge about the UA abstracting more water has to be assessed first. After that, the situation of the DA can be questioned in a straight forward way, since there is no accusing notion in the questions toward the DA. After first verifying the polity gap (Q 3.1.a), the degree of pressure to secure their own harvest to survive is approved in Q 3.2.a and Q 3.3.b. In a last question Q 3.4. a, the role of the water allocation dispute as the only dissent-motivating conflictive behavior is ascertained.

Hence, two different sets of questions were employed during the field research. Depending on a given constellation, it was assumed that the same actor can take the role of an UA and a DA. This was approved during the interviews. Many actors were complaining about actors further upstream, but at the same time stayed ignorant of downstream actors. However, it was decided from constellation to constellation whether an actor had to be considered a UA or DA.

Ideally, all the questions would be answered in favor of the working hypotheses - i.e. in favor of the proposed mechanism. However, it is expected that answers will deviate from what is expected in certain cases. These deviations from the mechanism expected will be used directly to identify alternative mechanisms and explanations that fit the answers given.

Having set the blueprint of questions to trace the proposed underlying mechanism, the cases to be scrutinized shall finally be selected in the following final methodological part. This selection of cases will be guided by methodological criteria from political science, but at the same time are restricted in terms of access restrictions given in the Yemen. The discussion is brought forward next in Section 9.5.

Table 9.4.: Operationalization - DMU III

| Nr. | Hypothesis |
|---|---|
| **H 3.1.** | ***Opportunity Structure.*** **If the opportunity structure for the DA to use non-violent means to secure its share of water is not given, then the DA will resort to violence.** |
| Q 3.1.a | Do you have any help from government officials? |
| **H 3.2.** | ***Endogenous Perception.*** **If the DA's environment is dependent on a secure harvest to survive, then the DA will do anything to secure the harvest.** |
| Q 3.2.a | Were you forced to (actively) defend your right of water? |
| **H 3.3.** | ***Beliefs on Consequences.*** **If the DA believes the loss of its harvest to be the only consequence from non-violent action, he will resort to violence.** |
| Q 3.3.a | Was your community sure about the fatal consequences of not intervening in the behavior of the people upstream? |
| **H 3.4.** | ***Preference Order.*** **If the DA's preference order is constricted to the retrieval of its harvest, gaining access to water is chosen as the only preferred action.** |
| Q 3.4.a | Were other issues at hand that led to this violent attack, such as earlier dissent or legacies of former breaches of customs? |

## 9.5. Case Selection

The above operationalized framework was applied to three different spate-irrigation systems in the North and South of Yemen (See Figure 9.1): *Wadi Zabid* in the *Tihama* region on the Red Sea coast; *Wadi Tuban* in the *Lahij* Governorate in the utmost South of the Arabian Peninsula; and *Wadi Al Jawf* in the Northern plains toward the border to Saudi Arabia. These three cases were chosen along two different types of criteria. The first type deals with criteria from political science methodology. A set of crucial requirements and advice is put together in order to show how the three cases meet these. Second, there are limits in admission and access that tie back the freedom of choice considerably. Since the Yemen is rated as rather unsafe, certain regions of the country are simply not accessible by the means at hand for this study. This point will be addressed quickly in light of the cases chosen.

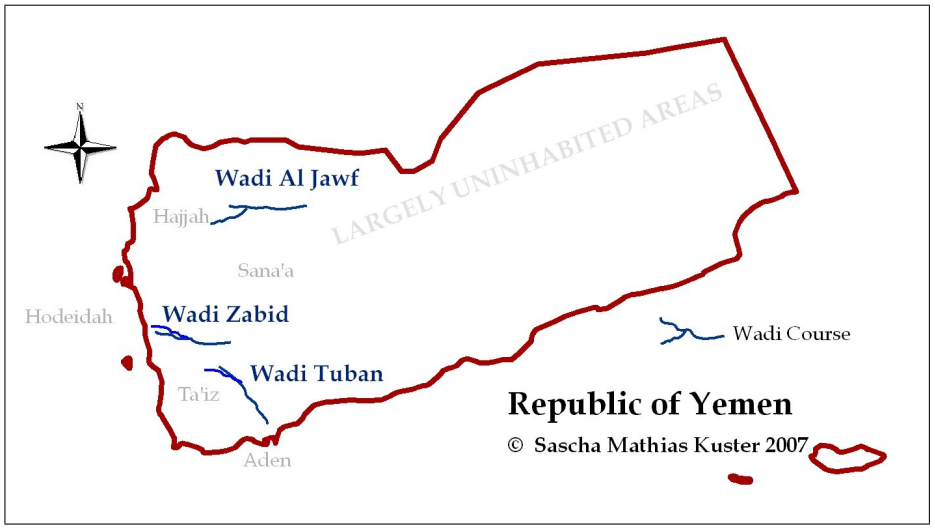


Figure 9.1.: Wadis Tuban, Zabid and Al Jawf

**Methodological Criteria** As Van Evera (1997, p. 78) holds, investigators should first and foremost select cases that best serve the purpose of their inquiry. The purpose of this very qualitative inquiry is twofold. On the one hand, the proposed mechanism ought to be supported by real-life evidence. On the other hand, antecedent conditions and factors shall be spotted in order to complement the underlying conflict mechanism towards a more capacious theory.

Van Evera (1997, p. 79) then urges for the choice of data-rich cases: "We learn more from case studies that let us answer more questions about the case." The rich narratives of the village elders in the Yemeni *wadis* eminently meet this criterion. However, not all of the cases were open to investigation because of access restrictions - hence such first-hand narratives are not at hand for *Wadi Al Jawf*.

Since the methodological approach employed is process tracing, cases have been chosen on the dependent as well as the main independent variables - against the strict canons

of political science. As Homer-Dixon (1995, p. 67) recommends, one should opt for such a method in order to induce from a close study of many cases the common patterns of causality and the key intermediate variables that characterize these links.

One of the most important rules, then, is to select cases with extreme values on the independent variable (iV), the dependent variable (dV) or one of the condition variables (cV). In order to *test* a theory, cases with extreme values on the independent variable ought to be selected (Van Evera 1997, p. 79). The cases under scrutiny in this thesis all received large infrastructure projects that altered the runoff rhythm patterns within the *wadi* during the 1970s and 1980s.

However, when the aim is to infer antecedent conditions, "cases with extreme and opposite values on the iV and dV" ought to be selected (Van Evera 1997, p. 81). Since this is the second purpose of the qualitative part of this thesis, this aim is attempted to be met as well. Antecedent conditions are best detected

> *"(...) with very high values on iVs and very low values on dVs. These are cases where the theory's posited cause is abundantly present but the predicted effect is notably absent." (Van Evera 1997, p. 81)*

This criterion is met in *Wadi Tuban* as well as *Wadi Zabid*.

Furthermore, a case is needed where the predicted effect is on display. Van Evera (1997, p. 80) argues that this method is especially apt for theory building - i.e. the case can be compared to cases where the effect is absent and then the antecedent settings can be compared. Therefore, *Wadi Al Jawf* was chosen with extreme values on the study (i.e. the dependent) variable.

Finally, Van Evera (1997, p. 84) recommends the selection of cases with prototypical background characteristics. All of the three *wadis* under scrutiny have highly similar background characteristics. The topological features resemble each other to a large extent. The geographical ranges of the *wadis* differ but slightly. The three *wadis* and the criteria met in each case are listed in Table 9.5.

Table 9.5.: Case Selection - Criteria and Cases

| Criterion | *Wadi Zabid* | *Wadi Tuban* | *Wadi Al Jawf* |
|---|---|---|---|
| Infrastructure projects (condition variable) | X | X | X |
| Topological features (condition variable) | X | X | X |
| High iv-value, low dv-value (predicted effect absent) | X | X | O |
| Extreme value on study variable (effect existent) | O | O | X |

**Limited Access** Doing research in the Yemen with a minimal budget involves difficult trade-off decisions more often than not. *Wadi Zabid* and *Wadi Tuban* are both part of the Irrigation Improvement Project by the World Bank and the Ministry of Agriculture and Irrigation. Thus, the infrastructure as well as existing expertise about the cases are properly accessible. In case of *Wadi Al Jawf*, interviews with the respective personae on the ground was not possible. In order to visit all the *wadis* in the North (e.g. *Wadi Al Jawf*), a military escort is required. Because of budget-constraints, such an effort was not feasible. However, local experts in irrigation and institutional matters repeatedly visit the Yemeni capital Sana'a. Required interviews were conducted during such visits in the Capital.

# 10. Process Tracing - Underlying Mechanism

In the following, the three cases under scrutiny are presented separately. The findings start with the rather untroubled *Wadi Tuban*, followed by a prime example of disrupted Islamic law in *Wadi Zabid* and concludes with the highly conflictive *Wadi Al Jawf*. Each case is presented with an overview on the *wadi* and its historical and institutional characteristics, the most important facts from the interviews and followed by a small in-case conclusion.

## 10.1. Wadi Tuban - An Institutional Role-Model

*Wadi Tuban* stretches from the high *As Sarat* mountainous range down through the *Lahij* Governorate, to ooze away into the plain toward the port city of Aden (See Figure 10.1). As far as self-governance as well as institutional framework is concerned, *Wadi Tuban* is by far the most sophisticatedly and modernly organized *wadis* in the whole of Yemen.

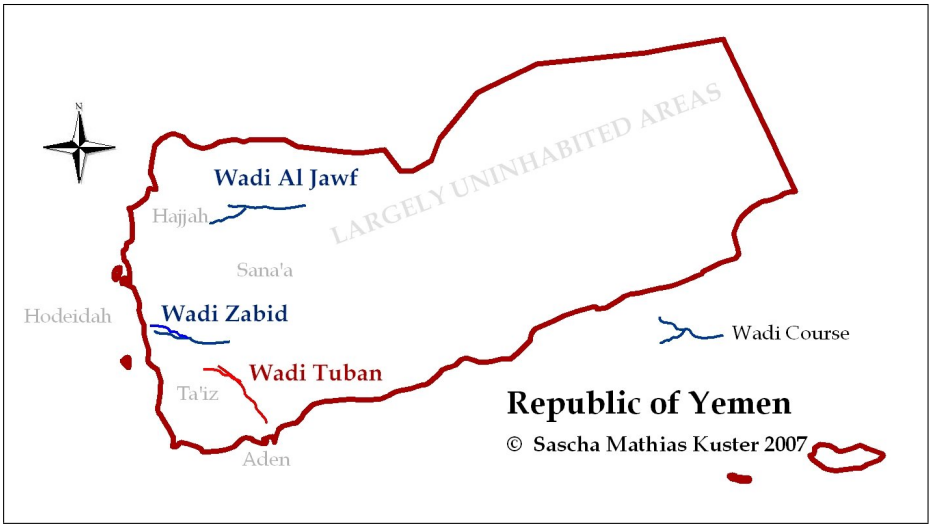


Figure 10.1.: Wadi Tuban

**Tuban - History, Topology and Institutions** *Lahij* was organized as a sultanate over a period of several centuries. It was a sultanate of the *Abdali* Dynasty under the

suzerainty of the *Zaydi* Imams of Yemen, and was later a protectorate of British Aden. Finally, *Lahij* became part of Socialist South Yemen under the sphere of influence of the Soviet Union. Stemming mainly from the Sultanate's sway and partly from the British rule in Aden, the area is characterized by highly civilized and sophisticated institutions. Furthermore, this state strength and a high level of education allowed for a high rate of government jobs for farmers and artisans.

The main irrigation area in *Wadi Tuban* extends from the village *Dar Al Arais* down to the Governorate's Capital *Lahij*. The *wadi* ranks among the most fertile *wadis* in Yemen. However, it is also one of the most wide-stretched *wadis* with regard to length *and* broadness. Therefore, in some years the villages in the lower part of the *wadi* - like *Ar Riyaad* and *Al Waht* - do not get any water at all during the whole season. Hence, one would expect this combination to aggravate the conflict potential within the *wadi*. However, as the institutional characteristics indicate, several buffering mechanisms may prevent open conflict in the *wadi*.

In the 1950s, the Sultan of *Lahij* promoted the codification of the traditional Agricultural Customary Law of *Lahij* and *Wadi Tuban* respectively. The central pillar of the management of this system was the Agricultural Council (AC). Later, 14 smaller water user associations (WUA) and an irrigation council (IC) were created to supplement the AC. Among the functions of the AC is the protection of customary water proportion and allotment rights.

Unique to the Sultan's enforcement institution of the *qanun* (codified law) was the introduction of a kind of food supply assurance. A special system was set up, whereby certain lands were appointed for the cogent planting with sorghum of the highly stable *ghirbah* variety. Furthermore, these lands should be ensured a first and second watering "(...) so that the community may be guaranteed its bread. Channels are not to be blocked until their allotted share of water is completed, by which we mean *[sic]* the lands assigned to the cultivation of *ghirbah*" (Lahij 1950). Hence, only the sorghum fields enjoyed the full water rights and the system was only self-regulatory as far as a certain threshold of food supply was met first. In addition, the *qanun* further defines that any plot of land irrigated in order to grow *ghirbah*, although it has not been assigned for the cultivation of *ghirbah*, must not be given a second watering.

Furthermore, the AC met as much as twice a week during the season of irrigation. Within these meetings, not only maintenance, disputes and respective penalties were handled. Also, the necessary *ad hoc* changes in the irrigation plan were deliberated. This measure enabled the institution to flexibly adjust the allotment sketch (drawn at the beginning of the season) to actual *wadi* discharge.

Two last pillars of the polity responsible for agriculture and irrigation in *Wadi Tuban* are the Islamic law (*Shari'a*) and the agricultural court. These two pillars formed the conflict-resolving part of the governing polity of agriculture and irrigation. The agricultural court only heard those cases which the *Shari'a* court considered-itself not competent to decide according to traditional customary law (*'urf*), and was called up on a temporary basis only. However, since the agricultural court resorted to the *qanun*, which itself stemmed from the traditional customary law, custom found its way into both jurisdictions.

**Tuban - The Sultan's Expiring Legacy** The first meeting in *Wadi Tuban* was held with 72-year old Saleh Mohammed Huaidir, chairman of WUA *Faleg Iyadh*, which lies in the middle of the *wadi*. All his life, Huaidir served the different governments in doing agricultural planning for the Agricultural Council. Hence, his knowledge about the peculiarities of *Wadi Tuban* is highly valuable. Within the *wadi*, the area of *Faleg Iyadh* can be considered upstream, since all the areas further up the *wadi* only cultivate a rather narrow band along the water course.

According to Huaidir, the dam in the middle of the *wadi* (which is just upstream of *Faleg Iyadh*) was already built in 1951 under the Sultan's rule. Further dams and channels were added in the 1970s and the mid-1980s. Surprisingly, the upstream actors (UA) in *Tuban* already began to cultivate water-intensive crop such as cotton, watermelons and tomatoes shortly before the Sultan codified the *'urf*. As Huaidir purports, the building of the dams led to professionalized cultivation and increased quality and quantity of the crops: and since the cultivation and irrigation plan was centrally planned, there was no such thing as illegal deviations from allocation policy - it was simply not necessary.[1] This, of course, is the claim of a UA.

Interviews with three more UAs were conducted during a meeting of the Irrigation Council of *Wadi Tuban* in the local office of the Irrigation Improvement Project (IIP) in *Lahij*. Also in attendance was IIP-representative Anuar Abdul Karim. When asked whether any DAs ever came to complain to the people of his WUA because of water conflicts, the chairman of WUA *Ras Al Wadi*, Jamal 'Ali, answered in the negative. He then stressed that if anyone ever had such a problem, he could go to the Agricultural Council or the Irrigation Council - and that these institutions were always able to solve disputes by and large. Hussain Al Ban, head of WUA *Beizag*, agreed with this and added that with the introduction of cotton during the 1950s, the income of all the WUAs in the *wadi* rose considerably.

When the group was then asked whether the situation of the downstream areas is now as positive as it is for them, they approved unanimously. Even the IIP-representative Anuar Abdul Karim agreed with this. Yet Abdul Karim added that there is one restriction to this. Since the price for crops is not set by the state anymore, the farmers were exposed to the free market and its price volatility. Nevertheless, this problem is not considered to be so strong as to cause conflicts. Hence, the absence of conflicts relating to the appropriation of irrigation water was stressed by the group once again.[2]

Statements by downstream actors (DA) were rather ambivalent. Two representatives of communities downstream were met with during the stay in *Tuban*. Abu Bakr As Salaam is head of WUA *Muttawassid Al Wadi Saghir* and was the first DA met. Throughout the meeting, As Salaam emphasized his being satisfied with the system as it is now and expressed a strong notion of the people in the *wadi* being equals and act

[1] Interview with Saleh Mohammed Huaidir, Water Official of WUA Faleg Iyadh, In a Land Cruiser, Wadi Tuban, Yemen, 25th February 2007.

[2] Interview with Representatives of the Irrigation Council of Wadi Tuban: Lutf Saalem Saleh of WUA Obar Yakup; Hussain Al Ban of WUA Bayzag; Jamal 'Ali of WUA Ras Al Wadi; Anuar Abdul Karim of the IIP, Water Official of WUA Muttawassid Al Wadi Saghir, IIP Office in Lahj, Wadi Tuban, Yemen, 27th February 2007.

as such.

The second DA interviewed is Abdullah Aydrus Mohammed Saqaaf. Saqaaf is about 87 years old and was a water official in *Lahij* for over 40 years. He has long since retired but keeps serving as an advisor in different matters of irrigation. This experienced water official compensated for the chairman of WUA *Al Waht*, who was unable to attend the meeting due to a funeral. Saqaaf stressed the fact, that before the unification of the Yemen, all conflicts were always easily controlled by the elders upstream. However, Saqaaf is also dissatisfied with how the system has become since unification, underlining the creeping disruption of this long-established system of rules.

Both DAs agreed upon the fact that the Sultanate system was a system of cooperation and worked out for UAs as well as DAs without any flaws: and that there were only a few instances were the rule was not accepted that are not worth mentioning. Some argued that even the *'urf* itself was generally sufficient to resolve such minor conflicts that happened - mostly between neighbors: and that the Sultan only made it organized and wrote it down in the *qanun*.[3]

Furthermore, after the introduction of cotton in the early 20th century, factories were built in the late 1940s. According to As Salaam, the tomato-canning factories as well as cotton-processing plants led to the launch of the Agricultural Council and agricultural planning, whereby there was special planning for every piece of land and every crop and water-allotment in order to increase the communities' profit. And since the AC was made up of the farmers themselves, they decided what kinds of crop they needed and wanted to grow by themselves.

However, according to the *'urf's* rule that the UA has the right to water first, the question remained whether there were any food shortages in times of drought. The answer, according to As Salaam, is negative because of three facts. First, the already mentioned rule to secure a first and second watering of selected sorghum fields by all means arranged for a fair distribution in times of negative discharge availability anomalies. Second, during the last famine in the 1940s, the Sultan corrected for this with food imports from the Sudan and other countries. Third, after the early 1960s, almost every farmer in *Lahij* also worked for the government. Thereby, an additional income was guaranteed.[4]

It was only after the unification of Yemen in 1995 that the situation started to change slowly. This fact was stressed repeatedly by Mohammed Saqaaf. The government system imposed by powerful North Yemen after the unification did away with the centrally planned economy. According to As Salaam, it is no longer the government that markets the crops and thereby sets the prices. Saqaaf added to this that the water is no longer divided in absolute equality but rather the old rule of *'urf*, *Al a'la fa al a'la* (The upper to the upper) is now also applied in *Tuban* without any institutional buffer.[5]

Adding to this, after the unification many dams were built in the upper catchment

[3]Interview with Abu Bakr As Salaam, Water Official of WUA Muttawassid Al Wadi Saghir, House of Abu Bakr As Salaam, Wadi Tuban, Yemen, 26th February 2007.

[4]Ibid.

[5]Interview with Abdullah Aydrus Mohammed Saqaaf, Retired Water Official in Lahij, Al Waht, Wadi Tuban, Yemen, 26th February 2007.

areas which belong to different governorates: and since this is their right, Lahij cannot do anything against the water being stopped within these neighboring governorates, said Lutf Saalem Saleh, head of WUA *Obar Yakup*. This again may be a potential catalyst for future conflict.[6]

**Tuban - Decrescent Peace** Several parts of the conflict mechanism flow chart in Chapter 8.6 are not existent in *Wadi Tuban*. First, UAs did not commit a shift towards water-intensive crops in ignorance of the needs of DAs at any point in time. As a matter of fact, the UAs did not act as a discrete and independent DMU. Rather, the community-led agricultural planning was the actual DMU - a part of which was composed of DAs as well.

Second, the institutions imposed by the Sultan foreclosed any structural scarcity to emerge at any point in time. Therefore, the main conflict-generating factor is absent.

Third, there was a two-tiered mechanism of dispute settlement within the community composed of the Agricultural Council as well as the *Shari'a*- and agricultural courts. Whether this can be seen as reason enough to dismiss the absence of a polity strong enough to handle all conflicts (and even more: to enforce penalties) is not clear. There has been no hard test so far. Due to these facts, there was no need for any DMU III as well.

However, there are signs of change that might reveal the real potential of existing dispute-settlement mechanisms. Yet these changes of opening up and rivalry about irrigation water are too recent in order to draw any conclusions yet. Only time will tell whether the people in *Wadi Tuban* will be allowed, and able, to adjust their body of rules and regulations, as well as their behavior to this new setting.

[6]Interview with Representatives of the Irrigation Council of Wadi Tuban: Lutf Saalem Saleh of WUA Obar Yakup; Hussain Al Ban of WUA Bayzag; Jamal 'Ali of WUA Ras Al Wadi; Anuar Abdul Karim of the IIP, Water Official of WUA Muttawassid Al Wadi Saghir, IIP Office in Lahj, Wadi Tuban, Yemen, 27th February 2007.

## 10.2. Wadi Zabid - A Thousand Years In Vain

*Wadi Zabid* lies inbound of the Red Sea Coast, in the coastal plain of the *Tihama* (See Figure 10.2). Having its source in the mountains of the *Ibb* Governorate, the *wadi* runs from East to West with a total length of nearly 250 kilometers, about the last 40 kilometers of which make up for the main cultivated area (Tahir & Noman 2002, p. 20). *Wadi Zabid* has one of the oldest and most developed traditional spate-irrigation systems in the Yemen. The functioning of its highly sophisticated *corpus iuris* concerning this system was dramatically disabled by development works in the 1970s.

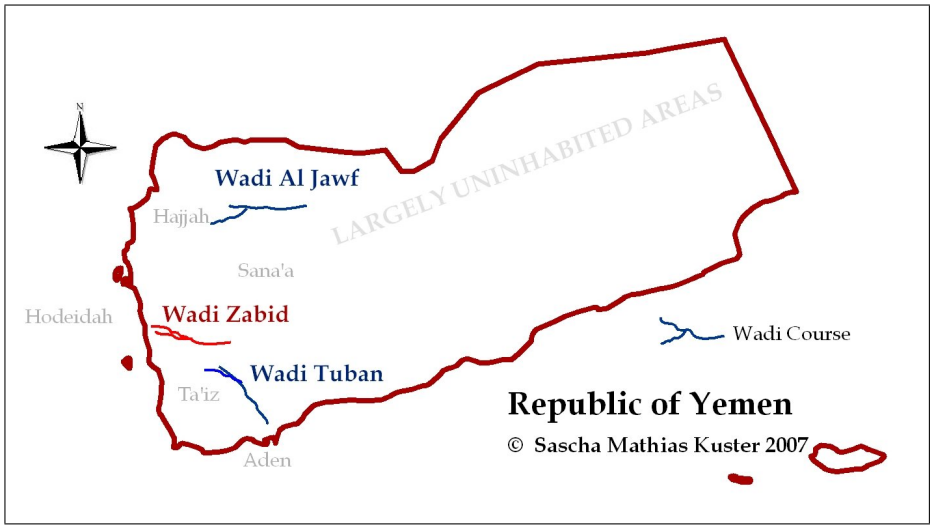


Figure 10.2.: Wadi Zabid

**Zabid - History, Topology and Institutions** At the Northern outskirts of *Wadi Zabid* lies the old city of *Zabid*. Having been Islamized in 631 AD, *Zabid* developed to become a prominent place of Islamic scholarship until today. The town, situated on the pilgrimage and trade route along the Red Sea coast, was home to several ruling dynasties, such as the *Fatimids*, the Ottomans and the *Zaydis* (Salameh 1995, p. 15). Soon after its establishment, *Zabid* became well known as a center of religious devoutness, and is said to have been home to the first Islamic university that emerged from the Asa'ir Mosque (arab.: *Jami'ul Asa'ir*), which was built during the Prophet's lifetime. The main pillar of research and scholarship in Zabid was the jurisprudence of the *Shafi'i* school of *Sunni* Islam. According to Salameh (1995, p. 17), the *Shafi'i* jurisprudence accounts for all of the significant clauses of water rights in the *Tihama* up until today without any significant exceptions. However, *Wadi Zabid* was one of the first *wadis* subjected to major irrigation development projects in the 1970s. The World Bank-sponsored project in *Wadi Zabid* was completed in 1979 (Tahir & Noman 2002, p. 18).

The *Tihama* plain ranks among the hottest inhabited regions in the world. The mean annual temperature is around 30 degrees Celsius, with a mean annual variation of about 8.6 degrees Celsius. There is literally no drainage into the Red Sea - all the water is being

fed to the farmland *via* diverging intake canals (Salameh 1995, p. 18). The main course of the *wadi* bifurcates after about half of the 40 kilometers of the main cultivated stretch into the smaller *Wadi Nasery* and *Wadi 'Ain* (Al Askari 2005, p. 187). This accounts for even more possible upstream-downstream relationships within the *wadi* course.

*Wadi Zabid* is the only *wadi*, for which a jurisdiction of water rights in written form is available that is old to such an extent (Salameh 1995, p. 27). This code of law was established about 500 years ago (Tesco et al. 1971) by a scholar of Islamic law named *Ibrahim Al Jiberti*. This code is in effect and adhered to up until today.[7] There was presumably one main reason for this codification of law in the 16th century. According to Salameh (1995, p. 28), the unconfined prerogative of the UAs allowed them to exploit their rights beyond a fair-minded extent. This must have resulted in repeated revolts from the DAs. At the time, the goal of this codification must have been then, to prevent such disputes by means of a fixed distribution key. Therefore, the experience of centuries about the course of rainfall and freshwater availability was harnessed by *Al Jiberti* in order to develop this allocation formula along the limitations set by the local traditional customary law *'urf* and the Islamic law *Shari'a*. However, according to Salameh (1995, p. 32) this also implies the existence of clear dynamic elements within the *'urf*.

*Al Jiberti* split the traditional canals in the *wadi* into three groups with distinctive water rights at specific times during the year. The upstream canals are served for the longest period from 19 October to 2 August (288 days). The middle canals, which account for more than double the command area of the upstream canals, are served from 3 August until 13 September (42 days). Finally, the downstream canals, with about a quarter of the upstreamers command area, are served from 14 September to 18 October (35 days) (Lawrence & van Steenberg 2005, p. 80). As is obvious from this rather unbalanced distribution, the rule of *Al a'la fa al a'la* served as a template for this regime and a daily umbrella for practice. The watering period for Group 1 is assigned during the the time when freshwater availability could be secured best (Abdulmalik 2003, p. 7).

The traditional irrigation system consisted of 16 supply canals that diverted the spate to the fields by means of deflectors in the *wadi* bed. These structures were made from poorly compacted materials like soil, gravel or tree branches, and hence were often damaged by medium or large floods (Tahir & Noman 2002, p. 20). Therefore, the water got through towards the lower part of the wadi right from the very beginning of their watering turn.

In addition to this codified body of law, *Al Jiberti* introduced the post of the *Shaykh Ash-Shareegh* (water officer). The *shaykh* had to control the times of appropriation as well as the state of the diversion structures and their maintenance respectively (Salameh 1995, p. 32).

**Zabid - Rushed Development Aid** As a first task during the stay in *Wadi Zabid*, the author interviewed the leading civil engineer of the Irrigation Improvement Project's

[7] Interview with Shaykh Abdul Saalim Da'ab, Representative of WUA Al Mawi, Mahall as-Shaykh, Wadi Zabid, Yemen, 21th February 2007.

(IIP) local project implementation unit, Ahmed Ahmed, as well as the head of the unit, Dr. Khaled Al Attas, in their offices in *Al Jarrahi*. Ahmed Ahmed very strongly stressed the unfair situation between UAs and DAs since the concrete diversion structures were built, and that the people in the lower part of the *wadi* suffer from these conditions. The amount of water they receive has decreased to such an extent that there is now even a new problem of desertification in the lower *wadi*. This was not the case before the dams were built. He furthermore attested that the growing habits of UAs changed with the dams. Therefore, the UAs mostly exhaust the water available in the spate.[8]

Dr. Khaled Al Attas then advised that the investigation be focused on Group 2 especially, since there were several conflicts among the Water User Associations (WUA) in this part of the *wadi*. As the people in Group 1 did, the upper WUAs within Group 2 changed their cropping patterns and hence appropriate more water. This resulted in a decrease of spate-water quantity for the lower part of Group 2.[9]

In accordance with these first insights, meetings were arranged with UAs and DAs. Depending on the WUA-cluster under scrutiny, an actor (WUA) can be UA to some other actors and at the same time also suffer the disadvantages of a DA with regards to actors further upstream. The first meeting with a UA was held with Shaykh Mohammed Sulaymaan Aydrus, head of WUA *Al Girbah* in *Roda Girbah*. Further attending the meeting was the local wise man (arab.: *'akil*) of *Roda Girbah*. *Al Girbah* is the topmost WUA in the *wadi*. Engineer Ahmed Ahmed told the author beforehand that the people in WUA *Al Girbah* are by far the wealthiest families in the whole of *Wadi Zabid*. Shaykh Aydrus himself is the head of almost 3,000 people.

According to Aydrus, water-intensive crops were mostly absent before the 1970s. First of all, it was not considered feasible to cultivate water-intensive cash crops. Water-intensive crops would have gone dry before the harvest. This would have jeopardized the income needed from food surplus.[10]

These insights were confirmed by the second UA interviewee, Shaykh Abdul Saalim Da'ab of WUA *Al Mawi*, which can be considered UA in Group 2. The interview was conducted in Da'ab's house in *Mahall Ash-Shaykh*. *Al Mawi* is by far the largest WUA in *Wadi Zabid* and within Group 2 they are the mostly well-off. Da'ab even claims that there was no sense of profit-oriented economic thinking in the minds of farmers in *Wadi Zabid* before the concrete diversion structures were built.[11]

A third meeting was held with the heads of three other upstream WUAs in the house of Shaykh Kaasim Hobeira, a prominent Islamic scholar in the *Tihama* and representative of WUA Ebri. Furthermore, this meeting was attended by Dr. Khaled Al Attas. The

[8] Conversation with Eng. Ahmed Ahmed, Leading Institutional Engineer of the Project Implementation Unit of the Irrigation Improvement Project, Al Jarrahi, Wadi Zabid, Yemen, 20th February 2007.

[9] Conversation with Dr. Khaled Al Attas, Head of the Project Implementation Unit of the Irrigation Improvement Project, Al Jarrahi, Wadi Zabid, Yemen, 20th February 2007.

[10] Interview with Shaykh Mohammed Sulaymaan Aydrus, Representative of WUA Al Girbah, Roda Girbah, Wadi Zabid, Yemen, 20th February 2007.

[11] Interview with Shaykh Abdul Saalim Da'ab, Representative of WUA Al Mawi, Mahall Ash-Shaykh, Wadi Zabid, Yemen, 21th February 2007.

representatives from WUAs Ebri, Gerhazi and Yusufi all ascertained the findings above. They all cultivated cereals and sesame before the dams were built. Only after the concrete structures did they change their cropping patterns toward bananas, mango, water-melons and the like.[12] Hence the preference order of the UAs was in favor of a secure harvest of water-saving crops according to tradition.

However, in the 1970s, the *wadi* received five permanent diversion weirs plus several concrete intake canals due to development aid (Al Askari 2005, p. 186). These irrigation development projects brought about a clear change of cropping patterns among all the UAs. All the exponents of the UAs unanimously mentioned their switching to the cultivation of water-intensive crops as soon as the concrete diversion structures were at hand. Even the UAs within downstream Group 2 were able to execute this switch, as the case of WUAs *Al Mawi* and *Ebri* shows.[13]

Concerning a possible threat stemming from DAs, there are two factors to be considered. First of all, the rules of *Al Jiberti* clearly allow the UAs to appropriate as much water as 'needed' during the whole time of their appointed watering term; or, as Shaykh Mohammed Sulaymaan Aydrus puts it: "It is just that now, we have the possibility to actually fulfil our rights, whereas the DAs lost their [structural] advantage they had during the times of earthen bounds."[14] This was not denied by any of the UAs *nor* later by any DA - this is a remarkable fact. Therefore, during their legitimate appropriation time, UAs did not expect any countermeasures.

However, the crucial time of possible dispute and countermeasures is during the transition between one appropriation period and another, when UAs are obliged to open their weirs. Usually, the excess water would have started to flood downstream to DAs during the watering period of UAs already. But now, with the UAs being able to control the water and discharge as much water as possible to their fields, the residual flow for the DAs is considerably smaller than it used to be. Yet even if the UAs did not mention at any point in time why they do not fear any reaction from DAs, the interviews with the latter would reveal why.

In order to trace the motivation structure of the DA's behavior, two interviews with prominent DAs were held. First, Shaykh Saalim of WUA *Al Mahraqi* was interviewed. *Al Mahraqi* is one of the three lowermost WUAs in Group 3. Second, farmer Saiid Baraba of *Wadi Nasri* was interviewed. *Wadi Nasri* is the lowermost WUA in Group 2. Furthermore, the insights from an extended meeting with Shaykh Abdul Saalim Da'ab and members of his family also reveal the WUA *Al Mawi's* position as a DA. Hence, these findings were included in the process tracing of the DA's behavior as well.

The perspective of DAs is very clear indeed. Since the late 1970s, they experience a dire state of structural scarcity. The water became dramatically less. This was greatly bewailed by Saiid Baraba and his fellow farmers when they were interviewed during a

[12] Interview with Shaykh Kassim Hobeira, Representative of Ebri, in the house of Shaykh Hobeira, Wadi Zabid, Yemen, 23th February 2007.

[13] Interview with Shaykh Kassim Hobeira, Representative of Ebri, in the house of Shaykh Hobeira, Wadi Zabid, Yemen, 23th February 2007.

[14] Interview with Shaykh Mohammed Sulaymaan Aydrus, Representative of WUA Al Girbah, Roda Girbah, Wadi Zabid, Yemen, 20th February 2007.

break from collecting the harvest in fields near the grave of *Ibrahim Al Jiberti*, South of *Zabid*. According to Baraba, the quantity of water reaching the fields of WUA *Al Nasery* dropped to less than half its level before the concrete structures were built in the upstream areas.

Having been asked about any polity for them to voice their concerns, Baraba and the farmers did not directly deny the existence of such institutions. Of course, there is the Irrigation Council, the Governor in *Hodeidah* as well as their respective community eldest *shaykh*. However, these institutions were not of any help because of two reasons. First, the institutions themselves are bound by the fact that most UAs still act according to the rules of *Al Jiberti*. As Dr. Khaled Al Attas, head of the Project Implementation Unit of the Irrigation Improvement Project told the author with regards to the people in Group 3: "These WUAs come to me to complain about their situation, they go to the Governor and even to the Minister because of this problem. But no one of us can do anything about this. *Al a'la fa al a'la* and *Al Jiberti* are the rules."[15] Second, according to Saiid Baraba and Shaykh Saalim, most of the farmers upstream are very rich and thereby able to bribe policemen or government officials.[16] Hence, there are no convictions in case of actual breaches against the law by UAs.

A further insight from the interview with Shaykh Saalim was that virtually all DAs dispose of stocked crops in order to provide for subsistence. Nevertheless, the structural scarcity and hence the meager harvest do not leave room for any financial improvement, which is needed in case of medical emergencies or the like; and as Saiid Baraba and Shaykh Saalim both stressed, there are absolutely no opportunities for any alternative income in the whole of the *Tihama* as well as the near abroad. The economic disadvantage was also repeatedly mentioned by Shaykh Abdul Saalim Da'ab in his role as a DA with regards to the WUAs in Group 1. Hence, there is a strong will to escape this state of structural scarcity and to improve their own wealth.[17]

As far as a potential reaction toward the UAs is concerned, the circumstances for the DAs are even more despairing. Because even in the case that DAs rightly defend the opening of the weirs upstream by the time their appropriation time starts, they are being bullied by AK-47-wearing UA militias that outnumber them by the dozens. This has been described in detail by Shaykh Saalim. He told the author about one incident when six of his people - armed with AK-47 Kalashnikov assault rifles - went to the diversion gates upstream to force the WUA there to close the gates of their offtake canals. However, he went on, the people from UA resoundingly outnumbered them. They could only go back to their villages and report the incident to the Governor and the Irrigation Council.

This power imbalance stems from the 1980s, when, according to Engineer Ahmed

[15] Conversation with Dr. Khaled Al Attas, Head of the Project Implementation Unit of the Irrigation Improvement Project, Al Jarrahi, Wadi Zabid, Yemen, 20th February 2007.

[16] Interview with Farmer Saiid Baraba, Fields near Qabr Al Jiberti, Wadi Zabid, Yemen, 20th February 2007 and Interview with Shaykh Saalim, Head of Local Council of WUA Al Mahraqi, Wadi Zabid, Yemen, 23th February 2007.

[17] Interview with Shaykh Saalim, Head of Local Council of WUA Al Mahraqi, Wadi Zabid, Yemen, 23th February 2007.

Ahmed, Yemeni expatriate workers returned relatively wealthy from the Sudan, Sa'udi Arabia and the Gulf States and bought up vast areas of land in the upstream region of *Wadi Zabid*. Due to the dimension of their land as well as their economic advantages since the 1980s, the UAs grew ever more powerful. Hence, the balance of power within the *wadi* is skewed to such an extent that there are absolutely no attempts by DAs to enforce an at least partly fair new allotment of water anymore.

**Zabid - A Peace of Power Imbalance** All the parts of the conflict mechanism flow chart in Chapter 8.6 are existent in *Wadi Zabid*. The means, perception and endogenous factors to 'cheat' are all at hand for the UAs to divert more water than during the traditional regime: the prospect of profit clearly outweighs the loss from countermeasures expected; second, a fierce structural scarcity accounts for a deprived situation for the DAs; and third, there is no polity at hand able to alter the situation of the DAs.

Nevertheless, so far there has never been an escalation of violent conflict surrounding a water issue in *Wadi Zabid*. A positive outcome of an armed strike is not perceived feasible because UAs are estimated to be too powerful. Therefore, the element of power balance has to be introduced as an additional explaining factor. The case of *Wadi Al Jawf* will assert the importance of this additional element within the conflict mechanism.

## 10.3. Wadi Al Jawf - The Wild North

*Wadi Al Jawf* stretches from the far North-East of the Yemeni highlands eastwards toward the deserted *Rub' Al Khali* (the Empty Quarter). *Wadi Al Jawf* is an intermittent spate stream of continental character - i.e. it is not flowing towards the sea (See Figure 10.3). The region remains among the tribe-controlled areas, where the central government does not have any decisive influence (*Jawf, Al* 2007). A field trip to the *wadi* was not possible due to security constraints. All information was gathered through secondary data and expert interviews.

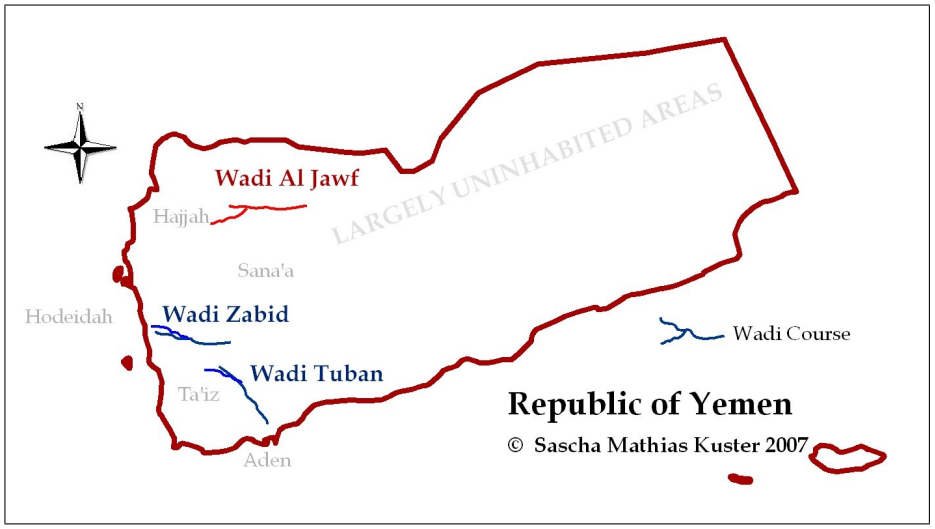


Figure 10.3.: Wadi Al Jawf

**Al Jawf - History, Topology and Institutions** Very little information about *Wadi Al Jawf* is existent in any non-Arabic language. This is largely due to the fact that the region ranks among the three most insecure areas in the whole of Yemen. During the civil war of 1962-1970, *Al Jawf* was part of the Royalist movement supporting the Imamate and the *Mutawakliat* Kingdom respectively. Even during the war, the tribes continued to be independent entities led by their elders. According to Manea (1996, p. 11), the war was seen by the tribes primarily as an opportunity for financial gain. Therefore they aligned with whoever would best serve their needs - either the Republicans supported by Egypt or the Royalists supported by Sa'udi Arabia. "By the end of the war, the tribes, having large sums of money and weapons, emerged as an economically independent social force, powerful enough to actively influence the political system" (Manea 1996, p. 12). *Al Jawf* was one of the last regions to remain under Royalist control after the civil war ended (*Jawf, Al* 2007), and is today known as one of the most notorious tribal-controlled regions of the Yemen.

*Wadi Al Jawf* stretches eastwards from the Northern highland range into the desert of the 'Empty Quarter' (*Rub' Al Khali*). It is considerably larger than *Wadi Tuban* and *Wadi Zabid*, comprising about twice the land (Tahir & Noman 2002, p. 41). Being a

typical spate-flood area characterized by high-peaking seasonal torrents, *Wadi Al Jawf* was repeatedly subject to heavy rain floods that resulted in the loss of human lives (Moulin-Acevedo 1996).

As far as information about institutions governing water allocation and irrigation is concerned, only one reliable source could be tapped. In the following paragraph, the institutional aspect of the conflict mechanism in *Wadi Al Jawf* will be sketched out following the conflict-mechanism narrative according to the main interview with Institutional Engineer Abdullah Al Mayadd of the Civic Democratic Initiatives Support Foundation (CDISF), which was held in Sana'a in March 2007.

**Al Jawf - All Elements for Conflict** According to Al Mayadd, the main sources for irrigation in *Al Jawf* are both the rain-fed spate and wells. Furthermore, there are fixed rules regarding the distributional patterns. These rules are written down. Within these rules, Al Mayadd continues, it is mentioned that if the spate is small, the first plots should get the water first. Hence, the rule of *Al a'la fa al a'la* holds in this *wadi* as well. This interpretation was confirmed by Al Mayadd. Only when there was enough water, or rather excess water, would the subsequent plots get the water. Only if all the appointed land was watered, would excess water be given to plots outside the codified irrigation scheme.

Al Mayadd was then asked to outline the process that leads to structural scarcity in *Wadi Al Jawf*. According to his details, the problem arose in two steps. First, the dams were built that allowed the people to withhold the spate from flowing downstream - so the water was kept at the first dam. Since the land in the catchment area is far more flat than in *Wadi Zabid* and *Wadi Tuban*, people started to use the land back in the valley and adjacent to the backed-up water as agricultural land, which was not the case before. Hence the water is directed back, and less and less reaches the fields downstream of the first dam. The point is that the *Shari'a* explicitly allows the watering of fields if land has been reclaimed and made arable. From this, a structural scarcity arises.[18]

Al Mayadd then stressed that adding to this structural scarcity with regards to the spate was a structural scarcity stemming from uncontrolled digging of new wells. This affected the disposability of older wells that belonged to other communities, which added fuel to already smouldering conflicts.

Furthermore, a generally more encroaching absolute scarcity of freshwater availability was on display in *Wadi Al Jawf*. As opposed to *Wadi Zabid* and *Wadi Tuban*, *Wadi Al Jawf* was a lot less about economic gains rather than about existential considerations. This repeatedly mentioned fact of absolute scarcity may cut back the significance of structural scarcity as a conflict factor in this case.[19]

However, as mentioned in the study lead by Abdullah Al Mayadd and financed by the UK Embassy in Sana'a, *Wadi Al Jawf* is prone to water-related violence and records many incidents of escalating violent conflicts. Hence the first question: to whom can

[18] Interview with Institutional Engineer Abdullah Al Mayadd, Senior Researcher at the Civic Democratic Initiatives Support Foundation, CDISF-Headquarters, Sana'a, Yemen, 1st March 2007.
[19] Ibid.

aggrieved DAs resort to in *Wadi Al Jawf*? Again, the same answer as in *Wadi Zabid* comes to the fore. As Al Mayadd recounts, community elders may handle smaller disputes, but are not authorized to decide on regional issues. Hence, the people usually went to the Governor of the region in order to resolve the dispute. However, as Al Mayadd lamented, the government usually acts too slow or is not able to enforce any decisions made. Hence, there is no functioning polity to resort to in *Wadi Al Jawf*.[20]

Finally, the question about why the conflicts escalate in *Wadi Al Jawf*, in contrast to *Wadi Zabid*, had to be clarified. On this, Al Mayadd gave a two-fold explanation. The first rather emotional answer was that "the people in the *Tihama* are generally nicer people, who do not want any conflicts." Of course, there had to be further explanatory elements. Therefore, Al Mayadd added to this explanation the facts that the view about water in *Al Jawf* was much more existential than economic - i.e. considerations were not about economic gains but rather about survival. Finally, Al Mayadd also mentioned, that "most of the people in *Al Jawf* do have the same power" and that "the levels of power are either equal or only slightly imbalanced."[21]

The main difference between *Wadi Al Jawf* and *Wadi Zabid* lies in the different distribution of power within the two *wadis*. On the whole, the people in *Wadi Al Jawf* do have the same power. The levels of power are either equal or if there is an imbalance, the difference is very small to the point of irrelevance.

According to this, it is concluded that a more evenly balanced distribution of power may be the crucial antecedent factor accounting for an actual violent escalation of a structural scarcity related dispute over spate-irrigation water.

## 10.4. Conclusion - A Holistic Water Conflict Mechanism

All things considered, the conflict mechanism flow chart needs to be complemented as follows in Figure 10.4. The proposed decision-making units were mostly met in the case of *Wadi Zabid*. The motivational structure as well as endogenous perception of UAs concurred with the working hypotheses in almost all aspects. The main deviance was the perception of their own action. According to *Al Jiberti*, UAs never considered the appropriation of more water as 'cheating'. Rather, they perceived their changing as being truly legitimized by the old rule.

With regards to the DAs, the motivational payoff-structure when considering the possibilities for a change toward water-intensive crops was less influenced by existential thoughts rather than considerations about economic advantages. It was never really a matter of survival, rather than grievance about missed economic opportunities that made the DAs demand more water. The word 'greed' is avoided in this view, since we are speaking of such a low-level income that such an accusation would be out of place.

When it comes to beliefs about consequences, the blatant power-imbalance and partial

[20] Ibid.
[21] Ibid.

legitimization of 'cheating' through the *Al Jiberti*-rule generated answers contrary to what was expected. It was expected that UAs consider cheating much more warily. Yet opportunities were readily harnessed. Here again, the DAs trade-off structure, based on the beliefs about consequences, was shaped by considerations about economic advantages and the odds of fighting rather than questions of survival.

The two interacting factors 'structural scarcity' and 'polity gap' were met in the case of *Wadi Zabid* as well as *Wadi Al Jawf*. However, DMU 3 (i.e. the violent reaction of the DA) did work out along the characteristics proposed. In the case of *Wadi Zabid*, the opportunity structure was foreclosed - i.e. opportunities were limited due to a restrictive power-imbalance that rendered any violent reaction unreasonable. Hence the mechanism was only fulfilled, if the additional factor of 'power balance' was introduced or already existent - as has been shown in case of *Wadi Al Jawf*.

As an additional antecedent factor, 'power balance' is added to the model. However, whether this factor has to be seen as more or less relevant as the 'polity gap' is not clear, and remains subject to further studies.

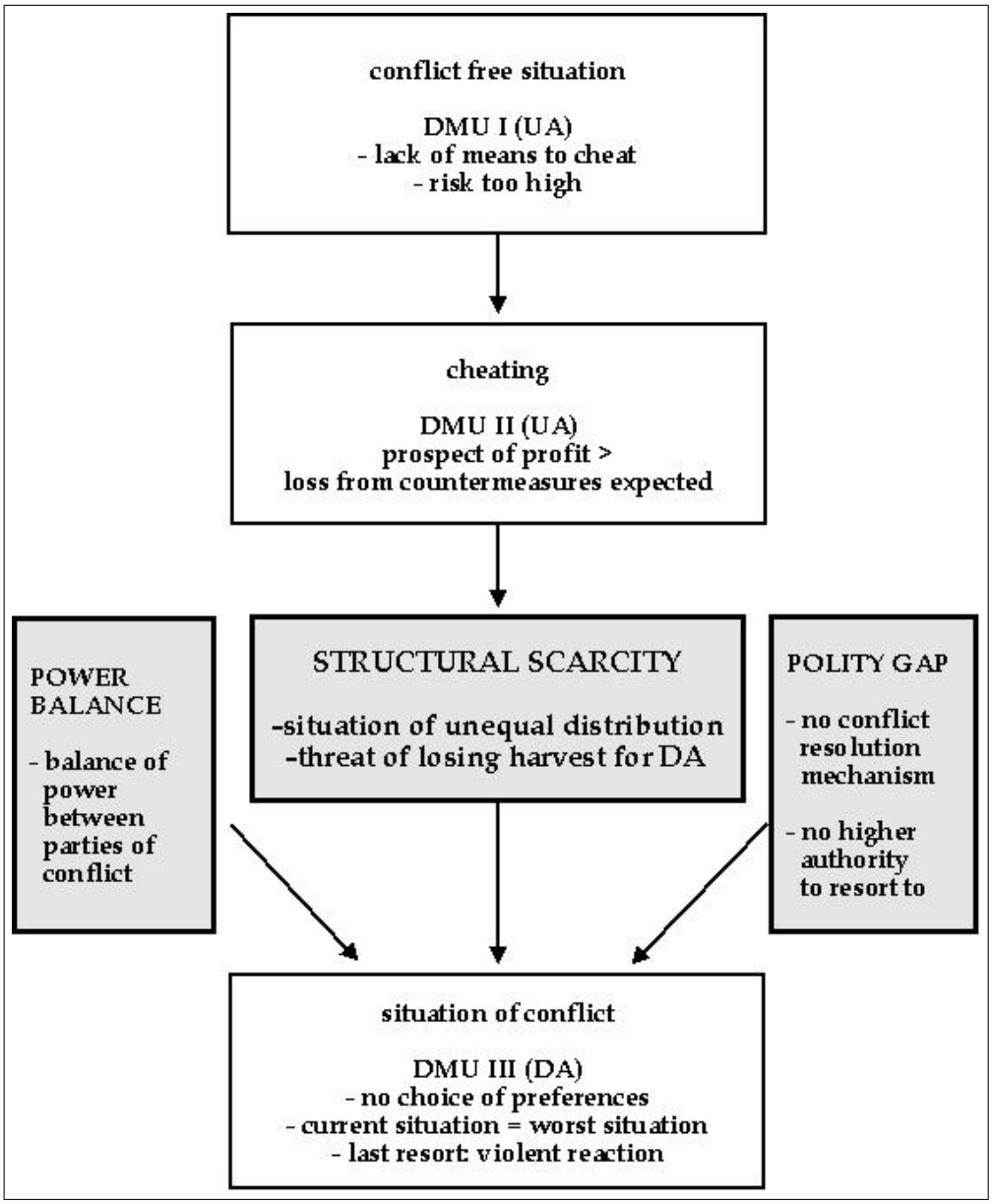


Figure 10.4.: Concluded Conflict Mechanism - Flow Process Chart

# 11. Water Conflicts - More than a Phantom

The aim of this thesis was twofold. The first goal was to detect whether there is any statistical correlation between negative freshwater availability anomalies and the occurrence of violent conflict at the local level in the Yemen. The second task was to trace the underlying mechanism between one particular form of negative freshwater availability anomaly - caused by structural scarcity through man-made irregularities in irrigation-water allocation - and the outbreak of local violent conflict.

The yet diminutive body of research on a quantitative correlation between the two factors has till now not been able to show such an effect. It was argued in the quantitative Part III of this thesis that the inability of Allan (1997) and Levy et al. (2005) to show such an effect is due to operational limitations within the methods applied by these authors.

By means of a compiled fine-grained dataset from geographic information systems, it has been shown in Part III that these effects *do* exist. Negative freshwater availability anomalies *do* correlate with the occurrence of violent conflict at the local level - at least in the Yemen during the period between 1995 and 2002.

The statistical findings also show that conflict incidents often happen within geographical and temporal proximity to previous conflicts. Therefore earlier conflict has a clear inhibition upon a correlation between the two main variables. This result shows that conflict is likely to beget conflict. Therefore even small-scale violent incidents cannot be put down as trivia. Even if at times they seem to be no more than heated fights over petty jealousy or a wrecked car. Hence small-scale violent incidents may act as a cause *and/or* catalyst of protracted conflicts at larger levels.

There is much more qualitative research on the mechanism underlying the interaction of freshwater availability and the outbreak of violent conflict at the local level. As Gleditsch (2004) has argued, the goal of qualitative conflict research should be to disentangle political, institutional, economic and social determinants from irrevocable physical sources of constraint. That is, to trace the mechanism of political, economic and social factors that mediates the correlation between negative freshwater availability anomalies and the occurrence of local violent conflict.

This goal has been pursued by different researchers, resulting in various outcomes about decisive, or at least important, mediating factors in this relationship. Some of these results have been referred to in the qualitative part of this thesis in order to design a holistic theoretical framework that could later be put up against real-life evidence (for a summary of these findings see the postulates in Section 3.5).

In a first step, the findings of Homer-Dixon & Percival (1996) were followed, that

scarcity (or negative freshwater-availability anomalies) can evolve through human-induced inequitable distribution. This postulate was clearly confirmed through the evidence from interview narratives in this thesis - structural scarcity was observed in *Wadi Zabid* as well as *Wadi Al Jawf*.

Second, Mason et al. (2007) demonstrate that all stakeholders within a river basin are somehow related to each other in an upstream-downstream constellation. This postulate has been deployed to identify the relevant agency of conflictive parties. That the conflict mechanism happens between actors upstream and downstream has been observed several times in the three cases studied.

As a third factor to mediate the two study variables, a political structure failing to give aggrieved groups the opportunity to voice their concerns and eventually restore order was argued for by Baechler (1998) as well as Homer-Dixon (1999). The (non-escalating and escalating) conflict cases within *Wadi Zabid* and *Wadi Al Jawf* provided ample evidence that a so-called 'polity gap' often accounts for parties acting (or planning to act) on their own authority to restore justice in their case. That is, they consider the application of violent means if no coercive authority resolves the dispute.

However, the fruitful field study *in situ* in three river basins in the Yemen revealed yet another factor that has so far not been referred to in the literature in conjunction with this conflict mechanism. This is the factor of power balance between conflicting actors. In the case of *Wadi Zabid*, where there is a strong imbalance of power, arguments about irrigation-water allocation never escalated into violent conflicts. Upstream actors here are much wealthier and better armed than aggrieved downstream actors. Only if the power among conflicting parties is levelled-out, as in *Wadi Al Jawf*, do such arguments later evolve and escalate into open acts of violent attacks by the aggrieved groups. Hence, the conflict mechanism was only fulfilled if the additional factor of 'power balance' was introduced or already existent.

Further research ought to study the relationship between the scarce resource of water and violent conflict along the following lines. First, these results have to be confirmed by further cases with similar background characteristics. Such cases may be found in different areas of the Middle East, the North of Africa, in the veldt areas of Central Asia as well as the dry Andean regions in South America.

Second, the findings have to be put up against evidence from areas with much more moderate climatic conditions and absolute freshwater availability.

Third, such further cases may reveal mediating factors that have not yet been thought of. These factors would be especially important in order to approach a holistic theory of the mechanism for this particular kind of conflict.

Finally, a weighting of these factors within quantitative analyses ought to clarify whether some factors are more important than others. Only then will policy makers be able to set priorities as to whether some problems ought to be tackled before others.

Even if future wars may not be exclusively over water, many may very well have their roots within this ever scarcer resource. Negative freshwater availability anomalies - whether caused by rainfall anomalies or structural scarcity - at least in the Yemen clearly account for violent conflict incidents; and these can lead to vicious spirals of violence in unstable environments - especially when the spate is the people's fate.

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