Fragmentation as a collective interest

A case study about irrigating farmers | water scarcity | and collective action | in the Upper Kromme River Catchment | South Africa

"At times, challenges hit with the force of a roaring, rushing waterfall. The true test, however, is whether you can put your arms up and enjoy the feel of the water." *Aviva Kaufman*

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Keywords: Water scarcity | Water control | Water reforms | Irrigation | Collective action | Kromme River | South Africa

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Abstract

Getting hold of the water … Who is … setting the rules of the game?!

A case study about irrigating farmers | water scarcity | and collective action In the Upper Kromme River Catchment | South Africa

This research aims to clarify on the perceptions of irrigating farmers on water scarcity, and collective action as a means to cope with water scarcity. The research has been executed as a case study in the Upper Kromme River Catchment (UKRC) in South Africa. Research has shown that the current water management situation in South Africa is cloaked within a dense web of powerful political, economic and social interests. Taking this into account water scarcity is analysed from the perspective of three different dimensions namely: "physical, management and political". The research outcomes show that physical factors had and will have a high impact on water scarcity problems, and that farmer land and water management practices helps to mitigate water scarcity problems in the perception of the farmers. In contrast the impact on water scarcity problems of government management and political side was perceived as not existing up till now, but is expected to have a high impact in the future. The main reason for this is the increasing water demand from Nelson Mandela Bay Municipality (NMBM) which drains water from the Kromme River and to a minor extent because of the water reforms aiming at the redistribution of water to Historically Disadvantaged Individuals (HDIs). Unless most farmers state that collective action is a viable manner for the farming community to have a positive impact on government induced- and political- water scarcity the island style of farming in the UKRC. The best strategy for the current UKRC farmers in resisting pressure from NMBM and government lies not in collective action but rather in fragmentation, in order to complicate involvement by NMBM and the government. The research outcomes show valuable and unique information, from a commercial farmer perspective, for professionals researching or working on water management and water reforms in South Africa.

Keywords: Water scarcity | Water control | Water reforms | Irrigation | Collective action | Kromme River | South Africa

Preface

"At times, challenges hit with the force of a roaring, rushing waterfall. The true test, however, is whether you can put your arms up and enjoy the feel of the water." *(Quote from Aviva Kaufman)*

The above stated quote can be connected to multiple discoveries that I made and experiences I had during my research in the Upper Kromme River Catchment in South Africa of which the results are presented in this report. The power of water became very much visible during my fieldwork through the experience of massive flooding. Ironically enough my research is about water scarcity. In the end the floods experienced do because of the damage they can create also add more to water scarcity problems instead that they help to obviate it. Besides the power of the water itself, humans have started a couple of hundred years ago to use their powers to make use of the power- and life- source that the Kromme River is. Currently this has resulted in a dense web of structures, power and people around the use of water. Different persons and organizations aim to secure or increase their access to the water resources of the Kromme River. Farmers in the Upper Kromme River Catchment are one group of persons in this dense web and are taken as a starting point in this research. They are faced with many challenges, and they anticipate that mainly the political situation in the country will produce new challenges with regard to water scarcity. Seeking new ways to manage the Kromme River water in a better way and getting people to work together is experienced to be very difficult in a situation in which the different stakeholders are especially well endowed to speak in negative terms about each other. Yet my greatest discovery is that despite all the challenges, catchment degradation and contrasting interests, the Kromme River is gifted with beauty. Many mountain streams flow down to the valley and the catchment is full of waterfalls some small some bigger as also shown on the cover page. For me the Kromme River Catchment was besides a very interesting research area, also an area of playful joy and in which I had many valuable and interactive contacts with locals around the river.

My aim with this report is to provide insights in the water management situation in the Upper Kromme River catchment, but most of all also to communicate the beauty and the value of the Kromme River, next to the negative load related to the topic of water management that you will experience in reading this report. I don't want water to be used as a subject to separate and antagonize people. On the contrary my vision is to let people interact with water in a positive manner and through that let them also interact with each other, in order to straighten what is crooked in the management of the Kromme River, and water management in general around the world.

I would like to thank a couple of people who helped me in doing the above during my time in South Africa. Marijn Zwinkels and the other people at Living Lands, thanks for giving this opportunity and for the space to develop and undertake this research in which I could include a lot of personal interests. Thanks to GIB and WFW for transport and housing facilities. Thanks to all the farmers in the Upper Kromme River Catchment for all the nice encounters, time and sharing of knowledge about- and passion for- the area. I also want to acknowledge the indispensable input in terms of personal passion and knowledge by Alex Bolding in supervising me during this research journey. You really energized me to keep going and also the "stroopwafels" that you brought with you during the field visit helped a lot in this!

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Summary

14 years after adoption of the most progressive water legislation in the world, many people wonder what has materialised of all the wonderful environmental and IWRM principles informing the South African 1998 National Water Act. The vision was to reform the management of water based on IWRM principles with special attention given to addressing the inequalities of the past between black and white people in South Africa. Zooming in on the Upper Kromme River Catchment (URKC) it becomes clear that implementation of this new water management approach faces with multiple challenges and difficulties, as is more or less the case in the whole of South Africa. The UKRC is a catchment in water stress, the lion share of the waters are allocated to Nelson Mandela Bay Municipality (NMBM) outside the catchment. Furthermore the environment is also under pressure and allocations have to be made available towards the Kromme River estuary to comply to the Ecological Reserve. Living Lands a South African NGO aiming at landscape restoration was the hosting organization during the field research period. The case study research presented in this report focuses on the upstream area of the Kromme River catchment and comprises an analysis of water scarcity as experienced by farmers and the latter's perception on water scarcity in the future. Furthermore it shows what means farmers do and do not have to secure their access to water. In doing so it aims to answer the question: *"How and to what extent do physical, management and political factors influence on water scarcity problems for the farmers in the Upper Kromme River catchment? And how can collective action of the farmers help to anticipate and cope with water scarcity?"*

Molle and Mollinga (2003) present different dimensions to distinguish different types of water scarcity. This research uses these dimensions as follows:

1) Physical scarcity: absolute scarcity, water resource availability is limited by nature due to climate (change) and land cover (change);
2) Management scarcity: scarcity because of lack of maintenance and management, both related to local land & water management practices of the farmers and how the Department of Water Affairs from an institutional level is (not) involved in this; and
3) Political scarcity: when people are excluded from accessing an available water source because they are in a situation of political subordination, because of downstream water use and the contrast between; 1) the political privileged but economically poor Historical Disadvantaged Individuals (HDIs); and 2) the political unprivileged but economically rich white commercial farmers in the Upper Kromme River Catchment.

Swatuk (2008:24) states that Southern Africa's history of underdevelopment has created a dense web of powerful political, economic and social interests linked by a shared technocentric understanding of and approach to water use. Mollinga's (2003) definition of water control relates seamless to this, he defines water control as: "a political process of contested resource use". Based on[1];

1) water control is technical in terms of control over and use of physical water flows by means of infrastructure to abstract and distribute water;

[1] Adapted in dialogue with supervisor (Personal communication, Bolding)

2) water control is *managerial* in terms of institutional oversight and regulation and management of water as a contested resource, both at farm and catchment level (farmer, WUA, CMA, DWA); and
3) water control is a *political* in terms of who can get water and whose water use legitimate. In this political process power plays an important role.

This research aims to clarify on the perceptions of irrigating farmers on water scarcity, and collective action as a means to cope with water scarcity. To do this the above provided framework is used in both developing the interviews for farmers, DWA and NMBM.

The research shows that water scarcity experienced by the UKRC farmers in the past was mainly from a physical- and farmer management induced- water scarcity kind, due to irregular rainfall patterns and land & water management practices of the farmers. Water scarcity events triggered farmers to change their management at single farm level. The independent water sources of all the farmers in the UKRC did not induce farmers to work together on water management in the past.

The impact of physical water scarcity is perceived by farmers to increase slightly in the future, climate change scenarios also indicate less rainfall on a yearly basis and a higher annual variation. Farmers land use practices in the floodplains have and do lead to riverbed erosion and incision, eventually this has an impact on physical water scarcity problems. Yet by farmers their land use practices are not perceived as having a negative effect on water scarcity. Looking to government management induced- and political- water scarcity a large difference can be seen between the perception on past up till current- and future-perceptions. While none of the farmers indicated an impact of both government management induced- and political- water scarcity for the past up till current time frame. For the future this is perceived totally different, namely more than half of the farmers expect a moderate to very high impact on water scarcity problems because of political and government management reasons. This is mainly based on the increasing demands from the side of Nelson Mandela Bay Municipality (NMBM).

From the interviews it became clear that both the UKRC farmers and interviewed officials of the Department of Water Affairs (DWA) together with water supply management team of Nelson Mandela Bay Municipality (NMBM) have a very negative opinion about each other. DWA and NMBM suspect the farmers of illegal water use activity and blame them for practising bad land use practices, that have a negative effect on the hydrological cycle in the UKRC. While the farmers see DWA as a corrupt government organisation incapable of performing proper water management. And NMBM is blamed to waste all the water out of the catchment due to an inefficient and leaking water distribution system.

After the promulgation of the new National Water Act in 1998 the political and institutional situation around water management in South Africa changed dramatically. The Water Allocation Reform (WAR) emanating from this new act aims to address equity in water distribution by re-allocating water from white farmers to Historically Disadvantaged Individuals (HDIs). In the UKRC this process is also being implemented. The white farmers in the UKRC are not feeling threatened by this WAR program from an economic perspective, and are sceptical about the success of the program. They are also not willing to give their perceived productive and efficient water use away to HDIs because their use is perceived as inefficient, as is also the perception on the use by NMBM. As part of the WAR program verification and validation of water uses and compulsory licensing is planned to take place in the UKRC within a timeframe of 3-5 years. The farmers in the URKC are particularly afraid that the government

will restrict their water uses in future, to meet the increasing water demands in NMBM. On the other hand farmers do have a strong control over water due to the geographical outline of the UKRC surface water system, with every farmer having his own remote mountain stream as water supply source. Currently there is no monitoring or regulation at an institutional level on these water abstractions, resulting in a situation in which water use restrictions because of droughts like in 2009-2010 are applied but not enforced. Farmers are afraid of future restrictions, but at the same time they do not have a strong belief in DWA being capable of monitoring and enforcing those regulations. Which therefore in the perception of the farmers keeps the strongest position in water control at the side of the farmers.

Water scarcity in the UKRC as a water stressed catchment is not only a threat to the secure access to water of the current white farmer majority, but also to the environment. Will the only right to water in South Africa, known as the ecological reserve, be honoured or will it be overruled by the water demands of NMBM? Besides this the addressing of the equity principle, is also conflicting with the water demands of NMBM and with the efficiency principle laid out in the NWA (1998), since emerging farmers are perceived to be not very productive. It again becomes clear that secure access to water is a relational concept and that the secure access of one (group of) person(s) does also imply insecure access of others.

Environmentalist like Living Lands and PRESENCE are pushing catchment restoration and Payment for Ecosystem Services (PES) on the agenda of DWA and NMBM, as an alternative augmentation scheme besides the currently dominant water supply approach to keep up with increasing water demands in NMBM. Yet in the UKRC farmer community, such schemes can be positive for the part time farmers, for the commercial farmers it can also have a negative impact, since it can enhance the monitoring and regulation in the area at an institutional level. NMBM will not start considering this option unless DWA will make it compulsory. The water supply management team of NMBM stated that they will point out to politicians what cheap options are in increasing water supply, of which the UKRC is currently the cheapest option. Currently the Working for –Water and Wetlands programs that directly relate to water scarcity for the farmers in the UKRC, are undertaken with high investments from the government side. Still the success on the environmental issues of these programs is constrained by a lack in farmer involvement. A PES scheme is further complicated since any new water made available through restoration belongs to the government and not to a farmer who did his best to restore his land. Direct benefits are because of this hard to generate and limits the involvement of farmers and subsequently success of these programs.

It can be concluded that the farmers in the UKRC expect and also will be confronted with new forms of water scarcity in the future, and that NMBM is influencing on this through its political network. In coping with these water scarcity problems, all the farmers indicated that especially for government management induced- and political- water scarcity no positive impact can be made at a single farm level. But that collective action is required to have a positive impact on these dimensions of water scarcity. Yet farmers are not willing to commit themselves to collective action at this stage, mainly because the expected water crisis has not emerged yet in the UKRC farmer community. Living Lands is operating in between the benefits of collective action which lie mostly in communication and creating understanding between the Working for –Water and –Wetlands programs and the farmers in the UKRC and the risk of negative government involvement. And is therefore in a very challenging position. The risk is that NMBM and DWA will use a collective action as a channel to enforce regulations. This leads to a conclusion that a continued fragmentation rather than collective action is the preferred option for the UKRC farmers to avoid government control.

1 Introduction

14 years after adoption of the most progressive water legislation in the world, many people wonder what has materialised of all the wonderful environmental and IWRM principles informing the South African 1998 National Water Act. The vision was to reform the management of water based on IWRM principles; as a process that promotes the coordinated development and management of water, and related resources in order to maximise economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems and the environment (GWP, 2012). In this special attention is given to addressing the inequalities of the past between black and white people in South Africa. Zooming in on the Kromme River Catchment it becomes clear that implementation of this new water management approach faces with multiple challenges and difficulties, as is more or less the case in the whole of South Africa. The case study research presented in this report focuses on the upstream area of the Kromme River catchment and comprises an analysis of the construct water scarcity as experienced by farmers and the latter's perception on water scarcity in the future. Furthermore it shows what means farmers do and do not have to secure their access to water.

The farmers in the Upper Kromme River Catchment are largely depending on the availability of water resources in the Kromme River Catchment (tributaries, main river, ground water). The Upper Kromme River Catchment is situated in an area with an instable yearly climate, and irregular rain patterns. Furthermore the catchment and especially the wetlands along the main river are degraded due to land use changes and the invasion of alien tree species. The general perception is that the base flow and water availability have decreased due to these factors. The implementation of new land and water acts in South Africa, puts secure access to water for the farmers into a completely new perspective. An example is the introduction of the environmental- and social- reserve and the registration and licensing of water uses. Furthermore water demands from the Kromme River dams to supply NMBM and other cities in the area are already large, but are projected to increase significantly. Taking all these factors into account, it is no surprise that the water resources in the basin are currently under stress. Due to the geography of the Upper Kromme River catchment in which nearly all farmers have access to their own independent mountain stream as their main water source, this research presents an interesting case in relation to water scarcity and farming at catchment level, when compared to more "mainstream" situations in which farmers are often hydrologically dependent on each other as abstractors from the same river.

1.1 Research problem & questions

The main research problem addressed in this study is:

> *"It is not clear; 1st) to what extent farmers in the Upper Kromme River catchment have experienced water scarcity problems and how they coped with this; 2nd) what the key factors are affecting water scarcity and what farmers' perceptions are on these factors; and 3rd) what the best way to go is for the farmers to cope with water scarcity problems."*

The objective of the study presented in this report is to bring clarity to the above stated research problem. In order to further operationalize the research, research questions were developed, taking also into account the conceptual framework as shown in chapter 3.

Main research Question:

> *"How and to what extent do physical, management and political factors influence the water scarcity problems for the farmers in the Upper Kromme River catchment? And how can collective action of the farmers help to anticipate and cope with water scarcity?"*

Sub-questions:

1. To what extent have farmers in the Upper Kromme River catchment experienced water scarcity problems in the past and how did they cope with this?

2. How and to what extent does climate (change) and land cover (change) induce "physical" water scarcity problems for the farmers in the Upper Kromme River catchment, currently and in the future?

3. How and to what extent do the land & water management practices of the farmers and the government induce "management" water scarcity problems for the farmers in the Upper Kromme River catchment, currently and in the future?

4. How and to what extent do political factors and downstream water demands induce "political" water scarcity problems for the farmers in the Upper Kromme River catchment, currently and in the future?

5. How can collective action of the famers in the Upper Kromme River catchment, help them to anticipate and cope with water scarcity problems?

1.2 Research methodology

In this research the farmers in the Upper Kromme River Catchment are taken as a starting point. These farmers are part of a playing field where economic and social welfare should be maximised in an equitable manner with also taking account of the environment according to the IWRM principles used in South Africa (DWAF, 1998). A detailed description of the studied farmer population is given in Chapter 4. In this playing field, besides farmers, multiple organisations and people do have a stake in either the management or use of the water resources. Part of this study is also to show how the different stakeholders approach concepts such as water scarcity and water security. In addition to the farmer perspective also an analysis is done on a catchment level.

Part of the research approach was also to consult farmers (representatives) during the proposal development for this research on their own ideas about this research, and to include their views on the research. The research was also presented and discussed during a workshop with farmers and finally shared with mainly farmers through a research summary/newsletter. A blank version of the interviews undertaken with the farmers can be found in Annex I. This interview consisted both of open en closed questions, the conceptual framework as presented in Chapter 3 was used to develop the interviews for the farmers. Besides the farmers, officials from the government departments of water- and environmental-affairs, some experts and representatives of the Nelson Mandela Bay Municipality (NMBM) have been interviewed to complement the picture on water management and water scarcity given by the farmers. An overview of these interviews can be found in Annex II. The

research took place as part of the PRESENCE learning network, which stands for Participatory Restoration of Ecosystem SErvices & Natural Capital, Eastern Cape. And in cooperation with Living Lands which is an NGO that facilities the PRESENCE learning network. A detailed description of PRESENCE, Living Lands and my own research journey, including a reflection on this can be found at the end of Chapter 2.

Besides the literature analysis presented on the topics of water security, water scarcity, water control and collective action in the conceptual framework. Extensive and topic specific literature analyses are presented in the different result presenting chapters. In chapter 5 about physical scarcity literature analyses are presented on climate change, catchment vegetation, alien invasive plants, and wetlands in relation to water scarcity problems. In chapter 6 about farmer management induced water scarcity a literature analysis is presented on dairy farming irrigation practices. In chapter 7 about government management literature on the water reforms including the Water Allocation Reform, compulsory licensing and environmental flow is presented as well as literature findings on the Working for Water and Working for Wetlands programs. In chapter 8 about political water scarcity literature findings on urban water demands and water augmentation strategies as well as literature on Payment for Ecosystem Services (PES) is interwoven with the results from the interviews. The main idea between giving literature findings a prominent place in the result presenting chapters is to compare the findings from the interviews with literature. Farmers' perception on water scarcity topics is compared to literature. In doing this differences between the literature and farmer interviews was easily recognized and described and more importantly the reasoning why they differ is discussed.

The research took place in the period of June – October 2012, in this period I was based at Living Lands office in Patensie. Approximately 150 km from the research area. Field visits took place on a regular basis with an intensive four week period in July in which all the interviews with the farmers took place. Limitation of the research are discussed in Chapter 10.

1.3 Thesis outline

The report is outlined as follows: chapter two provides background information on the hydro-political context including information about the region, water policies, historical development of water scarcity, the hosting organization and my personal research journey and motivation. Chapter three provides the conceptual framework on the topics of water scarcity, water security, water control and collective action. Chapter four to nine present the study results (all in relation to water scarcity) in the following order:

- Chapter four: description of studied farmer population and water use activities including an analysis on interrelatedness between the different water scarcity dimensions;
- Chapter five: addresses sub question two, elaborates on the topics of climate (change), catchment vegetation, invasive alien plants and wetland degradation;
- Chapter six: partially addresses sub question three, elaborates on farmers' land & water use practices;
- Chapter seven: partially addresses sub question three, elaborates on government management;
- Chapter eight: addresses sub question four, elaborates on politics; and
- Chapter nine: addresses sub question five, elaborates on collective action.

Chapter ten concludes the report stating the major conclusions, a discussion and recommendations.

2 Hydro-Political context

This chapter provides background information on the case study area, followed by a short review of the historical development of water scarcity in the Upper Kromme River Catchment. The chapter will then continue with a synopsis of the South African water policies. Finally the chapter will end with a description of the hosting organization and my own personal research journey and motivation.

2.1 Regional characteristics

The Kromme River catchment (Figure 1) is located in the Eastern Cape Province of South Africa, The Kromme River is ±100 km in length from its upper reaches (550m above sea level) to its estuary. From the upper catchment area it flows towards Humansdorp and after that into the Indian Ocean at Cape St. Francis (IWR, 2005). The Kromme River was named by Dutch settlers, because of the numerous twists and turns it made in the narrow valley (Raymer, 2008; cited in Gull, 2012), while looking to Figure 1 it looks very straight on a catchment level.

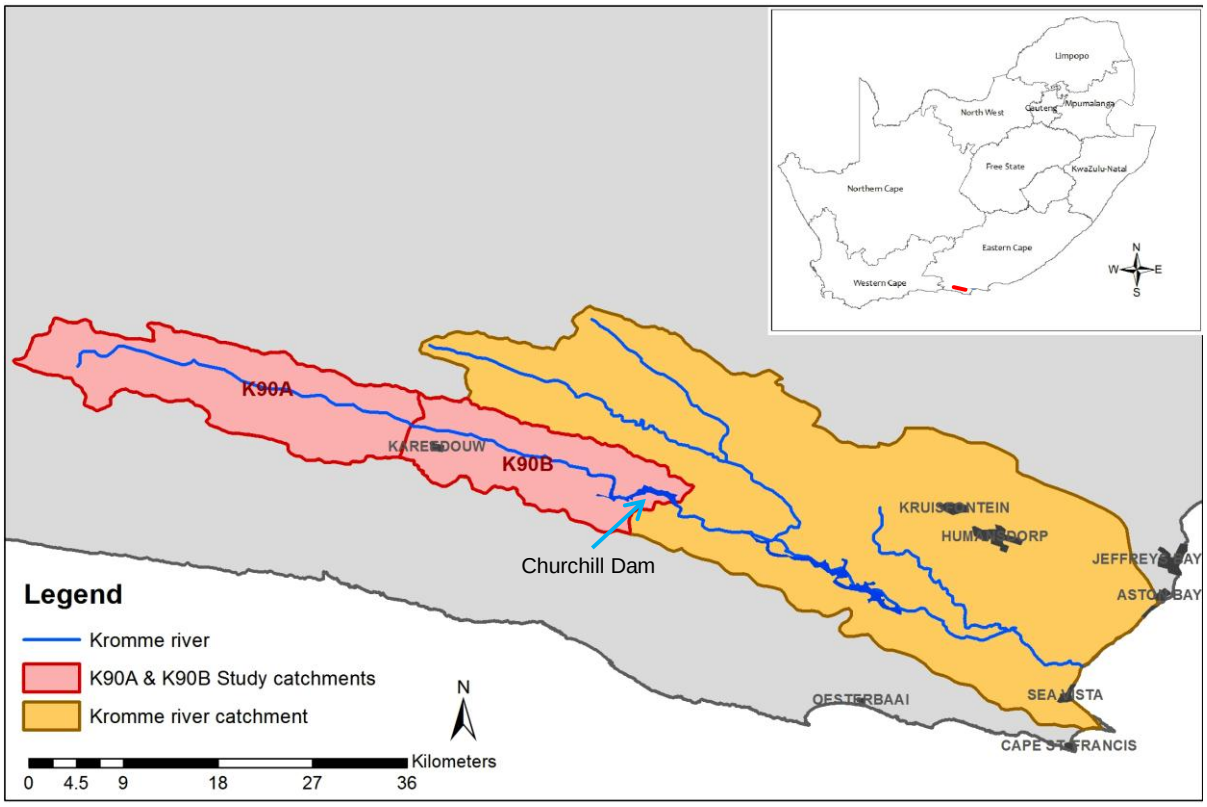


Figure 1: Kromme River catchment (Study area consists of quaternary catchments K90A & K90B)

The research area is the part of the Kromme River catchment upstream of the Churchill Dam, which are the catchments K90A and K90B as shown in Figure 1. The size of this catchment area is 365 km^2. From now on the study area is to be referred to as the Upper Kromme River Catchment (UKRC). Approximately 200 to 250 years ago the first European settlers came into the Langkloof. Data from 1995 show that the population in the Kromme catchments K90A and K90B comprises 2,700 people of which 2,250 people in urban settlements (Kareedouw) and 450 in rural settlements (DWAF, 2002).

2.1.1 Topography

The drainage network in the research area forms a trellis drainage pattern. Altitudes on the adjacent mountain ranges reach an elevation of 1073 m in the Suuranysberge to the north and heights of 1251 m (Witelskop) in the Tsitsikamma Mountains to the south. The catchment is narrow and steep, the valley sides have slopes between 20% and 30% on the north facing mountains and between 25% and 60% on the south facing slopes respectively (IWR, 2005).

2.1.2 Climate and Hydrology

From the Tsitsikamma mountains, most of the rainfall immediately flows on the south side to the sea, the part that flows down on the north side drains into the Kromme River. The mean annual measured rainfall is around 716,5 mm measured at Kareedouw police station (valley floor). This can however vary considerably, with the region experiencing as much as 1200mm in some years and as little as 300 mm in others (Kotze & Ellery, 2009:116). The potential evaporation is about 1500 mm. Figure 2 shows a map with the rainfall distribution in the area.

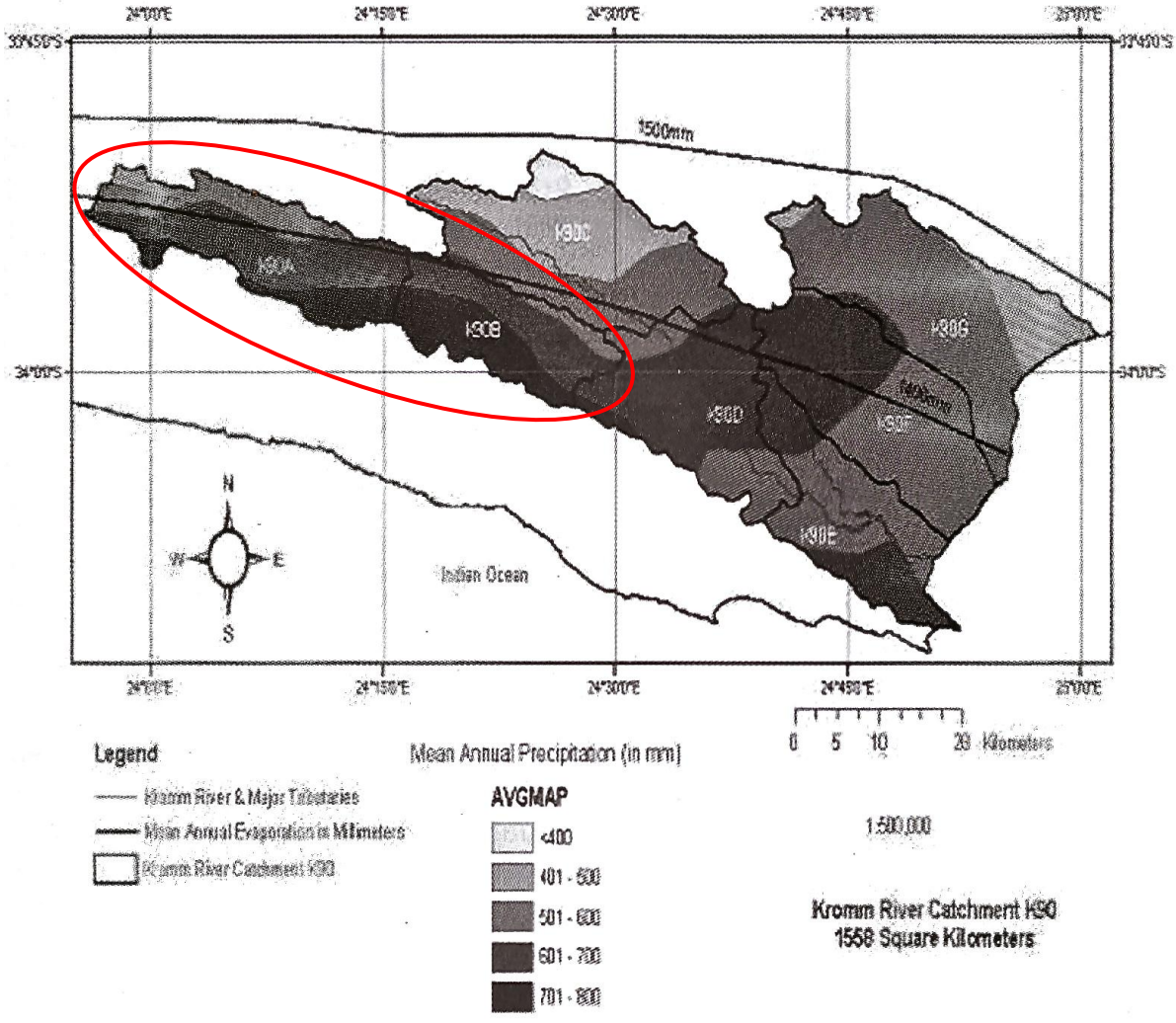


Figure 2: Quaternary catchments of the Kromme River Catchment showing the mean annual precipitation distribution, red circle shows K90A & K90B study catchment (Source: Kotze & Ellery, 2009:116)

The largest flood recorded at the Churchill Dam, the first impoundment downstream of the study area, occurred on the 22nd of November 1997 (1947-2000), when floodwaters to a depth in excess of 900 mm overflowed the dam wall. According to the DWAF (2004) report the mean annual runoff in the Kromme Catchment above the Churchill dam is 56,2 · 10^6 m^3 y^-

[1]. The Kromme River is gauged just at the outflow of both the Churchill Dam and Impofu Dam (DWAF, 2004). No weirs are installed upstream of the Churchill dam. In DWAF (2002) it is stated that groundwater resources are currently underutilized in the UKRC. A schematic overview on the main issues around water issues in the UKRC is given in Annex V.

2.1.3 Land & water use

The total area of the Kromme River Catchment is 1,556 km^2 (Mander *et al*. 2010; cited in Zwinkels, 2011). The area has been extensively transformed, especially in the lower estuarine reaches where there are a number of tourist resorts. The catchment has been invaded by alien plants. The upper reaches of the river are mostly privately owned and farmed.

In the Upper Kromme River Catchment farming predominantly compromises intensive fruit orchards, large livestock farming and vegetables, which respectively account for 100, 217 and 20 ha of irrigated land[2]. Water sources are mainly farm dams that are fed by side streams of the Kromme river and water abstracted directly from the river (DWAF, 2004, DWAF, 2002:50). Farms are commercial and mainly (large scale) and number circa 30 in total of which 3 are owned by emerging farmers. Irrigation systems are often gravity fed from side stream dams but farmers also use pumps to abstract water from the main river or increase pressure in the piped system which supplies water to mainly overhead sprinklers, microsprinklers (orchards) and pivot irrigation systems. The current irrigation water use is indicated as $2.0 \cdot 10^6$ m^3 y^{-1} for the year 2000 at 1:50 year assurance (DWAF, 2004). Some farmers are taking advantage of ecotourism and a few game and holiday farms have been developed to attract tourists. The DWAF (2004) report indicates that any new water abstraction schemes that may be considered (groundwater or surface water) will be for basic human needs and urban water supply rather than for expansion of irrigation, unless such expansion redresses past inequalities. A minor surplus water yield is indicated in the Upper Kromme Catchment, yet it is mentioned that surface water use authorisations/licenses will not be granted in the short term, since Reserve determinations have been undertaken and the UKRC is indicated as a catchment that is eligible for a compulsory licensing process.

There is one town in the catchment; Kareedouw. Wetlands are extensive. However, most are heavily degraded or completely transformed. There are large areas of degraded vegetation. This is reported to be the result of alien invasion (SANParks, 2009, Skowno, 2008; cited in Zwinkels, 2011).

Large areas of natural vegetation still exist. Fynbos is the dominant vegetation type, followed by grassland, thicket, renosterveld and forest (Euston-Brown, 2006, Mucina & Rutherford, 2006, Vlok *et al.,* 2008; cited in Zwinkels, 2011). The dominant vegetation on the peat beds is palmiet (P. serratum) with smaller patches of ferns, grasses, reeds and sedges (Haigh *et al.* 2002; cited in Zwinkels, 2011).

Peat beds are being destroyed by agriculture, ploughing of the wetlands, the removal of palmiet, water abstraction, draining, donga and head-cut erosion, the construction of dams, canalization, roads, bridges, railway lines and fences, alien plant invasion and peat fires (Haigh *et al.* 2002; cited in Zwinkels, 2011). In spite of these issues water quality in the Upper Kromme River is indicated as excellent by DWAF (2004), which observes that the quality decreases slightly in downstream direction, mainly due to changes in the underlying geology.

[2] According to data from DWAF going back to 1994, which implies that these numbers do most likely not correctly reflect current figures.

In 1996, Working for Water (WfWat) began clearing aliens in the Kromme River Catchment. This clearing revealed the extent of the damage to the wetlands, which included extensive in-stream gullying (especially in the peat basins) and widespread river bank erosion. Landowners in the UKRC argue that the clearing does sometimes aggregates the erosion problems in the river (floodplains), the extent of- and processes behind- this aggregation is currently unclear. In DWAF (2002) it is indicated that alien vegetation amounts to 15,72 km^2 in the UKRC. Streamflow reduction because of this alien vegetation is indicated as $2,9 \cdot 10^6$ m^3 y^{-1}. Currently clearing has been undertaken in 85% of the catchment, figures on current streamflow reduction because of alien vegetation are not known. In 2000, Working for Wetlands (WfWet) began a program of mechanical restoration of the Kromme River, mainly involving gabion construction to prevent (head cut) erosion. Programs on wetland rehabilitation and controlling of invasive alien plants are still on-going in the UKRC (DWAF, 2004).

2.1.4 Downstream water usage

The Kromme River System includes two major water storage facilities: the Churchill Dam and the Impofu Dam. The Churchill Dam is owned by the Nelson Mandela Bay Municipality (NMBM) and the Impofu Dam by DWA (DWAF, 2004). Both dams supply water to the Algoa Water Supply system. The Churchill Dam has a storage capacity of $32,5 \cdot 10^6$ m^3, a supply capacity to NMBM of $95 \cdot 10^3$ m^3 d^{-1}, firm water yield at an 1:50 assurance of both dams together is $42,4 \cdot 10^6$ m^3 y^{-1}. A total of $38,5 \cdot 10^6$ m^3 y^{-1} is allocated from both dams to the Algoa supply system, which eventually supplies to Nelson Mandela Bay Municipality (NMBM). (DWAF, 2002:67). The catchment contributes a significant amount of drinking water to NMBM namely; $10 \cdot 10^6$ m^3 from the Mpofu Dam and $25 \cdot 10^6$ m^3 from the Churchill Dam annually (on average). This constitutes about 55% of the entire water demand of NMBM (See Annex VI for an overview of the Algoa water supply system to NMBM). Supplies to Humansdorp, Jefreys Bay and smaller towns in the vicinity are also supplemented from this scheme (DWAF, 2004). Furthermore the Kromme River supports a large farming economy and is home to a sensitive and important ecosystem. NMBM has a long history of water access crisises and demands are expected to grow significantly in future, due to the continuous growth of NMBM. Also the expansion of the Coega Industrial Development Zone near Port Elizabeth and the growth of the cities in Jefferies' Bay and St Francis bay will put pressure on the water resources in the Kromme River (DWAF, 2004). The DWAF (2004) report indicates that $35 \cdot 10^6$ m^3 is the maximum annual water transfer limit due to a bottleneck in the pipeline from the Impofu/Churchill system. At the time it was planned to upgrade the system to allow another $11 \cdot 10^6$ m^3 to be transferred annually. It is not clear whether this has already been done. Also additional transfers of $2 \cdot 10^6$ m^3 per year are planned from the Kromme River dams from water released by the removal of invasive alien plants in the catchment.

2.1.5 Historical development of water scarcity in the URKC

As can be derived from the previous paragraphs, water scarcity did develop in the URKC because of the increasing water usage. Firstly from farmers and latterly also by NMBM, through water abstraction at the Churchill Dam and Impofu Dam. The pastoralist practices around 1800 were gradually replaced by more intensive farming operation of white settlers. Farming was further intensified during the Apartheid regime, due to a further removal of black people and due to irrigation and agricultural subsidies to further exploit the natural resources. Lately the water scarcity issues have become more urgent in relation to the stronger claims of NMBM on the UKRC water resources. The strategies of white farmers in the past have been with success in safeguarding and increasing their access to water. The question that arises

from the current situation is: "how do farmers envision to resist the pressure of NMBM and DWA to reduce agricultural water use in the area?".

2.2 Political context

This background chapter about the water policies in South Africa will provide some general information about the national policy and water reforms. Policy parts relevant for this research study will be elaborated more thoroughly in the conceptual framework of this research.

2.2.1 National policy and water reforms

The management of water resources in South Africa is regulated by the National Water Act (NWA), which was adopted in 1998. The NWA is based on IWRM principles and serves to protect the quality of water resources and aims at the integrated management of the water resources. The NWA deals with the management of water as a natural resource and deals with the water in rivers, lakes and groundwater. The NWA states that this water belongs to all people in the country and that the national government, through the Department of Water Affairs (DWAF) is acting as trustee for the people (NWA, 1998). This means that the State is the custodian of the water resources and responsible for implementing and enforcing the public interest in its water resources. With this the NWA has stepped away from the historical distinction between public and private water. The previous centralized system of water management is replaced with decentralized water management and water is managed within its natural drainage boundaries; the catchments. This research is also set up as case study in upstream part of the Kromme catchment. The NWA shifts the emphasis from the traditional "supply management" approach towards "demand management", for the conservation of South Africa's water resources by decreasing the demand and provision of a water pricing system. In this the NWA recognises water as a good to promote social equity, economic efficiency / productivity and sustainability. This principle of sustainability is partly addressed by the Reserve. The Reserve comprises two elements: the Basic Human Need Reserve (BHNR) and the Ecological Reserve (ER). The NWA states that the Reserve is the only right to water. This means that water is allocated to the Reserve before it can be allocated to any other purpose (NWA, 1998) (Achterkamp, 2009). In the NWRS II (2012: 15) it is stated that approximately 25% of the mean annual runoff of 49,000 million cubic meters per year needs to remain in the rivers and estuaries to support ecological functioning of the catchments, depending on the specific river systems. In many water management areas the ecological portion of the Reserve is not yet fully implemented.

While the Reserve is an new and progressive element of the NWA (1998) the main aim of the is to redress the past inequalities around the distribution of water between users (NWRS II, 2012). The well-known statement "Some for all" rather than "All for some" gives expression to this. In implementing the constitutional requirements, priority in planning and allocation of public funds will be given to those who are at present inadequately served (Simpungwe, 2006). In the UKRC until recently all the farms were owned by white farmers. These farmers state that when they came into the area, there were no activities at all. Currently the population in the area consist for the largest part of black South African people, yet this is not reflected in the ownership of farms. Reform processes around land & water aim to address this, by reallocating land and water to black farmers. In the Water Allocation Reform Strategy (DWA, 2008b) targets have been developed that by 2024 60% of the country's allocable water resources should be used by black owned business/farms. This Water Allocation Reform (WAR) process, has been undertaken in some areas, but implementation is not running smoothly at all as endorsed by DWA (DWA, 2008b; NWRS II, 2012:7). Also the third guiding

principle of the NWA namely efficiency further complicates this process since many new black farmers or emerging farmers have not yet proven to be very productive in contrast to most white farmers (DWA, 2008b). Concerns are also raised about that the socio-economic growth of South Africa potentially will be restricted if water security, resource quality and associated water management issues are not resolved in time (NWRS II, 2012: 7). If implementation of the water reforms further fails and does not get back on track, water will serve as a stumbling block instead of enabling economic and social development.

In the book "Transforming Water Management in South Africa" (Schreiner & Hassan, 2011) the design and implementation of the new policy framework in South Africa is evaluated. It is stated that South Africa has excellent policies and legislation in place at the macro level in relation to both water services and water resources management. The key challenge is not so much the policy itself, but the translation of this policy into practice. The South African context is policy rich, but relatively poor in implementation capacity. These challenges in implementation arise mainly from the over ambitious and highly technical interpretation of the policy, and the desire to do too much at one time, combined with a lack of capacity. Many qualified staff left DWA to start up their own business. This so called brain drain has left DWA with a decreased human resources capital base while an increase in human capital is required to implement the water reforms. Yet in the first essence the restructuring of the water sector in South Africa, which has been on-going since 1994, is to reinforce the water institutions. The transition process while important also has led temporarily to more unstable institutions, because of this restructuring and demise of the previous institutions. The slow establishment of CMAs, transformation of Irrigation Boards into Water User Associations and the establishment of new WUAs, does not add to an efficient finalisation of the restructuring process.

Achterkamp (2009) and Mendez (2010) do also mention that DWA is refusing to decentralize power to local stakeholders organized in CMAs because of the fear that one group of stakeholders, mainly the white farmers would come to dominate the CMA proceedings and in doing so would be able to maintain the status quo.

The re-allocation of water to HDI's is not implemented nearly to its expectations, Movik & de Jong (2012) argue that the whole verification and validation process of both water availability and existing water uses is very demanding in terms of financial, organizational and human resources. But this process is a necessity in many regions before water can be re-allocated to HDI's. Schreiner & Hassan (2011) argue that it is important to speed up and finalize this restructuring in order to have a stable platform, which can identify priority programmes in South Africa's water sector, and put focus on these programs with the institutional capacity available. You cannot not do more than you are capable of doing, that makes perfect sense, but an easy switch to such an approach cannot be made either. Since it will trigger new political discussions; why are the original aims of the NWA not being fulfilled and what is the rationale to choose priority areas for certain interventions? And in relation to the sustainability principle and Ecological Reserve Achterkamp (2009) found in his case study that monitoring and regulation is not in place, which consequently means that implementation of an Ecological Reserve is hardly possible due to practical limitations. This situation is most probably prevalent in most cases in South Africa. Merrey (2011) who has reviewed the above stated book (Schreiner & Hassan, 2011), raises another question not raised in the book itself: if the policies are so wonderful why are they demonstrably un-implementable? He states that "implementability" must be an important characteristic of any "excellent" policy. Furthermore Merry (2011) mentions that reallocating water to previously

disadvantaged people in the absence of effective land reform and support for new emerging farmers, is not likely to produce much impact. Although the New Water Act is highly acclaimed, more and more research such as (Movik, 2009, Swatuk, 2010) are also showing a critical reflection on the fundaments of the IWRM approach in South Africa's water legislation. This critical reflection also came into the mainstream in 2010 as shown by the Solidarity Trade Union that asserted the government's handling of the national water crisis was its most serious blunder in 2010" among the top ten it listed (Merry, 2011).

2.2.2 Reforms so far in the Upper Kromme River Catchment

Not much has yet been reformed with regard to water management specifically in the Upper Kromme River Catchment. In the DWAF (2004) report it is mentioned that compulsory licensing and an assessment of the Reserve were on going / about to start in the Upper Kromme River catchment. A comprehensive Reserve determination has been undertaken, yet it is not implemented (DWAF, 2005). The compulsory licensing process is expected to start in 2015 (Personal Communication, GOV4). The Kromme River is part of the Water Management Area (WMA) Fish to Tsitsikamma. The Nelson Mandela Bay Municipality, The Great Fish River Water User Association, The Gamtoos Irrigation Board, and the Sundays River Irrigation Board have submitted requests to DWAF for the initiation of a proposal process for the establishment of a Catchment Management Agency (CMA) for this WMA (WRC, 2003). To date some irrigation boards have transformed to Water User Assocations (WUAs), or are still in the process of doing so. Two Catchment Forums (CFs) exist in the Fish to Tsitsikamma WMA, of which only one is still active[3]. For the Upper Kromme River Catchment presently no WUA or Catchment Forum is in place, to enhance stakeholder interaction about water resource issues in the area.

2.2.3 Water -security and -scarcity policies

The preamble of the NWA (1998) starts off with the recognition that water is a scarce national resource. In the National Water Resource Strategy II this is further emphasized: "Although the regulatory framework and the institutional arrangements have changed since the advent of democracy, one aspect remains constant: water scarcity – whether quantitative, qualitative or both – which originates as much from inefficient use and poor management as from real physical limits" (NWRS II, 2012: 13).

This paragraph will elaborate on the water –security and –scarcity policies and what this implies for the Kromme River catchment. In the Upper Kromme River catchment all water users are required to apply for licences, the so-called "compulsory licensing" due to the stressed conditions on water availability in the whole catchment and the degraded wetland in the Kromme River (DWAF, 2004; DWAF, 2008a). In this process also the validity of the current uses that are continued as Existing Lawful Uses will be determined. A comprehensive Reserve study has been undertaken in the Kromme to support this compulsory licensing (DWAF, 2004; DWAF, 2005). For the Upper Kromme River catchment the issue of new water allocations has been put on hold (DWAF, 2004).

Furthermore as already touched upon in the Regional background part, the DWAF (2004) report projects an increased demand from the NMBM and other cities in the area. The dams in the Kromme River are planned to supply a large share of these projected demands. This puts the water resources in the Upper Kromme River catchment under further stress.

[3] This data is from the WRC (2003) report so situations might have changed in the meantime.

Also the Water Allocation Reform (WAR) as briefly discussed above puts another factor of uncertainty on the water rights of the current water users in the UKRC. Since the WAR aims to transfer water access from previously advantaged stakeholder groups (white farmers) to Historically Disadvantaged Individuals (HDIs) or groups. The targets on country scale of 60% of the water available for allocation in hands of black farmers by 2024, show the extent of impact it can potentially have on current water users.

2.3 Hosting organization

Living Lands was the hosting organization in South Africa. Living Lands is a South Africa based not-for-profit organization conserving and restoring living landscapes established in 2008. A living landscape as described by Living Lands consists of a variety of healthy ecosystems and land uses. It is home to ecological, agricultural, and social systems which are managed so that they can function sustainably. This ensures that natural and cultural resources are available for future generations and the system is resilient for adaptation to climate change. A team of ± 5 staff is taking forward the organization on a full time basis. Furthermore the organization hosts students from different countries for periods ranging from 4 months to 2 years. These students work on various research projects. Living Lands is based at the Kouga Dam ± 30 km west of the town Patensie. At this site it has two offices and a couple of houses. Living Lands is funded by a variety of funders: Partners For Water (The Netherlands), South African Dept. of Environmental Affairs – Natural Resource Program (Working for Water), Gamtoos Irrigation Board (GIB) (South Africa) among others. It is the mission of Living Lands to bring synergies and added value to the landscape through:

- Promoting living landscapes;
- Mobilizing civil society for sustainability;
- Enabling and facilitating social learning processes;
- Fostering mutually beneficial partnerships and participatory networks;

This all with a positive, creative, committed, honest and transparent approach. Living Lands aims at three key issues, namely:

- Building collective awareness and understanding (knowledge base) of the socio-ecological needs, challenges, values, norms, and behaviors of individuals and organizations;
- Creating collective intelligence surrounding the socio-ecological and economic opportunities and constraints;
- Producing collective action to create and mainstream a shared vision for a living landscape and grow a locally-driven learning network.

Currently Living Lands is working on the following landscapes: Baviaanskloof, Kouga and Kromme Catchments in the Eastern Cape, South Africa. Living Lands is the secretariat to the PRESENCE learning network.

2.3.1 PRESENCE

PRESENCE is a learning network which acts as a multi-stakeholder platform for: catalyzing capacity building initiatives; guiding trans disciplinary social-ecological research; and supporting implementation (best management practices) aimed at restoring 'living landscapes' in the Eastern Cape, South Africa. The research presented in this report is part of the PRECENCE learning network.

This PRESENCE approach is piloted in the Baviaanskloof Mega-Reserve (2007-present) through the collaborative research-implementation programme: *PRESENCE in the Baviaanskloof*. In 2011 PRESENCE has also expanded its activities to the Kouga River and Upper Kromme River catchments. The aim for the Upper Kromme River catchment is to mobilize civil society to create Living Landscapes. A living landscape in the vision of PRESENCE is a variety of healthy ecosystems and land uses and is home to ecological, agricultural, and social systems that are managed so that they can function sustainably. The current emphasizes of PRESENCE work in the Upper Kromme River catchment is to establish a communication platform in which farmers can come together and act collectively in cooperation with local and regional government, researchers and nature conservations organizations.

2.4 Personal motivation and research journey

This research is a product for the partial fulfilment of the MSc degree for the study "International Land and Water Management", with a specialization in "Integrated Water Management" at the Wageningen University. In my bachelor I did a similar kind of research in the Lake Naivasha catchment, Kenya. Which I was really enthusiastic about because I could work in a foreign environment, together with different organizations (government, NGOs, consultancy) on water issues from local to catchment level. In my masters I did my major thesis in cooperation with a Dutch consultancy in the field of urban precipitation management. For this research I'm glad to be able to do research that again is about water issues at a catchment level in a foreign context. I'm really searching whether working in a foreign context is something that I also want to pursue after my studies. This thesis research will contribute to this search. Furthermore I'm also driven by my passion to bring people to sources of water and see how through interaction around water between local people water can be appreciated and managed in a better way.

The first time I came into contact with Living Lands, it was clear to me that doing research with them would be a great opportunity. In consultation with Living Lands a research topic was framed. The topic was water scarcity for farmers in the UKRC and how collective action by farmers could be used as a means to anticipate on water scarcity. The latter relates closely to Living Lands aim to produce collective action to create and mainstream a shared vision for a living landscape and grow a locally-driven learning network, as described in the previous paragraphs. Living Lands focuses mainly on land owners / farmers, consequently I took the same focus in my research to align with the activities of Living Lands. The research period in South Africa was from June till October 2012, with a month holidays in August. I was mainly based at Living Lands office at Kouga Dam. Regularly I visited the UKRC study area with an intensive period of 4 weeks in July in which I undertook the farmer interviews. During the fieldwork period I stayed over at the local vet and his family. For transport a limited use could be made of the Living Lands vehicles.

Before me three other students already visited most of the farmers in the UKRC and two catchment forums were organized by Living Lands for the UKRC farmers. At the time I contacted the farmers most of them were already aware of the project on-going by Living Lands. I worked closely together with another student, Elodie Hesters, we did the field trips together and interviewed the farmers together. She was doing a short term internship and her study mainly focused on the establishment of a catchment forum in the URKC. Which linked very closely to the collective action part of my research. At the very start of my stay in South Africa we visited the study area and a couple of farmers, with whom I shortly discussed their ideas around the topic of water scarcity. This already showed me that the UKRC is a unique system in which farmers have a very isolated farming style and water is sourced

independently from each other. It also became clear to me that the area was mainly farmed by white farmers. And that the floodplains were under exposure of massive erosion at some spots in the catchment. Due to limited transport facilities it was not possible to talk to a lot farmers to include in the development of the research framework.

The interviews with each farmer were planned through the telephone. This proved to be a very challenging task, because of the patchy mobile network coverage. The farmers were in general very welcoming, and willing to cooperate with me. The interviews were conducted in English with sometimes Afrikaans or Dutch additions to clarify on the issues discussed. I have interviewed three emerging farmers, one of them spoke English fluently. The other two did not, in these cases we had arranged a translator.

After the interviews I was on holidays for a month in August, in the meantime Elodie Hesters organized a catchment forum. Directly after my return from holidays this forum was held. At this forum I presented some preliminary findings from the farmer interviews. Not so many farmers joined the forum; 9 out 30+ invited. The general reaction of the farmers present at the forum was that they had the feeling they had to act and do something and come together as farmers to deal with the anticipated water scarcity issues mainly in relation to the increasing demands from the side of NMBM. Personally I felt that the whole collective action thing, which Living Lands is aiming at to produce in the UKRC, has still a long way to go. To me it felt like some farmers feel it is necessary to start cooperating, but the majority rather wants to continue their business as usual without too much cooperation.

For me personally I had the feeling already on forehand that collective action could be of great value in the UKRC especially to get farmers involvement on alien clearing and wetland rehabilitation, to put on hold to current degradation in the catchment. From this perspective I spoke positively about collective action in the contacts with the farmers.

In October at the end of my stay in South Africa I made a 2 page newsletter in which I presented a summary of the study results. Together with an in the meantime newly arrived student I delivered this newsletter to the farmers, to give them feedback on the interviews undertaken, to discuss the outcomes with them. And also to introduce the new student, who from that point continued the research from the side of Living Lands in the UKRC.

What really came to the foreground for me during my research journey was the beauty of the river system in the UKRC, the numerous mountain streams coming down from the mountains, transporting crystal clear water, sometimes ponding down + 20 meters in a waterfall. In relation to this the discovery that people are hardly able to enjoy this beauty together because the water is a source of conflicts made me sad. Water is in the first place seen as an indispensable resource for the different users, black and white farmers and NMBM. This approach to water overrules for them the beauty aspect of the waters in the UKRC. Logic in relation to modern day thinking, in that we need to be efficient with our resources and make good use of them, and in the first place have to look after ourselves. Yet I hope that in the future I will be able to use water as a source of hope, beauty and just to get people really together and work towards a common vision on water resource management.

3 Conceptual framework for analysis

The main aim of this chapter is show the framework build around secure access to water for farmers, that forms the basis for analysis in this research study. First an introduction and definition for secure access to water will be given. Furthermore the concept of secure access to water will be broken up in different other concepts as shown below in Figure 3. Eventually a framework is created to analyse how farmer collective action in the Upper Kromme River catchment will enable farmers - or not - in anticipating on and coping with the different dimensions of water scarcity to secure the farmers access to water.

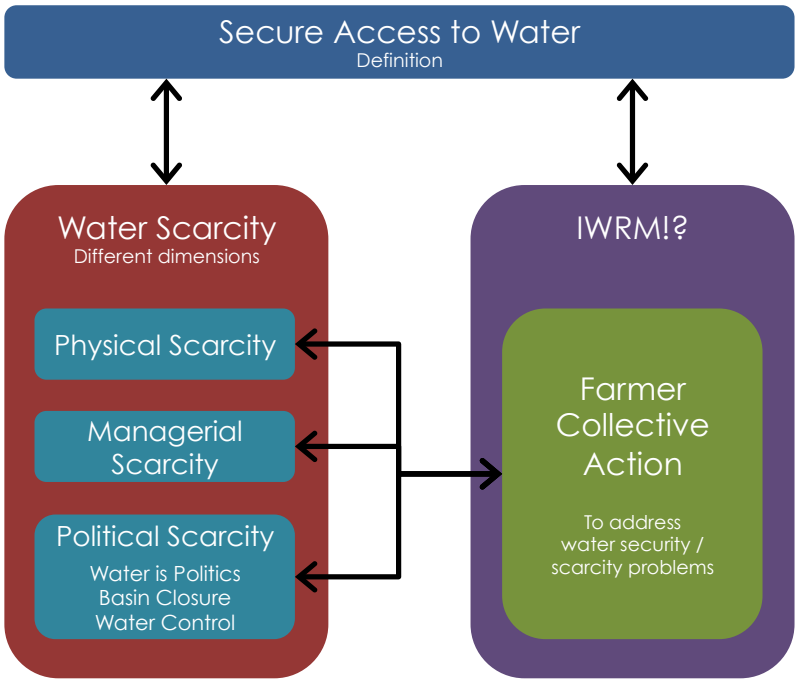


Figure 3: Schematic overview conceptual framework

3.1 Defining secure access to water

The most common used term in relation to secure access to water is water security. Several definitions of water security are in circulation. Ranging from narrow to very inclusive definitions, some examples are:

- "Water security is the capacity of a population to ensure that they continue to have access to potable water." (Wikipedia, 2012)
- "Water security is the reliable availability of an acceptable quantity and quality of water for health, livelihoods and production, coupled with an acceptable level of water-related risks." (Grey & Sadoff, 2007; cited in Muller *et al*, 2009:8);
- "Water security represents a unifying element supplying humanity with drinking water, hygiene and sanitation, food and fish, industrial resources, energy, transportation and natural amenities, all dependent upon maintaining ecosystem health and productivity." (UNEP, 2009:47)
- "Water security involves the sustainable use and protection of water systems, the protection against water related hazards (floods and droughts), the sustainable

development of water resources and the safeguarding of (access to) water functions and services for humans and the environment." (Schultz & Uhlenbrook, 2007:2)

- "Water security is the sustainable access, on a watershed basis, to adequate quantities of water of acceptable quality, to ensure human and ecosystem health." (Norman et al. 2010:14)

From the above stated definitions it becomes clear that scale, perspectives and the different dimensions of security can lead to different definitions of water security. Water security on a global scale is so to say a world of difference from water security on household scale. Also whether you look to water security from a single discipline or from a holistic perspective changes the way it will be defined. And apart from the availability of both quantitative and qualitative water also the destructivity of water related hazards is included in some of the definitions.

The purpose of this paragraph is not to come up with a new or adapted definition of water security to cover all water security related issues in the world. In line with the research objectives the concept of water security is firstly applied to a single discipline namely; the secure access of water for farmers and their water demanding agricultural activities in the Upper Kromme River catchment.

Since water -security and –scarcity are relative and relational concepts, they cannot be studied in relation to one person or one group of people. Taking in this research the current UKRC farmers as a departure point. The question arises who is excluded or under threat of exclusion from secure access to water in the UKRC? Water security consists of the belief that one holds a particular privilege, as against others, in the use, management or political-institutional control of water at a particular time. This security can be based on a variety of legal grounds but also on other processes and mechanisms through which access can be created, maintained and expanded (Ribot and Peluso 2003, Meinzen-Dick and Nkonya 2007, Peluso and Lund 2011; cited in Liebrand, 2012:775).

The concept of water security is used to put the secure access of water of current UKRC farmers into a broader perspective including other water users as the population of NMBM, future (black) UKRC farmers.

3.2 Water Scarcity dimensions

Secure access to water is closely related to water scarcity, if water is scarce or becoming scarce in a certain area the secure access to water of the people using water in that area will most probably be under pressure. Molle and Mollinga (2003) use five different dimensions to distinguish different types of water scarcity.

4) Physical scarcity (absolute scarcity, water source availability is limited by nature e.g. arid areas);
5) Economic scarcity (difficulties in capturing water through insufficient human and financial resources);
6) Management scarcity (scarcity because of lack of maintenance and management);
7) Institutional scarcity (a society's failure to deal institutionally with rising supply/demand imbalances);
8) Political scarcity (when people are excluded from accessing an available water source because they are in a situation of political subordination).

It is important to note that in its essence water scarcity is a social construct, a situation of scarcity only arises when people start to use it and use more than there is actually available. Looking to the above definitions physical scarcity will only arise when people want to make use of the scarce resources, if this is not the case there might be little water, but not a situation of scarcity. This is important to realize in interpreting the results under the topic of physical scarcity. While physical factors influence on water availability, it is the use of water that can lead to water scarcity situation. Furthermore human actions do on its hand have an influence on physical factors, taking for example climate change. The different dimensions of water scarcity will be used to operationalize the different research objectives. In this physical water scarcity will be linked up with climate (change) and land cover (change) in the Upper Kromme River catchment. Institutional scarcity will be included in management scarcity and will be linked up with the local land & water management practices of the farmers and how the Department of Water Affairs is (not) involved in this. With the new National Water Act the old institutional context has become redundant, yet as also touched upon in the background the new institutions (CMA & WUA) are not in place yet. This will inevitably lead to the emergence of management gaps; on for example water abstraction monitoring, environmental flow monitoring, and the development of catchment management plans. Economic scarcity will be included in political scarcity, which will be linked with the water policies, downstream water use and with the contrast between; 1) the political privileged but economically poor Historical Disadvantaged Individuals (HDIs); and 2) the political "unprivileged" but economically rich white commercial farmers in the Upper Kromme River Catchment.

3.2.1 Physical water scarcity

... Related to climate (change) and land cover (change).

All the rainwater that falls on the earth and that is not evaporated, transpired, or withdrawn artificially, contributes to the flow of rivers and groundwater. Depending on different physiographic characteristics, like climate, size of the river basin, topography (slopes and other terrain parameters) as well as soil and geological parameters, the discharge of a river differs significantly in space and time (Schultz & Uhlenbrook, 2007). Droughts or periods with little rain for longer periods can happen as a consequence of climatic variability and lead to a situation of physical water scarcity (Muller et al. 2009). Furthermore during the past years there have been quite some debates regarding the possible impacts of climate change on for instance:

- increase in average annual rainfall and in flood frequency and magnitude;
- increases in both length and severity of dry-spells and droughts;
- change in river regimes; or
- impacts of the design, maintenance and functioning of water infrastructure on hydrological behavior of rivers (Schultz & Uhlenbrook, 2007).

As far as the increase in length and severity of droughts is concerned, this may imply that rain-fed agriculture will become more vulnerable and that water availability for irrigation may become even more at risk in the arid and semi-arid zones (Schultz & Uhlenbrook, 2007).

Apart from climate induced water scarcity another "natural" process that has influence on water availability is the land cover of the catchment. Whether natural or direct human

processes mainly drive this process depends on the type of catchment. In the case of the Upper Kromme River catchment, the largest part of the catchment area consists of mountainous area with different vegetation types. The density and type of vegetation has a direct influence on the amount of water per unit of area that is evaporated. To go into this topic with high scientific detail falls beyond the scope of this research, but the possibility of land cover impacts on physical water scarcity should be kept in mind during the research.

3.2.2 Management water scarcity

… Related to local land & water management practices of the farmers and how the Department of Water Affairs is (not) involved in this.

Especially in highly managed water systems, for example irrigation systems, improper maintenance management practices can induce water scarcity, since users that normally should receive water fail to be served properly (Molle & Mollinga, 2003). Molle & Mollinga (2003) look with this type of scarcity mainly as a failure of water infrastructures that supply multiple users. This type of management water scarcity can also be downscaled to single farm level. The way in which a farmer abstracts water and maintains and manages his own system has a direct impact on the water availability for his own agricultural activities.

Up scaling from farmer level to catchment level, or in this case to the Upper Kromme River catchment, makes it clear that each farmer's activity or subsystem has an impact on the whole catchment, especially on the downstream part. In terms of quality and quantity, a farmer can have a direct impact because of inefficient water transport and use, or land use practices that have an impact on the quantity and quality of the water flowing through the river. Both this quantity and quality of the river water will determine if it is useful for irrigation purposes (Schultz & Uhlenbrook, 2007). The institutional dimension of water scarcity is also closely related to this, because at this catchment scale it is the responsibility of the DWA to: 1) allocate water to different types of users including the environment; 2) monitor the water resources; and 3) develop and implement a catchment management plan. But as argued before the DWA is mostly absent and found lacking in taking this responsibility all over South Africa (Merrey, 2011). This is also the case in the Upper Kromme River catchment, in the absence of a CMA and WUA.

3.2.3 Political water scarcity

… Related to water policies, downstream water use and the contrast between; 1) the political privileged but economically poor Historical Disadvantaged Individuals (HDIs); and 2) the political "unprivileged" but economically rich white commercial farmers in the Upper Kromme River Catchment.

Political water scarcity is one already with a rich history in South Africa. During the apartheid era people from European descent dominated the politics and most land and related water rights were in hands of the white people at the expense of the black people. In that time this political scarcity was reinforced through an economic scarcity namely; white farmers could make use of different kinds of subsidies on dam construction, and favourable allocation regimes for agricultural water use (Personal communication, Bolding). The political system in South Africa has been transformed dramatically, which may imply that political scarcity has changed, but does certainly not imply that it has become less nowadays. In the light of the ever-growing demands on the scarce water resources in South Africa, and the institutional failure, it is more likely that the political competition about access to the water resources will

increase. In the case of the UKRC the demands of the Nelson Mandela Bay Municipality also puts water scarcity in a political and economic intertwined context.

3.2.3.1 Water is politics

Water is politics; this paragraph will further deepen how politics and water (scarcity) are interrelated with each other. Next to this deepening on the politics of water some frequently discussed topics as 'basin closure' and 'water control' will also be touched upon in the next paragraphs.

In his thesis research Achterkamp (2009) has given an overview on the topic of 'water is politics'. This is used below and further developed to fit this research.

Water is a 'contested resource' [Wester *et al.,* 2003; cited in Achterkamp, 2009] for this reason water issues are at the top of many national and international political agendas. Since water is politics it is never neutral, several authors put this standpoint forward:

- Schoch (2007; cited in Achterkamp, 2009:16): Water is scarce and essential for life, health and welfare; it has become a contested terrain and therefore a political issue.
- Wester *et al.* (2003; cited in Achterkamp, 2009:16): The question who will represent groups of stakeholders in river basin management is a highly political one.
- Prince of Orange of The Netherlands (2002): "The world water crisis is a crisis of governance – not one of scarcity" from the No Water No Future speech at the Accra Summit.
- Mollinga (2008:10): The proposition that water resources management is an inherently political process is based on the idea that *water control* is at the heart of water resources management and should be conceived as a process of *politically contested resource use*.
- Swatuk (2008:24): Southern Africa's history of underdevelopment has created a dense web of powerful political, economic and social interests linked by a shared technocentric understanding of and approach to water use.
- Molle *et al*. (2009:336): Water bureaucrats, state-level and local politicians, water business companies, and development banks are often tightly associated in 'synergetic relationships' whereby the ways the flows of water are created or modified by water infrastructure are intertwined with flows of power and influence, often manifested in the form of political or financial benefits, whether private or collective.
- Schwartz & Schouten [2007; cited in Achterkamp, 2009:16] make almost the same statement about drinking water service: "The combination of water as a merit good, a private good, an economic good, and a good subject to market failure makes that the provision of water services is prominently on the political agenda in many countries, making it a 'political good'. While their statement is about drinking water service, the statement is also applicable for other water uses.

With the current literature stacks on this topic this list can be endlessly expanded. The message that comes out of all these statements is that water resource use and politics are intertwined at different political levels. Mollinga (2001) made a distinction between three different political levels: 1) official state and inter-state politics regarding water (or hydropolitics); 2) the politics of water resources governance (policy formulation and implementation as politically contested terrain); and 3) the everyday politics of water use. This

research deals with the last two levels, since level 1 is about trans boundary water management, which is not the case in the Upper Kromme River catchment. Level 2 and 3 will both be in cooperated in this research. For level 2 (the politics of water resources governance) the focus will be on which political powers are controlling the water resources in the Upper Kromme River catchment, and how the different political powers (state government, DWAF, Nelson Mandela Bay Municipality, white farmers, etc.) interact and are related to each other. For level 3 (the everyday politics of water use) the focus will be on the day-to-day politics of individual users trying to secure their water needs at farm level, solely or possibly through collective action as a group at catchment level.

3.2.3.2 Basin Closure

In the Kromme River catchment water resource development has led to a stressed water situation. In water governance literature this process is indicated as 'basin closure'. According to the International Water Management Institute a basin is closed when all the accessible and annually renewable water resources in a river basin are already in use or have been allocated to users (Seckler, 1996; cited in Achterkamp, 2009). Lankford and Beale (2006; cited in Achterkamp, 2009:21) make an interesting comment about this process of basin closure: "When demand exceeds a river's supply along its reach, the river switches in behaviour - it no longer supplies surplus water to autonomous points of demand but becomes a contested channel with infrastructure that divides and defines the distribution of a scarce resource". This statement can without doubt be applied to the Kromme River with its two dams along the reach, and competing claims over water between domestic, industrial, agricultural and environmental usages. Basin closure further implies that ultimately the organization / persons with the most influence on the water control determine who can and who cannot use water in the basin.

3.2.3.3 Water control

As stated by the National Water Act (NWA) (1998) the water resources in South Africa are owned by the public, and the government acts as a custodian over these water resources. The NWA (1998) is developed as a policy framework to guide the management and control of the water resources in a sustainable, equitable and economically efficient manner. Based on earlier statements about the politics of water it can be stated that water resources are not controlled by the law, but rather by the people / organizations that develop and implement the law, and by the people that influence these processes, or have a so-called power-stake in the process.

Water control relates closely to the main topic of this research "secure access to water for farmers in the Upper Kromme River catchment". Controlling the water means you have the ability to secure your access to water. Mollinga's (2003) definition of water control reflects the three scarcity dimensions (physical, management and political) used in this research. He defines water control as: "a political process of contested resource use". Based on[4];

1) water control is technical in terms of control over and use of *physical* water flows by means of infrastructure to abstract and distribute water;
2) water control is *managerial* in terms of institutional oversight and regulation and management of water as a contested resource, both at farm and catchment level (farmer, WUA, CMA, DWA); and
3) water control is *political* in terms of who can get water and whose water use is legitimate. In this political process power plays an important role.

[4] Adapted in dialogue with supervisor (Personal communication, Bolding)

Liebrand (2008) uses power in this context as the capability to secure outcomes where the realization of these outcomes depends on the agency of others. This can be understood as dominant power relationships.

3.3 IWRM

The guidelines to the NWA (DWAF, 2008a:15) define IWRM as follows: "Integrated water resource management is a process for coordinated planning and management of water, land and environmental resources. It takes into account the amount of available water (surface and groundwater), water use, water quality, environmental and social issues as an integrated (combined) whole to ensure sustainable, equitable and efficient use".

Integrated water resource management is also about providing sufficient information about water resources for proper planning and informed decision making between water resource managers and development planners. It requires co-operation and co-ordination between planners, institutions and individuals where water-related planning takes place. A further key aspect of integrated water resource management is participation of people in decision-making where decisions are decentralized".

As South Africa was the first African country to start implementing the IWRM principles, following on the widely (international) accepted opinion that IWRM was the way to go in managing the water resources, currently also more criticism about the IWRM is heard, mainly because IWRM failed to deliver its purported benefits.

Molle (2008) states that IWRM is a nirvana concept; a concept that embodies an ideal image of what the world should tend to. A nirvana concept represents a vision of a 'horizon' that individuals and societies should strive to reach. Although, just as with nirvana, the likelihood that we may reach them is admittedly low. Molle (2008) further states that IWRM evolved from the correct perception that water management has been unintegrated, or fragmented, between the different sectors, policy departments, up-stream vs. down-stream, quality vs. quantity, etc. This and more had led to a situation of perceived crisis, in which IWRM was conceptualized as the opposite of the rather chaotic situation. An important part of IWRM to enhance equity is the involvement of water users through stakeholder participation in the setting up of water sharing agreements. Soon it became clear that the large and powerful users dominated these processes and could set the agreement to their hand at the expense of less powerful water users (Molle, 2008). It is recognized that IWRM has degenerated into a buzzword that everyone makes use of but means also something different to different people (Johnch-Clausen and Fugl, 2001; cited in Molle, 2008).

Saravan et al. (2009) agrees with Molle (2008), but adds that critics of IWRM often emphasise complexities, contextuality, power dynamics and real world analysis, without offering any constructive alternatives. Saravan et al. (2009) state that IWRM should be redefined in the way it is approached to a process, where multiple actors/agents integrate diverse rules and resources in a strategic context to manage water resources in decision-making arenas, where there is dynamic interplay of power. Such an approach offers a new direction for the practice of IWRM for sustainable water resource management.

Approaching this discussion from the perspective of a water user, it is important in order to secure its water supply. That the water user has the means to engage in these decision-making arenas.

The structures to enable this process in South Africa are the Water User Association (WUA) (a statutory body) and the Catchment Forum (non-statutory body) (NWA, 1998, DWAF, undated). A WUA is a grouping of water users who wish to work together because of a common interest. The purpose of a WUA is to enable water users to cooperate and pool their resources (financial, human resources and expertise) to more effectively carry out water-related activities (DWAF, 2008a). The Guidelines on Water Management Institutions from the DWAF (undated) states that WUAs may be represented on the CMA's Governing Board and Catchment management Committees. The CMA is a statutory body established under the NWA (1998) that is responsible for the water resource management in a water management area. It is furthermore stated that the primary purpose of a CMA is to involve local communities in water resource management (DWAF, undated). The Catchment Forum is in contrast to the WUA a non-statutory body. Most of the Catchment Forums were established in order to facilitate the process of CMA development. A Catchment Forum provides an institutional mechanism to facilitate on-going participation of stakeholders with diverse interests (DWAF, undated). It is furthermore stated as the primary interface between the CMA and the body of stakeholders. Apart from the water sector issues the Catchment Forum can also involve other sectors such as water services, waste management, environmental management and land development in their activities.

Whether a WUA or Catchment Forum is a possible and promising way to go for farmers in the Upper Kromme River Catchment cannot be indicated yet. What can be concluded from this is that the WUA and Catchment Forum are bodies that offer the possibility to be engaged in the decision making process around water resource management. It has to be established whether this IWRM approach is seen as inadequate or not, it is the current way in which the water resources are managed in South Africa.

3.4 Collective action theories

The last part of the previous paragraph already specifies two institutional vehicles to facilitate collective action, namely the WUA and Catchment Forum. This paragraph aims to zoom-out again to provide a scientific review on literature around collective action processes and what the benefits are for the people involved in the collective action with regards to natural resource management.

Wade (1988; cited in Achterkamp, 2009) argues that when the resource is plenty there will be no cooperation, there is plenty of water so there is no need for cooperation. But as the resource becomes scarce people will cooperate. However, cooperation reaches a point where it does not make sense because there is no resource left to dismange (Figure 4).

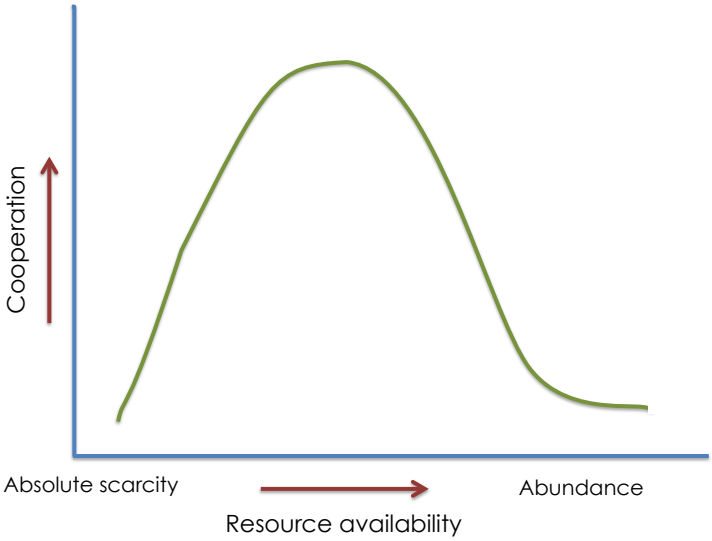


Figure 4: Graph relating value of cooperation to resource availability (adapted from Uphoff et al. (1990; cited in Achterkamp, 2009))

Currently in the Upper Kromme River catchment there is almost no cooperation between the farmers, nor is their cooperation with the governmental bodies that manage the water resources in the Kromme

River. The reasons for the lack of cooperation are currently not clear. According to Figure 4 part of an explanation can be that the water resource availability is currently still in abundance in the experience and perception of the UKRC farmers.

In research about participation in South African water resource management (WRC, 2003) it is stated that people are seen to participate because of some benefit to themselves, their family or their organisation. People join forums or other organisations because these are platforms for them to address particular issues or needs that they would not necessarily be able to address on their own. The research further states that forums that articulate a particular need and sometimes a particular interest group tend to encourage participation in broader IWRM issues, including an interest in the CMA process. Different stakes are identified by the research such as: "stakeholders are paid to participate, or indirect needs such as free meal, socialising are satisfied, but also access to power, or the safeguarding of economic activities" (WRC, 2003:32). Apart from this list of arguments pro participation, also arguments are given why stakeholders do not participate, such as: "more pressing needs than water management, disbelief that needs will be taken seriously, no incentive, no initiating space for 'real' participation"(WRC, 2003:33).

3.4.1 Factors for successful collective action

Ostrom (1990) identified eight design principles of stable common pool resource management. This design principles can be used in this research to study at what stage collective action in the UKRC is, what incentives are for the UKRC farmers to start collective action and what current obstacles are for collective action, and also the reason why those obstacles are in place. The eight design principles are:

- Group boundaries are clearly defined.
- Rules governing the use of collective goods are well matched to local needs and conditions.
- Most individuals affected by these rules can participate in modifying the rules.
- The rights of community members to devise their own rules is respected by external authorities.
- A system for monitoring member's behaviour exists; the community members themselves undertake this monitoring.
- A graduated system of sanctions is used.
- Community members have access to low-cost conflict resolution mechanisms.
- For common pool resources that are parts of larger systems: appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises.

Furthermore Ostrom (1990) claims that all efforts to organize collective action, whether by an external ruler, an entrepreneur, or a set of principals who wish to gain collective benefits, must address a common set of problems. These problems are "coping with free-riding, solving commitment problems, arranging for the supply of new institutions, and monitoring individual compliance with sets of rules." The above eight design principles can be used to address these problems. Since there is currently no collective action in the UKRC, it is interesting to look at the efforts that need be made in order to address these eight design princeples.

3.4.2 Incentives for collective action

The main theoretical incentives for collective action by the URKC in this research is that through collective action, farmers will be better able to solve water use issues within the

farmer group as well is with external users and stakeholders, namely DWA and NMBM. The theory is that as a group you can have a bigger voice than as a single farmers. Yet it should also be realized that the establishment of group does not only provide opportunities in addressing issues from the group to external stakeholders but also vice versa. The collective can be an organisational body through which DWA can better enforce water regulations, which do not necessarily secure the access to water of the current URKC farmers.

3.5 Concluding remarks

This overview is a set-up to further analyse how secure access to water of the farmers in the Upper Kromme River catchment is influenced by different factors. And how this also does affect other users. Furthermore it provides a framework on how collective action of farmers is a possible route to go in anticipating and coping with the different dimensions of water scarcity. This framework acts as the backbone for the research methodology and analysis of field and literature research results.

4 Water use in the UKRC

4.1 Description of studied farmers

This paragraph aims to give some general information on the farmers interviewed and studied in this research project. The information presented in this paragraph can help the reader to interpret the remaining study results.

4.1.1 Farmer identities within the group

A total of 26 farmers have been interviewed in Upper Kromme River Catchment. At the start 30 farmers were identified relevant for this study. It was not possible to interview 4 farmers due to planning circumstances, and transport and time limits. The analysis shown in this report will mainly give information on the interviewed farmer group as a whole, not on specific farmers including their names. Since the issues dealt with can be sensitive. The farmer community in the URKC consists mainly out of white farmers. This is also reflected in the interviews with farmers out of the 26 interviews 23 were with white farmers. These white farmers do all have an Afrikaner or English background. And mainly live with the family on the farm, one farm belongs to a big company, the owners do not live on this farm and the farm is managed by a hired person. Three emerging farmers have been interviewed. These emerging farmers represented a group of beneficiaries who work on the farm together. These three farms have been reallocated in the past five years. In contrast to the white farmers the emerging farmers do not live on the farm itself.

4.1.2 Farm size and activities

Figure 5 shows the distribution of total farm size of the studied farmer population in percentage of farms. This total farm size covers the whole property that is owned by the farmer, including: irrigated land, dry land, and mountainous catchment areas. The total farm size does not mean total arable land. This is normally a lower figure. Only beef cattle and sheep farmers use the more mountainous areas for extensive grazing.

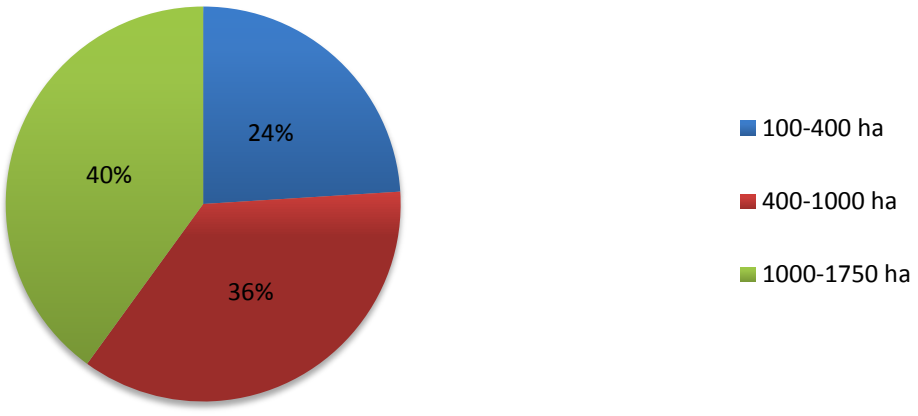


Figure 5: Total farm size (ha) distribution in % of farms

Figure 6 shows how many farms are undertaking a certain farming activity. The total number of farming activities is larger than the number of 26 interviewed farmers, because more activities can be carried out on one farm.

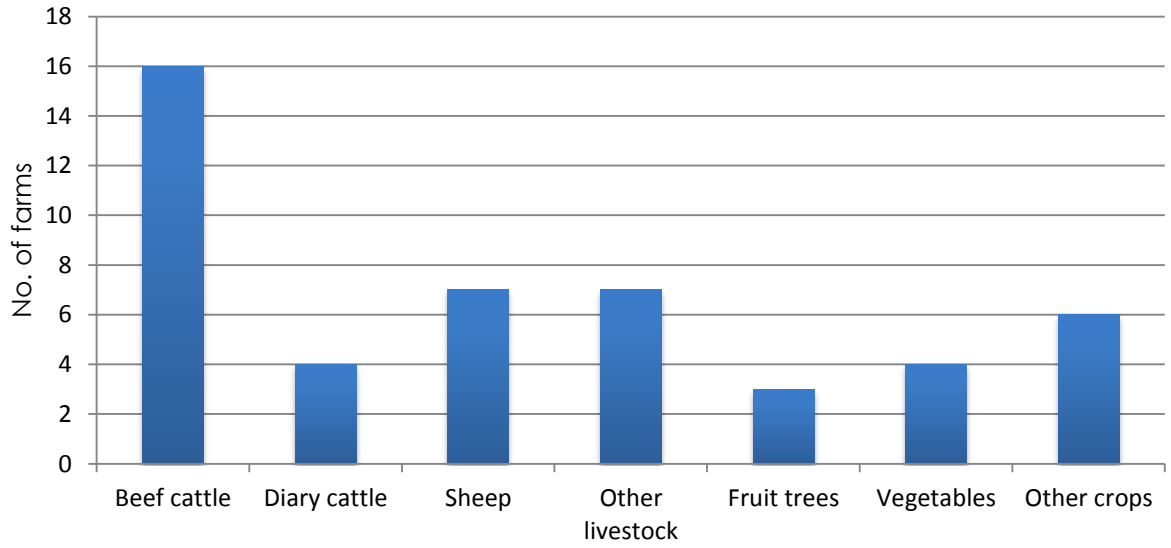


Figure 6: Number of farms with a specific farming activity

4.1.3 Water use information

Figure 7 shows the distribution of irrigated area size of the studied farmer population in percentage of farms. It also shows the total area under irrigation for each category. The total area under irrigation as indicated by the interviewed farmers is 716 ha. For comparison in Gull (2012) a figure of 690 ha is given based on farmer interviews and satellite images.

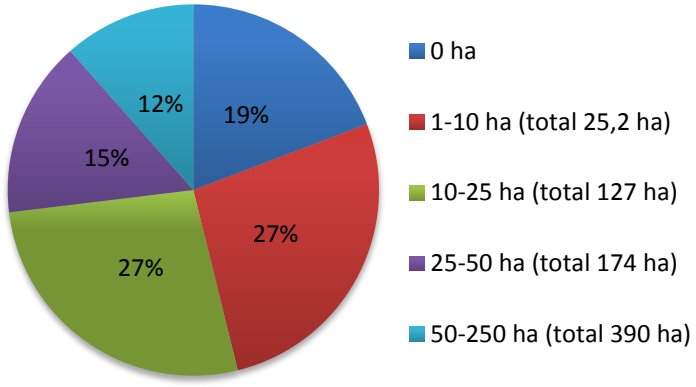


Figure 7: Irrigated area size (ha) distribution in % of farms, including total ha per category.

The farmers were also asked whether they are planning to expand their irrigation command area in the future. Half of the farmers indicated they want to do this. The farmers with currently no irrigation activities are part of the farmers that want to expand their irrigation area, and were therefor relevant for this study. All together the farmers in the UKRC want to expand to another 233 ha under irrigation (4 farmers did not mention how much they wanted to expand).

To give an indication of the water demand of the farmers, the farmers were asked to indicate the area they irrigate, how often they irrigate, how much water they apply during irrigation, how many weeks they irrigate in a normal and dry year. With this information the irrigation water usage is calculated to give an indication on a yearly basis. The irrigation water usage is calculated for a low demand scenario in a "normal/wet" year and for a high demand scenario in a "dry" year. The difference in calculation is that in a dry year the total weeks of irrigation is increased and in some cases the amount applied during an irrigation turn based on the information supplied by the farmer. The outcome of the calculation shows that for the low demand scenario the farmers in the UKRC have a water usage of ± 3,6 · 10^6 m^3 y^{-1} and ± 7,3 ·10^6 m^3 y^{-1} for the high demand scenario. For comparison in Gull (2012) a figure of 4,59 · 10^6

$m^3\ y^{-1}$ is given based on farmer interviews and satellite images. The eventual water usage for the indicated irrigation area expansion results in 1,5 $\cdot 10^6\ m^3\ y^{-1}$ for the low demand scenario and 3,5 $\cdot 10^6\ m^3\ y^{-1}$ for the high demand scenario. It should be noted that the information given by the farmer and used for this indication is susceptible to errors, since many farmers did not really know how much water they apply, and some farmers were conservative in sharing how much they irrigate since they were afraid that this information could end up in "wrong hands/ government" according to their perception.

In the chapter 2.1.3 the irrigation water use from DWA records is indicated as $2.0 \cdot 10^6\ m^3\ y^{-1}$ for the year 2000 at 98% assurance of supply (DWAF, 2004). This figure is significantly lower than the low demand scenario estimate in this study based on farmer information. One reason can be the high assurance level at which this supply is indicated, normally for agricultural water use planning this ranges between 80% and 95%. The irrigation water use at 80% assurance level will be higher than the indicated $2.0 \cdot 10^6\ m^3\ y^{-1}$, this information could only not be found specifically for the UKRC. In comparing the area under irrigation as indicated in Figure 7 with information from DWAF (2002: 50), the 716 ha from the farmer survey can roughly be split up in 624 ha pastures, 65 ha fruit trees and 4 ha vegetables. The DWAF (2002:50) (information in report seems to date back to 1994) information shows a total of 319 ha split up in 217 ha pastures, 100 ha fruit trees and 20 ha vegetables. That the area of fruit trees is lower than the DWAF (2002) information is explainable because some farmers in the Kromme stopped with fruit tree farming. But the pasture irrigation figure is significantly higher (3x) in the farmer survey. According to farmer information more farmers have started with dairy cattle, which requires more intensive pasture irrigation. The figure of 624 ha should also be taken with caution since some farmers say that they irrigate according to how much water is available. This would also mean that the high demand scenario in a dry year could be estimated to high since, some farmers might irrigate less hectares of pasture in a dry year.

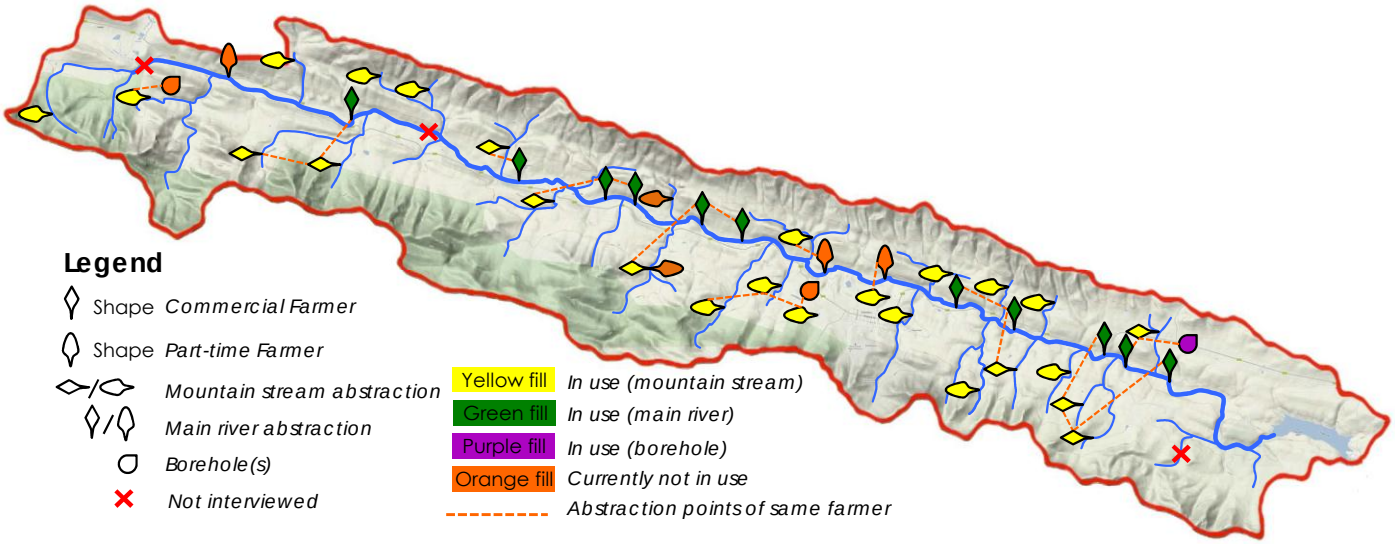


Figure 8: Spatial distribution- and source- of abstraction points, and type of farming

Figure 8 Shows the spatial distribution of the abstraction points of the interviewed farmers in the UKRC. The exact locations of some of the abstraction points can be slightly different in reality. Figure 8 also shows the type of abstraction source: mountain stream/spring, main river or borehole. And it shows whether the farmer related to the abstraction point is a commercial or part-time farmer. These two farmer descriptions do need some more clarification. The commercial farmer is the farmer that is fully and solely depending on his farming activities to sustain his income. The part-time farmer is a farmer, which is doing side activities such as,

another job or tourist accommodation and is not fully dependent on the farming activities to sustain his income. The commercial farmers are "coincidentally" the 27% of farmers as shown in Figure 7 that do have an irrigation command area between 25 – 250 ha. 4 of the 7 commercial farmers want to expand their irrigation command area. Figure 8 shows clearly as also shown in Figure 9 that almost every interviewed farmer has at least a mountain stream as abstraction source.

Figure 9 shows the distribution of water sources of the studied farmer group in the UKRC. Most farmers (54%) do have a spring/stream as their water source. In this system the water is mostly abstracted through a weir with a pipe in the stream, that brings the water to the farm by gravity. Only 4% of the farmers (one farmer) does not have a spring but relies only on the main river. The other 96% of the farmers do have a spring/stream gravity system, and some with an additional point from the main river or a borehole. It should be noted that when a farmer has multiple water sources it does not subsequently imply that he can change to different water sources, if a source runs dry. Since often the water transport systems to do this are not in place. And the water rights are also related to a specific water source, which means that a farmer cannot legally increase the abstraction from one source if his other source runs dry.

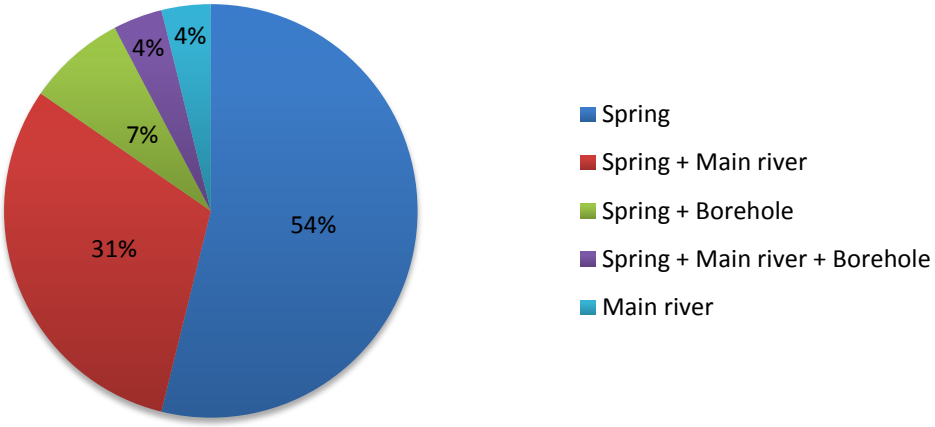


Figure 9: Water sources for irrigation

No farmer has a water meter installed in their abstraction systems from the spring/streams and main river. 54% of the farmers do have one dam or more to store flood runoff, out of this 54% 64% do have a dam that is not in the stream. Irrigation methods used are overhead sprinklers and pivot for pastures and micro sprinklers for the fruit trees and drip irrigation for the vegetables.

4.2 Interrelations between the three different water scarcity dimensions

As explained in the conceptual framework this research uses three dimensions of water scarcity namely: physical, management and political. These three different dimensions are further operationalized in the research questions and in the interviews undertaken with the farmers in the UKRC. The use of these three different dimensions is a great tool to give insights in the different sides of water scarcity and makes it possible to do specific analysis on these different sides. Yet it is also recognized that the different dimensions are an artificial construct. And that in reality it will be difficult to grasp a specific water scarcity related issue within a single dimension. As Figure 10 shows the dimensions overlap and most of the researched

topics cannot be attributed to a single dimension, but are connected to two or even all three dimensions.

The related colours in Figure 10 show which topics will be discussed under which water scarcity dimension. Under physical water scarcity the climate will be discussed as well land cover, flooding & erosion, wetlands and invasive alien plants. The latter four topics are indicated as overlapping with management water scarcity. The reason why they are discussed under physical water scarcity is because of the "natural/physical" processes that

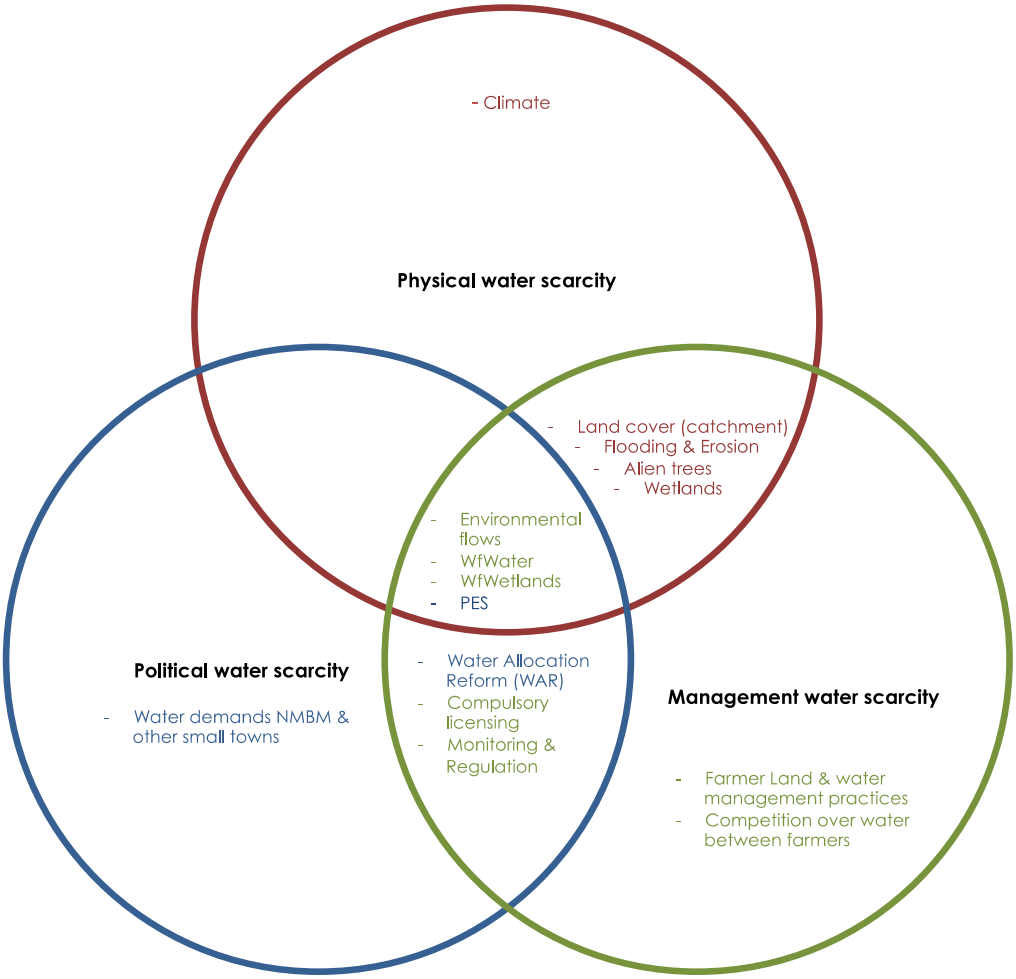


Figure 10: Interrelatedness between physical, management and political water scarcity.

are the driving forces in these topics, that may or may not be reinforced by management actions. Furthermore the management side of wetlands and invasive alien plants will be discussed under the Working for -Water and -Wetlands topics. Under management scarcity the land & water management practices of the farmer at single farm level and catchment level will be discussed. The also to the political and physical water scarcity dimension related compulsory licensing, monitoring & regulation, Environmental flows, Working for Water and Working for Wetlands will be discussed under management. Since direct impact on the farmers is through (non)-implementation of the government and is therefore a management issue from the institutional level. It is of course recognized that the decisions whether to implement or not certain interventions is often a highly political decision. This will also be taken into account under Water Allocation Reform under the political water scarcity dimension in which also special attention is given to the Water Allocation Reform (WAR) program in order to redress the inequalities from the past through the Black Empowerment program. Finally

under the political dimension the water demands of NMBM and the other towns supplied by the Kromme River dams will be elaborated on as they are holders of major share of water rights on the Kromme River system.

In Chapter 8 about collective action the different dimensions will be integrated again and Figure 10 will be used to analyse how the farmers in the UKRC do and can in future adapt their strategies on water management triggered by changes and events in for example the physical and political water scarcity dimension. In this analysis the research on water control as developed by Mollinga (2003) and discussed in the conceptual framework as having a physical, management and political dimension will also be used to show how farmers can have a positive impact on water scarcity problems as a single farmer and in a collective.

5 Physical water scarcity

5.1 Introduction

As elaborated in the conceptual framework physical water scarcity is absolute scarcity, the water resources are limited by nature. The main driving factors taking into account in this are the climate / raining patterns and land cover in the catchment areas (mountain slopes feeding the tributaries to the Kromme River). Furthermore this chapter will touch also upon alien tree invasion, wetlands, flooding and channel erosion as physical factors that do have an impact, pro or contra, on the presence of water scarcity. The aim of this chapter is to answer the sub research question: "How and to what extent does climate (change) and land cover (change) induce "physical" water scarcity problems for the farmers in the Upper Kromme River catchment, currently and in the future?".

5.2 Perceptions on past & future physical water scarcity

In the interviews farmers were asked to indicate how much impact physical water scarcity due to climate and land cover had on their farming activities in the past up till current and how what they expect in future (coming 10 / 20 years). The impact as such is, as water scarcity is regarded as a negative situation for farmers, negative. This measurement does not show the absolute reality of impact experienced by farmers, but shows how farmers perceive impact due to physical water scarcity. Negative impact can be understood as, farmers having a loss in crops / livestock, and/or reduced income because of mitigation (buying food) and adaptation (reducing livestock/ area under irrigation) measures taken by them during the period of water scarcity. From Figure 11 it can be derived that physical water scarcity had already a significant impact in the past as 30% of the farmers indicate that it had a high or very high impact on their farming activities. For the future this figure rises to more than 50% of the farmers that expect that physical water scarcity will have a high or very high impact on their farming activities.

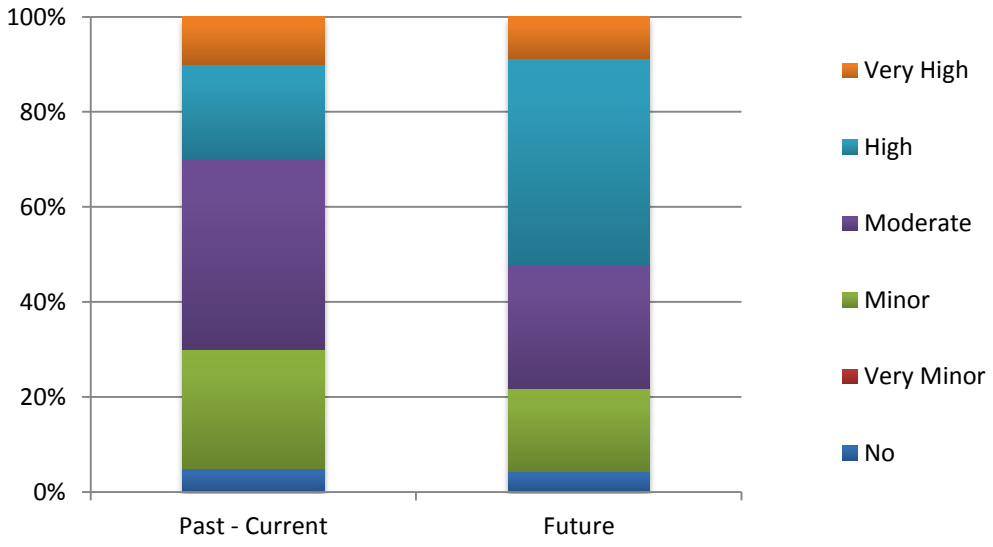


Figure 11: Graph showing the perception of interviewed farmers on past up till current and future impact of physical water scarcity on their farming activities.

83% of the farmers indicated that they have experienced an event of water scarcity in the past, which had a significant impact on their farming activities. Most of them say that the climate (dry periods / no rain) is the reason for the experienced water scarcity. By a few

farmers it is pointed out that if the natural Fynbos vegetation in the catchment gets to dense this also has a negative impact on water availability in the side streams. 25% of the farmers say that climate change will have a negative impact on water availability in the future, this also explains the difference between the past up till current and future perception on water scarcity as shown in Figure 11. During the interviews with (Personal communication EXP1, EXP2, NMBM1 and GOV1)[5] it was also mentioned that physical water scarcity is a major constrain on water developments in the area, because of fluctuating rainfall and higher summer temperatures. Figure 12 shows the information from the graph in Figure 11 in a spatial

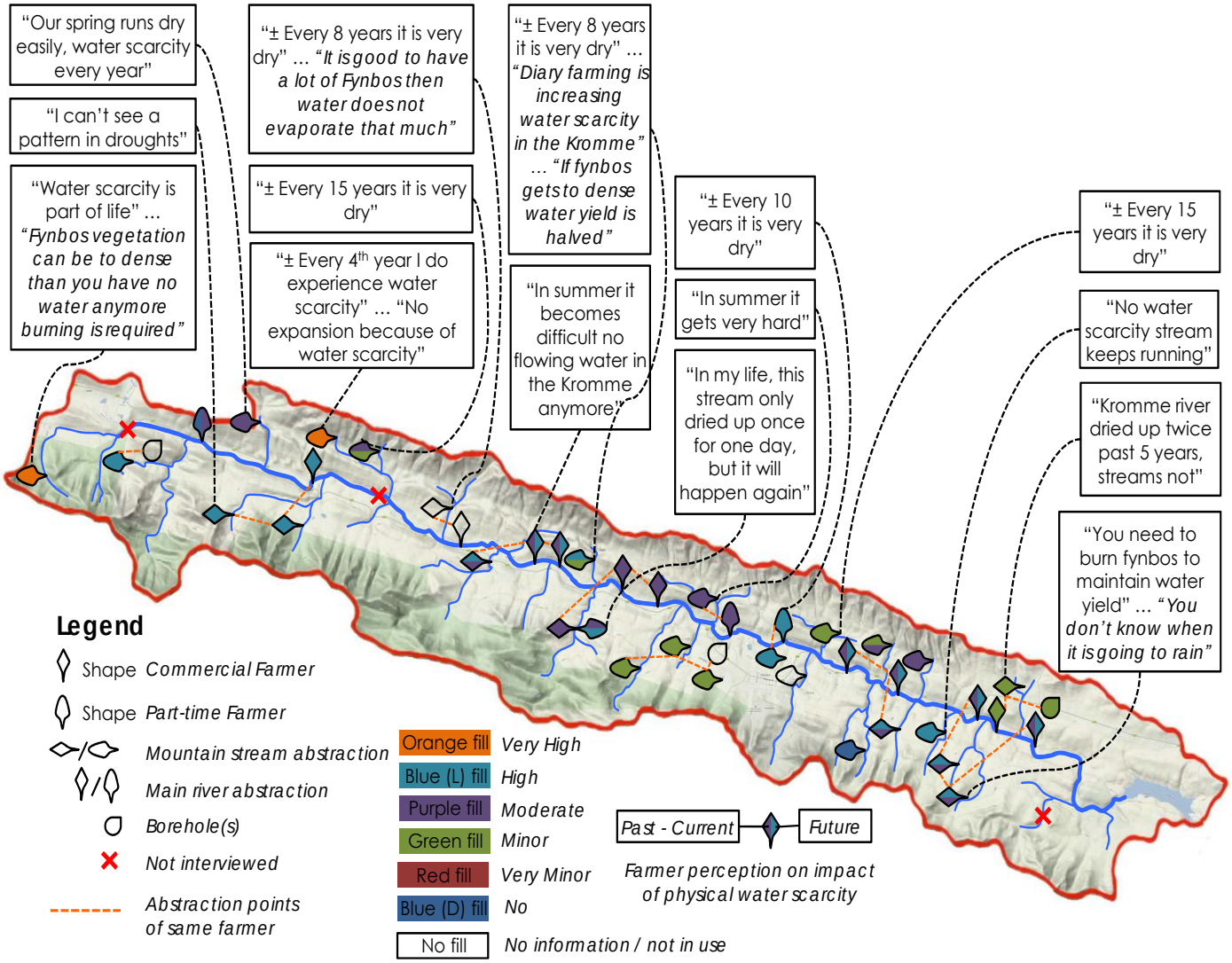


Figure 12: Map showing the perception of interviewed farmers on past up till current and future impact of physical water scarcity on their farming activities. The map highlights farmer quotes from interviews.

manner. Furthermore it also shows quotes from farmers captured during the interviews. Three of the seven commercial farmers with an abstraction point on the main river expect a higher impact of physical water scarcity on their farming activities in the future. Figure 12 shows each abstraction point, the perception of the farmer on water scarcity was asked in general and not specific for each abstraction point. This makes analysis of differences between mountain streams and main river abstractions complicated.

[5] Detailed information of interviewees can be found in Annex II

It can be concluded that physical water scarcity is not something strange to the farmers in the Kromme. Most farmers acknowledge that farming and water scarcity are inclusive towards each other in the Upper Kromme River Catchment. And that as a farmer you need to find a suitable way for yourself to cope with it. Looking to Figure 12 it is interesting to see that two of three farmers with boreholes indicate the impact of physical water scarcity relatively lower than the other farmers without boreholes. These boreholes provide a reliable source even when streams run dry, yet because of irrigation system limitations the farmers are probably not able to use their boreholes to provide the whole area normally irrigated with water from the streams/river.

In the following paragraphs the perception of farmers on this topic, will be put alongside more factual information (when available) to compare the farmers' perception with scientific based information.

5.3 Climate

This paragraph will deal with two topics namely irregular raining patterns, which came forward as an important factor influencing on physical water scarcity. Secondly climate change will also be dealt with. In this the perceptions of farmers on these topics are compared with findings from literature.

5.3.1 Irregular raining patterns

As elaborated in chapter 2 the highest and lowest value of annual measured rainfall in the catchment valley floor differ significantly with 1082 mm as highest and 286 lowest. From the interviews it is derived that 88% of the farmers say the climate has a major influence on water availability through the irregular raining patterns in the area. Some farmers also mention that the rain season is starting later than it used to be. And very few farmers say that rain intensities have increased as also drought intensities. Although not specifically asked for during the interviews, many farmers mentioned that the droughts come in cycles. Patterns mentioned vary between 15 and 4 year cycles (Figure 12). It was not clear on basis of what they made these statements, and according to the high variance between farmers it is coming from the farmers implicit knowledge on the local climate system and past experiences.

Another important factor that come forward out of the interviews. Is that the farmers on the Suuranyees Mountain side (northern part of the catchment with slopes facing south) mention more often that their streams run dry or low during summer. As for farmers with streams from the Tsitsikamma Mountains (southern part of the catchment with slopes facing north) this is the opposite their streams keep generally running even during droughts, as the farmers say. The most logic explanation for this is that the Tsitsikamma Mountains are the first major mountain range from the Indian Ocean side and get there for most rain coming from the Indian Ocean in the south (See Annex V). One farmer also mentioned that Tsitsikamma means "a lot of rain".

5.3.2 Climate change

Climate change is a worldwide debated issue, opinions differ and so does scientific research. The opinions of the interviewed farmers are as follows: 25% say that climate change has and will have a negative impact on water availability. The major part 67% says they do not know whether climate change has an impact on this. And 8% say climate change is not happening.

South Africa is viewed as a water-stressed country with an average annual rainfall of 500 mm, it is situated in a region with increasing levels of water scarcity and water-quality problems, compounded by population growth and issues of social and economic development. The introduction of additional stresses on water resources arising from potential climate change can intensify these problems over much of the country. (Dennis & Dennis, 2012: 417). Lumsden et al. (2009) present a study on the potential changes in hydrological relevant statistics of rainfall in Southern Africa (South Africa, Lesotho and Swaziland) under conditions of climate change that could be observed this century. As basis they use the at that date most recent IPCC global climate scenarios. The study was taking place under auspices of the Water Research Commission in South Africa and build on earlier climate change research done in South Africa. Results are presented on maps on the basis of quaternary catchments, which means that the Kromme River sub catchments have individual indications. These maps show ratio of different parameters compared to present situation, Table 1 shows these ratios for the Upper Kromme River Catchment.

Table 1: Future to present ratios of different hydrologic parameters in the Upper Kromme River Catchment under the conditions of climate change (derived from maps in Lumsden et al. 2009)

Parameter	Ratio	Direction of change
Ratios of intermediate future (± 2046 – 2065) compared to present (±1960-1990)		
Mean annual precipitation	0,8 - 0,95	Decrease
Variation of annual precipitation	1,2 - 1,4	Increase
Total number of days with no rainfall	No change	-
Total number of days with rainfall > 5mm	0,8 - 0,95	Decrease
Total number of days with rainfall > 10mm	0,8 - 0,95	Decrease
Total number of days with rainfall > 20mm	0,6 - 0,8	Decrease
Ratios of distant future (± 2081 – 2100) compared to present (±1960-1990)		
Mean Annual precipitation	0,6 - 1,05	Most likely decrease

On a country scale it is shown in Lumsden et al. (2009) that the eastern part of South Africa shows an average increase in rainfall, but also higher annual variability. The western part of the country from south to north shows the biggest decrease in rainfall figures. Specific for the Kromme river region all the figures in Table 1 do show a decrease in amounts of rain. And an increase in the annual variation of precipitation, which is already considered as large in the area. Also the relatively large decrease on total number of days with rainfall > 20 mm could have an impact on the hydrology in the area, as rain events generally need to be larger than 20 mm in order to create direct runoff in the streams and main river. This in particular can have an impact on the filling up of the Churchill dam, and farm dams in the area.

The general conclusion that Lumsden et al. (2009) derive form their research is that if correct the patterns would result in a decrease in flows and an increase in flow variability, since changes in precipitation are amplified in the hydrological cycle. Using the information presented in Lumsden et al. (2009) should be done with caution, since climate change on itself is a heavily debated issue and for the study global models are used, which are then downscaled with supplementary local information to quaternary catchment scale. The research of Lumsden et al. (2009) does not give information about possible shifts in the seasonal timing of rainfall, changes in extreme rainfall events, or impacts of climate change on temperature and potential evaporation. Midgley et al. (2005; cited in Mukheibir, 2008) states that specifically for South Africa, temperature is expected to increase by

approximately 1,5 °C along the coast and 2-3 °C inland of the coastal mountains by 2050. And along with temperature increases, changes in evaporation, relative and specific humidity as well as soil moisture are anticipated.

Dennis & Dennis (2012) state that the potential impacts of climate change on water resources and surface hydrology for Southern Africa have received considerable attention. But that little research on climate change and groundwater resources in South Africa has been done. The study is again on country scale and uses the DART method for analysis. The DART index is a regional index that combines: Depth to water level change, Aquifer type, Recharge and Transmissivity. According to the scenarios used in this report climate change will have a little negative effect on groundwater resource availability in the region of the Kromme River Catchment. In the light of the currently very low exploitation of ground water in the Upper Kromme River Catchment it is not so relevant to draw conclusions from this on possible impacts for farmers.

In looking to both the farmers' perception on climate change and the scientific research. It is arguable that a major part of the farmers (75%) do have little acknowledgement on the impacts of projected climate change on their farming activities. Mukheibir (2008) underlines this in general for the South African water and agricultural sector, he states that education and awareness is greatly needed on the topic of climate change.

5.4 Land cover

This paragraph is split up in three main themes namely: 1) fynbos as dominant catchment vegetation; 2) alien invasive plants; and 3) wetlands. As shown in Figure 10 these topics fall both within physical- and management- water scarcity dimensions. This paragraph will deal with the physical processes behind the different land covers and the relation to hydrological cycle. In this it will compare farmers perceptions with literature findings. The management side of alien invasive plants and wetlands will be elaborated on in Chapter 7.6 under the topics of Working for Water and Working for Wetlands.

5.4.1 Dominant catchment vegetation: fynbos

In the catchment area of the Upper Kromme River Catchment fynbos is the dominant vegetation. The fynbos region in the Western and Eastern Cape provinces in South Africa is one of the world's six floral kingdoms (Wilgen, 2009). Multiple authors show a link between the biomass density of the fynbos in catchments and the water yield[6] from that catchment, the denser the fynbos is the less the water yield will be is the main relation brought forward (Hope et al. 2009, Wilgen 2009, Scott 1993, Lindley et al. 1988). Wilgen (2009:355) shows that this current dominant opinion was totally opposite from the dominant opinion in the first half of the 20th century: "the 1926 Drought Investigation Commission stated that veld burning was harmful, especially in important water- shed areas, and they recommended that such areas should be protected from both grazing and fire. Thus, for much of the period between the 1920s and 1968, official policy was to protect fynbos areas from fire". Later on in 1968 a policy of prescribed burning was introduced. After new research came into the domain that argued that fire in certain cycles (± >10 years) was not harmful to biodiversity in the fynbos vegetation, but that fynbos is fire-adapted and fire dependent. And the observation that protection of fynbos from fire could have a declining effect on stream flow. The primary objective of this prescribed burning policy was to maintain a maximum permanent sustained flow of silt-free water (Wilgen, 2009). Currently prescribed burning is getting more to the

[6] Water yield is expressed as the ratio between P (precipitation) and Q (stream flow)

background as other research has shown that wildfires kept dominating the amount of fynbos areas burnt, and also because financial support to manage prescribed burning declined (Wilgen, 2009).

The reasoning behind optimising water yield in fynbos catchments through burning of fynbos, is based on the expectation that the reduction of plant biomass by burning will increase water yield by reducing transpiration and rainfall interception (Lindley et al. 1988). Lindley et al. (1988) present an experimental study on this topic and show that water yields did increase with an average of 16% after burning in cycles of 6 and 12 years. They cite also research from Bosch et al. (1986; cited in Lindsley et al. 1988) that show larger effects in well managed fynbos areas where annual increases of more than 180mm in water yield were shown in the first year after burning of old (> 30 year) fynbos vegetation. On the time in between two burnings it is argued by Wilgen (1981; cited in Lindley et al. 1988) that 6-year burning cycles have eventually a detrimental effect on fynbos vegetation in that the majority of seed-reproducing shrubs cannot mature and produce seed between fires. As a result, areas with short fire cycles are depleted of tall shrubs.

Scott (1993), apart from looking at water yield, also looks at the effect of fire on storm-flow, erosion and soil water repellence. He concludes that for the fynbos the different study catchments did not show an increase in storm-flow only a very little increase in sediment load. While annual total flow increased on average with 16% in the first year following the fire, which is in line with the research from Lindley et al. (1988). Soil water repellence increased slightly after burning. In contrast to findings in a catchment with forestry vegetation, in which soil water repellence, storm-flow and erosion increased hugely after burning. Scott (1993: 428) concludes on three important aspects of fire in catchments, namely:

1. That a high level of soil heating, which is a function of fuel load, fuel and soil wetness, site and weather conditions, positively relates to levels of induced soil water repellence and to post fire soil erodibility. Prescribed burns, which are only likely to be applied after rains, are unlikely to fully combust all fuels or litter, and cause widespread, serious soil heating.
2. Vegetation types have a different effect on post fire soil water repellence, storm-flow and erosion. While afforestation has a high positively related effect, in fynbos fire caused only a minor increase in these factors.
3. Wildfires are more likely to occur in hot, dry weather conditions and when soil and fuel moisture are low. Therefore wildfires pose the greatest risk in amplifying post fire hydrological responses.

Hope et al. (2009), another experimental study on the relation between fynbos vegetation biomass and water yield, concludes that increased biomass in the lowland region in the catchment had a disproportional effect on a decreased water yield. Compared to the upland portion of the catchment where this link was less evident.

Farmers in the UKRC were asked whether they see a link between the vegetation (type, density) in the catchment areas (mountain catchments that feed the streams) and water yield. 71% of the farmers stated that they see a link between vegetation in the catchment and water yield. Most of the farmers attributed this to Black Wattle in the catchment (see next paragraph), 21% of the farmers state that if the fynbos gets too dense water in the streams will be reduced and that burning is required to manage this (see also Figure 12). 29% of the

farmers do not know if there is a significant link between vegetation in the catchment and water yield.

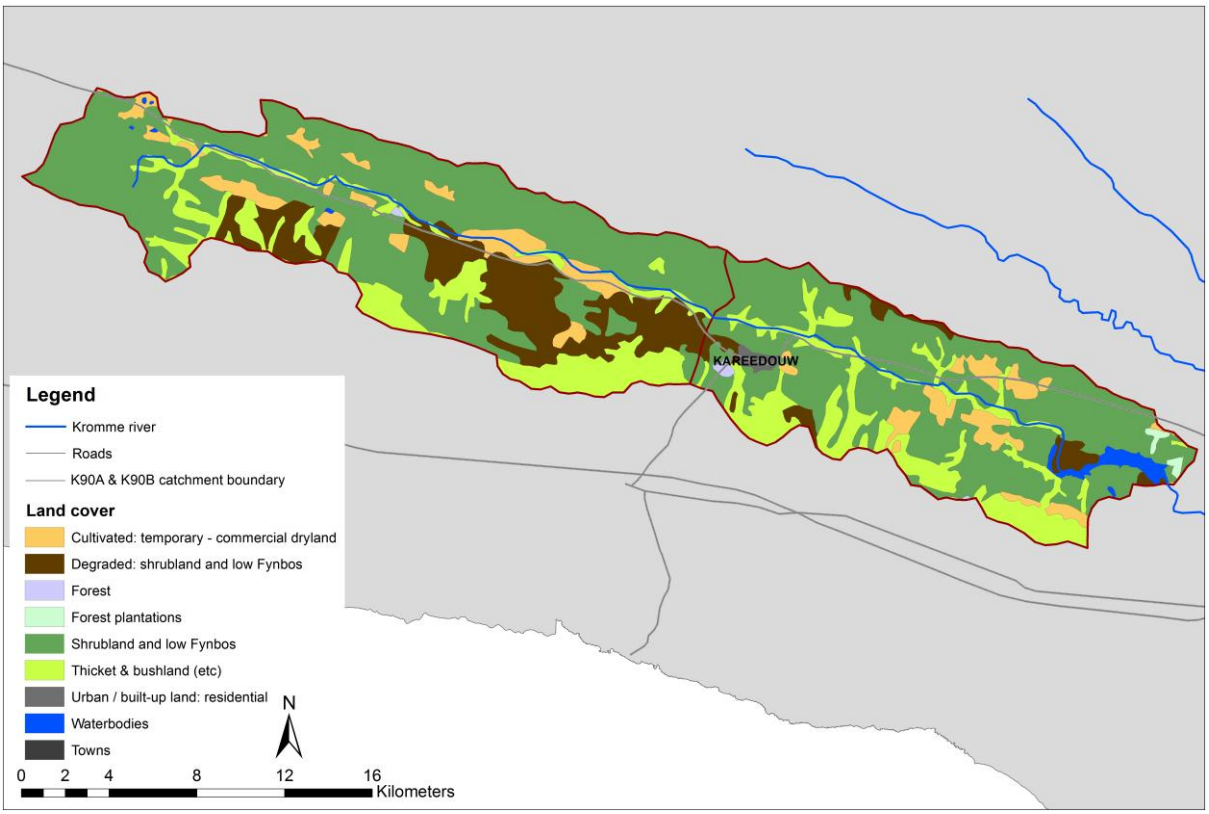


Figure 13: Land cover map of Upper Kromme River Catchment (Governmental data, undated)

Comparing the above literature findings with the farmers perceptions, only 21% of the farmers came up themselves with the reasoning that fynbos vegetation can reduce water yield. And one farmer even states the opposite: 'that it is good to have a lot of fynbos then water does not evaporate that much' (Figure 12). The question asked in general terms (not specific for fynbos vegetation) showed that Black Wattle is most often linked to reductions in water yield. Knowledge about the importance of burning in fynbos catchments in relation to water yield and the importance of timing and burning cycles as stated by Scott (1993) and Lindley et al. (1988) seems not to be widespread throughout the farmer community. In a water stressed area as the UKRC this topic should be taken into account in catchment management planning in order to cope with water scarcity problems both for farmers and NMBM. Since on catchment level potential impact of very dense fynbos vegetation in reductions on water yield can be substantial. Figure 13 shows that 90% of the UKRC is covered by fynbos / shrubland / bushland. Although these data might be out-dated and invasive alien plants are not included. Aligning this figure on fynbos cover with the figures on water yield increase after fire as shown above (Lindley et al. 1988, Scott 1993) shows the importance of fynbos management in relation to water yield in the UKRC. It is difficult to give an indication in volumes of water with the information available, it is recommended to study this in more detail.

5.4.2 Invasive alien plants

When speaking about invasive alien plants in South Africa, most people in the work field will connect it to the Working for Water program. This program is also initiated in the Kromme River basin and seeks to eradicate alien tree species that invade the area. This is mainly done

to enhance the water yield, to generate employment and to protect the ecosystem. This paragraph will not go into the management part of alien clearing, this will be dealt with in Chapter 7.6.1 This paragraph will show viewpoints on the effects of invasive alien plants on water yield, in relation to physical water scarcity.

The idea that invasive alien plants could have negative impacts on stream flow was first raised in South Africa in 1977 by mr. Kruger (Wilgen, 2009). Currently it is stated in multiple articles that invasive alien plant species reduce the availability of water through a reduction in total annual and low-season stream flow (Görgens & Wilgen, 2004; Cullis et al. 2007; Salemi et al. 2012; Wilgen, 2009). The water yield reductions reflect increases in transpiration and interception caused by alien vegetation, consequently leading to lower flow of water from soil storage to groundwater storage, sustaining the base flow. Or stream flow reductions of invasive alien plants in the riparian zones. In South Africa different nested and paired catchment experimental studies have been done on the effect of (alien) riparian vegetation on water yield. While the degree of effect differs per study they all show a decrease in annual stream flow in places that have been invaded by invasive alien plants compared to the natural / baseline vegetation (Salemi et al. 2012). Görgens & Wilgen (2004) indicate that reductions in the long-term mean annual runoff are in the order of 100-300 mm/year[7].

In the UKRC the dominant alien vegetation is Black Wattle. This tree typically produces large quantities of seeds and releases them on ripening. The seeds are hard-coated and accumulate in the soil. The seeds are spread along rivers, by moving soil around, or by birds. Soil-stored seed banks are stimulated to germinate in dense stands by fire (Wilgen, 2009).

In Salemi et al. (2012) it is stated that most studies on the topic focus mainly on stream flow, not on interaction with groundwater, soil water balance and storm flow patterns. Since the hydrological system is interconnected these narrowed stream flow studies give a limited and incomplete understanding of what is happening in reality.

Interview results from the UKRC farmers shows that 54% of the farmers indicated Black Wattle as an important water yield reducing vegetation type, on the general question whether farmers see a link between the vegetation (type, density) in the catchment areas (mountain catchments that feed the streams) and water yield. A next question specifically asking whether they see a link between invasive alien plants and water yield shows that 91% of the farmers indicate that invasive alien plants have a negative effect on water yield in general. Most farmers stated that Black Wattle uses a lot of water out of the streams. A lot of farmers also experienced this by themselves. The figure of 91% is surprising in relation to the earlier mentioned (Chapter 4.1.4.1.) 29% of farmers that do not see a link between catchment vegetation and water yield at all. 9% of the farmers are not sure whether invasive alien plants (more specifically the Black Wattle) is bad for water availability, because they argue that Black Wattle also "generates" rain. They stated that the rainfall became less after clearing: "*Since they take out all the trees there is definitely a climate change. There is less rain, with the black wattle there was much more rain*".

Comparing literature findings with the perceptions of farmers, the scientifically dominant opinion that invasive alien plants reduce the water yield compared to the natural vegetation, is widely acknowledged throughout the farmer community in the UKRC. This does

[7] Found in high-rainfall zones (>1100 mm/year) catchments, rainfall in the UKRC is on average lower than this.

not subsequently imply that the farmers are all positive about the clearing by the Working for Water program. This will be further elaborated on in Chapter 7.6.1.

It can be concluded that the relevance of this topic for the UKRC is huge since large areas in the catchment are invested with alien vegetation. In Gull (2012) a figure of 3.712 condensed ha[8] of IAPs in the UKRC is indicated. Combining this with a stream flow reduction of 100-300 mm ha^{-1} y^{-1} (Görgens & Wilgen, 2004) ammounts to a potential decrease in water yield in the UKRC of $3,7 \cdot 10^6$ m^3 y^{-1} - $11,1 \cdot 10^6$ m^3 y^{-1}. Since average rainfaill in the UKRC is lower than in the study areas of Görgens & Wilgen (2004) decreases in water yield will probably be at the lower side of indicated range.

5.4.3 Wetlands

Quite similar to the Working for Water program, the South African government has also introduced the Working for Wetlands program. This program aims to protect and restore wetlands. This paragraph will not yet go into the management side of wetlands, which will be dealt with in Chapter 7.6.2 The aim of this paragraph is to show the hydrological functions of the wetlands in the UKRC and to show how farmers' perceptions and scientific research compare to each other on this topic.

Extensive research on wetlands in South Africa has been done as presented in the Wetland Management Series under the auspices of the Water Research Commission. In Kotze & Ellery (2009) it is stated that the land use in the UKRC and wetlands is resulting in the degradation of these wetlands through erosion, which threatens both water quality and water security. The encroachment of Black Wattle is adding to this deterioration. Historically the peat basins in the K90A and K90B catchments covered a total area of 547 ha which has decreased to 147 ha of which ± $^1/_3$ is also critically impacted. It is recorded that some high rainfall events can have a high impact on wetland degradation; a head cut moved back 500 m into a wetland in a high rainfall event in 1974. In 1965 flood waters swept away orchards and fences, farmers response was the raising of river banks in an attempt to keep flood waters at bay. These earthworks eventually damaged the wetlands and resulted in channel erosion (Kotze & Ellery, 2009).

Kotze & Ellery (2009) state that in their intact state, the Kromme River wetlands have little direct economic value to farmers as the grazing potential is low and the wetlands are not directly utilised for their products. Consequently the wetlands and riparian zones have been extensively transformed for the cultivation of pastures and fruit orchards. This transformation greatly threatens the palmiet-dominated peat basins and has resulted in the poor condition of these areas. A further contribution to the poor state is the erosivity of the sandy soils. Kotze & Ellery (2009) state furthermore that ecosystem services provided by the wetlands such as flood attenuation, stream flow regulation and sediment trapping are important in terms of protecting the water resource and ensuring a sustained supply of good quality water to NMBM through the two dams in the lower part of the Kromme River system.

Kotze & Ellery (2009) present a WET-Health assessment based on Macfarlane et al. (2007). The WET-Health assessment shows how far a system has deviated from its historical undisturbed reference condition. This is assessed for three aspects namely: "hydrology, geomorphology and vegetation". Results of this assessment after the 2006 and 2007 floods are shown in Annex III. Separated for three sub basins in the K90A catchment (see Figure 29 in Annex III). The main

[8] Condensed ha is a ha with 100% IAP cover, area infested combined with related canopy cover of IAPs make amount of condensed ha.

conclusions of the WET-Health assessment are that the most upstream basin of assessment is largely un-impacted. This is also the largest wetland (101 ha). The other two basins (together 46 ha) of assessment are seriously impacted by erosion and degradation. Headcut erosion is one of the biggest threats to the wetlands in the UKRC (Kotze & Ellerly, 2009).

Next to the WET-Health assessment Kotze & Ellery (2009) also show a rapid assessment of the ecosystem service delivery of the wetlands based on the framework outlined in the WET-EcoServices tool (Kotze et al., 2007). The assessment was undertaken in May 2006 and repeated in March 2007 in the Upper K90A catchment. The outcome and explanation of these assessments can be found in Annex IV The main conclusions are that the most upstream wetland at Krugersland (Basin 1 see Annex IV) is providing the most eco system services and scores mostly moderately high on services as flood attenuation, stream flow regulation, sediment trapping, erosion control and water supply for human use. Furthermore it is indicated that losses on ecosystem service delivery on these points can be anticipated as substantial if head cut erosion is not prevented through rehabilitation structures (Annex IV).

From the Ecoservices assessment it is not completely clear how stream flow regulation must be interpreted. It is described as: "Streamflow regulation refers to the sustaining effect of a wetland area on downstream flow during low-flow periods" (Kotze et al., 2007:39). Although in the same report it is also stated that wetlands clearly do not generate water. All wetlands clearly do not generate water. All wetlands are users of water through evaporation and transpiration, and in some wetlands this may be considerable. This clearly limits the potential of wetlands to contribute to stream flow in low-flow periods (Kotze et al., 2007:39). Bullock & Acreman (2003) did a study on the role of wetlands in the hydrological cycle. They analysed 169 research studies on this topic. According to their main conclusion the general viewpoint that wetlands act like a sponge and release water during dry periods is put under pressure, because almost all studies indicate that the wetland (also specifically for floodplain wetlands) increases evaporation and also decreases outflow during dry periods compared to other land uses.

Perceptions of farmers in the UKRC on this topic show that 70% of the farmers link wetland degradation (erosion, conversion into agricultural fields, encroachment with alien trees) to a decreased water availability in the catchment, especially for those using water downstream of the wetlands (NMBM was often mentioned). Furthermore some farmers stated that the wetlands are good for flood attenuation, water quality and biodiversity. 30% of the farmers indicate that they do not know whether the degradation of wetlands has a positive or negative effect on water availability. They think that the wetlands also use a lot of water. Moreover for farmers themselves it is very case specific whether the wetlands are positive or negative in contributing to cope with water scarcity problems, it is very dependent on the location of the farmer and the water rights the farmer has. For example if the farmer can pump from the wetland it is most likely positive because the wetlands increase water storage and raise the water table. Rising of the water table is also good to prevent an accelerated drainage from adjacent lands due to incised or eroded and lowered riverbeds. A couple of farmers use these services generated by wetlands at the moment in the UKRC. It can definitely not be said that farmers downstream of wetlands have more water available during dry periods from the main river. Also the effect of the gabion structures on water outflow from the wetland during dry periods is unclear, but might be assumed that the gabions prevent outflow and so water is mostly drained by evaporation from the wetland itself. Although in the Kromme detailed studies or undertaken on the hydrological functions and ecosystem services of the wetlands. In the objectives of doing wetland rehabilitation it is stated as most important

to enhance water quantity and water quality supply to NMBM. Which seems not based on evidence that wetland rehabilitation is doing this, but more on the general accepted idea that wetlands do this. This is argued in Bullock (2003) to be a huge misconception.

It remains difficult to give waterproof statements on wetlands in the Kromme and water availability for farmers in terms of stream flow regulation. And it is definitely impossible to give volumetric indications on decreased or increased stream flow. Apart from the controversial stream flow regulation the wetlands do also provide other ecosystem services such as flood attenuation and preventing erosion. This will be discussed in the next paragraph.

5.5 Flooding and channel erosion

Extreme rainfall events and subsequently flooding are frequently experienced phenomena in the Kromme River Catchment. It can have significant impact on water scarcity problems for farmers. After flooding farmers often find that their abstraction systems are damaged or completely washed away. Another effect of flooding is that it accelerates erosion. As mentioned earlier a single high rainfall event in 1974 made a head cut in the river move 500 m in the upstream direction. Erosion caused by flooding leads to lowering of the riverbed. Which on its hand drains water faster away from adjacent farming lands. As argued above wetlands prevent this and do have a sustaining effect on groundwater levels. One farmer stated this same reasoning: "*Wetland degradation is a problem for farmers, because it lowers the water table, it also creates erosion because of this. The quality of water is also going down*".

The Kromme River is heavily eroded and incised at many places. Some farmers also stated that the clearance of invasive alien plants out of the riverbed also accelerated the erosion: "*…The Black Wattle are destroyed, I don't know if this is very successful. Shortly after black wattle clearing, the Kromme river became deep, before I could drive through not anymore now*". Although no studies have been done on this, it seems a reasonable argument that if the wattle is cleared and no other vegetation is put back or grows back naturally to hold the soil together erosion can increase. One farmer stated that the riverbed decreased by approximately 1-2 meters the last 7 years after the clearing work by Working for Water. It should be noted that a situation with Black Wattle vegetation is not preferred either, because of the very shallow root system of the black wattle which also makes it susceptible to increasing erosion during floods, yet a system without any vegetation, as is generated after alien clearing without re-vegetation is perceived as even more worse. It was also mentioned by the DEA area manager (Personal communication, GOV3) that after the 2007 floods farmers could apply for flood damage disaster subsidies at the DoA. One farmer channelled the Kromme River for about a kilometre, with funding of nearly a million Rand from the government. Using these kind of subsidies in this manner is rather contra productive in mitigating future flood impacts. An example of both a positive and negative effect of a wetland in relation to flooding is illustrated at one farm after the July 2012 flood. This flood lead to the siltation of the abstraction point on the main river which is situated in a wetland. Sediment from upstream was trapped in the abstraction hole and lead to a decrease in capacity of the abstraction hole. The farmer stated that if he is not allowed to empty the hole in the wetland he cannot use his water rights to its full extent for that abstraction point, because his irrigation system is functioning on the former much larger water holding capacity of the hole in the river. Yet because of the wetland, there is no erosion on his pastures. But again because of the wetland the farmer "lost"(temporarily) 12 ha of his pastures because of sedimentation. At some parts of his land half a meter of sandy soil was deposited, just before the start of the wetland. The wetland slowed the water down and made the water spread

throughout the floodplain, which subsequently lead to the sedimentation of the soil particles in the water. This example shows the love-hate relationship between farmers and wetlands. It depends on the management of the farmer and regulation of this management in what kind of way the farmer will deal with such situations and what kind of effects this will have in the future, this will be discussed in chapter 6.4.

The effects of flooding and erosion on physical water scarcity cannot be determined precisely, but it is more than reasonable that the erosion leads to quicker drainage of the catchment and more specifically of adjacent lands to incised river beds after rain events. Apart from the fact that farmers are at risk of losing their agricultural land from erosion, more irrigation is required to keep the soil-moisture content high enough for healthy plant growth compared to a situation in which the groundwater table would not have been lowered. A completely different discussion whether farmers should be farming at all in the floodplains because of the possible negative effects on wetland and river degradation falls outside the scope of this study. Yet one farmer who himself is not farming in the floodplain but in the catchment area states very clearly: *"You can't farm on the edges of the Kromme, that will cause erosion. You should stay out of the banks of the Kromme River"*.

5.6 Conclusion

In this chapter climate (change), catchment vegetation, invasive alien plants, wetlands and flooding and erosion have been discussed. The purpose of this chapter is to answer the sub question: "How and to what extent does climate (change) and land cover (change) induce "physical" water scarcity problems for the farmers in the Upper Kromme River catchment, currently and in the future?". In the perception of most farmers in the UKRC these physical factors did, do and will have a high impact on water scarcity problems (Figure 11 and Figure 12). In comparing the perception of the farmers and literature findings some imbalances can be seen. While literature indicates climate change specifically as a large threat, 75% of the farmers in the UKRC display a limited awareness on the impacts of projected climate change on their farming activities. The same accounts for the opinion on the effect of the dominant catchment vegetation, fynbos, on water yield. Knowledge about the importance of burning in fynbos catchments in relation to water yield and the importance of timing and burning cycles as stated by Scott (1993) and Lindley et al. (1988) seems not to be widespread throughout the farmer community, despite its importance in relation to water supply for farmers and at a catchment scale to NMBM. Invasive alien plants are in the perception of the farmers the biggest threat, in literature the effects of invasive alien plants on water yield are also indicated as significant. In contrast to invasive alien plants, the wetlands and the related flooding and erosion are not widely perceived to have a big impact on water scarcity problems. The opinions on wetlands differ in the UKRC farming community. This can be attributed to the fact that wetlands do both give positive effects such as protection against erosion, but on the other hand do not provide much value, in the perception of the farmer, since the farmer cannot use it as farmland and the wetlands do during floods also lead to sedimentation problems. Yet in the long term the degradation of the wetlands poses a great threat to the farming activities in the UKRC. What recently is coming more to surface is that the clearing of alien plants specifically in the floodplains might adverse erosion and the destructive effects of that on the URKC river system.

It is difficult to determine the effects of the different physical factors on water scarcity in absolute terms, specifically for the UKRC. Using estimates based on literature findings shows that the decreases in water use through high dense fynbos vegetation and invasive alien plants, amounts to an order of magnitude that is similar to the water use in total by the

agricultural sector in the UKRC. Climate change and wetland degradation can even amplify these physical water scarcity factors. All the above stated physical water scarcity factors demand a response of the farmers in terms of management in order to cope with water scarcity. This shows that the physical- and management- water scarcity dimension are largely intertwined.

6 Farming practices and water scarcity

Farming in the Upper Kromme River Catchment is highly dependable on irrigation. This chapter will elaborate on the interview findings around the water and land management practices of farmers. And how these practices positively or negatively influence on water scarcity on single farm- and catchment- scale. First the general perceptions of farmers on water scarcity induced by farming practices will be discussed. This will be specified into three sub themes, namely: water management, land use and competition over water resources between farmers.

6.1 Past and future perceptions at single farm level

In the interviews farmers were asked to indicate how much impact their own land and water management practices and those of other farmers influence on water scarcity problems for them. For example through the irrigation systems in place and their related water use efficiency and competition between different water users. Farmers were asked to indicate this impact for the past up till current time-period and what they expect in future. The impact as such is, as water scarcity is regarded as a negative situation for farmers, negative. This measurement does not show the absolute reality of impact experienced by farmers, but shows how farmers perceive impact due to farm management practices. Negative impact can be understood as, farmers having a loss in crops / livestock, and/or reduced income because of mitigation (buying food) and adaptation (reducing livestock/ area under irrigation) measures taken by them during the period of water scarcity. Figure 14 shows the perception of farmers on how their own farm practices impacts on water scarcity problems. It can be derived from this figure that in the past up till current most farmers perceive their own practices as having no negative influence on water scarcity problems. For the future it is expected that it will change. Some state it will become less because they will improve on their practices others say that it might get a slightly higher impact, because it will be expensive to maintain the irrigation systems. And because of more physical scarcity more costly interventions in management of the water are required.

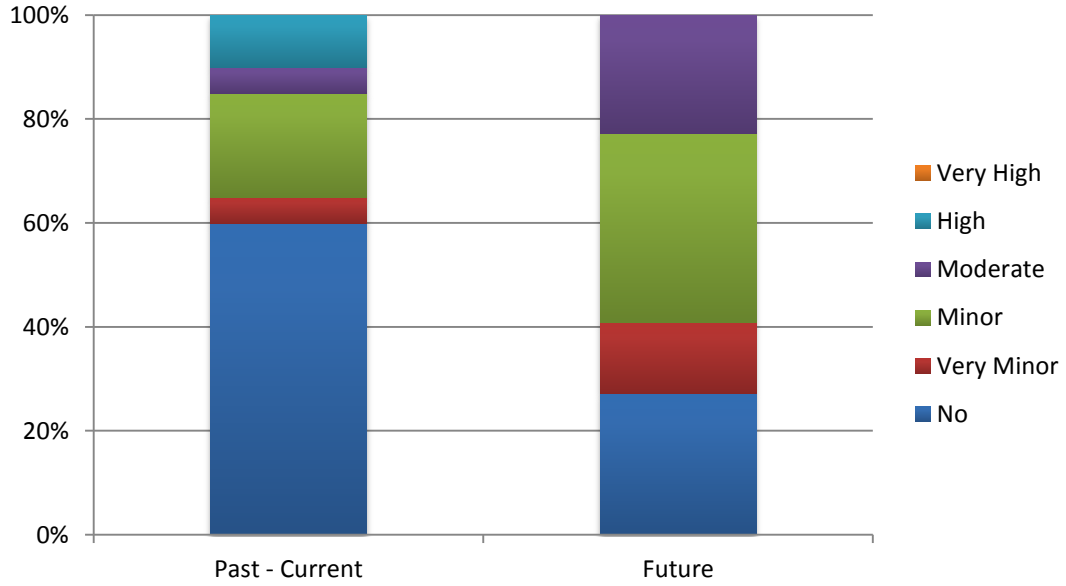


Figure 14: Graph showing the perception of interviewed farmers on past up till current and future impact of their own land & water management practices on (management) water scarcity and subsequent impact on their farming activities.

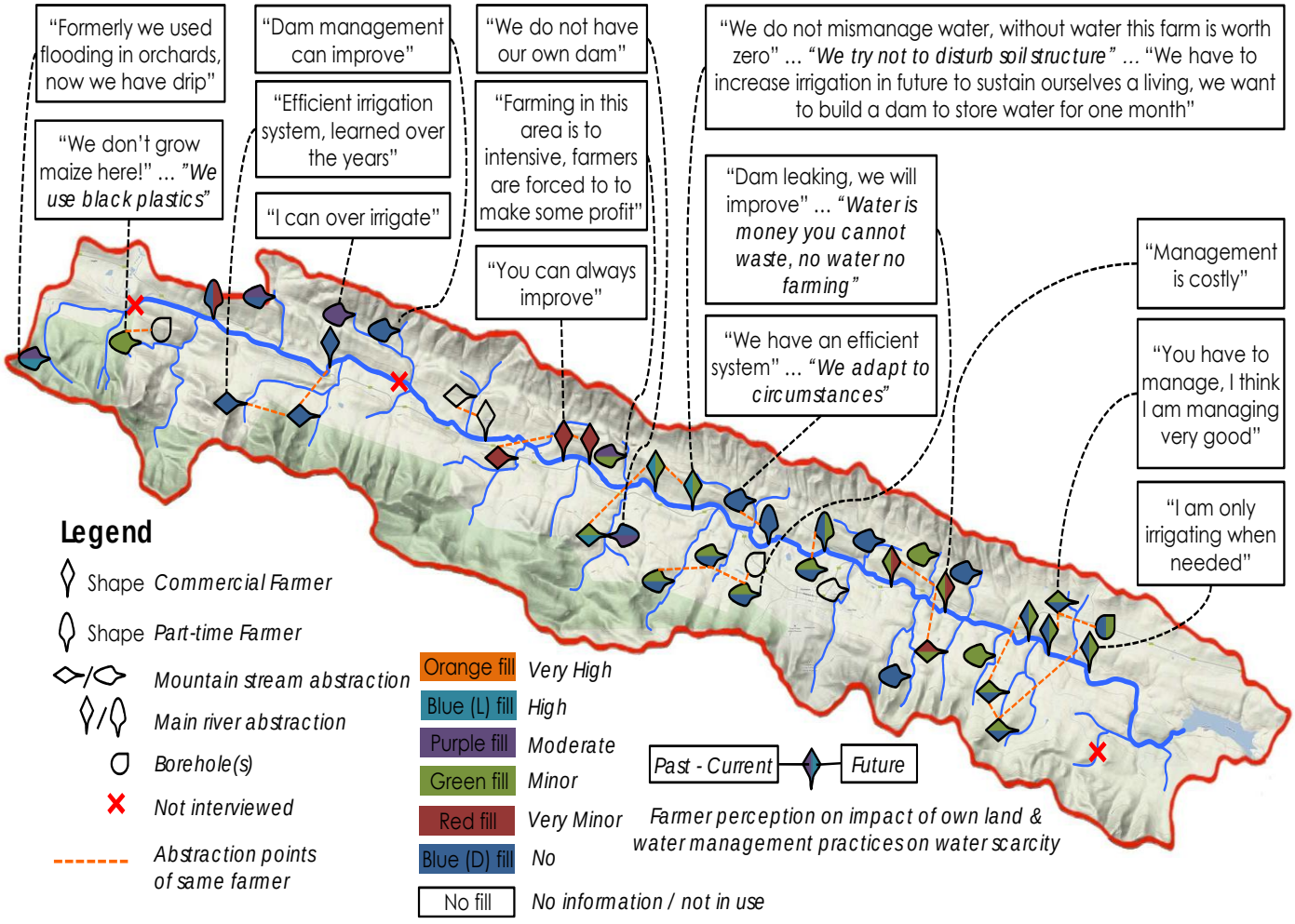


Figure 15: Map showing the perception of interviewed farmers on past up till current and future impact of own land & water management practices on water scarcity and subsequent impact on their farming activities. The map highlights farmer quotes from interviews.

Figure 15 shows again a spatial translation of the graph in Figure 14. As can be derived from the map one farmer indicated his own land & water management practices as having a high negative influence on water scarcity problems in the past. Actually in this case the farmer was talking about the previous owner and is indicating his own future impact as minor. In general the farmers, perceive their own practices as good and having only little impact on water scarcity problems. Water is seen as a highly valuable asset in farming, which cannot be wasted or mismanaged. The difference between this question and the other questions around physical, management and political water scarcity is that this question is about the farmer himself. It is arguable that a farmer tends to speak more positive about internal factors influencing on water scarcity compared to external factors such as climate, other farmers, government and politics. The following paragraphs will give some more detailed and farmer specific insights in the land & water management practices used in the UKRC.

6.2 Water management

To elaborate more on how farmers perceive their water management practices in relation to water scarcity. 21% of the farmers actually state that their water management practices do have a positive effect in coping with water scarcity. Because they grow less water demanding crops and have changed to more efficient irrigation systems such as drip

irrigation. 63% of the farmers state that that their water management practices do have hardly any effect on water scarcity problems. 17% state that is has a negative impact, because of leaking dams, having no dam at all, or because of black wattle at the abstraction point which prohibits access for maintenance. It must be noted that although most farmers stated that their own water management practices do not have a negative influence water scarcity. Some of them as observed do run sprinklers while it is raining, have broken pipe systems, and use furrows instead of pipes.

6.2.1 From abstraction to application

In Chapter 4.1 (Figure 8 and Figure 9) the water sources for irrigation are shown. Every interviewed farmer except one has a mountain stream as water source, sometimes in combination with an abstraction point on the main river or a borehole. Figure 16 shows a schematic overview of a typical mountain stream abstraction and irrigation system in the Upper Kromme River Catchment.

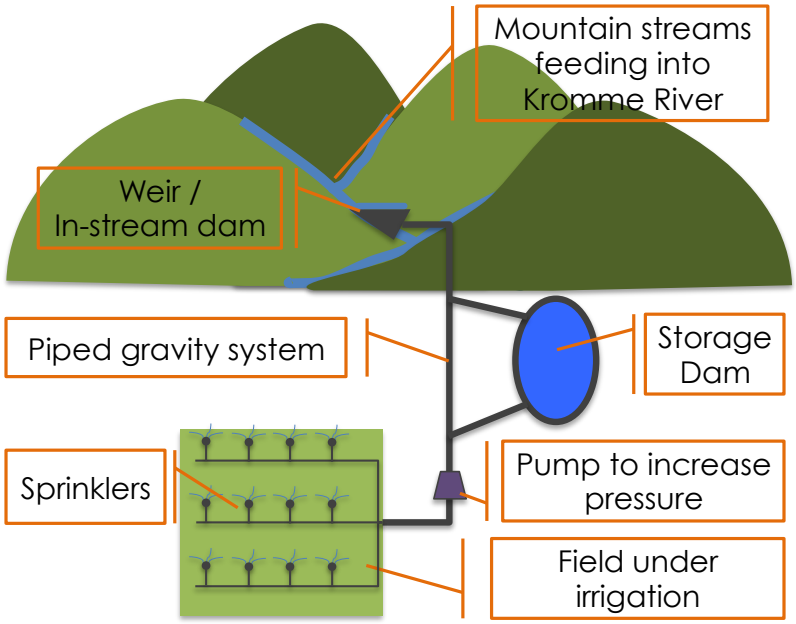


Figure 16: Schematic overview of typical mountain stream abstraction and irrigation system in the Upper Kromme River Catchment

The mountain streams are multiple in the UKRC and do often give a reliable whole year round supply of good quality water. Also if the abstraction system is piped, pressure is created which can be used to transport the water and run the sprinklers on the field by gravity-force without the need of additional pumps to increase pressure. This makes this system very popular in the UKRC. Most mountain stream abstraction systems are rather similar as the one shown in Figure 16, variability does exist and does have different influences on water management related water scarcity problems. Starting with the abstraction weir in the stream, this ranges from dam walls of +3 meter in height, to small concrete weirs to some sandbags and stones put together. While a sandbags and stones wall with a pipe is cheap and easy to construct, so it is also likely to be easily damaged during floods. Some farmers do use the dam wall in the stream also as a storage dam, while others do have dams outside the streams. An in stream dam is much more likely to silt up, if no flush gate is included, than a dam outside of the stream, because of sedimentation behind the dam wall. Eventually this will lead to a lower dam capacity and less water to bridge dry periods. In stream dams are also more exposed to

powerful flood waters which can damage the dam. No information is available about quantities of water that leak from dams. Dam construction is currently not permitted anymore. Still as can be derived from the farmer quotes shown in Figure 15 some farmers are pursuing the building of new dams. It is not completely clear if they want to do it illegally, the next chapter namely shows that most farmers are aware of the prohibition on dam building. While dam building is not allowed it is favoured by some farmers over using more efficient irrigation systems. If farmers do not align their water management plans and interventions with what is legally allowed this will most likely lead to water scarcity problems for those farmers. Yet a dam is from the perspective of water control as discussed by Mollinga (2003) a great asset to a farmer in securing his access to water. With a dam the farmer can control the physical water flows in a technical manner. In a drought situation, because of the irregular raining patterns as discussed in the previous chapter, a dam can help to bridge a dry period in which streams run dry, while a more efficient irrigation system does not help much if there is simply no water to irrigate with. Yet it will depend on the effectiveness of the institutional and regulation water control level whether a farmer will be allowed to build a dam. More on this topic in the next chapter.

Another difference in-between mountain stream abstractions is the transport medium. Most farmers have a piped system transporting the water from the weir to a dam, or directly to the field. Some farmers still use open furrows / earth canals, because of the investment requirements related to putting a piped system. The distance from the abstraction weir to a dam or the irrigation field is often in the range of 1-5 km. Conveyance efficiencies for this type of canalized water transport are ranging from 60 – 70 % (FAO, 1989) due to deep soil percolation, evaporation, damage to canals. This means that substantial water losses are generated on irrigation system scale. The "lost" water might became available again in the Kromme river system as groundwater sustaining the base flow, but it will not be available for the specific farmer. From the interviews it was also indicated by a farmer who was at the end of a furrow system, that during dry periods the water does not reach his farm anymore, because of leakage from the furrow system.

Sometimes a farmer has to use a pump to increase pressure in his irrigation system to make it suitable for irrigation. The most widespread used system in the UKRC for pasture irrigation is overhead sprinklers. Often not always a transport system is fixed, the sprinklers themselves can be attached to these transport system. For example a farmer may be able to irrigate one seventh of his total area under irrigation at a single time. Replacing the sprinklers involves a lot of labour. Farmers therefore tend to apply more during a single irrigation application. Which might lead to more runoff and percolation losses on system scale. Compared to a situation where the famer can more easily control his area under irrigation. For example the fruit farmers who do have fixed irrigation system that do not need replacement. The above paragraphs show that there is still room for many farmers to upgrade their irrigation transport and application systems to higher efficiency systems. In doing so farmers can expand their area under irrigation while using the same amount of water. From the farmers perspective this can be an opportunity, yet on a basin scale there will be less return flow into the river systems because of more efficient irrigation. This will decrease the water availability for downstream users and environmental flow as discussed in the next two chapters.

As mentioned before flooding is a frequently experienced phenomenon in the UKRC, next to its severe impact on erosion. Flooding also has destructive impacts on the irrigation systems of the farmers. During the field research period a flooding occurred and this leaded to damaged abstraction and transport systems on at least six farms.

No measured data is available on the above-discussed topics, so water management practices cannot be expressed in absolute numbers of water losses. But the discussion does show that different practices have different influences and during periods of drought every drop is valuable, and every lost drop can mean a loss in income for the farmer.

6.3 Literature review on pasture irrigation

The main share of irrigated land in the UKRC comes from irrigated pastures for dairy farming (240 ha) and other livestock farming. A recent study on irrigation practices in pasture production has been done under the auspices of the Water Research Commission (Fessehazion et al., 2012). The main grass types discussed are ryegrass and dryland kikuyu which are both also used in the UKRC often on a mixed basis. As a general rule, ryegrass needs about 1200 mm of water for the growing season (Dickenson et al., 2004; cited in Fessehazion et al., 2012). Irrespective of the difference of climate and soil factors, most researchers reported a rate of 25 mm irrigation per week in general in South Africa. The study done by Fessehazion et al. (2012) shows that best trade-off between water use efficiency and optimum crop yield was achieved with an irrigation frequency of once a week. Furthermore in the guidelines accompanying the main report of Fessehazion et al. (2012) several advanced methods are mentioned to further improve on irrigation efficiency. Examples are measurement of soil water content and a rainfall adapted irrigation calendar. These systems require inputs from nearby weather stations, and also soil depth and texture, irrigation system details. In the UKRC farmers generally rely on experience and tradition for irrigation management in pasture production. The irrigation optimization methods and findings presented in Fessehazion et al. (2012), can definitely contribute to more efficient water use in the URKC. But it is unlikely that farmers will start using this methods unless there is an urgent need, for example in cases they get restricted on their water use from government side. Three of the four commercial dairy farmers stated that they apply 25 mm of water a week during the irrigation season. This is perfectly in line with the information from Fessehazion et al. 2012. The other farmer stated he only applied 12 mm of water a week, which is only half of the other farmers. During the interview this farmer was also open about the fact that he did not want to share in too much detail how much water he is using and how much water rights he has since he is afraid that this information might end up in wrong (government) hands.

6.4 Land use

The biggest absentee in farmer mentioned impact of farm practices on water scarcity is land use in the floodplains of the Kromme River. The conversion of flood plains including wetlands in the history has leaded to devastating impacts on the river -geomorphology, -vegetation and -hydrology. None of the farmers who has incised riverbeds on his property and is farming in the floodplains next to this incised riverbeds, explicitly mentioned that this has a negative impact on his farm. Farmers were also used to canalize rivers with bulldozers in order to enhance drainage during flood times. This specific topic in relation to water scarcity seems to be miss- perceived by most of the farmers. Whether it is ignorance or coverage of past mistakes, this topic needs attention and awareness creation in the farmer community in order to mitigate further farmer induced impact, which does not only impact the farmers themselves, as thoroughly discussed in the previous chapter. But also has a negative impact on the downstream water users as NMBM, by reductions of base flow and siltation of Churchill dam and Impofu dam.

The reasoning behind what happen(s)ed can be illustrated with the following quotes taken during farmer interviews:

"The wetland is my biggest problem, I cannot do anything with it. Everybody has the same problems, they can't use it (wetlands/floodplains) for agriculture."

"The wetlands do not wash away during a flood it is quite dense, what does wash away is the next door pasture, the river changes course because of the wetlands."

"We see a problem in the wetlands alongside the road. Farmer X is the owner of that. The wetlands get sanded, what happens the water is not going through the wetland. But coming close to our road, it might destruct our road and it is invading Farmer X's land. Our problem is the road, not the wetland. The road is a public road. We have experienced during floods that the road was swept away."

Farming and wetlands are perceived as conflicting. Which makes sense in the short term and explains why wetlands are degraded in the UKRC. But on the long term only the wetlands can protect the floodplains from erosion. The last quote also shows that wetlands are brought into a negative relation with simple but important day-to-day values as road accessibility. A strategy in managing and protection of the wetlands from the government side can be to give more attention to such day-to-day values of farmers in order to get the cooperation of the farmers. Instead of only focusing on ensuring good water in terms of quantity and quality to NMBM through the Churchill dam.

6.5 Competition over water resources between farmers

6.5.1 Past and future perceptions at multiple farm level

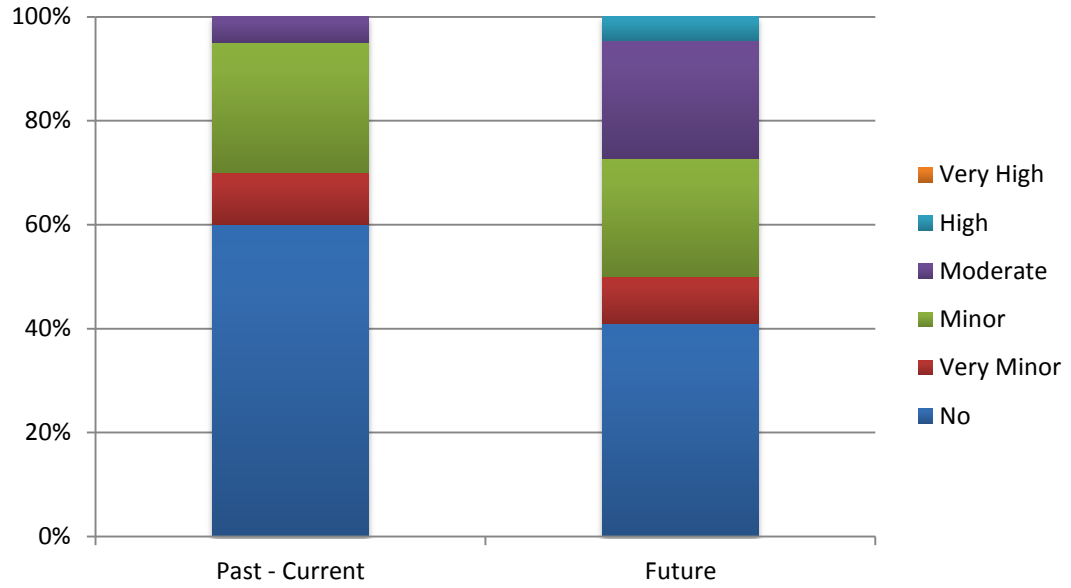


Figure 17: Graph showing the perception of interviewed farmers on past up till current and future impact of other farmers land & water management practices on (management) water scarcity and subsequent impact on their farming activities.

Figure 17 shows the perception of farmers on how other farmer land & water management practices impacts on water scarcity problems. During the interviews the farmers only responded from the perspective that other farmers water use can have an impact. In an irrigation context you would expect hydrological interdependency and that farmers would see other farmers as competitors over the water resources. Figure 17 although general shows the opposite. Other farmers' impact is seen as "none" by 60% and 40% of the farmers in respectively the past up till current and future timeframes. Other farmers did experience and do expect very minor to high impact of other farmers' water abstractions.

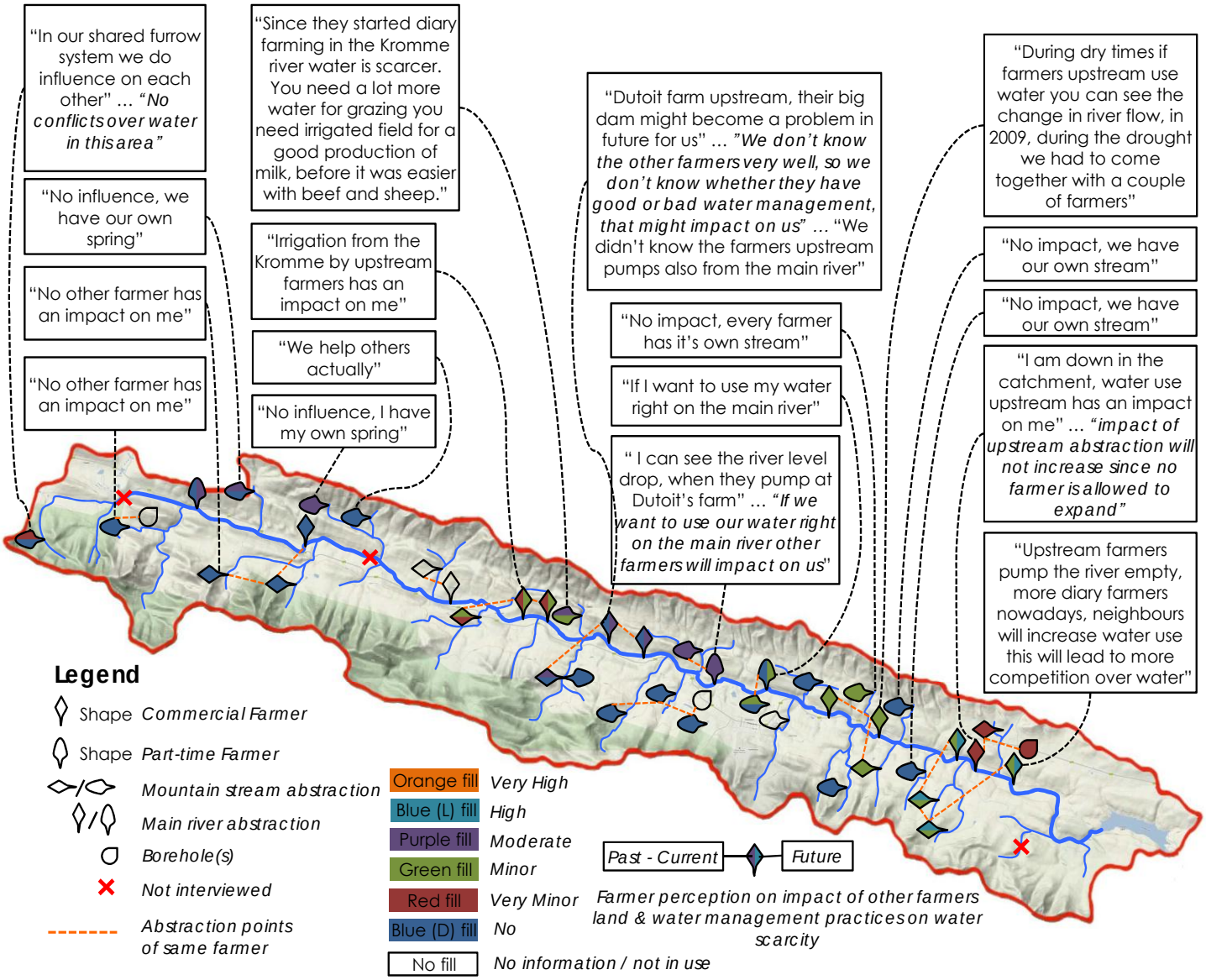


Figure 18: Map showing the perception of interviewed farmers on past up till current and future impact of other farmers' land & water management practices on water scarcity and subsequent impact on their farming activities. The map highlights farmer quotes from interviews.

Using the spatial translation of Figure 17 shown in Figure 18 the explanation behind the large amount of farmers that have indicated impact as 'none' from other farmers. Do have this opinion since they all have their own mountain stream supplying them with water hydrological independent of other farmers. Every farmer has its own stream and is also farming on its own, and is not impacted by other farmers is mostly mentioned. This is partly true, since some farmers do have next to their mountain stream an abstraction point on the

main river. Looking to the farmer quotes in Figure 18 it can be derived that the farmers with an abstraction point on the main river do state that upstream abstraction has an impact on them. With the most downstream farmer not surprisingly indicating that he expects a high impact of other farmers in the future. Of the seven commercial farmers which all have an abstraction point on the main river the five most downstream do expect impact of other farm abstractions. It is also argued that you can see changes in river flow when an upstream farmer starts pumping from the main river. At one stage in 2009 it the hydrological dependency between the main river abstractions triggered farmers to come together, in order to cope with the drought. Unfortunately no additional information is available about this. Also two part-time farmers who do currently not use their right on the main river do expect that other farmers will have an influence on them if they start using that right. It should also be realized that although the side stream abstractions do not influence on each other, they do eventually on the abstractions from the main river, since the side streams are the sources feeding the main river. Asking the question shown in Figure 17 & Figure 18 the other way around: "do you influence on other farmers with your water abstraction?" puts hydrological dependency into another perspective. In this manner all the farmer are connected whether in a status of generating or subject to impact of water abstraction.

The change to dairy farming in the UKRC by some farmers is argued to have a bigger influence than the former, less water demanding beef cattle farming. Looking to the future it is depending firstly on the physical situation as discussed in the previous chapter whether farmers will have more impact on each other in terms of water use. Furthermore it is also depending on the expansion of irrigation mentioned as a wish of many farmers. Together the dairy farmers want to expand with ± 120 ha. The two most downstream farmers quotes shown in Figure 18 show two different opinions, one stating that farmers will increase their area under irrigation and water use. And the other stating that he does not expect a higher impact of other farmers water use since no farmer is allowed to expand anymore. This topic of regulation from government side will be elaborated on in the next chapter.

Strategies used and yet unused by farmers to cope with water scarcity at farm level and at catchment scale will be discussed in Chapter 9.

6.6 Conclusion

In this chapter the farmers land and water management practices have been discussed. The purpose of this chapter is to answer the farmer part of the sub question: "How and to what extent do the land & water management practices of the farmers and the government induce "management" water scarcity problems for the farmers in the Upper Kromme River catchment, currently and in the future?". In the perception of most farmers in the UKRC farmer management did have a very minor impact on water scarcity problems (Figure 14, Figure 15, Figure 17 and Figure 18). The main reason behind this perception is that the every farmer except one does have a mountain stream as water source, which makes the farmer hydrological independent of other farmers. The mountain stream systems are also perceived as solid and reliable. Looking in more detail uncovers that the farmers with an abstraction point on the main river and especially the more downstream commercial farmers do experience and expect impact from upstream farmers. Yet current management strategies do mainly focus on single farm management interventions, cooperation between farmers or agreements between farmers on water use are very rare to absent in the UKRC. The water resource is indicated as a very important asset for the farmer, and therefore good water management is also perceived as important, but also indicated as costly which limits the farmers ability to implement water management interventions. The perception of farmers on

the very minor impact of land use practices on water scarcity is not in line with what is seen in reality and derived from literature. The wetlands are the main issue in this and are perceived as conflicting in delivering both positive and negative assets to the farmers. This explains why wetlands are degraded in the UKRC, because of short term benefit. But on the long term only the wetlands can protect the floodplains/farmer lands from erosion.

In linking this chapter to previous chapter on physical water scarcity and the next chapter on government management induced water scarcity. It can be concluded that most farmer management interventions (dam building, change in crops) currently focus on coping with the irregular raining patterns. Opinions on- and actions in- the management of land cover in the catchment and land use in the floodplains are very diversified. And past and current management interventions in this seem to also enhance water scarcity instead of reducing it. A new concern of farmers in relation to future water scarcity coping management interventions is about regulation through government management, this will be discussed in the next chapter.

7 Government management

As the previous chapter dealt with farmer side of management water scarcity this chapter will elaborate on how government management has and will/might have an impact on secure access to water for farmers in the UKRC in the future. On the side of the government a lot has changed in the past decades in South Africa around water management. Most intended changes coming forward out of the National Water Act (1998) are currently only still on paper, and are still waiting to be implemented.

First a short exposition will be given on the institutional context around water management. After that the perception of farmers on how government management has an impact on water scarcity will be discussed. Followed by an analysis on the main components of government management in relation to secure access to water, namely: "Water allocation reform, compulsory licencing, environmental flows and monitoring and regulation". Last the discussion around invasive alien plants and wetlands will be continued from the angle of the "Working for …" programs.

7.1 Institutional context

As elaborated in Chapter 2.1.5 the institutional context in the water sector of South Africa is undergoing a major restructuring since 1994, with the aim to develop Catchment Management Agencies (CMA's) in a stakeholder engaging process as institutions to manage water at the catchment level. This transition process while important also has led temporarily to more unstable institutions, because of this restructuring of the previous institutions. The slow establishment of CMA's, transformation of Irrigation Boards into Water User Associations (WUA's) and the establishment of new WUA's, does not add to an efficient finalisation of the restructuring process. This institutional context is closely related to the topic of secure access to water for farmers in the UKRC since at the catchment scale it is the responsibility of the DWA to: 1) allocate water to different types of users including the environment, strategic purposes, industries and agriculture; 2) monitor the water resources and enforce regulations; and 3) develop and implement a catchment management strategy. But as argued before the DWA is mostly absent and lacks in taking this responsibility all over South Africa (Merrey, 2011). This is also the case in the Upper Kromme River Catchment, with the absence of a CMA and WUA.

In the Kouga catchment, which is situated just north of the Kromme catchment, the Gamtoos Irrigation Board (GIB) is in the process of transforming to a WUA. An interview with the CEO of the GIB (Personal communication, EXP2) gave some interesting insights in this process and how DWA positions itself in this process. Below some quotes are shown from the interview:

"Although the DWA is trying to assist in the process of transforming to a WUA, there is no continuity in the people that they sent to us. At this stage it is about four different persons that came, all with different ideas"

"One of the problems in the transformation process is that in the old water act the votes that each farmers had to vote for representative on the board was related to his water rights (linear). With the new act there are four options on voting rights, one of the options is the same as the old one. When we compiled the draft institutions for the WUA, we all agreed to use the same old method. The guy from DWA is now saying we must change that, the minister will otherwise not approve. We have to change it to the option that each farmer has one vote, he said the minister will approve only this option. Most of resource poor / black farmers do not have many resources / rights and so also no voting rates"

"No we hire a consultant to get it done." (All personal communication, EXP2)

The above quotes show that the institutional context is quite challenging in terms of getting something done. The chaos at DWA in terms of communication, staff and strategies is leading the water users into a disoriented status quo. DWA themselves also recognize these challenges and are themselves stating that basic things such as a language barrier between only Afrikaans speaking farmers and only English speaking DWA officials is making the process of communication very difficult (GOV4). Also the equity principles laid out in the NWA finds a lot of resistance within the white farmer community. A farmer in the UKRC stated the following:

"Since 1994, we still need on our side a whole lot of acceptance of the change in water management, for a long time water rights did not bother us. Formerly farmers amongst themselves sorted this out; there was not much regulation."

7.2 Past and future perceptions

This paragraph will go into detail on the perceptions of farmers on how government management, mostly management from DWA, did have and will have an impact on the secure access to water of the farmers in the UKRC. Current experience of farmers in the UKRC with DWA does for most of them not extend beyond receiving a bill every year and paying for the water they are registered for. Figure 19 shows the farmer perception on how government management has (had) an impact on water scarcity problems for them. Government management should be interpreted as implementation and enforcement of the NWA (1998); "Water use registration, validation and verification, licensing process, water allocation reform and the Reserve / environmental flows".

What stands out is that all farmers state that in the past up till current there was no such thing as government management induced water scarcity. Actually some farmers stated that

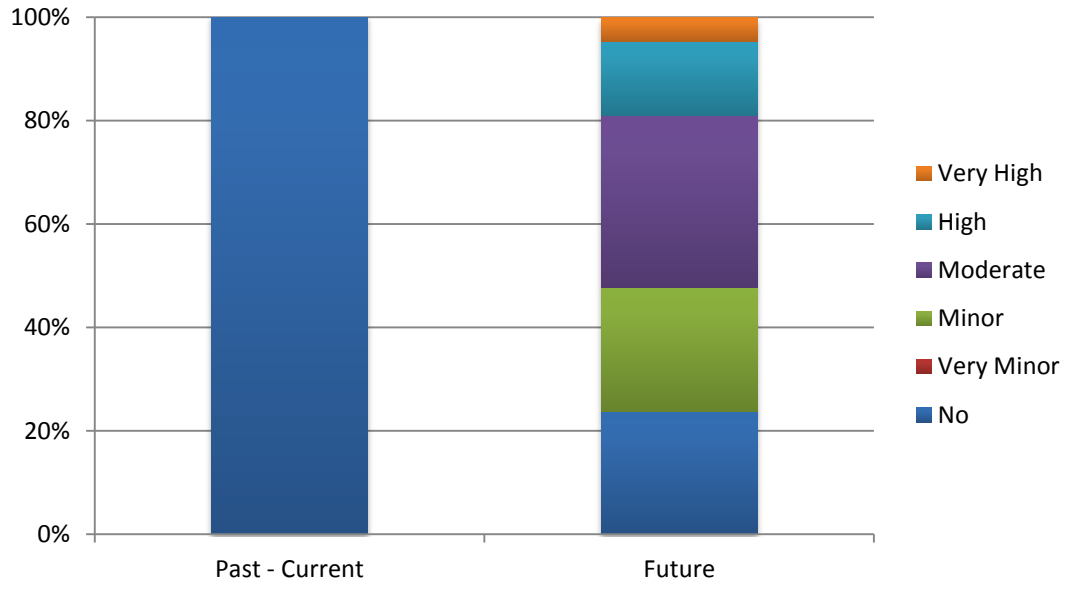


Figure 19: Graph showing the perception of interviewed farmers on past up till current and future impact of government management DWA on (management) water scarcity and subsequent impact on their farming activities.

although not always implemented properly they are appreciating the efforts of the government in clearing the alien invasive trees through the Working for Water program. For

the future only 24% of the farmers hold on to this opinion. And 50% indicate that they expect a moderate to very high influence of government management on their secure access to water. Figure 20 shows the spatial translation of Figure 19. In the farmer quotes it can be seen that the farmers indicate that there is no government regulation at all at this moment. The

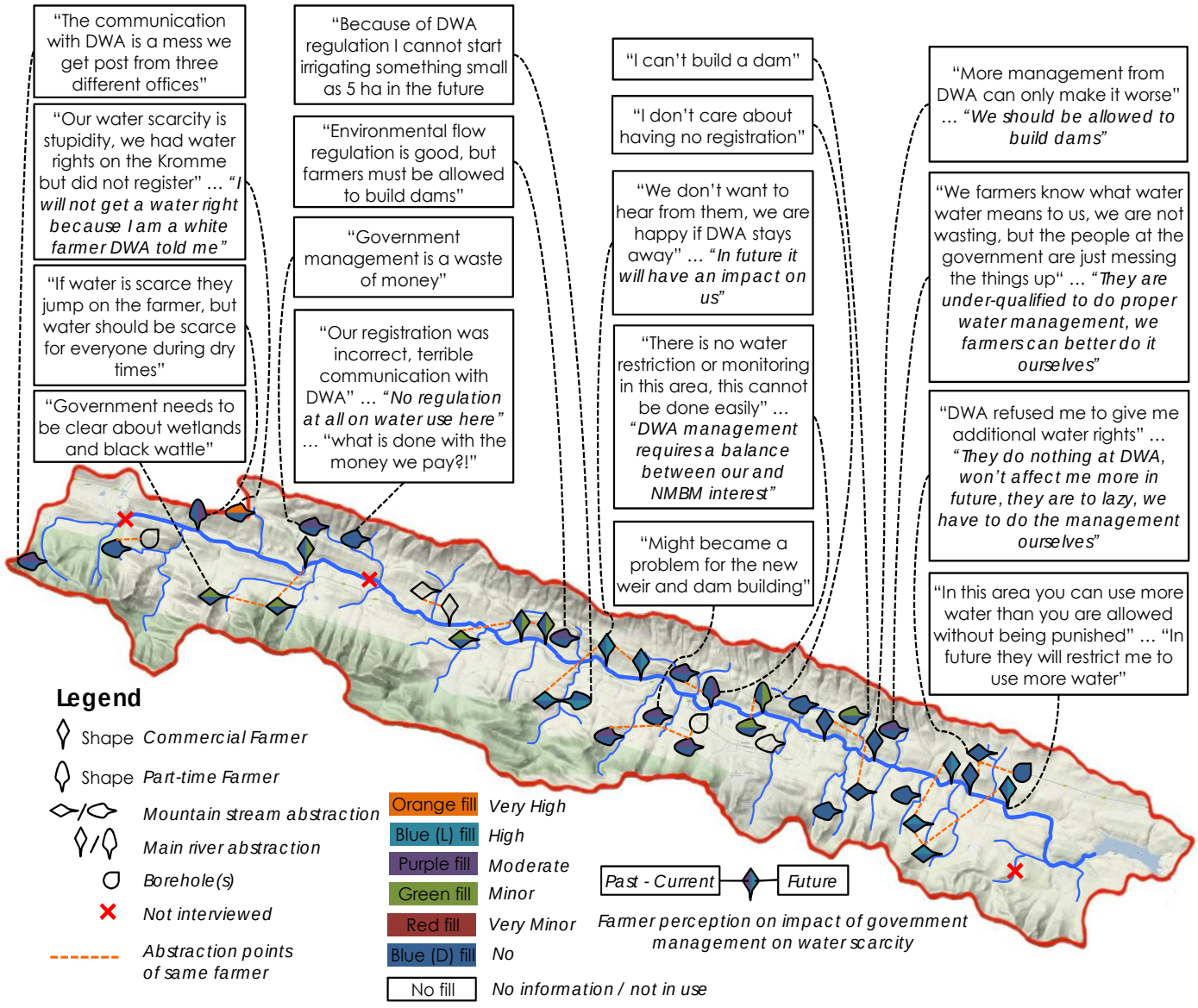


Figure 20: Map showing the perception of interviewed farmers on past up till current and future impact government management on water scarcity and subsequent impact on their farming activities. The map highlights farmer quotes from interviews.

perception of DWA and government in general seems rather negative from the UKRC farmers' side looking to quotes as:

"Government is a waste of money"

"Communication with DWA is a mess"

"More management from DWA can only make it worse"

"We farmers know what water means to us, we are not wasting, but the people at the government are just messing the things up"

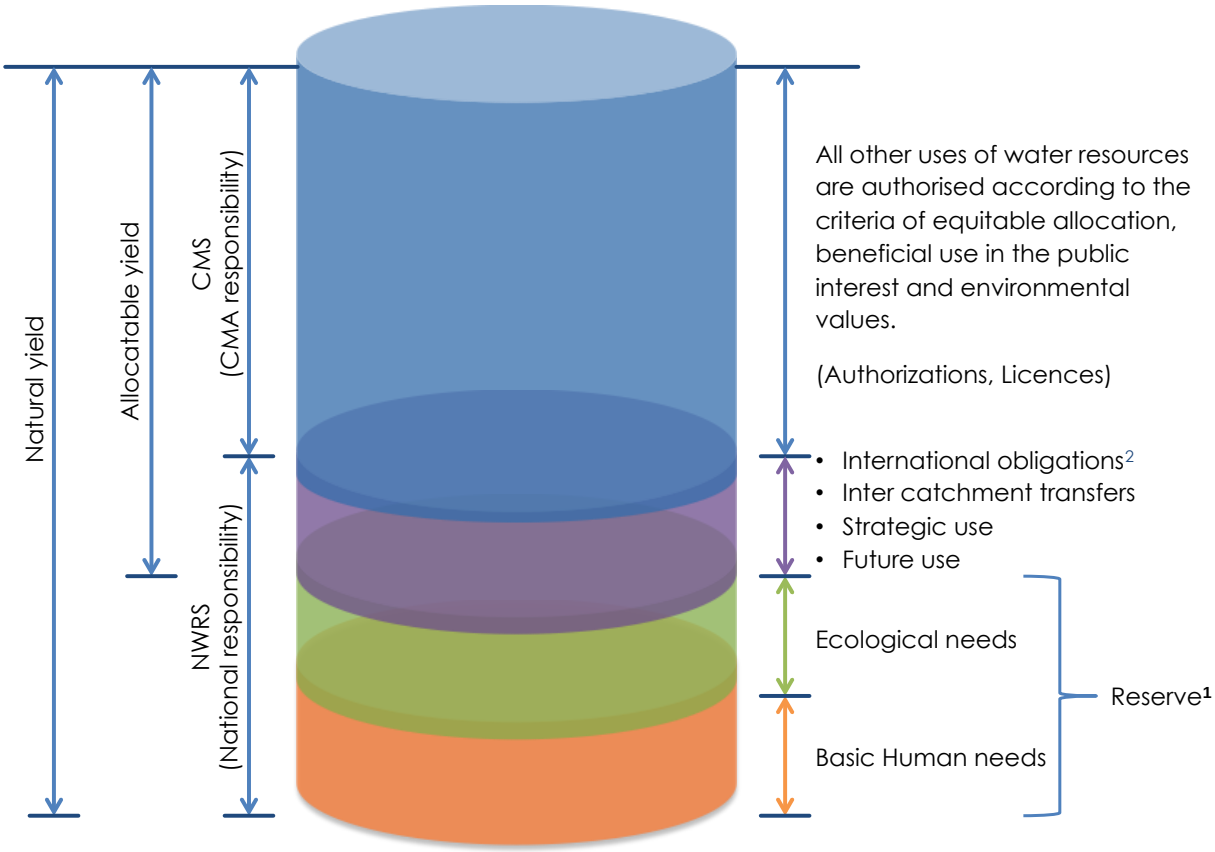
Looking specifically to the commercial farmers, two expect a high impact of government management induced water scarcity, because they expect restrictions. Also the prohibition on dam building is mentioned as having a major impact. The second most downstream

farmer is stating that DWA refused to give him additional water rights. Yet he does not expect any impact from DWA in future since according to his opinion they do nothing at DWA. Some farmers state that more management and regulation from government side might not be that bad at all, since it can prevent mismanagement and misuse of water in the catchment. Yet there is a widespread uncertainty within the farmer community whether DWA is able to execute proper water management. Farmers think that a lot of staff working at DWA are under qualified, they do not expect DWA to be any different than other government departments.

In the following paragraphs the farmer perception on government management will be put alongside specific water management interventions that are on-going or will be implemented in future.

7.3 Water Allocation Reform

In this paragraph the Water Allocation Reform (WAR) program will be discussed. WAR is mainly about addressing the historically unequally allocation of water resources. Steps in the WAR process are that every water user has to register after the implementation of the NWA (1998), from the side of DWA studies on water availability in catchments and on the requirements for environmental flows need to be executed. Eventually a process of verification and validation of water use registration and compulsory licensing can be started



[1] *The Reserve is the only right to water in the National Water Act (1998).*
[2] *Allocations made in accordance with the National Water Resource Strategy (NWRS) must be provided for in the CMA's Catchment Management Strategy*

Figure 21: General consideration in water allocation (Adapted from DWAF, 2008).

including the re-allocation of water rights towards Historically Disadvantaged Individuals (HDIs). In (Movik & de Jong, 2012) a very comprehensive overview is given of the water licensing process in South Africa. This paragraph will deal with verification and validation of water use registrations and compulsory licensing process, which is currently not yet undertaken in the UKRC. The topic of re-allocation of water rights towards HDIs will be discussed in the next chapter because of its highly political nature.

Figure 21 shows the general considerations for water allocation used in South Africa. The highest priority is given to the Reserve compromising of basic human needs and ecological needs. What this implies for the UKRC will be discussed in Chapter 7.4. After the Reserve priority is given to the so-called international obligations, inter-catchment transfers, strategic use and future use. In the case of the UKRC there are no international obligations, but the water allocated to NMBM falls under water use of strategic importance. This is water use that is considered to be of critical national importance, this water use is authorised by the minister of water affairs. The remaining water yield available for allocations falls under the responsibility of the CMA and can be used for example for agricultural purposes.

Farmer in the UKRC were asked whether they have heard of the water reforms (NWA, 1998), and what they understand of it. 67% of the farmers have heard of the water reforms. The understanding was interpreted as almost nil to minor for 87% of the farmers the other 13% did have a reasonable understanding of the water reforms and what this implies for them. Looking specifically to the commercial farmers group their understanding of the NWA was in line with the above stated figures. Farmers mentioned that you had to register your water use back in 1998, and that the water is belonging to state/public instead of the riparian landowner. One farmer who applied for a new water right stated that there is a lot he does not understand of what is written in the (NWA, 1998). In general it seems that the farmers in the UKRC are not completely aware of what the water reforms imply, and that it might have severe impacts on them through the compulsory licensing process. On the other hand the little understanding of the water reforms, also implies that the farmers have not been confronted with it a lot. This is also found by Mendez (2010), who did a case study in the Little Thukela catchment, South Africa. And found that most commercial farmers did not really experience a change in government management after the introduction of the water reforms. Which would imply that the farmers can continue business as usual, and nothing really changes because of the water reforms.

7.3.1 Compulsory licensing

7.3.1.1 The why of compulsory licensing

The compulsory licensing process is very important in relation to secure access to water, since a licence will eventually legitimate a farmer's water use. Currently the UKRC is regarded as a water stressed catchment, which means that no water is available for new licences for both domestic and irrigation purposes, and that existing water uses might have to be rationed (Personal communication, GOV1). Although the exact amount of water that is over allocated / registered is unknown, also due to limited hydrological information on water resource availability in the catchment. At this moment DWA is putting out tenders for consultants to do the validation and verification process in the Kromme River Catchment. This process is planned to start in April 2015 and to be completed in March 2016 (Personal communication, GOV4). DWA states that they have al registrations in place and are ready for the verification and validation and compulsory licensing process (Personal communication, GOV1). On the

question to a DWA water resource manager; "What do you see as the main issue around water management in the Kromme River?" was answered:

"Illegal activity, we suspect that some farmers have increased their water use activity. We have seen the shortage of water happening on the low flow component, that's why we suspect there is over abstraction." And;

"Farmers are not honest they do not give the correct information on water use in their registrations." (Personal communication, GOV1)

The question arising from these statements is what is legal and what is illegal activity? First of all water users did need to register their water use, already back in 1998; if they did not do this they have the risk of losing their existing water entitlements. Water use by farmers in the UKRC does in general require a license unless the water use is only for domestic purposes, small non-commercial gardening and watering animals for subsistence use, this type of water use has a small impact on the water resource and falls under Schedule 1 of the NWA (1998) which does not require a licence. In the UKRC all water users will be asked to apply for licences, this process is called compulsory licensing. And is required in the UKRC because the demand exceeds the supply, water needs to be re-allocated in order to balance the water availability with demand.

7.3.1.2 The process and legislative side of compulsory licensing

The process of compulsory licensing is shown in Figure 22. Farmers that registered their water rights will first go through a process of validation and verification. This process will determine

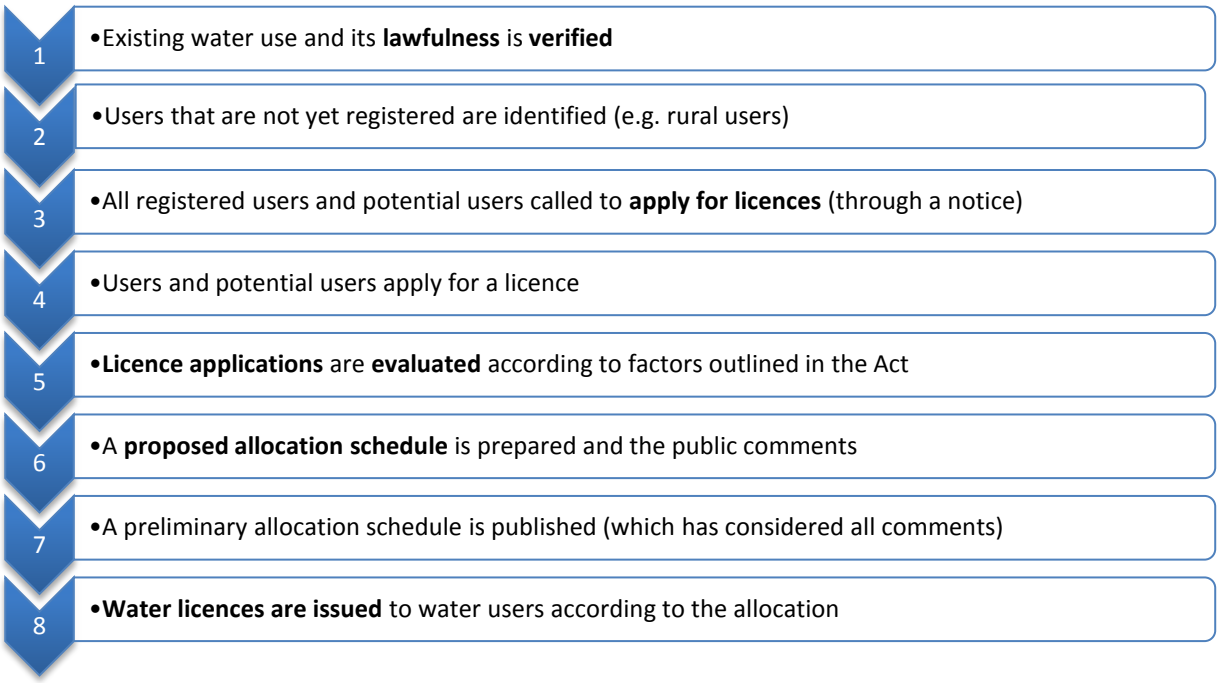


Figure 22: Diagram showing the different steps in the compulsory licensing process (Adapted from DWAF, 2008).

whether the water use is lawful and whether the amount of water the user registered for will be validated. The topic of lawful water right is very important, looking for example to a farmer quote from Figure 20:

"Our water scarcity is stupidity, we had water rights on the Kromme but we did not register"

Because the farmer did not register, he is currently at risk that he will not get a licence anymore, because the catchment is in water stress. The NWA (1998) states the following about an existing lawful water use (parts relevant to the UKRC case are quoted):

"*(Section 32)*

An existing lawful water use means a water use-

a) which has taken place at any time during a period of two years immediately before the date of commencement of this Act and which-
   i. was authorised by or under any law which was in force immediately before the date of commencement of this Act;
b) which has been declared an existing lawful water use under section 33. And which
   i. was authorised by or under any law which was in force immediately before the date of commencement of this Act;

(Section 33)

(3) A responsible authority may declare a water use lawful if it is satisfied that the water use-
a) took place lawfully more than two years immediately before the date of commencement of this Act and was discontinued for good reason; or
b) had not yet taken place at any time before the date of commencement of this Act but-
   i. would have been lawful had it so taken place; and
   ii. steps towards effecting the use had been taken in good faith before the date of commencement of this Act. " (NWA, 1998)

The category of existing lawful use covers water use that has lawfully taken place two years prior to the promulgation the NWA. This category primarily consists of white farmers. The intention is that existing lawful uses will eventually have to be converted into licenses, either directly or after adaption of the extent of water use through the compulsory licensing process (Movik & de Jong, 2012). The above stated quote from the NWA means that a current water use will be declared as existing lawful water use by DWA, if it was lawfully used in the period from 1996-1998. It may be declared as existing lawful water use if it has been used more than two years before 1998 and would have been lawful if used in the period from 1996-1998 or steps were taken in good faith to start with the use of water. In the verification process, which is an obligatory process if water users are called to verify their uses. The water user has to proof at his own costs he had a lawful water right before 1998 under the old act and was using this right in the period between 1996-1998. If the water user is able to do this he should receive a license, to continue his water use. If a lawful water user did not use the water in the period of 1996-1998 or cannot proof that he did, he still may get a licence, but in a water stressed catchment as the UKRC these water users will be the first to receive no license and do have to stop their water use eventually. If a water user does not apply in time on a government call for verification or his application has been refused, the water user has to stop using water (NWA, 1998).

In the UKRC all water users will have to apply for a license and in the development of an allocation schedule their applications will be evaluated according to the factors outlined in the NWA. The main things that the allocation schedule must reflect are the quantity of water:

- Assigned to the Reserve;
- Assigned to meet the requirement of existing licenses;
- Allocated to redress the results of past racial and gender discrimination;

- Allocated to existing lawful water uses.

A proposed allocation schedule needs to be published on which stakeholders can give feedback. After processing the feedback a preliminary allocation schedule is published and water licenses are issued to water users according to their allocation.

7.3.1.3 Implications of compulsory licensing for UKRC farmers

What do or can all the above statements imply for the farmers in the UKRC? If a farmer in the UKRC cannot proof that he has an existing lawful water right under the conditions explained above he is likely to lose his water right either completely or partially. For example if a farmer is using more than his existing lawful water right is allowing him to do. This illegal activity is what DWA is expecting to be the case in the Kromme (Personal communication, GOV1). With the information gathered during the interviews it is very difficult to assess whether farmers do have an existing lawful water right or not, this requires detailed research in the registrations of farmers and in their historical activity with regards to water use. Most of the farmers in the UKRC stated that they have a water right for their water use activities. Yet it is unclear whether their current use falls within the limits of these water rights. Furthermore new farmers came in recently, in relation to proofing water use in the period of 1996-1998 might be difficult for them due to limited information of the activities on the previous owner. According to the law this might imply that if such farmers fail to proof, they can lose their water right. Or especially in the case of some part-time farmers who have rights on the main river, but have not been using this for a long time, they also might lose that right because they have not been using it. A farmer mentioned the following:

"we came in recently on this farm, you could say that the previous owner was not managing his water properly. But because of his mismanagement more than ten years ago we can be restricted?! That is not fair in my opinion"

Another issue related to proving the lawfulness of existing water uses, is related to management interventions a farmer has implemented in between 1998 and present. From the NWA as stated in the previous paragraph it does not become clear whether the existing water uses are linked to volumes of water use or to the area under irrigation. For example if a farmer switched to a more efficient system, but increased the area under irrigation is he allowed to continue irrigation on the expanded part? Furthermore the expectance of the compulsory licensing process is no incentive to farmers to already shift to more efficient systems, since it is unclear what effects this will have on the water rights they will obtain in the compulsory licensing process. Most probably DWA will look to the area under irrigation and not only to volumes of water since a shift to more efficient irrigation over a larger area, will lead to a decrease in return flow and subsequently less water downstream as discussed in the previous chapter

The future on compulsory licensing remains uncertain, at this stage it is not possible to say what the extent of impact will be on farmers. Is the worst to be expected for the existing farmers? It is unknown. And DWA themselves seems also not very sure about their planning on starting with compulsory licensing in 2015 in the UKRC (Personal communication, GOV4). Yet it is reasonable to expect that eventually when the validation and verification process will be implemented that the shit will hit the van.

In personal communication with (EXP1) it was mentioned that farmers will become paranoid when the validation and verification process will be implemented and they are subject to compulsory licensing.

What is clear is that a farmer who is applying now for a surface water abstraction will not get a new water right in the UKRC. Farmers are also not allowed to build or enlarge dams, some will probably even been told to demolish dams (Personal communication, GOV1). And eventually if in the allocation schedule that DWA needs to make water demand does not balance with water availability, DWA will start rationing the water uses in agriculture (Personal communication, GOV1).

7.4 Environmental flows

As shown in Figure 21 the Reserve consisting out of basic human needs and ecological needs and is the only right to water in the NWA (1998). In allocating water the Reserve receives the highest priority. This paragraph will discuss about the issues with regards to environmental flows in the UKRC. Formerly a provision in the Water Act around environmental flows was not in place. The new policy is regarded as a breakthrough in water policy from an environmental perspective, yet implementation of the environmental flow policy is faced with multiple hurdles and is not yet put into motion in the UKRC as is the case for most catchments in South Africa. Achterkamp (2009) who did a specific study on environmental flow implementations in the Incomati basin, South Africa states that implementing the Reserve has proven to be difficult, and that the new water policy is faced with a difficult transition period. Achterkamp (2009) explains that the highly controlled nature of water flows in most catchments through water infrastructure also leads to obstacles in implementing the Reserve, (costly) infrastructure amendments are needed before it is even possible to implement the Reserve. Furthermore Achterkamp (2009) mentions that a water transfer was put in place in his case study area, but that the Ecological Reserve is overruled by the political reality to satisfy the basic needs of the population (voters). The satisfaction of basic human needs does also relate to the "social equity principle" of the NWA. In this sense the Ecological- and Basic Human Needs- Reserve as the NWA's fundamental principles are conflicting with each other. This case is rather similar to the Kromme River Catchment in which the Ecological Reserve and the Basic Human needs are somehow at odds with each other. The water demands of NMBM do not literally fall under the Basic Human Needs Reserve of the Kromme River, since NMBM is out of the catchment, yet NMBMs water demands is to supply to mainly human needs of a large electorate. More on this topic will be discussed in the next chapter. At the NMBM municipality they are fully aware of the environmental flow regulation, they state that:

"…we know that a certain volume of water should be left in the river for ecological purposes"
(Personal communication, NMBM1)

But in the case of the downstream part of the Kromme River it is not so much about leaving water in the river, but about releasing water since the river is dammed up. NMBM is the owner of the Churchill dam DWA of the more downstream Impofu dam. NMBM is managing both dams, the Impofu dam on behalf of DWA. They do not know much about the amounts of water that needs to be released from the dams and the timing of the releases. They state that the backwash water from the Churchill dam, which is water used to clean the water purification plant, cannot be reused and should flow back into the river. It is questionable whether this ± 5000 m^3 d^{-1} serves the environmental needs of the river ecosystem since that backwash water is loaded with chemicals used in water purification (Personal communication, NMB1 and NMBM2). The water managers at the NMBM municipality are afraid of the environmental flow regulation:

"We don't want water taken out of the dam for the environment, but we have to comply with the regulation. The ecological requirements of 5 · 10⁶ m³ y⁻¹ is a lot of water" (Personal communication NMBM1)

7.4.1 Environmental flow regulations in the UKRC

Non-implementation of the environmental flow policy does not necessarily mean that the Reserve is violated, it is only not possible to monitor the compliance towards the Reserve if there is no reserve determination or no infrastructure to monitor. In case of the Kromme River Catchment the Reserve is violated, the river is highly dammed, with dams that do not provide in automatic releases for the environment. A farmer from the UKRC mentioned that in 2009he saw the main Kromme on his place run dry for a full year. Although farmers are not allowed to pump the river empty, most focus when it comes to the Reserve is put on the most downstream Impofu dam on the Kromme River in releasing environmental flows to serve the Kromme River estuary. In the Algoa Reconciliation study, which is a strategy plan to anticipate and cope with the future water demands of NMBM, they did take account of future environmental flow releases. Only for an unknown reason they used a figure of 2 · 10^6 m^3 y^{-1} instead of the required 5 · 10^6 m^3 y^{-1} as determined in the 2005 Kromme/Seekoei Comprehensive Reserve Determination Study (DWA, 2011a). Is it expected that the 5 · 10^6 m^3 y^{-1} requirement does not have to be implemented to its full extent? It is stated that the influence on system yield because of making environmental flow releases for the Reserve could be significant, and therefore the process of Reserve determination should be carefully approached at adequate levels of detail (DWA, 2011a). In their study they assume that the implementation of the Reserve in their supply schemes will be phased in over 3 years commencing in 2015 (DWA, 2011a). It is although not stated that this will be enforced by DWA.

In any case it is not the farmers that do have to open a tap in order to comply with the Ecological Reserve in the case of the Impofu dam. Yet as the farmers are part of the hydrological interdependent system in the Kromme river, the environmental flow regulation could have an effect on them when implemented. Achterkamp (2009:116) mentions that a reason for compulsory licensing can be when the Reserve cannot be met without cutting the water allocated to certain companies or individuals. In the case of over allocation the government, through the CMA, has a constitutional obligation to cut the allocation in order to guarantee the right to water as it has been articulated within the NWA. In this sense farmers can be rationed in their abstractions to provide for the Ecological Reserve. Releases that have to be made from the Impofu dam managed by NMBM will not necessarily mean NMBM will be the water user rationed on their water allocation. According to a statement from DWA shown in the next paragraph, DWA will start cutting from agriculture in case of water allocation shortages.

A study on the Ecological Reserve has been done by consultancies in the period of 2003-2005 (DWAF, 2005). In the main Kromme river, areas researched are the estuary, area downstream of both the Impofu and Churchill dam and in the UKRC an area just upstream of Kareedouw at Melkhoutboskraal. In this study the hydrology, geomorphology, water quality, fish aquatic invertebrates and riparian vegetation have been researched from an environmental perspective. The study concludes that for achieving the required ecological flows in the rivers no additional management interventions are required, as the flows recommended are being met under present conditions. For the Kromme estuary an additional release of 5 · 10^6 m^3 is needed in November from Impofu dam, additional to present day flows. The most effective delivery of the proposed 5 · 10^6 m^3 to the Kromme Estuary would be 5 m^3 s^{-1} for 6.5 days and 1

$m^3\ s^{-1}$ for 25 days. The implementation of this recommended release on system yield is a 11% reduction from $44 \cdot 10^6\ m^3\ y^{-1}$ to $39 \cdot 10^6\ m^3\ y^{-1}$ (at 98% assurance level). If the estuary releases can be reduced during droughts, the reduction in yield will be less.

7.4.2 Farmer opinions on environmental flows

During the interviews the farmers in the UKRC were asked whether they had heard of the Ecological Reserve policy, 30% of the farmers said they know about this regulation. On the question what their opinion was on this regulation 87% stated that they see it as a positive regulation, although 83% of the farmers think that the regulation can have an impact on their access to water. The reasons why the regulation is regarded as positive is that the farmers agree to the conception that you cannot pump the river empty, there should be water left for the environment, fish and birds etc. Looking to other places for example the case study presented in Achterkamp (2009) in the Sand River, South Africa, the farmers there and other water users did use all the water available in the river resulting in a regular dry river. The high percentage 87% of farmers that is positive about the Ecological Reserve regulation, might have been under the influence of giving "politically correct" answers. If a farmer on farm level has to choose between leaving water in the river and reduction in yield because of less irrigation it is more likely that without regulation the farmer will use the water, to sustain his farming activities, since the economic situation of most farmers in the UKRC is marginal. Farmers do not have much room, economic wise, in reducing their production. Some farmers stated that they should be allowed to build dams to store water during flood flows, so water can stay in the stream during low flow periods. From a policy perspective it is questionable whether this will lead to a higher compliance to the Ecological Reserve, since when you are allowing a farmer to build a dam, you allow him to have more control over the water. Enforcing compliance will in such case require more monitoring from DWA, for which is no capacity available. Farmers anyway were wondering how such a regulation as the Ecological Reserve could be enforced since DWA is not regulating and monitoring at all, and the build-up of such a system in the UKRC is not expected. It can be stated that currently the compliance to the Ecological Reserve in the UKRC is depending on the goodwill of the farmers.

During an interview with a DWA officer it was stated that DWA and farmers in the UKRC need to come to an agreement on how much water must stay in the river, and that DWA needs to construct a weir to measure compliance (Personal communication, GOV1). Measuring of compliance to the Ecological Reserve in the UKRC will be high in cost if this is going to be done through exact flow measurements. It is more likely that if it is going to be enforced farmers probably have to proof that their water abstraction structures always allow a certain amount or proportion of water to flow though.

7.5 Monitoring & Regulation

The water discussed in this report is part of the hydrological cycle, physical flows of water are pouring down on the earth, flow through rivers, aquifers etc. This physical nature of water makes that control over water is in first instance very technical; do you have the means as a water user in technical terms to abstract and distribute the water from a physical water flow? This is the first form of water control as argued by Mollinga (2003). The second form of control is about management in terms of institutional oversight and regulation of water as a contested resource. Mollinga (2003) also argues that water control is political in terms of who can get water, and whose water use is legitimate. The NWA (1998) is the policy framework around water management and the basis for the desired situation on water control, from a policy perspective. But it is something on paper; effective implementation of such a policy

framework requires control at a management level that is coherent to this political control. Eventually the control needs to level down to the base of water control, which is technical control over the physical water flows. Without having a coherent system on these three levels it is unlikely to achieve the aims laid out in your policy framework.

7.5.1 Who is in control of the water?

Monitoring and regulation are two important things in between technical control at the base level and managerial control from the government. Monitoring of water abstraction is required, to know whether a farmer complies to his water rights and does for example not over abstract. Which DWA suspects is currently happening in the UKRC. Monitoring can be done in different ways, but the most straightforward option is installing water meters at each abstraction point. This is also what DWA wants to introduce in the UKRC:

"We are going to introduce water metering, water users will be limited. We will prescribe to farmers what kind of meter they have to install. They have to pay it themselves unless they can't." (Personal communication, GOV1)

The NWA (1998:158) is also providing for this regulation. A water user can be required to install a recording or monitoring device to monitor storing, abstraction and use of water. Furthermore it can be required that the system is linked up with an automatic management system, or that the water users keeps records on the storing, abstraction and use of water that need to be submitted to the CMA. If the water user fails to comply with a requirement, the CMA may undertake the installation of a monitoring system and recover any reasonable cost from that water user.

7.5.2 Water use restrictions

If water meters are installed abstraction can be monitored and regulations and restrictions can be enforced when necessary. Reality learns that it is very difficult to have a successful and reliable monitoring system based on these principles. Also looking to the nature of the water system in the UKRC, which consist mainly of abstractions at remote places in mountainous areas. This is for example completely different from the GIB area next door in the Kouga Catchment were a canalized system is distributing the water from the Kouga dam towards the farmers, the Gamtoos Irrigation Board which is monitoring and regulating the water use in this catchment really cut off a farmer if he has used his complete allocation (Personal communication, EXP2). The nature of the system, a mostly closed canal system, in combination with a highly organized irrigation board, also makes it possible to do such kind of monitoring and regulation. The Kouga dam is also supplying water to NMBM, during the 2009-2010 droughts the farmers in the Gamtoos irrigation area were rationed to 60% of their normal allocation. And this was enforced (DWA, 2010)(Personal communication, EXP2).

The NWA (1998) has made provision for these kind of restrictions in Schedule 3 of the Act. It states that if a CMA on reasonable grounds believes that a water shortage exist or is about to occur within an area it may, despite anything to the contrary in any authorisation, by notice in the Gazette or by written notice to each water user in the area who are likely to be affected:

- Limit or prohibit the use of water;
- Require any person to release stored water under that person's control;
- Prohibit the use of any waterwork; and
- Require specified water conservation measure to be taken.

In this the CMA has to give preference to the maintenance of the Reserve and treat all water users on a basis that is fair and reasonable. And consider the effects of the shortage on water users; the strategic importance of any water use. The CMA may require the water user to modify a water work so that it cannot be used to take more water than that allowed for in the notice; or remove the water work (NWA, 1998:160). During the 2009-2010 drought restrictions were gazetted by DWA for agriculture on the Kromme River (same gazettment as for the Gamtoos irrigators mentioned above), namely:

"The taking of water by irrigators for agricultural use from the Kromme River is restricted to 5600 cubic metres/hectare/annum (70% of the uncurtailed use)"(DWA, 2010)

Yet while for the Gamtoos irrigators this was enforced through their irrigation board, in the Kromme enforcement did not take place. Not even a single farmer mentioned something about this curtailment on water use, and when asking specifically about it the UKRC farmers did know about the restrictions for the Gamtoos irrigators, but they did not know that the same restriction also applied to them. This shows that DWA is currently both not able to enforce regulations, but also not able to effectively communicate to farmers about restrictions in the URKC.

7.5.3 Institutional under capacity

The legal requirements for monitoring and regulation are in place, but yet at the management level there is large deficit on institutional, human resource and financial capital. A CMA is not in place, current DWA officials are overloaded in work and a recent study by DWA reveals that the capital requirement for the entire water sector over the next 10 years, in real terms, sums up to R670 billion, and that the funding gap is R338 billion in this 10 year period (NWRS II, 2012:17). Looking from this perspective a situation in which DWA can effectively enforce water control at the base level of water abstraction in a catchment such as the UKRC seems to be far from reality.

Yet, the NWA (1998) provides with another way of overcoming this insufficient capacity of DWA at CMA level to monitor and regulate water use; The Water User Association (WUA). The purpose of a WUA is to enable water users to cooperate and pool their resources (financial, human, and expertise) to more effectively carry out water-related activities. WUAs have an important role to play in respect of poverty eradication and providing food security. The functions of a WUA can be to prevent water from any water resource being wasted, to protect water resources, to prevent any unlawful water use or act that negatively impacts on the water resource, to generally supervise the water resources, to regulate the flow of any watercourse and to investigate water quality and water use (DWAF, 2008a). This form of decentralized management is introduced, because it is believed that it is one of the ways to achieve IWRM and also because DWA is not able to manage at such detailed level from CMA level. The CMA can deal with organised groupings rather than with many individual users. Yet as the same for the establishment of the CMAs the development of WUAs is also far beyond schedule in South Africa. Currently there is no such thing as a farmer community in the UKRC, and the eventual establishment of a WUA seems to be far away, more on this topic will be discussed in Chapter 8 under the topic of collective action.

Summarizing the above, DWA will execute the validation and verification and compulsory licensing process. But in terms of a continuous monitoring and regulation in a remote water use a system as the UKRC, DWA is currently empty-handed, and looking to the deficit in resources it is unlikely that DWA will be able to set up adequate monitoring and regulation in the UKRC to enforce the policy framework laid out in the National Water Act.

7.6 Working for Programs

7.6.1 Working for Water

As discussed in Chapter 5.4.2 Invasive Alien Plants (IAPs) can have a significant impact on decreasing annual runoff, figures have been found between reductions of 100-300 mm/year (Görgens & Wilgen, 2004). The South African government created the Working for Water (WfWat) programme in 1995, in order to reduce the impacts of IAPs on water supplies through the employment of poor people in the rural areas. Political support for this programme stems almost entirely from its employment creation, upliftment and empowerment benefits (Wilgen, 2009). The benefits in water yield and economic terms of the clearing programme are often viewed with some scepticism by decision makers (Wilgen, 2009). The Working for Water program was initially proposed as a 20-year activity, but Wilgen (2009) mentions that near a century is required to clear some of the important species, if current clearing methods are continued. For the Kromme River Catchment a specific estimate has been made by McConnachie (2012) that continuing current with current intensities another 54 years is need to clear the Kromme River Catchment.

7.6.1.1 Cost-effectiveness

Although government is contributing R380 million per annum in the form of the current WfWater activities, Cullis et al. (2007) argues that because of the current extent of the problem this will not be enough to eradicate IAPs and that the contribution of the land user is a key requirement in enabling more efficient clearing. In Wilgen et al. (2012) the same concerns are brought to the table, it is shown that total costs of the WfWat program in the 15 years it has been running sums up to R3.2 billion. But the invasions appear to have increased since inception of WfWat in 1995, and remain a serious threat. Wilgen et al. (2012) states that in order to more effectively control IAPs the national-scale strategy should be substantially modified. Rather than attempting to control all species, and to operate in all areas, a more focused approach is called for. With prioritization in both the species and areas to be cleared. And biological control should be used more since success where most notable using this method.

McConnachie et al. (2012) present an evaluation on the cost-effectiveness on the WfWat program specific for the Kromme[9] and Kouga catchments. These two projects are among WfWat's oldest and largest in terms of hectares cleared and jobs created. The post-treatment cover (December 2008) is compared with the first recorded pre-treatment cover. The study found that WfWat spended R9.89 million in the Kromme in the period from 2002-2008. This boils down to R11.987 per condensed[10] hectare cleared. Which is low compared to a figure of R70.517 for the Kouga catchment but high compared to an earlier estimate of R4463 made by Marais and Wannenburgh (2008; cited in McConnachie et al., 2012). Gull (2012) shows a figure of R22 million spended by WfWat in the UKRC up till 2010. And according to the senior managers in the Eastern Cape, the Kouga and Kromme are considered to be the most effective projects in the province. A reason given for the relative low cost-effectiveness is the high post-treatment re-invasion, which is also acknowledged by the farmer in the UKRC. These farmers or landowners are according to the Conservation of Agricultural Resoures Act, responsible for the control of IAPs on their own property (Cullis et al., 2007). In the agreement

[9] Kromme project is comprised of K90A&B catchments (UKRC) and the K90C catchment, total area is ± 1,8 x the size of (UKRC).

[10] 100% equivalent cover, used for comparison across sites, using the formula: $C=d/100 \cdot A$, where C is the area expressed as condensed ha, d is the % canapy cover of the alien plant, and A is het area in ha that was treated.

a land owner has to sign a contract with WfWat that the land owner agrees to take responsibility for site maintenance after the second follow-up treatment carried out by WfWat. This did not occur in both the Kromme and Kouga projects according to Mcconnachie et al. (2012). Part of this may be due to landowners' insufficient capacity resource wise to cope with the required follow-up and willingness to do so, and part may be due to the clearing not having been completed to the expected standard before handing back to the landowner. Especially this last argument is widely acknowledged by farmers in the UKRC.

7.6.1.2 Farmers opinions on Working for Water

Hearing from farmers in the UKRC about how they experience the WfWat program on the ground, you hear different stories, below a selection of farmers' opinions on the WfWat program:

"I am very positive about the work done by WfWat."

"I believe they (WfWat) are spending millions every year on this program. Which is a very good thing, but it should be more intensive I believe. They need to follow up quicker and better."

"I want WfWat to come. They are saying next week all the time, this doesn't work. Even when I am asking for poison they don't give it to me, I am willing to put my own people to clear, but they (WfWat) are not willing to help me."

"Communicative WfWat is very weak, I think it is an inefficient organization."

"Black Wattles are destroyed, I don't know if this is very successful. Short after black wattle clearing, the Kromme river became deep, before I could drive through not anymore now."

"WfWat is not working on a scientific basis, they should take the trees out when they are small"

"They (WfWat) should start downstream, otherwise all the trees left in the flood zones will block the river and this will create a lot of damage on bridges etc."

"They (WfWat) need to move the trees out of the flood zones, and start in the top of the catchment because seeds come down again otherwise"

"They (WfWat) do a crap job, they leave open the gates and do only the parts close to the road."

The three main issues raised by farmers in the UKRC are: 1) communication with WfWat; 2) follow-up treatments and land owners responsibility and; 3) clearing in the main river with regards to erosion and flooding. About the communication issue, WfWat should be organizing a meeting with the landowners and other stakeholders every 1-3 months during the clearing. This is currently not done in the UKRC, the last meeting heard of dates back to the very start of the process. And for the meetings Living Lands is organizing on a regular basis in the area WfWat is not joining, because as they state they have their own meetings with the farmers. Apart from these forums communication direct between a landowner and WfWat project leader is also regarded as problematic in which the project leader is making a lot of promises, which he does not keep. Secondly the follow-up treatments and contract signing between the landowners and WfWat is perceived as problematic. Farmers are not willing to sign the contracts because they see the work done by WfWat as inappropriate and are not willing to become responsible for what WfWat leaves behind. From the side of WfWat the unwillingness of the farmer to maintain his land after clearing is a main concern in the effectiveness of the

program. In an interview with the WfWat manager of the whole Eastern Cape, it was stated that if the farmers consequently fail to maintain their lands after clearing WfWat will stop working on their land (Personal communication, GOV2). The farmers think the other way around and state if I start clearing WfWat will not come anymore to help me. There is a clear bottleneck in the perception of both parties regarding this issue. Farmers can get help in their own clearing activities in the form of biological control or poison to put on cut-of stems, but they also have to proof that they used those resources in a good manner afterwards (Personal communication, GOV4). The last issue is about clearing in the main river and floodplains, these are the areas that are largely invested by the water appreciating Black Wattle. While the Black Wattle already made the system more vulnerable to erosion, compared to its natural vegetation, clearing of the black wattle probably even further increases the risk of erosion. Trees are after clearing not removed out of the flood plains. And during floods the trees are forming large dams against bridges and other water related infrastructure, with devastating impacts. Some farmers argue that because of this they should start downstream and work upward, this however is according to seed spreading along rivers as explained by (Wilgen, 2009) not advisable.

7.6.1.3 Working for Water and water scarcity

Approaching the WfWat program from a water scarcity perspective, there are some interesting things to mention. As already stated before, 91% of the farmers in the UKRC indicate that IAPs have a negative effect on water yield. It is stated by the project managers of WfWat that the project in the Kromme was primarily initiated to enhance water security for the NMBM via two Kromme River dams and the Algoa Water Supply Scheme, besides employment creation (Personal communication, GOV2). Yet from the side of NMBM this is not taken into account in their Water Supply Reconciliation Report (DWA, 2011a). They recognize clearing of invasive alien plants (IAP) in upper-catchment areas as important. But no attempts are made to quantify the potential benefits, and it was not included amongst the strategies considered viable as a way of increasing water supply and security (Talbot, 2012).

Using a figure of ± 2250[11] condensed ha cleared in the UKRC, this would according to the water yield reduction indicated by Görgens & Wilgen (2004) of 100-300 mm per ha per year result in an increased water yield between 2.3 – 6,7 · 10^6 m^3 y^{-1}. This are significant numbers compared to for example the abstraction by NMBM at the Churchill dam of ± 25 · 10^6 m^3 y^{-1}. But again the calculation shown here is a quick desktop estimate and does not give much proof for the actual situation. Yet although these numbers on increased water yield sound promising. Gull (2012) did a cost-benefit analysis on restoration through clearing as a strategy for NMBM but founded that restoration is not an economically viable investment in the UKRC.

7.6.2 Working for Wetlands

The rehabilitation of the wetlands in the UKRC through the Working for Wetlands (WfWet) program began in 2000, with the construction of gabion weirs to stop gully development and head cut erosion (Kotze & Ellery 2009). In the period of 2000-2005 a total of R6.5 million is spended through the WfWet program. Construction and maintenance continues up till now. Using a same investment rate as in the period of 2000-2005 current investment costs in the UKRC by WfWet can be estimated at ± R12 million. These investments are made in order to protect and restore the integrity of the wetlands, that do provide eco system services such as flood attenuation, protection from erosion, increasing water quality and sustaining baseflow.

[11] Calculated with information presented by Edwil Moore, project manager WfWat in the Kromme and Kouga, during a workgroup meeting organized by DWA (25-09-2012) around catchment restoration and water security for NMBM.

An important driving force is also to sustain the water supply to NMBM through the Churchill Dam (Kotze & Ellery, 2009). Without the rehabilitation the remaining part of the wetlands in the UKRC are under serious threat of losing the above stated eco system services to a large extend. The coordinator of the WfWet program in the Eastern Cape explained the following:

"The top wetland in the Kromme at Krugersland has an estimated of 12,3 · 10^6 m^3 of peat, if you use 700 l per m^3 of water holding capacity, a total of 8,6 · 10^6 m^3 water is stored in that wetland. We saw it quite nicely last year, you had big rains in May before that it was very dry, we just completed the structure at the bottom of the Krugerland wetland. With the first rain there was no water flowing over the structure. In June we got another amount of good rain, but only in the July rain it did flood. It dried out during the three year drought. The water level raised up to the structure and then will release water around the structure, but I also think that the biggest effect of wetlands is flood mitigation and not stream flow regulation"(Personal communication, EXP3)

A flood experienced during the fieldwork period of this research also personally showed me the difference between wetland floodplains and floodplains under agriculture. In the wetlands hardly any traces of the flood could be detected afterwards, while in the floodplains used for agriculture, erosion has had a massive impact. Which could be both seen from the incised riverbeds, and eroded riverbanks as well as from huge sediment deposition just upstream of the wetlands in the UKRC in which two dairy farmers lost (temporarily) 15 ha of pastures. Gull (2012) tried to do a cost-benefit analysis of the WfWet program in the UKRC for the improved water quality, capturing of sediment and flood attenuation provided to NMBM through the Churchill Dam, but stated that this was not possible due to a lack of (hydrological) data.

Both farmers and NMBM are positive towards the WfWet program, but are not involved in terms of doing maintenance or financial support (Personal communication, NMBM1, EXP3). In relation to water scarcity it has already been discussed that wetland degradation poses a threat to farmers depending on their position in the catchment because of lowered ground water tables and loss in land. Yet while most farmers perceive the wetlands and WfWet positive with regards to water availability they also see it as land that cannot be used for agricultural purposes, and even sometimes as a threat to their agricultural field and roads. Furthermore the farmers with wetlands on their property are confused about what their responsibilities and use rights are. The main issues raised by the WfWet coordinator are that it is difficult to work together with the farmers and get them to do the right things that do not impact on the wetlands (Personal communication, EXP3). It is clear that there is a lack of communication and understanding between farmers and WfWet. WfWet argues that farmers are not allowed to undertake any activity in the wetlands, but at the same time are responsible for keeping it clear from alien trees, because the alien trees push the Palmiet vegetation in the wetland away (Personal communication, EXP3). Farmers are confronted with a lot of sedimentation in the wetlands, which because of the river changing course poses a threat to their roads and agricultural fields.

The wetlands do provide in ecosystem services, although they are currently not quantifiable, both for farmers and NMBM. It advisable to WfWet and farmers to get more engaged with each other in order to overcome the current communication and understanding gap.

7.7 Conclusion

In this chapter the government land & water management practices have been discussed. The purpose of this chapter is to answer the government part of the sub question: "How and to what extent do the land & water management practices of the farmers and the government induce "management" water scarcity problems for the farmers in the Upper Kromme River catchment, currently and in the future?". In the perception of most farmers in the UKRC government management did not have any impact in the past up till present, but is expected by 50% of the UKRC farmers to have a moderate to very high impact in future on water scarcity problems (Figure 19 and Figure 20). This major change in perception can be mainly contributed to the fact that farmers expect restrictions from DWA that are flowing forward from the water reforms and indirectly from the large water demands in NMBM. Farmers are although this concern unable to point out in specific terms what the water reforms imply and what impacts as for example through the compulsory licensing process can be. This also shows that farmers have not been confronted with the water reforms a lot yet. It is clear that new or expanded water uses will not be licensed by DWA in the UKRC. Also the building of dams is prohibited and farmers can expect to be the group to be cut of first from water if more water is allocated than available. This enduring uncertainty on water rights for farmers will discourage investments, and eventually undermine farming activities in the URKC.

Looking to monitoring and regulation, which are required in order to implement and enforce the environmental flow regulation and water use restrictions during droughts. DWA is currently empty-handed, and looking to the deficit in resources it is unlikely that DWA will be able to set up adequate monitoring and regulation in the UKRC to enforce the policy framework laid out in the National Water Act.

WAR, compulsory licensing, environmental flows and monitoring and regulation all part of the water reforms are presented as potential threats to the secure access to water of the current UKRC farmers. Yet this water reforms is not being implemented, the threat is in this sense very theoretical. In the current situation not so much has changed for the white farmers in the UKRC and they can continue their business as usual, taking as much water as they want.

The Working for -Water and –Wetlands programs are major investments from the government side in the UKRC. Yet the effectiveness of these programs is threatened by a lack of understanding, communication and willingness to cooperate between land owners and the Working for programs.

In linking this chapter to previous chapters on physical- and farmer management induced-water scarcity and the next chapter on political water scarcity. It can be concluded that government management in the UKRC is currently only focusing on physical water scarcity aspects of Invasive Alien Plants and wetland degradation. Yet in this ample cooperation is pursued with farmers. The main concern of farmers in relation to government management induced water scarcity for the future is that political factors will lead to restrictions on water use implemented through the government, this will besides already in this chapter more thoroughly discussed in the next chapter.

8 Political water scarcity

8.1 Introduction

Political water scarcity in the Kromme river is related to downstream water use by powerful users and the contrast between; 1) the politically privileged but economically poor Historically Disadvantaged Individuals (HDIs); and 2) the politically "unprivileged" but economically rich white farmers in the Upper Kromme River catchment. The phenomenon of political water scarcity has a long history in South Africa. During the apartheid era the white people dominated State politics and most land and related water rights were concentrated in hands of the white people at the expense of the black people. The political system in South Africa has since been transformed dramatically, reversing the nature of political scarcity but without becoming less pronounced nowadays. In the light of the ever-growing demands, especially from large towns supplied by the Kromme River and the institutional failure as discussed in the previous chapter, it is more likely that the political competition about access to the water will increase. Swatuk (2008:24) states the following about the Southern Africa situation:

"Southern Africa's history of underdevelopment has created a dense web of powerful political, economic and social interests linked by a shared techno centric understanding of and approach to water use"

While during the apartheid situation political, economic and social power was mainly in the hands of the white. The regime change in 1994 has led to the collapse of this powerful coalition. The techno centric understanding of water use is still persistent, but political and economic powers have been dissociated from each other, with the political power mainly in the hands of black people and economic power still in the hands of white people.

This chapter aims to show how politics is involved in the distribution of the Kromme Rivers water resources, which is often approached from a technocratic perspective in search of an economic and social optimum. The latter perspective ignores that politics and power are inherently involved in this. I will start by showing and discussing the perceptions of the UKRC farmers with regard to political water scarcity. After that I will delve into how NMBM and other small towns (can) impact on water scarcity problems in the UKRC and how politics is involved in this. This will be followed by a short discussion on catchment restoration and Payment for Ecosystem Services (PES). The other main topic discussed in this chapter is the Water Allocation Reform in which specific attention will be given to the situation around black emerging farmers in the UKRC.

8.2 Past and future perceptions

This paragraph deals with the perceptions of farmers on how politics did have and will have an impact on the secure access to water of the farmers in the UKRC. With regard to political water scarcity; all interviewed farmers did indicate that for the past until the present period there was no such thing as political water scarcity (Figure 24). But with regard to the future only one farmer does not expect impact from politically induced water scarcity. 30% expect a moderate impact and the majority of the farmers (55%) expect a high to very high impact of politically induced water scarcity. Political water scarcity here should be interpreted as a process of diminished access to water by farmers, driven by the increasing water demands of NMBM and the stated government goal of addressing past-inequalities between black and white farmers as part of the Water Allocation Reform program. This general finding shows already that politics is expected to have a major impact in the future.

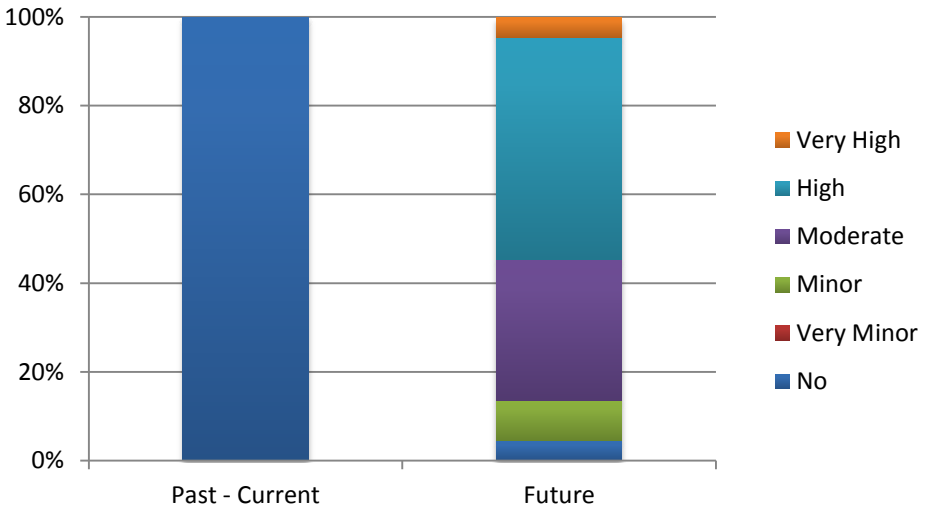


Figure 24: Graph showing the perception of interviewed farmers on past up till current and future impact of politics on water scarcity and subsequent impact on their farming activities.

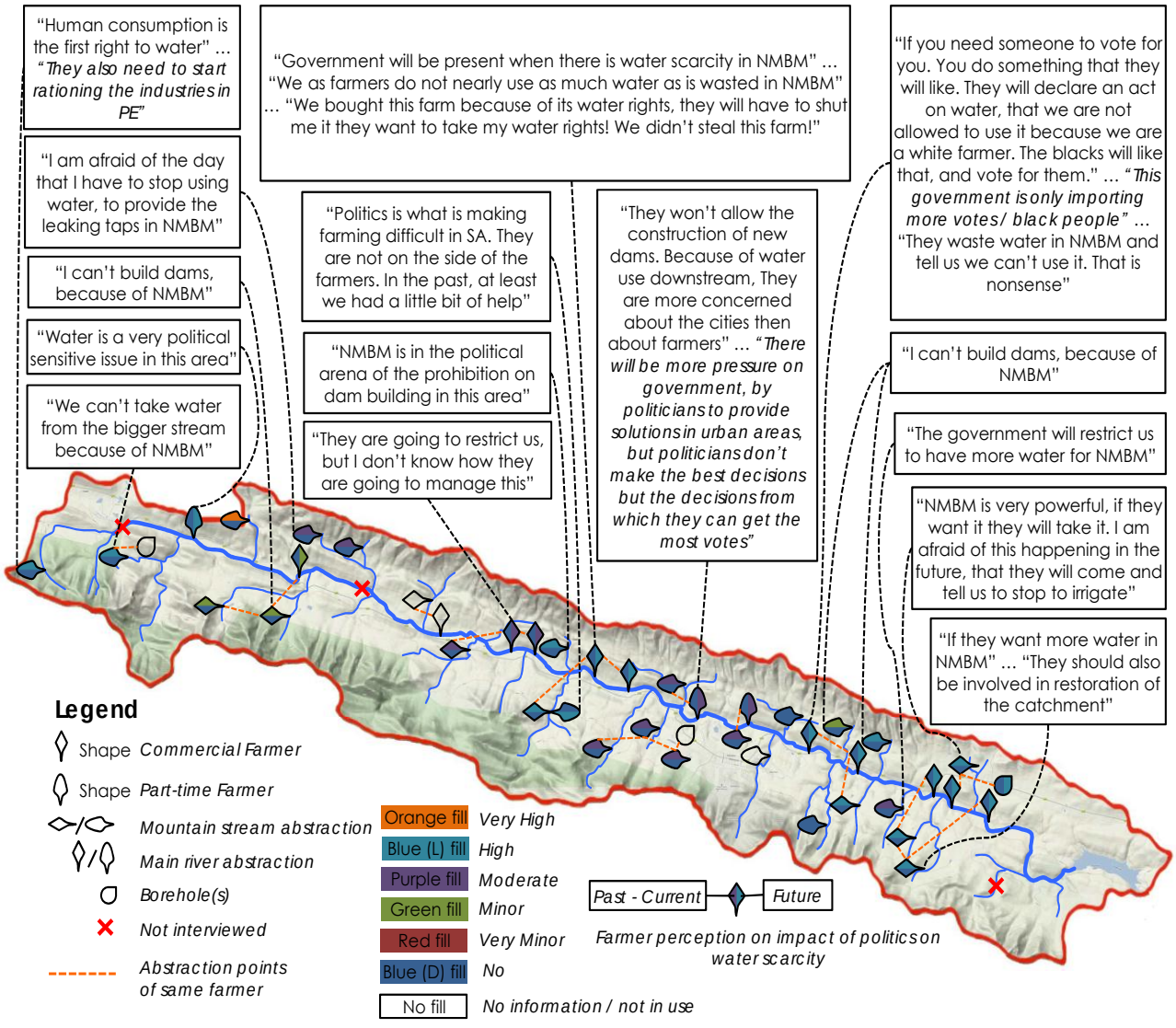


Figure 23: Map showing the perception of interviewed farmers on past up till current and future impact of politics on water scarcity and subsequent impact on their farming activities. The map highlights farmer quotes from interviews.

Figure 23 shows a spatial translation of the findings presented in Figure 24. Looking in detail at Figure 23 the following things stand out. The four most downstream commercial farmers expect all a high impact through restrictions on water use. Two farmers link it specifically to election politics, stating that water management interventions will be implemented in favour of the majority "black people in NMBM" at the expense of the agricultural water users in the UKRC, in order to gain votes. The most interesting statement is from a farmer who stated that he bought the farm because of its water rights, and adding a bit of anger in his comments he states:

"They will have to shut me if they want to take my water rights! We didn't steal this farm!"

His current "water right" is like most of the farmers in the UKRC an Existing Lawful Use of water. But because of the anticipated compulsory licensing water redistribution process as discussed in the previous chapter. These water rights are in limbo. The other farmer quotes around the topics of politically motivated re-allocation of water to black people, inefficient water use of NMBM, the freeze on dam building and catchment restoration will be elaborated on in the related paragraphs.

8.3 Water demands NMBM

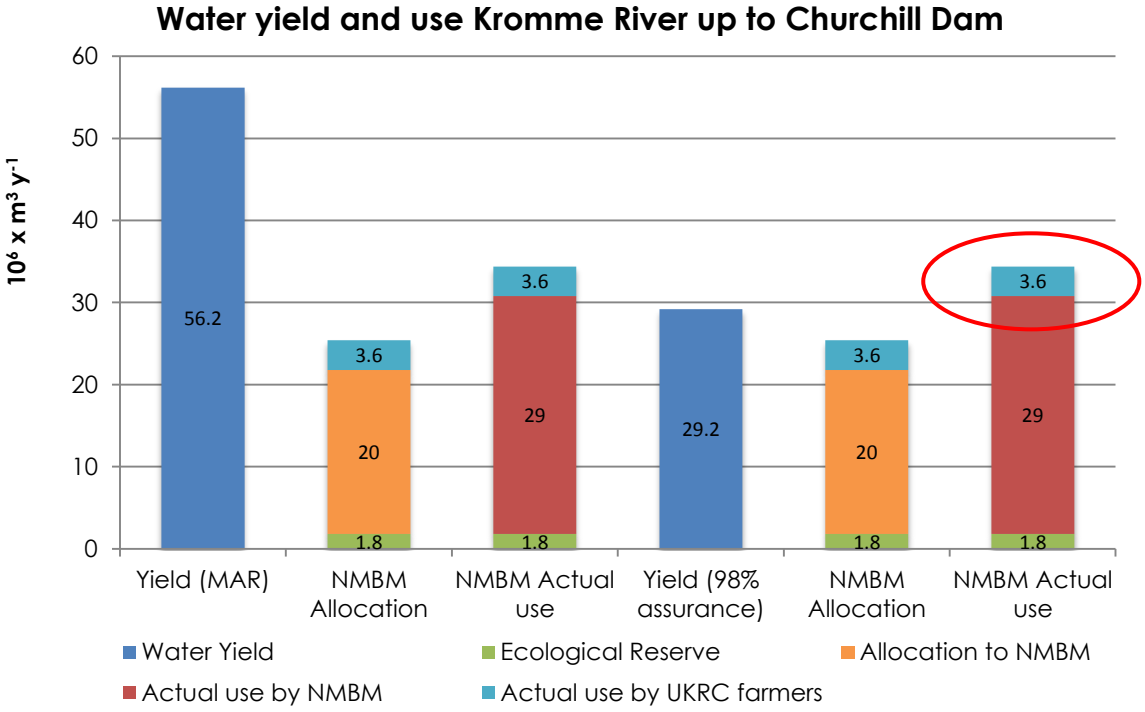
8.3.1 Ever increasing demands

DWA's Water Use Authorization and Registration Management System (WARMS) shows that in 2007 the registered water use of NMBM was 87,6 · 10^6 m^3 y^{-1}. The water requirements of the NMBM have increased steadily over the past few years, due to in-migration, increased service levels and industrial activity. In 2009 total urban and industrial use from the system was estimated to be 103 · 10^6 m^3 y^{-1} (DWA, 2010). In the Algoa Reconciliation Strategy (ARS) it is further projected that the water requirements for urban use and industries in NMBM will increase to 170 - 235 · 10^6 m^3 y^{-1} by 2035 (bandwidth between low- and high- growth scenario). NMBM itself is also facing water scarcity problems, of a physical (droughts), management (leakage) and political nature. Recently the water allocation from the Garib Dam (inter-basin transfer from the Orange river) has been drastically reduced.

The registered water right of NMBM from the Kromme River system is 20 and 18 · 10^6 m^3 y^{-1} respectively for the Churchill dam and Impofu Dams. This allocation is almost completely used. NMBM is using the main share of available water yield in the Kromme River system which is 44,4 · 10^6 m^3 y^{-1} at 98% assurance (DWA, 2011a). Yet information from the interview with water supply management team of NMBM shows that they are using 29 · 10^6 m^3 y^{-1} from the Churchill Dam and ± 15 · 10^6 m^3 y^{-1} from Impofu dam. Water supplied to other towns in the vicinity as discussed in the next paragraph is included in this. The maximum water abstraction, after the upgrade on treatment works at the Churchill Dam have been completed, will be 36,5 · 10^6 m^3 y^{-1}, the potential abstraction from an operational perspective of both the Churchill Dam and Impofu dam is 73 · 10^6 m^3 y^{-1} (Personal communication, NMBM1). Yet comparing this figure with the yield of the total Kromme system of 44,4 · 10^6 m^3 y^{-1} at 98% assurance (DWA, 2011a), shows that abstraction capacity and yield are far out of balance using the 98% assurance level. Information on yield at lower assurance levels is unfortunately not available. A lower assurance level will result in a higher yield, but comparing the abstraction capacity to the registered water rights of 38 · 10^6 m^3 y^{-1} also shows a large difference between water use rights and water use control from a technical perspective (DWA, 2011a).

8.3.2 Over utilization of the Kromme River

Figure 25 shows two graphs with the water yield in the Kromme River system specified for the portion up to the Churchill Dam and up to Impofu Dam. The latter includes the portion up to the Churchill Dam and the additional portion between Churchill Dam and Impofu Dam. The water yield is expressed in Mean Annual Runoff (MAR) at a 98% assurance level. In the graph the ecological reserve is included 1,8 · 10^6 m^3 y^{-1} at Churchill Dam (WTW backwash water) and the 5 · 10^6 m^3 y^{-1} required release to the Kromme estuary from the Impofu Dam. Furthermore it shows NMBM allocated and actual usage amounts of water as given above and the actual usage of the UKRC farmers based on the own estimated low demand



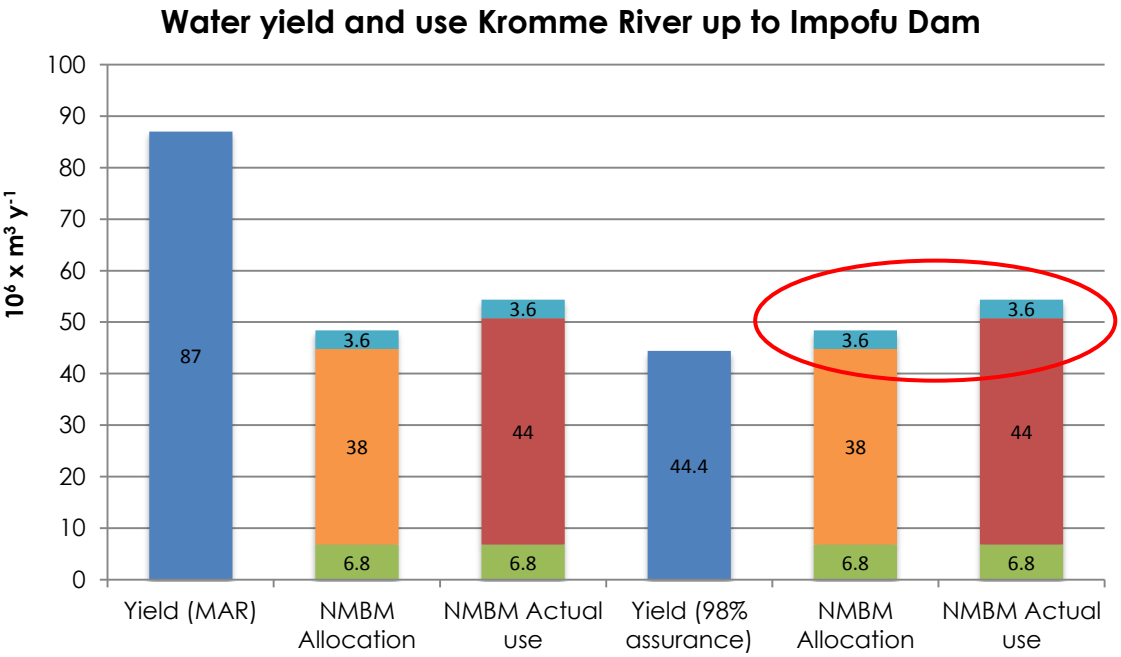


Figure 25: Kromme River water yield, ecological reserve, allocation / actual use NMBM and actual use UKRC farmers. (Source DWA, 2004)

scenario as shown in Chapter 4.1.3. The abstraction of farmers for the portion between Churchill Dam and Impofu Dam is not known and has therefore not been included. The graph is made to make a comparison between available yield in the Kromme system and demand by the ecological reserve, NMBM and farmers. The data, apart from the UKRC farmer use, in the graph has been derived from the Internal Strategic Perspective for the Tsitsikamma to Coega portion of the Fish to Tsitsikamma WMA (DWA, 2004). When looking to the Mean Annual Runoff of the whole Kromme system a large surplus of water is still available. But for allocations to domestic purposes DWA uses a 98% assurance level. Comparing the yield at 98% assurance and the allocation shows the system is just in balance when the Ecological Reserve and allocation to NMBM are taken into account. Looking at the last column including the ecological reserve, actual usage by NMBM and the UKRC farmers the system is over utilized using the 98% assurance yield. For irrigation allocations normally a 80% assurance level is used but no information was available on the 80% assurance yield of the Kromme River system so no comparison on this can be made. Yet the graph already shows that in an average year no water scarcity problems are to be expected on a catchment level. The MAR is well above the usage. But in drier situations the system will be in water stress as shown in the comparison between the 98% assurance yield and the total usage. This will also have its implications for the implementation of the ecological reserve as discussed in Chapter 7.4.

Specifically looking to the Kromme River system up till the Churchill Dam shows also an over utilization taking the 98% assurance yield as a starting point. The main conclusion is that in a dry situation occurring twice every 100 years, the Kromme River water resources are over utilized. A related comment made by NMBM water managers about the Kromme system claims that severe droughts affect the river more frequently:

"On average there is severe drought every five years, and the whole water system is just in balance. It is quite alarming, we do not have other resources, we are over utilizing the yield of that system."(Personal communication, NMBM1)

While the system's resources are already characterized as over-utilized, NMBM is still putting management interventions in place to enlarge its physical control over water, by building bigger treatment plants and pipelines. The water supply from the Kromme River provides 40% of NMBM's total water demand on average. The Churchill dam is the cheapest source for NMBM of the major water supply schemes (Gull, 2012). In Mander et al. (2010) it is stated that the current abstraction of $36{,}5 \cdot 10^6$ m^3 y^{-1} will increase with another $10 \cdot 10^6$ m^3 y^{-1} after a new pipeline from Churchill Dam is finished. This information cannot be corroborated in the Algoa Reconciliation Strategey (ARS) (DWA, 2011a), yet in a status report on the ARS of September 2012 (DWA, 2012) it is claimed that groundwater developments are underway in the area owned by NMBM around the Churchill Dam. This will yield an additional $3\text{-}4 \cdot 10^6$ m^3 y^{-1} and also has to be transported by the Algoa WSS.

8.3.3 NMBM's Augmentation strategies

In order to cope with the projected increase in water requirements, a number of potential interventions have been identified by the Algoa Reconciliation Strategy, namely:

- Water conservation and water demand management (WC/WDM);
- Increased operational efficiency of the current water supply system;
- Trading of water use authorizations;
- Land use changes (alien clearing);
- Re-use of water;

- Groundwater schemes;
- Inter-basin transfer schemes;
- Desalination of seawater;
- Desalination of brackish river water; and
- Surface water schemes.

In this strategy no additional allocations from the Kromme River system are mentioned. Moreover concerns are raised on the status of the currently available data on catchment hydrology, which for the Kromme River system are based on an unacceptably short period. This needs to be updated as a matter of urgency (DWA, 2012). The main strategy that relates to the UKRC and is mentioned repeatedly in the ARS and its status reports is that NMBM is urging DWA to undertake verification and validation studies in the Kromme and Kouga upper catchments. It is stated:

"… actual water usage as at 26 August 1998 (the date of promulgation of the National Water Act, Act 36 of 1998) would need to be determined based on aerial photography or satellite imagery at that time. As a lawful right is also based on the water use for the 2 year period leading up to the date of promulgation, any aerial photography during this period would also be of value in this exercise." (DWA, 2009)

In the interviews with the water supply management team of NMBM the following was stated with regard to this topic and the perception on government water scarcity:

"We work very closely with DWA, we have a very good relationship, ten years ago it was very poor, three droughts has made us work together"

"We can have moderate positive impact on government management, because of regulation on farmers through a WUA. We have a very good relationship with DWA, they wanted us to write up a document on our achievements in managing the droughts."

"A WUA can function as a platform to regulate water use allocations, you can only use water if you have rights, like the system for the Gamtoos irrigators, farmers there are improving their efficiency in large amounts. How can this be promoted in the Kromme River Catchment?" (All personal communication, NMBM1)

The verification and validation process is perceived as an instrument by NMBM to reduce water usage by agriculture in the upper part of the catchments supplying the city. And it is seen as a first step towards enforcing regulations on farmers in the upper catchments in dry periods, as happened during the 2009/2010 drought when Gamtoos Irrigators were curtailed to 60% of their full allocation. The establishment of WUAs and collective action by farmers is furthermore perceived as a way to achieve abstraction monitoring and as an essential vehicle to enforce abstraction reduction during droughts and increased water use efficiencies.

"DWA is at this moment looking at starting with regulation on water abstraction. In the Kromme there is no regulation on how much water farmers can abstract. This is especially a problem during the droughts." (Personal communication, NMBM1)

During the 2009/2010 drought the level of the capacity of the Churchill Dam decreased to a minimum of 10%. Looking at the farmer quotes in Figure 23 it is the main concern of the farmers in the UKRC, that eventually they will also be restricted to ease the water scarcity experienced by NMBM:

"The government will restrict us to have more water for NMBM"

"NMBM is very powerful, if they want it they will take it. I am afraid of this happening in the future, that they will come and tell us to stop to irrigate"

It was also mentioned several times that NMBM has played a role in the prohibition on dam building in the area. This implies that NMBM already has had an impact on water scarcity, since dams are a main management strategy of farmers to cope with dry periods. The freeze on dam building is a serious limitation on agricultural growth possibilities.

"NMBM is in the political arena of the prohibition of dam building in this area"

Considering both the statement of NMBM and the farmers, it can be observed that they are very much in line with each other. And NMBM is stating that they influence DWA as a vehicle to enforce regulations, because they have the right connections and a good relationship. What annoys/upsets farmers most in relation to the water use by NMBM from the Kromme River is that they see NMBM as water wasting.

"We as farmers do not nearly use as much water as is wasted in NMBM"

"I am afraid of the day that I have to stop using water, to provide the leaking taps in NMBM"

The first quote makes perfect sense since the farmers in the UKRC do approximately use 3,7 · 10^6 m^3 y^{-1} of water. In NMBM the water loss percentage is 26% (Personal communication, NMBM1), which amounts to a figure of 6,5 · 10^6 m^3 y^{-1} water losses when one multiplies the loss percentage with the average 25 · 10^6 m^3 y^{-1} abstraction from only the Churchill Dam. The white farmers are not prepared to give up their water use, for inefficient water supply in NMBM. The farmers believe that they are better able to use the water productively than NMBM water distribution can.

8.3.4 Economically driven politics

The recent drought in 2009/2010 triggered a rapid implementation of water conservation and water demand management measures, also tweaked as part of a main strategy to cope with the increase in future demands (DWA, 2011a). Talbot (2012:13) states the following in relation to this:

"During the recent drought crisis in Algoa, considerable effort was invested in such a campaign. In fact, this campaign, combined with energy saving exercises, was so successful that it reduced the Municipality's revenues from the sale of water and electricity by R400 million. This situation has resulted in the municipality having a shortage of funds and having to secure additional funding from the National Treasury. Consequently, this experience effectively acts as a disincentive for the Municipality to save water and puts more pressure to find ways of augmenting water supply."

This again shows that at a political level, decisions to implement certain measures to cope with water scarcity are not purely driven by a concern to reduce water consumption as much as possible. Rather the dominant concern is to maximize monetary returns, which puts in this case more pressure on the water supplying catchments. The statement of Swatuk (2008:24) *"Southern Africa's history of underdevelopment has created a dense web of powerful political, economic and social interests linked by a shared techno centric understanding of and approach to water use"* links closely to this. Especially if we take into account the following statements of the water supply management team of NMBM:

"In future our own management is going to have a high impact on water scarcity because of the lack of finance to maintain the system"

"We can have a moderate positive impact on politics, because we can show politicians what cheap options are for water use. Politicians want us to use desalinization (expensive), inland waters (Orange river allocation) are going to be used inland" (Both personal communication, NMBM1)

Gull (2012) identified that the Kromme River and specifically the Churchill Dam is currently the cheapest source of water for NMBM. Politics and economics are interwoven on this topic and water use is very much approached from a techno centric water supply mind set. In the light of a lack of financial resources in NMBM, exploiting the Kromme River water resources to its full potential is the economically preferable option. Instead of focusing on water demand management and reducing losses in urban drinking water supply networks.

Another strategy to cope with the increase in future water demand is water trading. Focus areas in this are currently the Baviaanskloof River and Upper Great Fish River, but this could eventually also be applied to the UKRC. Gull (2012) claimed that in comparing the different water supply regions for NMBM the agricultural value of water was the lowest in the UKRC, and that water trading with farmers in the UKRC proves to be the cheapest option in trading for NMBM. According to Talbot (2012) it is unlikely that very productive irrigation farmers would consider selling their water rights, but more marginal farmers may, if the price of water provides a higher return than their current land uses and if they are planning to change their agricultural activities to ones which require the use of less water, or to restore their land and increase its productive potential. In fact, a shift to more sustainable land use practices and the restoration of degraded land has the potential to encourage farmers to sell their productive water entitlements. While this water trading might indeed offer an opportunity for the marginal farmers, or the couple of farmers that do have rights but do not use them, it poses a threat to the farmers that do use their full allocations.

If water is traded from UKRC farmers to NMBM this would imply a higher allocation from Churchill Dam, higher abstraction and a higher chance on low dam levels. Since water rights sold by marginal farmers were formerly not in use or mostly only partly. This eventually would pose the active farmers under the threat of more restrictions because of low dam levels. Yet currently trading in water entitlements is discouraged by DWA and would not be feasible unless there was an effective system of monitoring water use and ensuring compliance with registered water uses (Talbot, 2012). The verification and validation process needs to be undertaken first in order to resolve how much water the farmers are entitled to use. In this process it is unclear whether unused or partially used water rights will be licensed. The impact of water trading on water scarcity for the farmers in the UKRC is therefore difficult to determine.

NMBM and farmers blame each other vice versa when it comes to the topic of water, while the interest of both parties are clearly competing. NMBM does not anticipate for the near future that a voluntary cooperation will evolve between NMBM and the farmers. Yet NMBM also stated the following:

"There is definitely a need for closer cooperation between NMBM and the farmers, in the past we were indifferent on what the farmers were up to. It was about issues we do not consider, we were stuck in our own little world" (Personal communication, NMBM1)

8.3.5 Water demands of small towns

Besides NMBM some small towns in the Kouga municipality south east of the UKRC are also supplied through the Algoa WSS, namely: Humansdorp, Jeffreys Bay, Loerie, St. Francis Bay, Thornhill and Oyster Bay (Table 2). Their water demand strategies as presented in reconciliation strategies reports (DWA, 2011b) show that all of the towns aim to increase the allocation from the Churchill Dam part of the Algoa WSS. The ARS status report of September 2012 (DWA, 2012) provides a summary of all small towns and comes up with different figures shown in Table 2. Total water use from the Churchill Dam part of the Algoa WSS was 3,6 · 10^6 m^3 y^{-1} and is projected to increase with 7,6% annually, augmenting to a figure of 22 · 10^6 m^3 y^{-1} by 2035, which is a lot more than derived from the separate reconciliation reports as shown in Table 2. It was also mentioned that although NMBM is operating the Algoa WSS it has no authority regarding the Kouga Municipality towns water usage (DWA, 2012). Water crises are also experienced in these towns and politics whether through election politics or other power plays, can be expected to put extra pressure on the supply from the Churchill Dam to these towns. This would augment the already huge pressures emanating from NMBM's side.

Table 2: Overview of allocation from Algoa WSS to some towns and projection of future demands (source DWA, 2011b)

Town	Current allocation from Algoa WSS (10^6 m^3 y^{-1})	Current use from Algoa WSS (10^6 m^3 y^{-1}) (% of total water use)	Current total use / Future demand 2035 (10^6 m^3 y^{-1})	Comments
Jeffreys Bay	0,45	1,9 (63%)	3,0 / 4,1	Water demand strategy is to increase allocation from Algoa WSS. Water demands peak in summer during holiday season
Humans dorp	0,06	0,38 (36%)	1,0 / 2,0	Water demand strategy is to increase allocation from Algoa WSS.
St. Francis Bay	0,19	0,38 (29%)	1,29 / 1,75	Water demand strategy is to increase allocation from Algoa WSS.
Thornhill	Unknown / no registration	0,03 (100%)	0,03 / 0,04	Water demand strategy is to increase allocation from Algoa WSS.
Oyster Bay	0	0	0,07 / 0,09	Water demand strategy is to increase allocation from Algoa WSS. Pipeline from Algoa WSS is upgraded to a capacity of 3 · 10^6 m^3 y^{-1}
Total	**0,7**	**2,66**	**5,39 / 7,98**	

8.4 The potential of catchment restoration and PES

From the scientific and conservationists world efforts are made to get catchment restoration and Payment for Ecosystem Services (PES) on the agenda of NMBM and DWA as a suitable strategy to cope with increasing water demands of NMBM. The philosophy behind this is that in doing so a win-win situation can be created in which more and better quality water can be delivered to NMBM and in the upper catchments degradation due to invasive alien plants and wetland degradation, can be stopped or even reversed. Looking only at the UKRC case it has already been shown that without the on-going help and commitment of the landowners implementation of restoration programs like Working for Water and Working for Wetlands is very difficult. Yet the problem in these programs is to secure the involvement and commitment of the landowners in maintaining and expanding restoration work, for several reasons as discussed earlier. One of the main reasons is that the landowners, who are mainly

farmers, do already have marginal incomes and do simply not have the extra resources to execute restoration works on their lands. PES is put forward as a system to overcome this bottleneck. The end-user of water, in the case of the UKRC NMBM, pays for restoration works executed by the landowner. In exchange NMBM can use the benefits of improved base flow, water quality and yield as argued to be the result of maintenance on natural capital (Blignaut et al, 2007, Blignaut et al, 2008, Turpie et al, 2008, and Bel et al, 2009; All cited in DWA, 2009). In Gull (2012) it is stated that action needs to be taken in the UKRC in order to reverse the current degradation of the natural capital and related threat to the delivery of ecosystem services.

8.4.1 NMBM and UKRC farmers compatible?

In this section I investigate the opinions of the two main role players in an eventual PES scheme for the UKRC, namely NMBM and the farmers in the UKRC. On the question whether the farmers are needed to secure NMBM's water supply? The water supply management team of NMBM answered:

"I don't think so, no we only need our water rights. With farmers there is a possibility of pollution. Basically you need regulation in the Kromme River catchment area. Contact with farmers would be through DWA." (Personal communication, NMBM1)

"Currently we are not involved in what happens in the UKRC" (Personal communication, NMBM1)

NMBM's opinion on PES was expressed as follows:

"Possibly we should go that way, but whether this will ever happen? I don't think it will happen voluntary. DWA can maybe enforce this. Our council is not going to pay voluntary to farmers in the Kromme. If it must be part of the water tariff structures it might work out." (Personal communication, NMBM1)

Another reason put forward in Talbot (2012) for NMBM and DWA not wanting to consider restoration and PES is related to their perception of rural landowners as people who are a law unto themselves and having a disproportionate share of the productive water use rights due to previous racist policies. Farmers in the UKRC and also Upper Kouga catchment have already been accused by DWA and NMBM of privatising the water benefits from restoration (alien clearing) by using the cleared land and additional water to expand their irrigation activities.

Looking to this topic from the side of the farmers it was asked to the farmers whether NMBM is involved in what happens in the UKRC, all farmers answered that there is no involvement at all in the UKRC from NMBM apart from the fact that they use water out of the Churchill Dam. The next question was whether NMBM should be involved according to their opinion. Almost all farmers stated that NMBM should be involved, as some quotes below show:

"You (NMBM) can't only be a user, you must be a giver too. At least come and talk to the people in this area"

"We need to create understanding between NMBM and us as farmers"

"They (NMBM) should also be involved in restoration of the catchment, if they want the water"

"They (NMBM) should be involved in alien clearing etc."

"They (NMBM) should know what is at stake in the Kromme Catchment and think ahead many years."

"They (NMBM) can learn from us that managing water is important."

"Wetlands are good, farmers should be compensated to leave wetlands intact."

"NMBM are not involved at all in the UKRC, they should be involved because it is absolutely in their interest. Ideally NMBM should buy out the wetlands" (Personal communication, EXP2)

"I think the government should buy the land from farmer Y (owns large wetland), NMBM should buy that land from him at a good price, because the sponge is mainly for them in the future."

The last quote also shows that a farmer equates the government in one breath with NMBM. It seems he perceives them as being more or less the same. While the above quotes show that most farmers share the opinion that NMBM should be involved in restoration, and communication, a couple of farmers also shared their concerns around involvement of NMBM in the UKRC. They only expect involvement from NMBM when they are in trouble, because of water scarcity:

"They (NMBM) only start worrying when the dam is empty"

"They (NMBM) will only get involved when they are in trouble"

"I am afraid of saying NMBM needs to be involved, because they just want more water"

These quotes show that there is also a distrust within the farmer community towards NMBM, and the earlier quotes from NMBM in this report show that vice versa there is not a lot of trust from NMBM in farmers in the UKRC. In an ARS report (DWA, 2009) the following is also stated about catchment restoration, which further exemplifies the lack of trust:

> *"There is concern that additional base flows generated will be intercepted by other catchment users upstream of the dams and will not be available for NMBM to use;"*

This puts the main aim of catchment restoration in doubt from the perspective of NMBM, which is to increase their water licence on the Kromme (DWA, 2009). From the perspective of farmers in the UKRC, the impacts of such an increase in water license for NMBM on their secure access to water is unclear. As stated before the current data and information on water yield in the UKRC is unreliable. It is therefore questionable whether the allocation NMBM currently has can also be provided with a 98% assurance level. An additional allocation seems to be opportunistic in the light of these uncertainties. Furthermore it is unclear what the situation was in the catchment during the data collection period on which the water yield is currently based. It may be questioned whether these data reflect a period with or without alien infestation, and if so to what extent. If infestations were minor during this period, alien clearing and restoration will not generate more water, but only potentially bring back the yield at the level of the original estimate. Moreover, it needs to be taken into account that climate change as discussed in Chapter 5.3 is most likely to have negative impact on water yield in the UKRC. Which puts this discussion even more in an environment of uncertainties.

Furthermore in the interview with NMBM the following was stated:

"We can only have a very minor impact on physical water scarcity through involvement in WfWat/ WfWet programs"(Personal communication, NMBM1)

The impact NMBM can have on government management and politics is perceived as moderate. According to this information NMBM's perception is that the government and politics channels are easier to have a high positive impact on, and therefore also more likely to be used in securing their access to water. This in turn makes it less likely that NMBM will choose for PES as a perceived more difficult option in order to secure their access to water. Furthermore NMBM argues that they need to diversify their water supply. When a drought hits the Eastern/Western Cape both the Kromme and Kouga system, which supplies 70% of the total demand, are under pressure, and because of this uncertainty PES or catchment restoration does not create a lot more water security for NMBM and it is also not very cost effective compared to other options. These are the main reasons why NMBM would prefer other options instead of catchment restoration in the UKRC.

8.4.2 The tandem: PES and verification & regulation

Yet Talbot (2012) indicates that PES, besides giving a higher water security, can also be a vehicle to implement the verification & validation and monitoring & regulation in a process of combined efforts. The development of any effective PES scheme will depend on the ability to monitor water use and ensure compliance with existing registered water uses or licenses (Talbot, 2012). This is of key importance to guarantee that additional water made available by catchment restoration is delivered to those paying for it and no other water use developments or free riding occurs. DWA is currently lacking the capacity to implement both the verification & validation and monitoring & regulation in the UKRC, despite this being part of their responsibility (Talbot, 2012). PES can in contrast to the verification & validation and monitoring & regulation interventions be perceived as positive by the land owners in the UKRC since they can gain some benefits out of it. Hence efforts can be combined and less resistance of farmers to cooperate can be expected (Talbot, 2012). It should be noted again that this reasoning cannot be generalized for all the farmers in the UKRC. Part time or inactive farmers, may welcome something like PES as an additional source of income and as a suitable manner to restore the catchment. In contrast, The commercially oriented farmers may still see PES as a vehicle that brings in the verification & validation and monitoring & regulation, which might eventually lead to cut-backs and more water scarcity problems for these commercial farmers.

8.5 Water Allocation Reform

The main aim of the Water Allocation Reform (WAR) Program is to redress the inequalities of the past with regard to the distribution of water. Before the end of apartheid in 1994, the white farmers in South Africa dominated politics and did and still do possess the largest economic means. This led to a situation in which the major share of water rights was in the hands of white farmers. Currently the white farmers are politically marginal powered compared to HDIs farmers. The main aim of the National Water Act (1998) is to create a more equal distribution and balance between water rights allocated to white and HDIs farmers. After the ecological and basic human needs reserve allocation the redress of racial and gender equity carries the third highest priority in water allocation (NWRS-2, 2012). Yet it seems that the WAR Program got stranded resulting in a status quo in which the policy exists but the implementation is failing (NWRS-2, 2012). In order to overcome this status quo the Water Allocation Reform Strategy (WARS) (DWA, 2008b) has been developed. In this strategy national targets have been benchmarked which should be progressively achieved by the year 2024 (DWA, 2008b). 60% of the allocable water should be in the hands of HDIs of which

half should be women. WARS identified a number of mechanisms to reach this target. Those relevant to the UKRC are:

- *Set asides;* In stressed catchments water that is freed-up through water conservation or recovered illegal water use during the verification & validation process will be set aside for Blacks;
- *Compulsory licensing;* all water registrations in an water stressed area are reconsidered in order to achieve a fair allocation;
- *Development support;* to overcome the financial obstacles for HDIs precluding the latter to get access to water;
- *Strategic alignment with the land reform program;*
- *Partnerships;* Joint venture initiatives / Public Private Partnerships

While the first four mechanisms speak for themselves, The last mechanism may need some explanation. With partnerships is mentioned that HDIs seek cooperation with other business or vice versa to create more support in setting up and running an emerging farm. The relevance for the UKRC is that such partnerships can also be developed in between white farmers and HDIs farmers. Yet this is a very political sensitive topic since it is perceived as a strategy for white farmers to maintain their dominant position in farming, of which the objective of WAR is to help HDIs in becoming more present in the farming scene.

8.5.1 Emergent farming in the UKRC

Currently, in the UKRC there are three medium sized farms (compared to other farms in the UKRC) in the hands of HDIs for on average 4 years. These farms have been bought from white farmers as part of the land reform program. One farm is inactive and according to my information has been rented out to a white farmer. The other two farms are active and efforts are made to get production off the ground, but on one of these two this is done to a very little extent. Activities undertaken in the past and currently range from: "pig farming, diary, beef cattle, sheep, goats, medicinal plants, vegetables and pine forestry". In the interviews with the emerging farmers it transpired that they face multiple challenges. To give a detailed insight in the world of emerging farmers in the UKRC some extensive quotes from the interviews are highlighted below:

"The government gave us three years in order to prove ourselves. These three years have gone by, nothing happened at the farm. The government wanted to take it back, but we applied for another three years, and we got the farm again. Now we have a guy who is monitoring our farm. He is from the government. When we started we had to bring our own animals, and equipment. We have a lot of costs (petrol etc..) We do not make any profit yet."

"We had a problem with the animals. The fences were burnt during a fynbos fire, and the majority of the people took the animals to the township. 123 goats are now in the township, but they are coming back when the fences have been rebuilt."

"I must say that our people are not very serious. They want to see money first and then they do something. But you need capital to start, besides the farm. If there is no starting capital it will not succeed. If people are involved in the land reform they need to get land, start capital and equipment. If they are barehanded it is a problem. You won't find emerging farmers doing a lot if there is nothing. A mentor is also important to assist and guide them."

"During a cold period, we lost almost all our sheep we got when we started farming, because we sheared them just before"

The above quotes show that the start-up is very difficult for the emerging farmers; they are not used to managing a large farm. Furthermore to get and keep the farm operational a lot of resources are necessary that they do not have. At the largest farm currently a former politician from the municipality is managing the farm, he has big plans and a big vision for the farm:

"With this project we want to make a pilot, and show SA and the World that we can do something good as coloured farmers."

"A lot of emerging farmers acquired land, but they don't do anything on it. We want to assist them with that. Our vision behind this, government gives people land, but the people are doing nothing, this burdens the economic situation of the farms. The ones that are doing nothing have a burden on the ones that are doing good. I don't like the word emerging farmers, I am also a farmer. We want to be a commercial farmer."

"*We are talking to you today (5 July), by September we will have 35 ha planted. This is because we already have a marketing plan for it, we start with marketing and business and then start planting. These skills are missing in other emerging farms. You must have a manager on the farm, you must have a market*"

"*We don't need a mentor we have experience and can manage the thing.*"

While this person, leading the farm, had great plans even going to the extent of mobilising an investor at the farm, in a joint venture, when September 2012 passed, the intended 35 ha were not planted. Yet the aim of this study is not to look at the general challenges experienced by emerging farmers. It is often mentioned that the land and water reform program are not well integrated leading to situations where HDIs farmers got for example land without water rights, which put an enormous restriction on development opportunities. In a case study presented by Mendez (2010) it is also shown that unless HDIs farmers got land and water rights, access to water was still a problem, mainly because white farmers do have much better infrastructure to control the water, compared to the HDIs farmers. In a shared river system without proper regulation from government, this difference in power can result in water scarcity for the less financial privileged persons. Yet this reasoning does largely not apply to the situation in the Kromme, as like all farmers also the emerging farmers have access to their own streams, with a sophisticated abstraction system that was already in place as an inheritance from the previous white farmer. The emerging farmers also did not expect much impact from physical scarcity as they stated they have very reliable streams:

"The stream we use is flowing the whole year through. It never stops. The flow is not going down during dry periods. Maybe in a very severe drought it might dry up."

Water availability does not seem to be the root cause behind the dis-functioning of the farms. Other farmers in the UKRC were also asked about their opinion on the land and water reform program; the following quotes highlight some opinions:

"You have white farmers that are battling for years but don't make it. They then sell farms to government. So how can you expect an inexperienced farmer to succeed on these farms? You need mentors, and they need to live on the farm. We tried to help but they haven't got their priorities right."

"We approached the government during the land reform process and proposed to work together, sell most of the farm. And work together with emerging farmers, but nothing

happened from government side. The people driving the processes are not competent. They stick to their prescription, not thinking out of the box."

"The problem with the reform program is that it is not coming from within but from outside. This model to me is not going to work. And the emerging farmers have a survival mind set but you need a business mind set."

Farming in the UKRC is already indicated as a marginal business, and expecting an inexperienced farmer to make a profit, is therefore highly unlikely. Furthermore it is argued that the government and also the emerging farmers themselves are not open to joint ventures between HDIs and white farmers. This is of course also a delicate issue in the light of the whole idea behind the program. By having white farmers involved you would still have a situation in which the white farmer might not own the farm, but still is managing the farm. Another comment made by a white farmer is:

"I don't have a problem with it. I do have a problem with the unfairness of it. Why? What makes them different to me, I am also an upcoming farmer? Why can they get water rights and I can't. That is my only biggest issue I got with the whole thing."

The above quote originates from the farmer that did not register in 1998, but is currently trying to get a water right. However, all he hears from DWA is that he will not get a water right, because he is a white farmer. Currently it is unknown whether he will really not get a water right, and also the situation for the other white farmers remains unsure, particularly with regard to the potential impact of compulsory licensing.

8.5.2 Equity vs. Efficiency

Comparisons need to be made in order to make decisions. Also in this chapter the message is: "it is black farmers vs. white farmers". Even when one wishes to avoid these bland stereotypes it is hard to escape from this comparison. Currently in the UKRC the quoted farmer above is not the only one who articulates strong feelings of black farmers vs. white farmers. Alike to intra white farming community attitudes farmers in general are on their own and are not too much bothered with what neighbour x is doing or not doing. Yet this situation might change when WAR will be implemented in the UKRC. A dilemma that emanates from the NWA (1998) is the balancing act between equity and efficiency, two of the three guiding principles of the NWA, or as stated in the second National Water Resource Strategy:

"The objective of managing the quantity, quality and reliability of the nation's water resources is to achieve optimum, long-term, environmentally sustainable social and economic benefit for society from their use".

"This is premised on principles of equity, sustainability and efficiency. The NWRS2 is, therefore, aimed at managing our water resources in a manner that will achieve optimum, long-term, and environmentally sustainable and equitable social and economic benefit for society. These aims and values must remain central and conscious in the interpretation and implementation of the NWRS2." (NWRS2, 2012:23)

It can be understood from this statement that an optimum is pursued while staying loyal to all three principles of equity, (environmental) sustainability and (economic) efficiency. Molle (2008; cited in Bourblance, 2012) argues that it is not possible to achieve maximum equity, sustainability and efficiency all together, and that a trade-off needs to be made. Looking at this trade-off in relation to the WAR program Bourblance (2012:641) states the following:

"Both social justice and economic productivity of water are endorsed by the Act. According to this last principle, people demonstrating the most productive use of water should retain their user rights, meaning existing lawful water users who are making efficient use of water and contributing to socioeconomic growth would not be necessarily curtailed. However, how, in a water-scarce country, this goal will be accommodated with the objective of enabling a more equitable access to water resources or with the objective of alleviating poverty in rural areas where people engage in subsistence agriculture remains unanswered"

A trade-off needs to be made, currently it is unknown how this will be done in the UKRC, but looking to the ambitious objectives of the WARS (DWA, 2008b), it seems inevitable that more water has to be transferred from white farmers to HDIs farmers in the UKRC. In the interview with a DWA representative the following was stated:

"There is no opportunity for new emerging farmers, because of the water issue, unless emerging farmers buy water rights from commercial farmers."

"The WAR program, is going to happen. We do not compensate if water rights are taken unlawfully. If it is lawful, we have to compensate, for investment and losses." (Both personal communication, NMBM1)

"The reduction of assurance of supply for existing water users as well as reduction of water losses will be critical components of making more water available to historically disadvantaged, small scale users"(NWRS2, 2012:48)

According to these statements different scenarios can be drawn. Either there is a lot of unlawful use in the UKRC, which will provide enough water for emerging farmers, while white farmers will not be compensated. The other scenario is that the amount of unlawful use does not provide sufficient water for emerging farmers, and the government will have to re-allocate water / complete farms or reduce the assurance of supply and compensate farmers that lose their water rights / farm. A final scenario is that NMBM's water demand is largely overruling the process. Eventually taking into account the efficiency principle, NMBM's demand, and the lack of available financial resources at government level it is most likely that the WAR targets will not be achieved in specifically the UKRC. The targets also do not refer to specific sub catchments, but act on country scale. Yet this will trigger a political discussion also between farmers from different regions whether in one region more water will be allocated to HDIs compared to another region for example the URKC. Other regions can come up with the argument that farming in the UKRC is very marginal and should therefore be used in reallocation instead of farming in other regions which might be more productive.

8.5.3 Political WARfare; what if the flagship is sinking?!

The NWA (1998) was praised because it embodied a political revolution in water management. Yet currently the high expectations have boomeranged on its inspirators and politicians are under pressure to deliver. In the WARS (DWA, 2008b:15) risks associated with failure to implement the WAR Strategy effectively were identified and analysed, whereby the biggest risk indicated is a political risk, namely:

"*The single biggest risk is the failure to fulfill the Water Allocation Reform mandate given to the National Minister in terms of the National Water Act (Act No.36 of 1998)*"

The indicated consequences of this are:

"Loss of faith in government by the electoral constituency of the ruling government. Aggrieved citizens may resort to alternative remedies as witnessed elsewhere in the Southern African regional states."

The above statements show that the WAR Program and election politics are strongly related to each other. What will the government do when the WAR Program is going to be more and more mainstreamed in election politics? If the seats of the currently reigning government will be put on pressure, it is likely that politics will put much more pressure on implementation of WAR, to secure their position. Yet it is difficult to indicate how these kind of politics on a national scale will influence the WAR implementation in a very specific catchment like the UKRC, but in general if the risk as described above develops, WAR will gain priority in water management in South Africa.

8.5.4 WAR only threat or also opportunity

As this study is about all the farmers in the UKRC it is also about the future farmers in the URKC. In this sense WAR offers an opportunity for new emerging farmers. Yet also for current farmers in the UKRC WAR can be an opportunity when approached in the right manner. Some farmers are already trying this as shown in the following farmer quote:

"We want to cooperate with emerging farmers, with the chicken, fish, hydroponics system. We proposed this plan to Department of Trade and Industry, but they do not want to listen to it. You know there is a lot of politics involved in this. We whites should not help emerging farmers, but the emerging farmers themselves come to us asking if we can help them. Instead of giving them 1000 ha of land, give them something with a business plan."

As a mechanism to more successfully implement the WAR program partnerships are mentioned. It might be that in contrast what the above quote shows the political climate will change and joint venture initiatives can be started between HDIs and white farmers. In such a manner a white farmer can still continue agricultural business in cooperation with HDIs farmers, who do have access to the resources (land and water) required for undertaking agricultural activities. Yet it all depends on the political climate and goodwill of local governmental officers and politicians involved whether such initiatives will take shape in future. Yet it is a promising manner for farmers in the UKRC to find their way around the negative impact of the WAR program. The danger in it is that in setting up such joint-ventures white farmers will still overrule the HDIs farmers. Which will then again eventually lead to an unstable political climate around such joint-ventures. It is therefore important that such joint-ventures will really benefit both white and HDIs farmers in order to secure a stable political climate around the topic. More on different strategies that farmers in the UKRC can use in order to cope with the expected water scarcity will be discussed in the next chapter.

8.6 Conclusion

In this chapter the politics involved in water management have been discussed. The purpose of this chapter is to answer the sub question: "How and to what extent do political factors and downstream water demands induce "political" water scarcity problems for the farmers in the Upper Kromme River Catchment, currently and in the future?". In the perception of most farmers in the UKRC politics did not have any impact in the past up till present, but is expected by 85% of the UKRC farmers to have a moderate to very high impact in future on water scarcity problems (Figure 24 & Figure 23). This major change in perception can be mainly attributed to the fact that farmers expect that the rising water demands of NMBM will lead to water use restrictions and cutting on allocations in the UKRC. The Water Allocation

Reform (WAR) is also perceived as a factor that can induce political water scarcity, but to a much lesser extent than impact from the water demands of NMBM.

Aligning this farmer perception with the factual findings shows that the water demands of NMBM are ever increasing, that the Kromme River through the Churchill dam is the cheapest water source for NMBM and that NMBM is recently putting up new infrastructure to enhance their water control. Furthermore the water resources in the Kromme River are over allocated. Combining this with the water supply mind set which is still dominant in NMBMs water supply management and NMBMs efforts to push DWA to undertake compulsory licensing and setup WUAs, provides a list of multiple connected factors that do indeed pose a great threat to the secure access to water for the farmers in the UKRC.

Catchment restoration and Payment for Ecosystem Services (PES) is put forward by environmentalists as an alternative water supply augmentation scheme for NMBM. Yet from the side of NMBM and DWA trust both in the real hydrological benefits and in the custodians of these benefits, the UKRC farmers, is missing. A PES scheme is further complicated because any water made available through restoration belongs to the state and not the farmer. Trading in water made available is not possible. It is completely up to DWA how these water savings are allocated. Furthermore an eventual PES scheme might act as a vehicle for compulsory licensing and monitoring and regulation, which can have a severe impact on the secure access to water of the UKRC farmers.

The Water Allocation Reform (WAR) program shows us that election politics has a big influence on who, and more over who not is getting access to the available water resources. The present day discussion moves around the equity and efficiency discourses, which are put forward as two of the three pillars of water management in South Africa. Yet achieving an optimum for both involves that a trade-off needs to be made. The white farmers in the UKRC are not willing to give up their use perceived as productive for the perceived unproductive uses by both emerging farmers and also the leaky water distribution system in NMBM.

When linking this chapter to previous chapters on physical- and farmer/government management induced- water scarcity, it can be concluded that political and government management are acting as a tandem in the perception of the URKC farmers. Physical water scarcity will trigger more political pressure from NMBM towards DWA to start regulating the water use in the URKC. It is a matter of time before the UKRC will experience impact from this on their secure access to water. What farmers can do to cope and anticipate on these forms of water scarcity will be discussed in the next chapter. The farmer comments that NMBM will only get involved when they run out of water, raises the question whether it will be useful to start acting as a collective to resist the pressure of NMBM, since a through a collective or eventual WUA it will be much easier for NMBM to enforce water use restrictions. Yet the current fragmentation makes that NMBM and DWA are faced with a multiplicity of interest of farmers, and will need to negotiate with every single farmer rather than with a group. NMBM and DWA do not have the time, means and commitment for this.

9 Strategies to cope with water scarcity

The four previous chapters elaborated on the three different water scarcity dimensions: physical, management and political, and how farmers perceive the impact of these water scarcity dimensions on their farming activities. This chapter will elaborate on how farmers did cope with water scarcity in the past explaining why they used certain strategies. The main aim of this chapter is to elaborate on the opinion of the farmer towards collective action as a means to anticipate and cope with water scarcity. As shown in Chapter 4.2 the three different water scarcity dimensions cannot be dealt with in isolation, since most factors influencing water scarcity do not fall within a single dimension of water scarcity used in this research (Figure 26). In the previous chapters this artificial categorization was used to enable an analysis on how each dimension impacts on water scarcity. This chapter will show how changes in for example the physical and political water scarcity dimension induce the farmer(s) to implement certain management interventions in order to cope with water scarcity. In the past changes in physical water scarcity induced the farmer to change his management, for example changing to more efficient irrigation, or building a (bigger) dam. Currently strategies used by farmers are only applied at a single farm level. The farmers anticipate new forms of water scarcity induced through government management and political factors. This chapter aims to investigate how the farmers see their possibilities to cope with water scarcity at a single farm level but also as a farmer collective. Such a collective is currently not present in the UKRC. Apart from the catchment forums recently organized by Living Lands this chapter shows the perceptions of farmers if such a collective will be developed in the URKC.

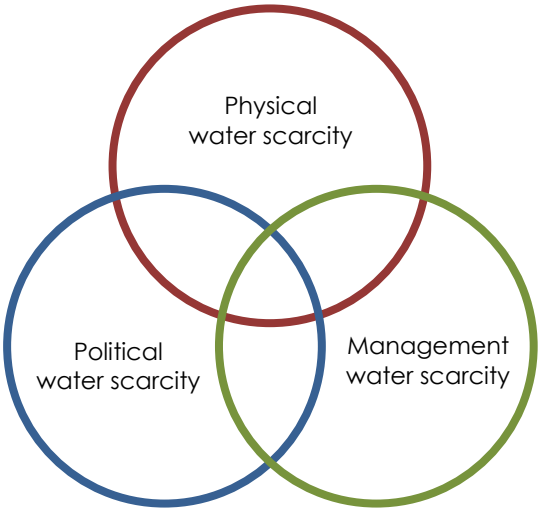


Figure 26: Interrelatedness between the three different water scarcity dimensions

This chapter is divided into a couple of sections. Following this introduction the next section will show the perceptions of the UKRC in general about single farm and collective action strategies, and its suitability to cope with the different water scarcity dimensions. Furthermore in two subsequent sections single farm strategies and collective action will be elaborated on in detail. Finally a short conclusion will be given.

9.1 Perceptions on single- vs. collective- action

Figure 27 shows the response of farmers on how much positive impact they can have on the different forms of water scarcity, either as a single farmer or as a collective of farmers in the URKC. Contrary to the similar graphs in the four previous chapters, this graph is not translated into a spatial map since this did not generate any substantial additional insights. Looking at the distinction between commercial and part time farmers, no difference could be found in how they perceive the impact they can have.

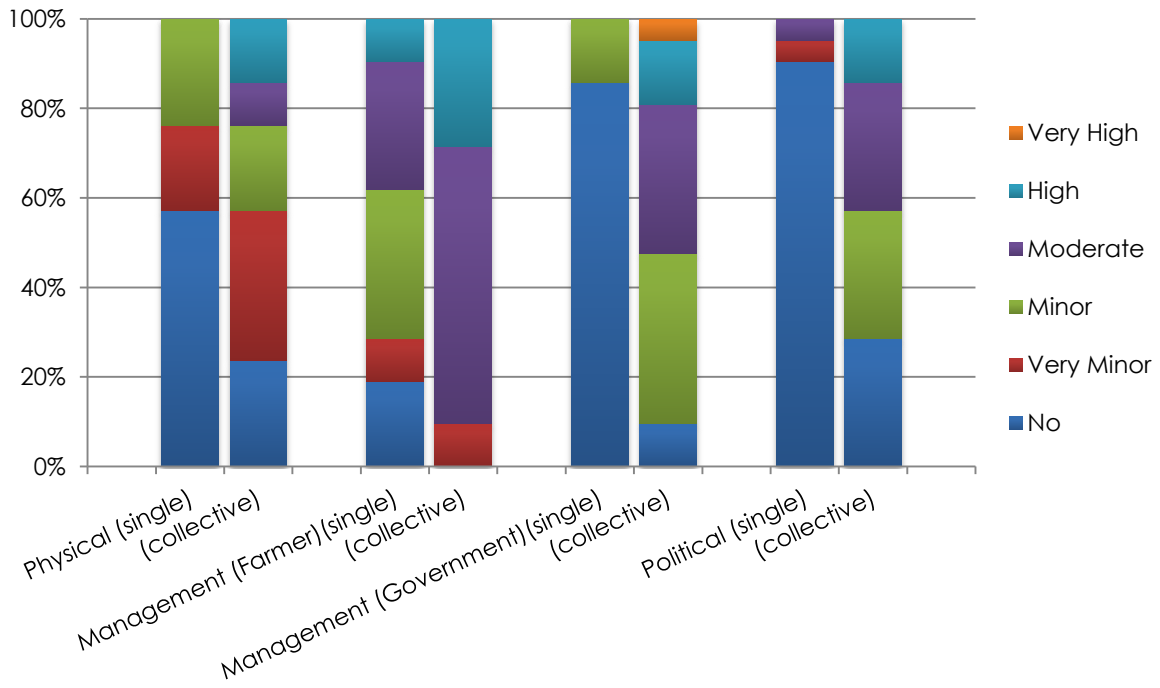


Figure 27: Graph showing the perception of the farmers of how much positive impact they can have on the different water scarcity dimensions (physical, management (farmer / government) and political), as a single farmer and as a farmer collective.

9.1.1 Physical water scarcity

Farmers perceive physical water scarcity as having a high influence both for the past and future, as shown in chapter 5.2. The positive impact that farmers on this can have is perceived as minor as shown in Figure 27. "You can do nothing about the climate as farmers" is the reason often mentioned by farmers. The farmers that indicated that you can have a minor positive impact refer to the catchment vegetation in the catchment. If the fynbos vegetation and Invasive Alien Plants (IAPs) are managed well, a positive impact can be achieved on physical water scarcity. And if this is done collectively impact can even be bigger according to some farmers (Figure 27).

9.1.2 Farmer management water scarcity

The impact of farmer management (the land and water use practices) is perceived as very minor by most farmers as shown in chapter 6. Figure 27 shows that 40% of the farmers indicate that they can have a moderate to high positive on their farming practices to reduce water scarcity problems. As argued by the farmers, maintenance to the water abstraction and irrigation system is required to keep it functioning properly. Some farmers also mentioned that they can upgrade their irrigation system, to a more efficient system, but that such interventions are only done when really necessary because of the large investment costs

involved. As a collective 90% of the farmers think that they can have a moderate to high positive impact on their farming practices in the UKRC as a whole to reduce water scarcity problems. The collective approach shows a substantial difference compared to the single-farm approach. Positive elements of collective action that were mentioned are:

"I can get to know the farmers in the area" (by a relatively new farmer)

"We can solve problems and conflicts in the area" (by a downstream farmer)

"We can learn from each other, for example water saving irrigation methods"

The above statements indicate that collective action can help as vehicle to solve conflicts about water use from the main Kromme River, and that farmers can learn from each other's practices. Yet also something basic is mentioned as getting to know the other farmers. This statement exemplifies very well the current situation, farmers might know their neighbours, but beyond that most is unknown. The very essence of collective action is that you need to know each other and each other's needs to be trusted between each other and a common interest is needed. Knowing each other is the first level, trust will not be developed if this first requirement is not fulfilled. Another point mentioned by farmers that were sceptical about collective action as farmers is the perceived absence of a common interest, since everybody has his own stream and it was stated that you need to farm on the same things, to make cooperation interesting. Yet a common interest most likely will become more prominent in the future since the government management and political induced water scarcity will affect all farmers to a certain degree. But currently as shown in Figure 27 the sceptics towards collective action are still widespread.

9.1.3 Government management induced water scarcity

In chapter 7.2 about government induced water scarcity a lot of negative opinions about the government are shown. In light of this it is interesting to question whether the farmers think they can have a positive impact on the government to address their (potential) water scarcity problems. Figure 27 speaks for itself if the farmer perception on positive impact as a single farmer or as a collective is compared. While as a single farmer more than 80% states they can have no impact, as a collective more than 80% state they can have positive impact ranging from minor to very high.

9.1.4 Political water scarcity

The results for political water scarcity are very much comparable to that of government management induced water scarcity. In chapter 8.2 about political water scarcity again a lot of negative opinions are shown, mainly towards NMBM. Figure 27 shows clearly the difference between single farmer or collective action in order to have an impact on political water scarcity. While as a single farmer more than 90% states they can have no impact, as a collective more than 70% state they can have positive impact ranging from minor to high. The paragraph on collective action will go into detail mainly on the topics of government management and politics.

9.2 Strategies at single farm level

Before continuing with the above shown statistics that as collective farmers think they can have a better positive impact on water scarcity. This paragraph will elaborate on the strategies at single farm level used and unused and its implications for the secure access to water in the future for the URKC farmers.

9.2.1 Strategies in the past

In the past up till now farmers strategies to secure their access to water mostly focused on water control at the first level as defined by Mollinga (2003), namely physical control of water flows. Farmers did not bother much about the other types (institutional management and political) of control. Which is in line with the perception for the past that government management induced- and political- water scarcity were non-existent. On the contrary politically the water was theirs. Furthermore as mentioned, each farmer has its own mountain stream as water source. This situation did not induce farmers to cooperate and take actions collectively. On the contrary it led to a situation in which farmers only implemented strategies to cope with water scarcity at a single farm level and not at a collective scale. What are these strategies? Physical droughts in the UKRC have been of such an extent that it either demanded from the farmer to adapt his management or to stop or switch to less water using agricultural activities. The primary strategy, which is currently still favoured by most farmers is the building of dams. Simply because it enlarges the physical control over water through technical means. In the light of the irregular rainfall patterns a farmer can increase the assurance of supply to a large extent by building a dam. The irregular rainfall patterns within years and within a growing season makes that a farmer cannot rely on rainfall and directly related river runoff too much, but needs to have a backup storage to cover dry periods. For example a farmer without a dam lost his orchard during a drought simply because he did not have a dam that could supply water to that orchard.

Besides the building of dams, many farmers mentioned that proper and adequate maintenance of the whole water abstraction and application system is essential in keeping leakage losses low. Shifting to more efficient irrigation methods was, besides one farmer, not mentioned by farmers as a strategy used in the past. Many farmers mentioned also as strategies that they had to sell livestock, buy fodder crops for the livestock or reduce the area under irrigation. These strategies that have in common that they are very short term show also that more long term strategies on the water supply side have been inadequate several times. A mainstream strategy often used at other places around the world is the building of boreholes to cope with dry periods. Nonetheless as shown in Figure 9 only 7% of the farmers in the UKRC do have a borehole. The others rely purely on surface water. This while the potential for boreholes is quite large in the UKRC. Apparently the threshold has not been reached yet where investment in borehole drilling provides advantages.

The lack of insight in the process of how farmers registered their water use under the new Act, is unfortunate. Many farmers did not know how much water they were registered for, and strangely enough they did not bother much about it either. Mendez (2010), who did a case study in a different area, found that some farmers registered for more than they were using, with the idea to make expansion of irrigated command area possible in the future. Others did register for less than they were actually using, with the idea that doing so they have to pay less water fees to the government. Liebrand (2008) who did another case study, adds to this that some farmers did not pay the water bill as a sign toward DWA of not acknowledging their involvement in water management. It is unknown to what extent these findings also apply to farmers in the UKRC.

9.2.2 What is mentioned as future strategies

Not surprisingly, many farmers do again mention dam building or enlarging their storage capacity as the main strategy at single farm level to secure their access to water. Even when the prohibition on dam building is known by almost all of the farmers. This shows that the

technical water control / water supply approach is still dominant in the farmer community. One farmer also stated the following in relation to dam building:

If I can build more smaller dams, if the farmers can do this. When NMBM is running scarce of water, then the government can go to the farmers to release some water to NMBM. The government can pay the farmers for storing."

A win-win situation according to the farmer. But in the eyes of DWA and NMBM this will only be seen as giving the farmer better means to control the water in a dry period, without the real security that it will be released for the supply of NMBM. Besides dam building farmers mentioned that they could change to more efficient irrigation systems, but that this involves large investments. Some farmers also acknowledged the need to clear Invasive Alien Plants (IAPs).

One would expect according to the farmer perception that government management and politics is going to have a major impact on water scarcity, that farmers would also have thought about strategies to anticipate on this to secure their farming activities and subsequently their income. The opposite is true, and it seems that as long as government intervention and restrictions do not happen farmers will not take action. Some farmers mentioned that they do not see how the government can restrict the farmers in the UKRC since it is a very complicated system to control from outside. This can also be a reason that farmers are not worried much about government restrictions. And that a good strategy can be to keep the UKRC system very complicated to control from outside, in staying fragmented as farmers. On the other hand farmers do expect intervention from the government and seem to be unsure on what the eventual effects will be of this.

9.2.3 Strengths and weaknesses of single farm strategies

The geographical outline of the UKRC makes that every farmer is very much on his own in managing water -abstraction and –application. This makes first that collective water management strategies are not a prerequisite for the farmers. Moreover the strength of single farm strategies is that other farmers and also the government do not have much insight in the activities of the farmer. It is easy for the farmer to undertake 'illegal' activities or activities that do affect on other farmers or NMBM, without a need to explain his actions. The

In case of dry periods this can be a weakness, since there is no local organisation in which farmers have to justify their actions. Especially on the main river this is favourable for the upstream farmers, but can be destructive to downstream water users on the Kromme River.

The single farm strategies are very water supply oriented, yet government management and political factors will reduce the possibilities to increase water supply in future. Rather it will decrease water supply. In the perception of farmers it is as a single farmer difficult if not impossible to have positive impact on government management induced- and political-water scarcity, as perceived by the farmers as shown in Figure 27. On the other hand the current situation of fragmentation in the UKRC makes it very difficult for DWA to enforce regulations on every single farmer. Staying fragmentised does not mean farmers can have a strong positive impact on NMBM and DWA, but it does mean that it is more difficult for NMBM and DWA to have strong impact on the UKRC farmers, compared to a situation of collective action. This is in line with the feedback from the interviews with DWA and NMBM officials in which was stated that a farmer collective / WUA would be a good channel to enforce regulations.

9.3 Collective action

Collective action arises when the effort of more than one individual is needed to accomplish an outcome. Does collective action provide the opportunities to complement the current single farm strategies in the URKC and to cope with its weaknesses? Does collective action only provide opportunities or also threats? And what problems to deal with first to enable collective action in the UKRC? These are questions that this paragraph aims to answer.

The Oxford Dictionary of Sociology describes the term collective action as: "action taken by a group (either directly or on its behalf through an organisation) in pursuit of members' perceived interests". Ostrom (1990; cited in Simpungwe, 2006:37) argues that a motivation for participating in a collective action by individuals is in the economic returns gained from the common pool resource and hence individuals will join the collective action to enhance their productivity. Olsen (1995; cited in Simpungwe, 2006:37) further argues that the individuals must be able to discern that the collective benefit is achievable only through a collective action. Participants would otherwise see no purpose in collective action when individual, unorganised action can serve the interests of the individual as well or even better than an organization.

Currently in the UKRC farmers opinion on collective action link closely to Olsen's statement above. The island style farming in the UKRC does not generate a collective interest which can only be achieved through collective action. Government management induced- and political water scarcity are factors according to the perception of the farmers that will increase the need for collective action. Since the collective interest "secure access to water" for the farmer group will be put under pressure. These factors are not present and do therefore not urgently trigger collective action by farmers yet.

9.3.1 Internal relations farmers

Besides a common interest internal relations are also essential in collective action. Assessing farmers' opinions on the internal relations between the farmers in the UKRC shows the following:

Current relationships are not very excellent in the Kromme, we are very much on our own as farmers"

"but.... everybody is on its own"

"we are all different farmers. This makes cooperation difficult. Maybe you can work together on water issues"

"If it gets difficult everybody will get together"

In analysing this selection of farmer statements, it can be derived that the farmer relations are mostly characterized by the fact that they are not existent. Due to the fact that every farmer is very much on his own. Besides the fact that the geographical outline of the URKC makes that farmers are on their own. Also the fact that the farmers are farming on totally different things, makes cooperation less interesting, because you have less shared interest. The argument, everybody is using the same water, so no matter what you are farming on is acknowledged. But it is also stated by a farmer that farmers will only get together if the crisis hits and not before. Water is a shared interest by UKRC farmers, but will only trigger collective action in a situation of water resources becoming scarce.

Another interesting comment was made by a downstream farmer. He stated the following:

"Farmer Z upstream, they started using water. Now there is no water anymore in the Kromme! I will not join if they are in the management team"

The statement shows that the downstream farmer was very opposite the fact that a certain upstream farmer was already taking up an active role in the catchment forums recently organized by Living Lands. Giving as a reason the water use activities of the farmer more than 20 km upstream. The hydrological dependency, with supposed negative effects for the downstream farmer. You would expect willingness of the downstream farmer to be part of such a forum, since he might be able to address his issue in this forum. What the downstream farmer most probably tried to communicate is that some new farmers came in the UKRC and that he does not like the fact that they are taking the lead in the catchment forums co-organized with Living Lands.

Because many farmers came in anew recently in the UKRC there is no common history in the farmer community. Which is often argued to be a necessary condition for establishing trust. On the other hand a common history can also be a history of conflicts and therefore it does not necessarily lead to trust within a community. New farmers coming into the URKC are both white and black farmers. You do see some cooperation between emerging farmers and the white farmers but this is to a minor extent. Also the opinions on emerging farmers differ significantly within the community, as shown in chapter 8.5. Some white farmers state that nothing good can come from black people, while others are positive about the reform addressing the inequity, but do have their doubts about the successfulness of it.

What can be concluded from this short exposition of farmer statements is that the relations in between farmers need to be improved to enable effective collective action. This does not necessarily need to be done before collective action can start. The first phases of collective action should rather focus on relation building to eventually enable effective collective action.

9.3.2 External relations

The advantages of a catchment forum are besides coordinated cooperation between farmers in the UKRC, mainly about being able as a farmer community to have a positive impact on government management induced- and political water scarcity. The two major external role players in this are DWA and NMBM. How is the relation between the URKC and these two role players characterized? The statements from both farmers and DWA and NMBM in previous chapters speak for themselves and show that the URKC farmers; and DWA and NMBM are very much each other's opposites in terms of water interest, and that they think rather negative about each other. DWA does not trust the farmers and suspect illegal activities on their part. The farmers don't see anything good coming from the government and are very sceptical about the capacities of the government to perform good water management, as shown in the farmer quotes below:

"I don't see whether government can do anything good."

"Collective action will not make a big difference for us, because I don't trust the system, in which DWA and NMBM operate"

NMBMs interest is to get more water out of the Kromme River and the farmers are seen as the people preventing this. While farmers see NMBM as a water wasting city, and as a powerful

player in politics. The expected verification and validation and compulsory licensing process will most probably put farmers and the government even more opposed to each other than at present. And the farmers will also see NMBM as a player influencing negatively on this process.

Collective action is in first instance about actions taken collectively by farmers. DWA and NMBM do not need to be involved in this. Yet the purpose of eventual collective action will among others be to secure access to water. DWA and NMBM are the stakeholders to cooperate with in order to achieve something on this topic. It again can be concluded that the current relation does not provide a solid foundation for cooperation. From both sides a willingness has to emerge to listen to each other and to get a better understanding of each other's problems and where these problems link. A collective action in the light of the current relationship between UKRC farmers and NMBM and DWA is more likely to be used as a channel to put pressure on the other. NMBM and DWA will use a collective action to enforce regulations on the UKRC farmers.

9.3.3 Advantages of collective action

Although the above paragraphs show already a difficult starting position for collective action due to bad internal- and external- relations in the UKRC, 85% of the farmers is positive about the idea of collective action as farmers in the UKRC. And Figure 27 shows that quite some farmers assign significant opportunities to collective action as a means to cope with water scarcity. Some reasons for this are shown in the farmer statements below:

"It is better to deal with other farmers through a farmer collective instead of directly. The group can put more pressure to influence farmer behaviour"

"Water control in the area, but other farmers might not agree with me. Everyone wants to irrigate as much as they can"

"It can be of great value for the future of the Kromme, to prevent further degradation of the river"

"We can solve problems/conflicts in the area"

This first set of statements shows that collective action is seen as a means to enhance farmer management on a catchment level. The top two comments are made by two downstream farmers, who clearly see an advantage of acting as collective to address water use activities of certain farmers that affect on them. But it has to be acknowledged that the above stated quotes do not reflect the opinions of all the UKRC farmers. As shown in Figure 27 not every farmer is seeing collective action as a proper means to address farmer land and water management in the UKRC. On the side of collective action towards external stakeholders the UKRC farmers mentioned the following:

"We farmers should speak with one voice, what can a single person do? You have no power to do something. You need each other."

"Government will listen more to a group of people than to a single individual"

"we can work together around water scarcity problems. Only a listening government would already be a great improvement"

"You have to do your homework as farmers. If you wait for the government they will come one day and take our water."

"we can improve on communication with them, and resist if they want to take our water"

"Protection of my rights. Get information. Talk about Working for Wetlands, to get them doing the right things"

The first three farmer quotes show the perception that government will not listen at all to a single farmer, but will listen to a farmer collective. This is related to the power assigned to a single farmer and to a group of farmers. If farmers would get the feeling that the government is listening to the problems the farmers are facing, instead of only coming in with new regulations. The farmers would already see this as an improvement. The last three quotes clearly show both the concern from the farmers that they will lose water usage rights and that collective action is seen as a means to protect the water usage rights.

As mentioned in Chapter 8.5.4 about approaching the Water Allocation Reform as an opportunity for white farmers, it was mentioned that collaborations between white and emerging farmers could give joint-benefits to both parties. A collective action in which the emerging farmers are involved can help to increase transparency on such collaborations and as a channel to impact on the reticent attitude of the government and politicians towards cooperation between black and white farmers as part of the land and water reform process.

9.3.4 Collective action; Risks and prerequisites

Ostrom (1990; cited in Simpungwe, 2006:38) identifies a common set of problems that collective actions have to deal with namely: 1) free-riding, 2) solving commitment problems, 3) arranging for the supply of new institutions, and 4) monitoring individual compliance with sets of rules. Some of these problems are also brought to the fore by the UKRC farmers, a risk of collective action mentioned is:

"other non-farmers telling farmers what to do"

Firstly a catchment forum in which farmers can come together to discuss and start acting collectively is also seen as a possible channel for outsiders to come in and tell what the farmers do wrong and prescribe what they have to do. This can refer for example in the UKRC case to Living Lands telling the farmers from the start they have to change their farming practices because the current practices lead to environmental degradation. The main risks put forward in relation to secure access to water is that NMBM through DWA will use a farmer catchment forum or eventual Water User Association (WUA) as a channel to implement for example water use restrictions. In the interview with the water supply management team of NMBM the following was mentioned:

"A WUA is a good channel through which regulations can be enforced on the UKRC farmers, like in the Gamtoos irrigation area" (Personal communication, NMBM1)

In chapter 8.3 on political water scarcity because of downstream (NMBM) water usage, it was already shown that the farmers expect only negative involvement of NMBM, since they will only get involved if they are in a water crisis because of a drought. The feeling that a catchment forum in such a case can act as a vehicle for DWA and NMBM to implement water use restrictions makes sense from the perspective of the farmers. An unorganized farmer community is difficult to deal with for DWA, as shown by the 2009-2010 drought

restrictions. The organized Gamtoos- and unorganized UKRC- farmers were both restricted, but restrictions were only enforced on the organized Gamtoos farmers and not on the unorganized UKRC- farmers. Some farmers feel most safe with the idea that others do know as little as possible about what they exactly do. The above reasoning is the most critical point in looking to risks of collective action. Rather staying fragmented like in the current situation the UKRC will be better able to resist the pressure from the side of NMBM and DWA, since NMBM and DWA do not have the time and commitment to deal with every farmer separately. But in light of this reasoning why did 50% of the URKC indicate that collective action would enable to have a positive effect on government management induced- and political- water scarcity? The question asked in the interview were asked mainly from the perspective farmer having a positive impact on NMBM and DWA, and not NMBM and DWA having an impact on the UKRC farmers. Only some farmers realized that a collective action by farmers also means an easier channel for NMBM and DWA to enforce regulations.

The idea of a WUA is partly to make water users self-regulating. Some farmers acknowledge the benefits of this in case of disputes over water use between farmers in the UKRC. But in the light of the external threat from NMBM none of the farmers will see benefits from a WUA regulating the farmers for the sake of the water needs in NMBM.

In getting back to the free riding problem, collective action theory is challenged by the fact that joint benefits obtained through the collective will flow back to the people that invested in the collective. In the case of collective action around a common pool resource which water is, free riding is likely to happen (Simpungwe, 2006). A UKRC farmer also shared this concern, in giving his view on risks of a collective action:

"nothing happens, misuse by a single farmer"

Furthermore some of the farmers perceive the idea of a collective action as group of farmers talking and talking and doing nothing as shown in the following statements:

"I don't want to be part of a group that is just talking and nothing happens, because we are quite busy"

" I do not feel a necessity under farmers of having a forum talking about nothing"

"A forum with farmers talking nonsense to each other, does not add any value"

"Each farmer has its own mind-set"

Olsen (1965; cited in Simpungwe, 2006:38) argues that the logical place to begin any study on an organisation is with their purpose and one purpose that characterises most organisations is the furtherance of the interest of their members. The three top farmer quotes show that farmers are afraid that collective action will become an ends in itself because local NGOs like the concept, but that it does not come up with a purpose relevant for the farmers and will act in pursuing this purpose. The last farmer quote shows that there is also concern whether it will be possible to come up with a joint purpose since every farmer has his own mind-set. Yet it can be expected that the emergence of a common enemy, like NMBM can quickly change this perception.

The commitment problem as mentioned by Ostrom (1990; cited in Simpungwe, 2006:38) is also mentioned by the farmers, as shown below. Time and money are constraining factors for the farmers and required investments reduce the willingness to work together.

"No willingness to work together"

"No commitment from farmers because of time constraints"

"it costs energy, time and money"

In looking at the two last problems mentioned by Ostrom (1990; cited in Simpungwe, 2006:38); arranging for the supply of new institutions and monitoring individual compliance with sets of rules. Living Lands is providing an opportunity for the farmers because you could say that they are partly arranging the supply of a new institution. This is again also a threat for future collective action: what if Living Lands will pull out? This is likely to happen within a time-frame of 1-5 years. Will the farmers without external input be able to organize themselves. Examples from other farmer organizations in the area show that it happens, but for the UKRC specifically it is unknown if the farmers will be able to do this. The last problem is difficult to analyse for the UKRC, since there is a Living Lands organized forum but no written rules. For example an unwritten rule in this starting phase can be that every farmer is putting in some effort to show up at a forum, yet the last forum only had 9 out of the more than 30 invited farmers attending. The farmers present did not show that they were going to tell the other farmers that they should be there the next time.

Ostrom (1990) eight design principles brought forward to be necessary for stable common pool resource management, show that a collective action in the UKRC around water management has a long way to go. What are the group boundaries? Watershed boundaries? How does NMBM situated outside of the watershed fit in this? The rules of a collective action need to be matched to local needs and individuals affected by these rules should be able to participate in modifying the rules. The current island style farming, and the feeling everyone for its own and God for all does not give a solid foundation for the development of a set of rules governing water resource management in the UKRC. Ostrom (1990) states that community members should be able to devise their own rules which are respected by external authorities. What the reality shows is that DWA does not trust the UKRC farmers. How will then allow them to come up with their own rules. The same is seen in the Gamtoos irrigation area. The transformation of the local irrigation board into a WUA is not proceeding since DWA does not accept the rules developed by the irrigation board. They do probably have good reasons for that mainly related to the redressing of the past inequities. But management becomes very top down, and the consequence of this is that more resistance will be found in the farmer community to join such collective actions. Self-monitoring is also mentioned by Ostrom (1990) as a prerequisite for collective action. The island style farming and the individualistic approach to farming makes self-monitoring in the farmer community a challenging task. While Ostrom (1990) identified even more design principles for collective action the above already show the immense challenge for producing collective action in the URKC.

Concluding on this paragraph it can be said that the farmers in the UKRC will be faced with many hurdles and risks in the process of collective action. It requires at least a long-term vision and purpose which is coming from within the farmer community and is acknowledged by the farmers to make farmers look beyond these hurdles and risks. Otherwise they will most likely lose interest from the very start. A social change process is required to enable farmers think long term and out of the box on this topic.

9.3.5 UKRC; an interconnected basin with distant stakeholders

In the NWA (1998) the units of water management are based on drainage boundaries. In the case of the UKRC which forms the most upstream part of the Kromme River Catchment. The question arises how does NMBM relate to these drainage boundaries. Since NMBM is out of the catchment (see Annex VI), but uses the lion share of the water resources available in the catchment. In Lankford and Beale (2006; cited in Achterkamp, 2009:21) an interesting comment is made about this topic: "When demand exceeds a river's supply along its reach, the river switches in behaviour - it no longer supplies surplus water to autonomous points of demand but becomes a contested channel with infrastructure that divides and defines the distribution of a scarce resource". It becomes clear that in the UKRC it are no longer the natural units that define the flows of the water, but that it are human made infrastructures that divide and define the distribution of the scarce water resource. This artificial network encompasses an area that is larger than its natural watershed suggest. This relates to the first level of Mollinga's (2003) definition of water control: "water control is technical in terms of control over and use of *physical* water flows by means of infrastructure to abstract and distribute water". But it goes beyond this, Mollinga (2003) defines the total of water control as: "a political process of contested resource use". Because of this reasoning Warner *et al*. (2008) argue that the choice to manage water on the basis of river basins is a political choice, and thus river basins are as much political units as they are natural units. Decisions made in the delineation of river basin boundaries, the structuring of stakeholder representation, and the creation of institutional arrangements for river basin management are political processes (Warner *et al.,* 2008:121).

What does this imply for collective action around water resource management in the URKC? The disquisition above raises the question whether collective action at the catchment scale is sufficient to achieve IWRM and sustainable management, as advocated by DWA, or whether it should go beyond the catchment boundaries and include the NMBM population and institutions. The interbasin transfer to NMBM namely militates the IWRM concept. Besides the fact that within the UKRC farmer community different opinions are emergent about an eventual involvement of NMBM. Does NMBM have a legal obligation to be involved in resource management in the URKC? Based on the catchment boundaries no. From this point of view it looks like NMBM can pick the fruits of the water resources coming out of the UKRC but is not legally obliged to take care of the catchment and make sure the area is managed in a sustainable manner. This culminates in a very one-sided relationship. From the perspective of the farmers it is this reasoning that makes them sceptical on the involvement of NMBM. Involvement from NMBM only to ensure their secure access to water, by implementing regulations etc. does only feel as a threat to farmers and does not include any positive incentive for them. Rather than the watershed approach the hydro-social network should be taken as a starting point in dealing with water resource management. DWA has an important role to play in this, in order to make sure that the costs and benefits are equally shared between the UKRC farmers and NMBM. In this they have to take account of the implications the NWA (1998) does give on this topic.

9.3.6 The role of Living Lands as facilitator

The South African based NGO Living Lands is active as a facilitator in the UKRC for stakeholder engagement and sustainable resource management and tries to connect different stakeholders. But their primary objective is to achieve the so called "living landscapes" in which local stakeholders are enabled to manage their natural resources in a sustainable manner. Because of this their primary focus is to enable stakeholder engagement

at the local level mainly between land-owners/farmers. Looking back to the previous chapter Living Lands can act as an intermediary between NMBM, DWA and the UKRC farmers. Yet this might also be perceived different both as an opportunity or threat by the different farmers. The threat can be that farmers will start seeing Living Lands as an extension of government, bringing in validation and verification of water uses and compulsory licensing. This might completely undermine the trust of farmers in the organization, and be counterproductive for the objective of Living Lands.

Still from the perspective of the UKRC farmers Living Lands is an opportunity in relation to achieving collective action. To achieve collective action social change is needed as can be concluded from Chapter 9.3.4 to achieve a shift towards thinking long term and collectively by farmers. In order to succeed in making these shifts, the UKRC farmers need to engage in a social change process that increases awareness, mobilises human, physical and financial resources, and builds capacity and new social networks and alliances. Without active agents who will take on this mobilising responsibility, such shifts are unlikely to occur, as also argued by (Talbot, 2012). Farmers are faced with a deficit in time, effort and motivation to build such collaborative relationships. It can be argued that it is unlikely that farmers will be able to set up collective action themselves at this stage, and in the initial stages, will need help from outside organisations such as Living Lands acting as facilitator.

Does the success of collective action in the UKRC fully depend on the involvement of Living Lands? Yes and no. At the current stage yes, but in future when a water crisis probably will hit harder in the farmer community there will be more need for farmers to start cooperation as shown in Figure 28. The current situation and perception in the URKC is that there is still abundance in water resource availability, yet the future perception is that external factors increase pressure on the available water resources in the UKRC. When a crisis hits it is often too late to start cooperation to cope effectively with that water crisis. Living Lands can play a major role in internalizing the already present perception that a water crisis in the future is inevitable and requires collective action to cope with, in the UKRC farmer community. There is a risk that Living Lands has to pull back in the short term, because funding will stop and new funding might not be found. Talbot (2012) argues that a potential alternative source of funding for Living lands could be to contract out their services, and the services of their partners, to government agents like DWA who need to undertake particular tasks relevant to Living Land's agenda, but have insufficient capacity to take on these tasks themselves. Obviously such contracts should be limited to those tasks that are critical to the process of creating living landscapes and PES schemes. In the case of DWA, this could include undertaking validation and verification surveys, developing effective water use monitoring systems, as well as facilitating the creation of Water User Associations and the Catchment Management Agency. Yet from an engagement perspective with local

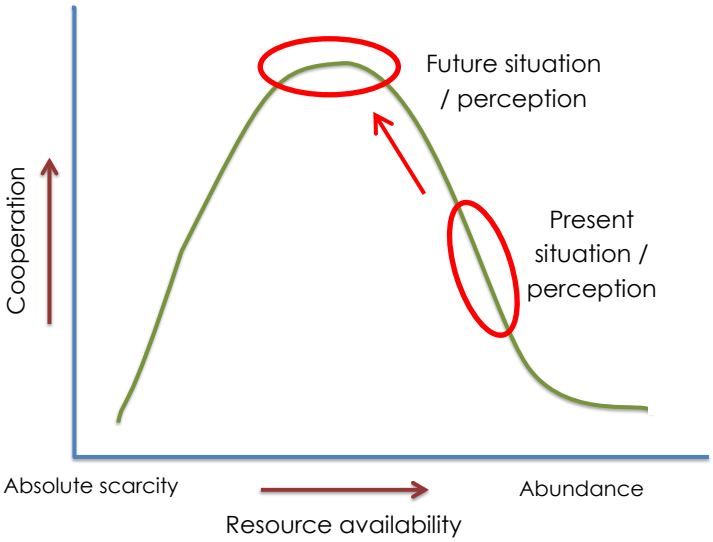


Figure 28: Graph relating value of cooperation to resource availability (adapted from Uphoff et al. (1990; cited in Achterkamp, 2009))

stakeholders this should be approached with caution since even currently the independent position of Living Lands is questioned by farmers in the URKC. Executing such obvious DWA tasks can undermine the trust of farmers in Living Lands. Especially in a case where after such surveys and monitoring systems are used to restrict the water usage of farmers. Besides it will make Living Lands financially dependent on DWA and therefore trust in the independency by farmers in Living Lands will most probably decrease.

Besides the challenges DWA is facing in the validation and verification and compulsory licensing process also the land and water reform process is on hold. In the NWRS II (2012:70) it is stated that the establishment of new WUAs should be supported, and these WUAs should act as vehicles for building the capacity of emerging farmers. The relationships between emerging farmers and white farmers seems currently not yet to be at odds in the URKC. In contrast to the relation between NMBM and DWA and the UKRC farmers. To sustain the involvement of Living Lands in the UKRC new projects could focus on capacity building of emerging farmers in cooperation with white farmers, alongside the focus on the land and water management problems both emerging and white farmers have to deal with.

9.4 Conclusion

The perceptions on collective action compared to actions at single farm level to cope with water scarcity are clear. The UKRC farmers indicate that as a collective they will be better able to anticipate on- and cope with- water scarcity problems. Unlike these perceptions pointing towards the need for collective action and the expected advantages, the current discussion is overruled by the numerous risks and prerequisites that require visionary steps and investments to overcome. Furthermore the process of collective action around water management is further complicated by institutional arrangements from the side of DWA, and the unclear impacts of the eventual involvement of NMBM. Since a collective action can be used as a channel by NMBM and DWA to enforce regulations, from this perspective fragmentation is a better strategy for the URKC farmers to resist pressure from the side of NMBM and DWA.

The most promising action that is currently happening in the UKRC with regards to collective action are the efforts made by Living Lands in facilitating engagement between land owners in the UKRC and the creation of awareness around land and water management issues. The continuation of this social change process is essential as a kick start for collective action. The strong benefits in this can be better cooperation between farmers and the Working for programs. Yet Living Lands need to be aware of the eventual risk of collective action and involvement of NMBM and DWA and the to be expected negative opinion of farmers on this.

10 Conclusion and discussion

10.1 Conclusion

Water is a contested resource in terms of its control over usage as can also be seen in this case study example in the Upper Kromme River Catchment (UKRC). Yet also from a research perspective the South African waters have been a contested resource, multiple researchers have aimed to bring clarity in understanding the troubled water management in South Africa. This research specifically aimed to investigate; firstly to what extent farmers in the UKRC have experienced water scarcity problems and how they coped with this; secondly what the key factors are affecting water scarcity and what farmers perceptions are on these factors; and thirdly what the best way to go is for the farmers to cope with water scarcity problems.

Comprehensive analyses have been given in the previous six chapters on the main research question: "How and to what extent do physical, management and political factors influence on water scarcity problems for the farmers in the Upper Kromme River Catchment? And how can collective action of the farmers help to anticipate on and cope with water scarcity?". Answering this question in a concise manner shows that water scarcity experienced by the UKRC farmers in the past was mainly from a physical- and farmer management induced-water scarcity kind, due to irregular rainfall patterns and land & water management practices of the farmers. Water scarcity events triggered farmers to change their management at single farm level. The independent water sources of all the farmers in the UKRC did not induce farmers to work together on water management in the past.

The impact of physical water scarcity is perceived by farmers to increase slightly in the future, climate change scenarios also indicate less rainfall on a yearly basis and a higher annual variation. Farmers land use practices in the floodplains have and do lead to riverbed erosion and incision, eventually this has an impact on physical water scarcity problems. Yet by farmers their land use practices are not perceived as having a negative effect on water scarcity. Looking to government management induced- and political- water scarcity a large difference can be seen between the perception on past up till current- and future-perceptions. While none of the farmers indicated an impact of both government management induced- and political- water scarcity for the past up till current time frame. For the future this is perceived totally different, namely more than half of the farmers expect a moderate to very high impact on water scarcity problems because of political and government management reasons. This is mainly based on the increasing demands from the side of Nelson Mandela Bay Municipality (NMBM).

From the interviews it became clear that both the UKRC farmers and the Department of Water Affairs (DWA) together with Nelson Mandela Bay Municipality (NMBM) have a very negative opinion about each other. DWA and NMBM suspect the farmers of illegal water use activity and blame them for practising bad land use practices, that have a negative effect on the hydrological cycle in the UKRC. While the farmers see DWA as a corrupt government organisation incapable of performing proper water management. And NMBM is blamed to waste all the water out of the catchment due to an inefficient and leaking water distribution system.

After the promulgation of the new National Water Act in 1998 the political and institutional situation around water management in South Africa changed dramatically. The Water Allocation Reform emanating from this new act aims to address equity in water distribution by

re-allocating water from white farmers to Historically Disadvantaged Individuals (HDIs). In the UKRC this process is also being implemented. The white farmers in the UKRC are not feeling threatened by this WAR program from an economic perspective, and are sceptical about the success of the program. They are also not willing to give their water rights away to HDIs because their use is perceived as inefficient, as is also the perception on the use by NMBM. The white farmers in the UKRC see themselves as productive and efficient users in contrast to HDIs farmers and NMBM. As part of the WAR program verification and validation of water uses and compulsory licensing is going to take place in the UKRC within a timeframe of 3-5 years. The farmers in the URKC are particularly afraid that the government will restrict their water uses in future, to meet the increasing water demands in NMBM. On the other hand farmers do have a strong control over water due to the geographical outline of the UKRC surface water system, with every farmer having his own remote mountain stream as water supply source. Currently there is no monitoring or regulation at an institutional level on these water abstractions, resulting in a situation in which water use restrictions because of droughts like in 2009-2010 are applied but totally not enforced. Farmers are afraid of future restrictions, but at the same time they do not have a strong belief in DWA being capable of monitoring and enforcing those regulations. Which therefore in the perception of the farmers keeps the strongest position in water control at the side of the farmers.

Water scarcity in the UKRC as a water stressed catchment is not only a threat to the secure access to water of the current white farmer majority, but also to the environment. Will the only right to water in South Africa, known as the ecological reserve, be honoured or will it be overruled by the water demands of NMBM? Besides this the addressing of the equity principle, is also conflicting with the water demands of NMBM and with the efficiency principle laid out in the NWA (1998), since emerging farmers are perceived to be not very productive. It again becomes clear that secure access to water is a relational concept and that the secure access of one (group of) person(s) does also imply insecure access of others.

Environmentalist like Living Lands and PRESENCE are pushing catchment restoration and Payment for Ecosystem Services (PES) on the agenda of DWA and NMBM, as an alternative water augmentation scheme besides the currently dominant water supply approach to keep up with increasing water demands in NMBM. Yet in the UKRC farmer community, such schemes can be positive for the part time farmers, for the commercial farmers it can also have a more negative impact, since it can enhance the monitoring and regulation in the area at an institutional level. NMBM will not start considering this option unless DWA will make it compulsory. The water supply management team of NMBM rather stated that they will point out to politicians what cheap options are in increasing water supply, of which the UKRC is currently the cheapest option. Currently the Working for –Water and Wetlands programs that directly relate to water scarcity for the farmers in the UKRC, are undertaken with high investments from the government side. Still the success of these programs is constrained by a lack in farmer involvement. A PES scheme is further complicated since any new water made available through restoration belongs to the government and not to a farmer who did his best to restore his land. Direct benefits are because of this hard to generate and limits the involvement of farmers and subsequently successfulness of these programs.

It can be concluded that the farmers in the UKRC expect and also will be confronted with new forms of water scarcity in the future, and that NMBM is influencing on this through its political network. In coping with these water scarcity problems, all the farmers indicated that especially for government management induced- and political- water scarcity no positive impact can be made at a single farm level. But that collective action is required to have a

positive impact on these dimensions of water scarcity. Yet farmers are not willing to commit themselves to collective action at this stage, mainly because the expected water crisis has not emerged yet in the UKRC farmer community. Living Lands is operating in between the benefits of collective action which lie mostly in communication and creating understanding between the Working for –Water and –Wetlands programs and the farmers in the UKRC and the risk of negative government involvement. And is therefore in a very challenging position. The risk is that NMBM and DWA will use a collective action as a channel to enforce regulations. This leads to a conclusion that a continued fragmentation rather than collective action is the preferred option for the UKRC farmers to avoid government control.

10.2 Discussion

10.2.1 Revisiting the conceptual framework

As already stated secure access to water has been analysed from a very limited perspective in this research namely from that of the current farmers in the UKRC, which are a majority of white farmers. It is acknowledged that secure access to water in a broader perspective also relates to the environment, domestic needs and to equity in access. This specific angle has been chosen to enable a specific analysis on how farmers manage their way around securing their access to water, and how farmers perceive different dimensions of water scarcity. Although the results presented in this report might be interpreted as written up by someone who is pro white farmers and contra water use by NMBM and water reforms, this is not the case. This report rather shows the opinions of the farmers in the UKRC and an analysis of those opinions, which provide valuable insight in the view of the farmer on the water management situation in South Africa.

In the conceptual framework three water scarcity dimensions identified by Molle and Mollinga (2003) were presented to be used as backbone in this research. In analysing physical scarcity it became indeed clear that climate (change) and vegetation cover in the catchment are the two important driving forces in physical water scarcity. Management water scarcity, which in the conceptual framework was made out of the combination of Molle and Mollinga's (2003) management- and institutional- water scarcity dimensions. Eventually turned out in two separate resulting chapters about farmer- and government-management. While the first about farmer management was mainly about management in the area and the latter about government management mainly about failing institutions. From this point of view the combination of the two during the development of the conceptual framework could also have been omitted at that stage. If not farmer- and government- management was not so much intertwined on the topics of alien clearing and wetland rehabilitation. This namely in the case of the UKRC shows that government intervention is not aligned with farmer management and the two are not working together towards a common goal, which undermines the long term effectiveness of the governmental Working for programs.

Under the topic of political water scarcity in the conceptual framework most emphasizes was put on the Water Allocation Reform, coming forward from the most dominant discussion in South African water management which is the addressing of past inequity in water distribution between black and white people. In the URKC this political threat to the white majority of farmers is not perceived as a major threat, but rather as an inefficient and unsuccessful reform. Rather the downstream water demands of NMBM is perceived as the major political threat to the secure access to water. This again emphasizes that the categorization in different water scarcity dimensions is very artificial, and has its limitations. In

analysing within a single dimension as shown above, but also because of overlap between dimensions, especially between political- and government management induced- water scarcity. The topics of environmental flow, Water Allocation Reform and water use restrictions because of NMBM do all have both a political and government management element.

In revisiting the three dimensions of water control as given by Mollinga (2003) the results of this report show that these three dimensions align well with the three water scarcity dimensions and are interrelated to each other. Farmers do have physical control above Churchill dam, hence they still have managerial and political control over UKRC waters. DWA and NMBM want to dismantle this control from farmers through establishment of a WUA, in order to enhance their managerial and political control in the UKRC. Which for DWA is also needed to implement the WAR program.

While in many other researches that relate closely to the water reforms, a lot of emphasis has been put on the Water Allocation Reform to address inequity in water distribution, this research did not focus much on the often put opposed white and black farmers. Due to time limitations and scoping this topic was not researched into much detail. Out of the information gathered it did also not come forward as a big issue in the UKRC. Still a couple of comments can be made with regards to Water Allocation Reform and why the current white UKRC farmers continue their business as usual without finding hinder from on-going reform programmes. There do not appear to be land claims in the area, also the water use of the farmers is registered and therefore lawfully acknowledged. Up till recent white farmers could count on flood-relief subsidies of the DOA, just like under the apartheid government, and use it freely to redirect the riverbed. The UKRC is mainly inhabited by white farmers and their properties benefits from large scale subsidy programmes of the government like WfWater and WfWetlands. The island style farming is an exceptional situation and fits their style of business and operation, even dam building while illegal will be done if they feel its necessary. The white farmers see themselves as economic efficient and environmental friendly farmers, they claim their business is efficient and green opposed to the inefficient farms of black people. Concluding not so much has changed for the white UKRC farmers and they can continue their business as usual

The part on collective action, was an interesting but also challenging part to research, since it stayed very theoretical, it was about asking farmers what they think about what positive impact they can have on something that is not yet there namely: "the government management induced- and political- induced water scarcity dimensions". And positive impact through something which is also not yet there namely: "collective action". This also limited the ability to research how farmers think they can have a higher positive impact as farmers, besides the frequently managed argument the government will listen more to a group. In this farmers did not mention, whether this should be a WUA, or how they are going to achieve to get themselves present at DWA meetings. Furthermore the emphasizes in the conceptual framework and research was on the eventual positive impact of collective action. While the main conclusion is that collective action is a potential threat for UKRC farmers since NMBM and DWA can use it as a channel to enforce regulations.

Yet the outcome of the research does show that a continuation especially on the part of collective action is very relevant, from a research perspective, but also for the farmer in the UKRC themselves and for organisations such as Living Lands. Living Lands should realize that they are in a difficult position of having interest in restoring landscapes though collective action of farmers, yet involvement and commitment of farmers is under threat it the collective

action will be used by NMBM and DWA to enforce regulations. This research gives also valuable insights for the government in getting a better understanding of how farmers perceive water management and the role of the government in this. Since the government is faced with major challenges in getting the water reforms off the ground in agricultural areas also because of a lack of understanding on how the farmer community works.

10.2.2 Methodological limitations

As a researcher you are always confronted with limitations and unexpected circumstances during your research. This requires a flexible and adaptive research approach. Although I also experienced enough limitations I was able in my humble opinion to manage my way around them. Due to limited access to the case study area, it was not possible to interview all the farmers. Besides this for a proper interview two hours were needed at a minimum. Not all the farmers had so much time at their disposal. These farmer interview limitations gave eventually not a full and complete view on the situation in the UKRC.

The categorization of water scarcity in three different dimensions was sometimes difficult to grasp for the farmers in the UKRC, as also for myself as discussed in the previous paragraph. When the farmers heard about this categorization for the first time, especially the difference between the government management- and the political- dimension since they overlap a lot was sometimes misunderstood. This has an effect on the results presented in this report. For example on the part in which farmers could indicate the extent of impact of either physical, farmer management, government management and political water scarcity on their farming activities on a scale from no impact to a very high impact. Furthermore with the categorization used in this research it was not possible to analyse the extent of impact in these kind of "quantifiable" terms for example for WAR and NMBMs water demands separately.

Also the questions during the interviews were asked to farmers on a farm level. As the different water source figures show in this report farmers do have mainly mountain streams as water sources, but also some points on the main river. The farm level approach did not enable a detailed and separate analysis for both mountain stream abstractions and main river abstractions, which would have been interesting since the difference in hydrological dependency between the two type of abstractions.

As stated in the discussion collective action around water management is currently not practised in the UKRC and does not fit easily in the current world view of the UKRC farmers. This makes that the answers of the farmers on this questions are very perception based. This lead sometimes too vague answers on the questions around this topic.

A big limitation was the time frame for this research: within four months a research proposal, the data collection and analysis and writing up of this report had to be done. Yet looking to all the different dimensions of water scarcity and collective action the research was still quite broad and requires therefore enough time to research it to its full extent. This time was not always available, from this perspective it could also have been interesting to research a single water scarcity dimensions for example the political and leave the others for the parts were they do not overlap.

Since Living Lands was the hosting organization the research adopted a farmer approach. This made that getting into contact with the farmers was not difficult, but also that the farmers do already have their ideas about who you are. For example farmers asking when are you going to come and help us clearing the trees. Only asking questions can in such a situation

be disappointing for farmers. Furthermore the main focus of Living Lands and PRESENCE is on the restoration of landscapes, in cooperation with the land owners. In this the white vs. black farmers issue in SA is not much taken into account. While in research around water management this is inevitably an important topic. The affiliation with Living Lands and PRESENCE further made that contact with NMBM and DWA needed to be done carefully since the staff at Livinglands realize that government involvement does not necessarily imply positive involvement in the light of their mission.

I started my research with the aim to consult farmers to adapt my research methodology to local needs. I did my best in doing this, yet the limited transport possibilities and relative large distance to the case study area made this a complicated task. Especially at the start, when everything and everybody is still new. More contact with farmers prior research development would have been useful to better adapt it to local needs, and could have helped me in gaining a quicker understanding of the dynamics in the area. I managed well to give feedback on the research findings through a presentation on a farmer meeting and the personal deliverance of a newsletter about the study outcomes. And this was appreciated by the farmers.

A challenge from a different kind of order was the organization of interviews with DWA representatives. DWA played an essential role in this research yet, due to the busy time-schedules of the well informed DWA personal and the limited transport possibilities it was no easy assignment to organize an interview with DWA representatives.

10.2.3 Cross case comparison and relevance

While I did not find other research cases in which the perception of farmers on water scarcity was measured and analysed like in this study. The numerous studies done already in South Africa provide plenty opportunities for comparison. This paragraph shows makes comparisons on the topics of water allocation reform and collective action.

Liebrand (2008) found, in his case study in the Olifants basin, that the land and water reform programs were not aligned to each other. While land has been reallocated, the Water Allocation Reform (WAR) program had not re-allocated a drop of water yet as a result of licensing. Liebrand (2008) argues that this re-allocation of water resources and appropriate water technology is the key for reform instead of an outcome. Comparing Liebrands findings to the case study presented in this report, shows that the situation in the UKRC is partly different from Liebrands findings and subsequently also leads to partly different conclusions. In the UKRC the three emerging farmers do have their own mountain stream as water source, with rights to use the water from these streams. Also the water technology to abstract the water is still in place as an inheritance from the previous white farmer. The access to water from this perspective is not different from that of the white farmers in the UKRC. Yet the emerging farmers are yet not very much successful in their farming activities, as also acknowledged by themselves. While Liebrand (2008) pointed out that the falling behind of re-allocation of water is one of the main reasons for failure of the reform program, in the case of the UKRC this cannot be identified as a main reason. Secondly Liebrand (2008) also stated that water technology cannot be simply transferred to users who have very different social requirements for use. This will lead to a neglect of the water technology. Exactly this you also see happening in the UKRC. Emerging farmers feeling unfamiliar with the (water) technology from the previous white owner. The UKRC emerging farmers themselves also stated, that the challenges they face are mostly because of lacking resources, and experience to run a white commercial like farm. Liebrand (2008) also stated that a constraining factor in the reform

program is that it takes place under the conditions set by the government, for example run the farm like the white people did. These government conditions are not necessarily adapted to the needs of the families and communities that are going to farm.

Furthermore Liebrand (2008) argues that the water reforms are perceived by the white farmers as a denial to their right of existence. Farmers are compensated if they lose their farm, WAR is therefore not a major economic/political threat. White farmers mainly feel threatened in the fact that their livelihoods and cultural values would diminish. They see themselves as highly productive farms building a 'new' world and want to protect this. Liebrand (2008:118) concludes that "the white farmers are not only water users or land users, but people with a cultural background who value certain ways of living, and value certain ways of management of land and water resources". In the UKRC you see the same, farmers are not willing to give up their rights for non-productive uses by emerging farmers and in the case of the UKRC also not for the inefficient use of NMBM. The latter, does contrary to the water reforms also provide a bigger economical threat to the white farmers in the UKRC.

Mendez (2010) and Liebrand (2008) both found in their case studies that farmers, especially white farmers, proactively approached the land and water reforms and develop strategies to minimize losses and maximize benefits of the land and water reform programs. They did this by being present at catchment forums and CMA meetings. In the UKRC this proactive attitude of white farmers towards the land & water reform cannot be found. A reason for this can be that in the cases of Mendez (2010) and Liebrand (2008) the land and water reform was more urgently implemented, but also because in these cases farmers were much more organized than the case of the URKC. Both examples show that collective action of farmers proved to be a powerful tool in lobbying at the governmental and political level, to adjust the land and water reforms to the benefit of the white farmers. Yet as also concluded this does not contribute to the essential aim of the reform to address the 'past' inequity. In contrast to the findings of Liebrand (2008) and Mendez (2010), Simpungwe (2006) in one of his case studies, found that white farmers were also not very proactive towards safeguarding their water rights like in the case of the UKRC, since they did not make the effort to be present at Catchment Management Forum (CMF) meetings, but instead let them be represented by emerging farmers. Which can also be interpreted as a clever political move, since you are not going to take water from a couple of resource pour farmers.

The examples above show that collective action can work to the benefit of white farmers at the expense of emerging farmers. DWA should in the light of the aim of the water reforms ask themselves while their participatory approach, which is developed to enhance involvement of black communities, does not work against those black communities in certain cases. DWA needs to understand case specifically which social-political conditions around participatory management do enable both chances for black and white farmers and which do not and lead to an unbalanced situation. The research presented in this report is as such also relevant for DWA to understand how farmers perceive the government, and what kind of implications this gives for participatory management. How can the objectives of both farmers and DWA be integrated, while they are only talking negative about each other, and are perceiving the other as having a negative impact on their own objectives? The water reforms are yet to be implemented in the largest part of South Africa. This makes that the findings in this report are not only relevant for DWA and other organizations specifically working in the UKRC, but also in other areas in South Africa.

10.3 Recommendations

In this paragraph I formulate a couple more conclusions which in my opinion are relevant for other researchers, but also practioners and policy makers in the water management domain of South Africa. First of all it is recommended to the reader of this study to interpret the results yourself, think about it, cross check it and draw your own conclusions on what you can do with the findings presented.

Recommendations to Living Lands:

- No study has been done on the devastating floodplain erosion in the UKRC from the perspective of the farmers which are the main role players in the erosion processes. Living Lands should start studying these issues both from a social and physical perspective. Social to get a better understanding of the why of farmer land use practices and be better able to manage a way around those. Physical to better understand the system, and how erosion and deposition would look like in a natural system state and what this implies for the current Working for –Water and Wetlands management interventions.
- Looking at the results presented in this report, Living Lands needs to take into account the water management issues and the expected validation and verification and compulsory licensing. While the main focus of Living Lands is on sustainable land use and not an water usage rights, it is clear that in the UKRC water use and land use are very much intertwined. And do therefore also provide an opportunity to work on land issues through water issues. In this, options like catchment restoration and PES should be lobbied for at DWA and NMBM.
- While Living Lands' main focus is on sustainable land use and therefore not specific on white or black farmers, it can be an opportunity for Living Lands to focus on emerging farmers, and on cooperation between emerging and white farmers. Since this is actually faced with challenges at a political and also local social level. In doing so new funds can be found to sustain Living Lands objectives to enable sustainable farming in the UKRC.
- The water management issue is a delicate issue both for farmers and DWA. As Living Lands you have your own set of objectives, while being kind of entangled between farmers and DWA. To generate interest of the farmers, the water issue can be a nice thing to focus on. Yet a good relationship with DWA is also required. Living Lands should think well ahead on what strategy they want to use in this. And what the implications of a strategy are for the relation with both farmers and DWA.
- An out of the box approach for Living Lands can be to take the same approach they currently apply in rural areas, into the townships of Port Elizabeth to address the issue of urbanization, water wastage, healthy living, and as a connection between urban and rural areas.

Recommendations to the UKRC farmers:

- Farmers land use practices in the floodplains have and do lead to riverbed erosion and incision, eventually this has an impact on physical water scarcity problems. Yet by farmers their land use practices are not perceived as having a negative effect on water scarcity. Farmers should organize themselves and work together with Working for Wetlands and also Working for Water in order to stop further degradation, that pose a direct threat to their farming activities, to the environment and the water supply towards NMBM.
- Farmers should realize that the role of Living Lands in the area is to restore landscapes and not to act as a vehicle to bring in water reforms, and water use restrictions. Farmers should communicate their concerns with regards to this topic clearly to Living Lands and choose an approach together to deal with this concerns.

Recommendations to DWA and other government organizations:

- Working for Water should start organizing the meetings with farmers around alien clearing or join the meetings organized by Living Lands. Currently the immense investment do not lead to the desired outcomes mainly because of a failure in the uptake of follow up clearing and maintenance by farmers. Intensifing communication can create a better understanding and open up ways for better cooperation.
- Working for Wetlands should not only focus on the long term objectives of wetland rehabilitation. In implementing their rehabilitation projects (mainly gabions), also acknowledgment should be given to day to day values of farmers to make their rehabilitation work better adapted to the local situation.
- Currently the Working for –Water and Wetlands programs that directly relate to water scarcity for the farmers in the UKRC, are undertaken with high investments from the government side. Still the successfulness of these programs is constrained by a lack in farmer involvement. A PES scheme with direct benefits for farmers can have a positive effect on the involvement of farmers and success of these programs. DWA and DEA together with NMBM should take this into consideration in the implementation of the Working for programs. Working for- project managers should lobby at DWA to give PES a more prominent position on their agenda.
- DWA personnel responsible for the implementation of validation and verification and compulsory licensing should read the parts of this report on the perception of farmers on government management and politics with an open attitude, and should also communicate this to the water supply management team of NMBM.
- DWA needs to understand case specifically which social-political conditions around participatory management do enable both chances for black and white farmers and which do not and lead to an unbalanced situation. The research presented in this report is in such relevant for DWA to understand how farmers perceive the government, and what kind of implications this gives for participatory management.
- Water scarcity in the UKRC as a water stressed catchment is not only a threat to the secure access to water of the current white farmers majority, but also to the environment. DWA should be clear to both NMBM and farmers that the Ecological Reserve is a constitutional right and cannot be hijacked by NMBMs or farmers water demands.
- Specifically looking to the addressing of the equity principle, DWA should realize themselves that increasing the allocation towards NMBM, will put a successful water reform program even more under pressure.
- NMBM suffers from hydrological dependency on farmers in the UKRC if they (NMBM and DWA) want to gain managerial / political water control in UKRC, farmers are the inevitable vehicle. Hence in setting up a WUA they should think of tangible incentives for farmers to get them on board.

Recommendations to other researchers:

- This research has shown that doing research more or less only from a white farmer perspective does also give very valuable insights in how those white farmers perceive the water reform process. While often in current research the white farmers are dealt with as the cause of the problem in unequal water distribution and environmental degradation, a large part of the solution lies also in better understanding the world view of the white farmers. Researchers should take this into account in doing new research around the land and water reforms in South Affrica.

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Annexes

Annex I. Farmer Interview (blank)

Theme → Water scarcity and securing access to water analysis for farmers in the Upper Kromme River Catchment (UKRC)

Specific topic within theme → Clarifying to what extent farmers in the UKRC have experienced water scarcity in the past. How they coped with this, and to what type of water scarcity they attach this. Also clarifying what farmers see as the future perspective on water scarcity.

Finally also ask farmers to what extent they see collective action as a good method to anticipate and cope with water scarcity problems.

Objectives

Objective 1. Clarify some general details about the farmer and his farming activities.

Objective 2. Clarifying to what extent the farmer has experienced water scarcity in the past, how he coped with this, and what he sees as the driving factors behind these water scarcity problems.

Objective 3. Clarifying how the farmer foresees water scarcity problems due to climate (change) and land cover (change) (Physical water scarcity).

Objective 4. Clarifying how the farmers foresees water scarcity problems due to his own land & water management practices, that of other farmers in the catchment and the way in which these practices are (not) regulated by the government (Management water scarcity).

Objective 5. Clarifying how the farmers foresees water scarcity problems due to political reasons and downstream water use. (Water reforms, WAR program, demands from NMBM) (Political water scarcity)

Objective 6. Clarifying how the farmers ranks his possibilities to have positive impact on the three different water scarcity dimensions

Objective 7. Clarifying on the farmer opinion on: "collective action as a good method to anticipate and cope with water scarcity problems".

Objective 8. Further clarification of farmer's opinion on Catchment Forum and WUA.

Objective 9. Observation of land & water management practices during farm visit

Importance of interview

Farmers are the main stakeholders in this research.

Interview questions

Objective 1. Clarify some general details about the farmer and his farming activities.

1. Name:
2. Farming activities:
3. Farm size (total/arable) (ha):
4. Area under irrigation (ha):
5. Source(s) of water:
6. Type of irrigation (abstraction method, transport, storage, application):
7. Frequency of irrigation:
8. Water demand per day in a normal year (m^3):
9. Water demand per day in a dry year (m^3):

10. Do you measure the amount of water you abstract? If yes why and how, if no why:
11. Do you plan to increase the area under irrigation?:

Objective 2. Clarifying to what extent the farmer has experienced water scarcity in the past, how he coped with this, and what he sees as the driving factors behind these water scarcity problems.

12. Have you experienced water scarcity problems in the past?
13. If no, what is the reason that you have not experienced water scarcity problems?
14. If yes, when was the last time? How often do you experience water scarcity?
15. If yes, how did you cope with these water scarcity problems?
16. If yes, what were the reasons behind these water scarcity problems?
17. Do you foresee and are you afraid of future water scarcity problems, why?

Objective 3. Clarifying how the farmer foresees water scarcity problems due to climate (change) and land cover (change)(Physical water scarcity).

Physical water scarcity, which is absolute scarcity, the water source availability is limited by nature (climate / land cover);

18. Do you experience that the climate in the area, for example through irregular raining patterns influences on the availability of water for you?
19. Do you think that climate change has already or will worsen this? Why?
20. Do you see a link between land cover (change) in the catchment and the water availability?
21. Could you indicate the extent of the impact of climate (change) and land cover/vegetation on water scarcity problems experienced in the past? On a scale from 0-5. (and future expectation)

	No Impact	Very minor impact	Minor impact	Moderate impact	High impact	Very high impact
Past - current						
Future						

Explanation:

Objective 4. Clarifying how the farmers foresees water scarcity problems due to his own land & water management practices, that of other farmers in the catchment and the way in which these practices are (not) regulated by the government (Management water scarcity).

Management water scarcity, which is scarcity because of the land & water management practices of the farmer and other farmers in the catchment, and because of a lack of management in the catchment from institutional level (DWA, CMA)

22. Do you think that your management practices around water use have an influence on water scarcity problems for you? *(refer to mentioned management practices under objective 1)*
23. Do you think that your management practices around land use have an influence on water scarcity problems for you?
24. Do you think that the land & water management practices of other farmers in the catchment influence on water scarcity problems for you? If yes, which practices?
25. What has been your experience with the Department of Water Affairs so far?
26. Have you heard of the water reforms, what do the water reforms imply for you?
27. How does regulation from the department of water affairs influence on your access to water?

28. Do you think that water needs for the environment in the Kromme River, called the Reserve in the National Water Act, will influence on your access to water? How?
29. How does alien tree invasion (black wattle) have impact on your access to water?
30. How does clearing of alien trees (Working for Water) have impact on your access to water?
31. How does the degradation of the wetlands have impact on your access to water?
32. How does the rehabilitation (Working for Wetlands) of the wetlands have impact on your access to water?
33. Could you indicate the extent of the impact of land & water management practices of you, other farmers and the government on you water scarcity problems in the past? On a scale from 0-5. (and future expectation)

	No impact	Very minor impact	Minor impact	Moderate impact	High impact	Very high impact
(Own) Past - current						
Future						
(other farmers) Past - current						
Future						
(DWA) Past - current						
Future						

Explanation:

Objective 5. Clarifying how the farmers foresees water scarcity problems due to political reasons and downstream water use. (Water reforms, WAR program, demands from NMBM) (Political water scarcity)

34. Which political factors do according to you influence on your access to water? How does this work?
35. Which downstream water users do according to you influence on your access to water? How does this work?
36. Do you think that the water demands of downstream cities, such as the Nelson Mandela Bay Metropole, will influence on your access to water? How?
37. Do you know of any emerging farmers in the area that got land because of the land and water reform program?
38. Do you think that the Water Allocation Reform program will influence on your access to water? How?
39. Are you prepared to give some of you water rights away in favour of emerging farmers, to address the equity issue?
40. How are the downstream water users (NMBM) involved in what happens in the Kromme Catchment according to you?
41. Could you indicate the extent of the influence of politics and downstream water use on you water scarcity problems in the past? On a scale from 0-5. (and future expectation)

	No impact	Very minor	Minor	Moderate	High impact	Very high

		impact	impact	impact		impact
Past - current						
Future						

Explanation:

Objective 6. Clarifying how the farmers ranks the three different dimensions and his possibilities to influence on the three different dimensions

In my research I use three different dimensions of water scarcity namely:

1. *Physical scarcity, which is absolute scarcity, the water source availability is limited by nature (climate / land cover);*
2. *Management scarcity, which is scarcity because of the land & water management practices of the farmer and other farmers in the catchment, and because of a lack of management in the catchment from institutional level (DWA, CMA)*
3. *Political scarcity, which is scarcity because people are excluded from access to available water resources because of political reasons, (water rights of downstream water users).*

42. Could you rank this three dimension in order of influence, from high to low.

43. Can you indicate to your opinion how much positive impact you can have as a single farmer on the different dimensions of water scarcity to anticipate and cope with future water scarcity problems? (on a rank from 0-5)

	No impact	Very minor impact	Minor impact	Moderate impact	High impact	Very high impact
Physical scarcity						
Management scarcity (farmer)						
Management scarcity (government)						
Political scarcity						

Explanation:

Objective 7. Clarifying on the farmer opinion on: "collective action as a good method to anticipate and cope with water scarcity problems".

44. What is your opinion on collective action of the farmers in the Upper Kromme River catchment to anticipate and cope with water scarcity problems?

45. Do you think that collective action of the farmers in the Upper Kromme River catchment is a good way to anticipate on and cope with;

    1) Physical water scarcity problems?

    Explanation:

    2) Management water scarcity problems?

    Explanation:

    2) Political water scarcity problems?

    Explanation:

46. Can you indicate to your opinion how much positive impact you can have as a farmer collective (WUA) on the different dimensions of water scarcity to anticipate and cope with future water scarcity problems? (on a rank from 0-5)

	No impact	Very minor impact	Minor impact	Moderate impact	High impact	Very high impact
Physical scarcity						
Management scarcity (farmer)						
Management scarcity (government)						
Political scarcity						

Explanation:

47. If the outcome of this research will be that collective action of farmers is a promising manner to anticipate and cope with water scarcity problems, are you willing to be involved in this farmer forum?

Objective 8. Further clarification of farmer's opinion on Catchment Forum and WUA.

48. During the last workshop with the land users in the end of March, most of them were very interested and motivated in having a Catchment Forum; what are your thought about this idea of developing a catchment forum?
49. According to your point of view, what are the advantages of a catchment forum? And what are the risks? What would be its strength and weakness?
50. What should be the functions of such a forum?
51. According to your point of view, how do you think the catchment forum should evolve in the future?
52. If a kind of farmers' association would be developed in the Kromme, what should be its functions? Would you like to be a part of it? Would you like to occupy a main role?
53. Have you heard about WUA? Do you know what is its role/function?
54. We are planning a new meeting at the end of august, with the land users in the upper Kromme. Thomas and I will present our results from our researches, and, according to the feedback of the different land users' interviews, we will have presentations and discussions about the main topics that people ask for.
55. Would you be interested in joining?
56. What kind of topics, do you think, should be discussed there?
57. What would be the best time for you to have this meeting? The best period, day, and time?

Objective 9. Observation of land & water management practices during farm visit

Annex II. Interview overview table

Table 3: Overview of interviewed persons, showing reference code to which is referred in the main text.

Code	Category	Interviewee	Profile	Relevance	Date
EXP1	Researcher / Expert	Maura Andrew	PhD PES at Stellenbosch and Rhodes Universities	Maura Andrew has a long research experience in the area with regards to new concepts in water resource management	30-06-2012
EXP2	Expert	Pierre Joubert	CEO Gamtoos Irrigation Board	Pierre Joubert has a lot of knowledge about the process of becoming a WUA, and about downstream water use by NMBM	28-06-2012
EXP3	Expert	Japie Buckle	Working for Wetlands manager at SANBI	Japie buckle manages the wetland rehabilitation in the Kromme River	17-07-2012
NMBM1	NMBM	[1]Stan Groenewold, [2]Shannon Barkes, [3]Paul du Plessis, [4]Stuart Ferguson	[1]Director water supply, [2]Water engineer, [3]Water treat-ment officer, [4]pipeline/dam manager bulk supply side	NMBM is the biggest water user from the Kromme River. These people are in charge of managing this process and develop future plans.	17-07-2012
NMBM2	NMBM	Eric Roux	Churchill Dam manager	Eric Roux knows what is happening at and around the Churchill dam	12-07-2012
GOV1	Govern-ment	Gibson Gumude	DWA Water resource management, Eastern Cape	Gibson Gumude is strongly involved in the Kromme River and in the upcoming verification and licensing process	18-07-2012
GOV2	Govern-ment	Michael Kawa	DEA Working for Water manager, Eastern Cape	Michael Kawa is responsible for WfWater in whole Eastern Cape, as such also for the current program in the UKRC.	29-06-2012
GOV3	Govern-ment	Gerrie Ferreira, Hennie Swanevelder	DEA, Nature conservation Jefreys Bay office. Biodiversity officers	Gerrie Ferreira and Hennie Swanevelder, are custodians from DEA at local level. Interview focused on Kromme River Estuary and related environmental flows	16-07-2012
GOV4	Govern-ment	Sisiwe Blie	DWA Water resource management, Eastern Cape	Sisiwe Blie is strongly involved in the Kromme River, in the upcoming verification and licensing process and the formation of CMA and WUAs	25-09-2012

Annex III. WET-Health assessment

WET-Health is designed for the rapid assessment of the integrity of wetlands. It focuses on the question of how far a system has deviated from its historical undisturbed reference condition, and does not assess ecosystem services (Macfarlane et al., 2007). Figure 29 shows the K90A catchment in which the studied wetlands are located. The map shows three different basins, which are used as the units for the assessment.

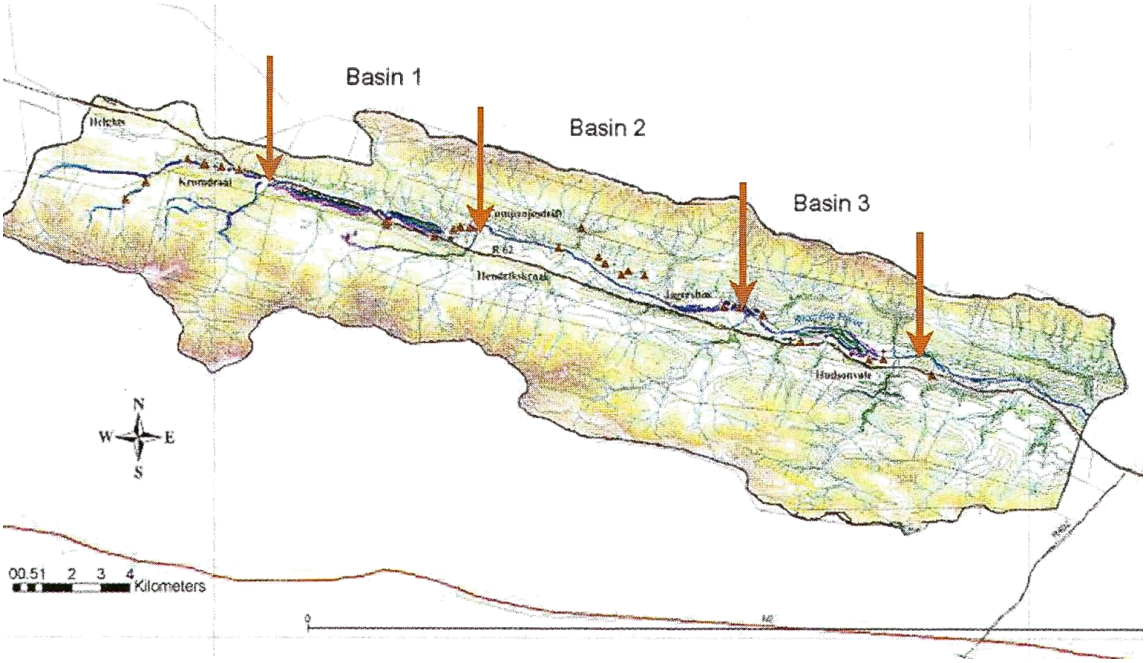

Figure 29: Map of catchment K90A indicating the recorded erosion gullies (triangles) in 1997. Arrows indicate the points at which the basins begin and end (Source Kotze & Ellery, 2009: 111)

Table 4 shows the outcome of the WET-Health assessment undertaken after the 2006 and 2007 floods. Below the table the wetland health indicators (hydrological, geomorphological, vegetation) are described using descriptions from Macfarlane et al. (2007).

Table 4: Summary of WET-Health assessment results for all three basin of the Kromme River in catchment K90A

	Basin 1	Basin 2	Basin 3
Hydrological	1*	8	5
Geomorphological	2	8	6
Vegetation	1	10	6
Integrated health score	1,3	8,6	5,6
Percentage of wetland and its condition	83% un-impacted 17% critically impacted	18% un-impacted 53% seriously or critically impacted 29% channel	43% moderately impacted 57% seriously or critically impacted
Area of extant wetland (ha)	101	28	18

** Score: 0 = no discernible modification; 10 = critically impacted*

Hydrology: For the purpose of this assessment, hydrology refers to the movement of both surface and sub-surface water into, through and out of a wetland. Hydrology is the defining

feature of wetlands and therefore forms a key component of the assessment of wetland health.

The hydrology of a wetland can be altered through:

1. Human modifications to the wetland's catchment that change the quantity and timing of water inputs to the wetland

2. Modifications taking place within the wetland that alter the distribution and retention patterns of water within that wetland

Geomorphology: An increase in sediment output from a wetland threatens a wetland's natural structure and functioning, particularly as this invariably takes place through incision by gullying. We would describe erosion as one of the most serious problems facing South African wetlands, which makes this module particularly important.

Two types of sediment that accumulate within and/or leave a wetland are of interest to users of this module:

1. clastic sediment (mineral particles);

2. *organic* sediment (organic material).

The location of depositional features within the wetland is also important, as their occurrence lower down in the wetland from tributary streams whose catchments are undergoing erosion, may have a desirable effect on wetland development in that they may have a damming effect that enhances flooding and sediment deposition in the main wetland upstream. Conversely, excessive deposition at the head of the wetland will steepen the longitudinal slope of the wetland, thereby increasing the risk of erosion within the entire wetland.

Vegetation: Wetland vegetation has compositional and structural characteristics that provide specialized habitats for a range of important wetland dependent species such as the red chested flufftail and wattled crane. Wetland vegetation may also provide a range of locally important goods for local communities such as reeds for weaving, and services to downstream users such as flood attenuation and nutrient retention. It is therefore important to be in a position to assess vegetation health.

Alien vegetation poses one of the most significant threats to wetland vegetation and is typically a major focus of rehabilitation programs.

Annex IV. WET-EcoServices assessment and potential losses

The assessment shown in Kotze & Ellery (2009) is done on 18 indicators and separated for the three sub basins in the Upper K90A catchment (Figure 29). Out of the 18 indicators 8 indicators or (in-) directly related to water security namely: flood attenuation, stream flow regulation, sediment trapping, erosion control, water supply for human use, threats and future opportunities. The results in Table 5 show both the assessment of these indicators for May 2006 and March 2007 and also a column with potential ecosystem delivery loss due to head-cut erosion, but which can be averted by halting the head-cut erosion through rehabilitation measures.

Table 5: Combined table of: 1. Assessment of ecosystem delivery in 2006 and 2007 (pre and post flood) and; 2. Loss of ecosystem services likely to result from unhalted head-cut erosion in catchment K90A

	Basin 1			Basin 2			Basin 3		
Ecosystem services	**2006**	**2007**	**Potential Ecoser-vice loss**	**2006**	**2007**	**Potential Ecoser-vice loss**	**2006**	**2007**	**Potential Ecoser-vice loss**
Flood attenuation	2,5[1]	2,4	**[2]	2,0	2,1	#	2,4	2,3	**
Stream flow regulation	2,8	3,2	**	1,7	1,8	#	2,3	2,3	**
Sediment trapping	2,4	2,6	**	2,7	3,3	#	3,0	3,0	**
Erosion control	3,3	3,4	*	2,7	1,5	#	2,5	2,5	**
Water supply for human use	3,5	3,0	*	2,3	2,5	*	2,6	3,2	**
Threats	3,0	4,0		4,0	4,0		2,0	2,0	
Opportunities	3,0	2,0		1,0	2,0		2,0	2,0	

[1] *The performance of the different ecosystem services indicators are assessed on a scale from 0-5 in which 1=moderately low; 2=intermediate; 3=moderately high; 4=high.*

[2] *Score for ecosystem losses, if head-cut erosion is/was not halted (# = no significant loss anticipated; * = slight loss anticipated; ** substantial loss anticipated).*

Below each ecosystem service is shortly described using Kotze et al. (2007).

Flood attenuation refers to the spreading out and slowing down of flood waters, downstream and the potential damage thereby reducing the severity of floods that the floods may cause

Streamflow regulation refers to the sustaining effect of a wetland area on downstream flow during low-flow periods

Sediment trapping refers to the trapping only diminishes water quality by increasing and retention of sediment carried by runoff turbidity but also leads to significant loss waters. Excess sediment not of storage capacity in dams.

Erosion control (on site) refers to the control of erosion at the site through on-site factors that prevent the loss of soil from the HGM unit. It should be added that by reducing downstream flooding intensity wetlands may also contribute to reducing the level of erosion downstream but this downstream contribution is not included in this assessment.

Water supply for human use refers to the provision of water for direct human use includes water extracted directly from a wetland area for domestic, agricultural or other purposes. Although this provisioning service is related to some extent to the regulatory service that a wetland may have in regulating streamflow, the latter is considered separately in the assessment of streamflow regulation in.

'Threat' in this context refers to potential or impending pressures (forces, activities or events) in which a detrimental impact on the ecosystem services supplied by the HGM unit is likely to occur. Some threats that may be encountered include:

- Active gully erosion in the wetland which threatens to dry out an extensive portion of the wetland.
- Proposed extensive transformation of the surrounding landscape that will substantially reduce the connectivity of the wetland with other natural areas.
- Invasion by alien species.

'Future opportunities' in this context refers to the prospects of enhancing the delivery of ecosystem services by the HGM unit. Such future opportunities include:

- Opportunities for enhancing effectiveness of the HGM unit (e.g. by plugging artificial drains in a wetland and reinstating a naturally much more diffuse water flow pattern through the wetland).
- Opportunities for increasing the current level of direct use of a wetland (e.g. the HGM unit may have an extensive bed of currently unutilized Phragmites australis reeds that could be sustainably harvested.

Annex V. Schematic overview of Upper Kromme River Catchment

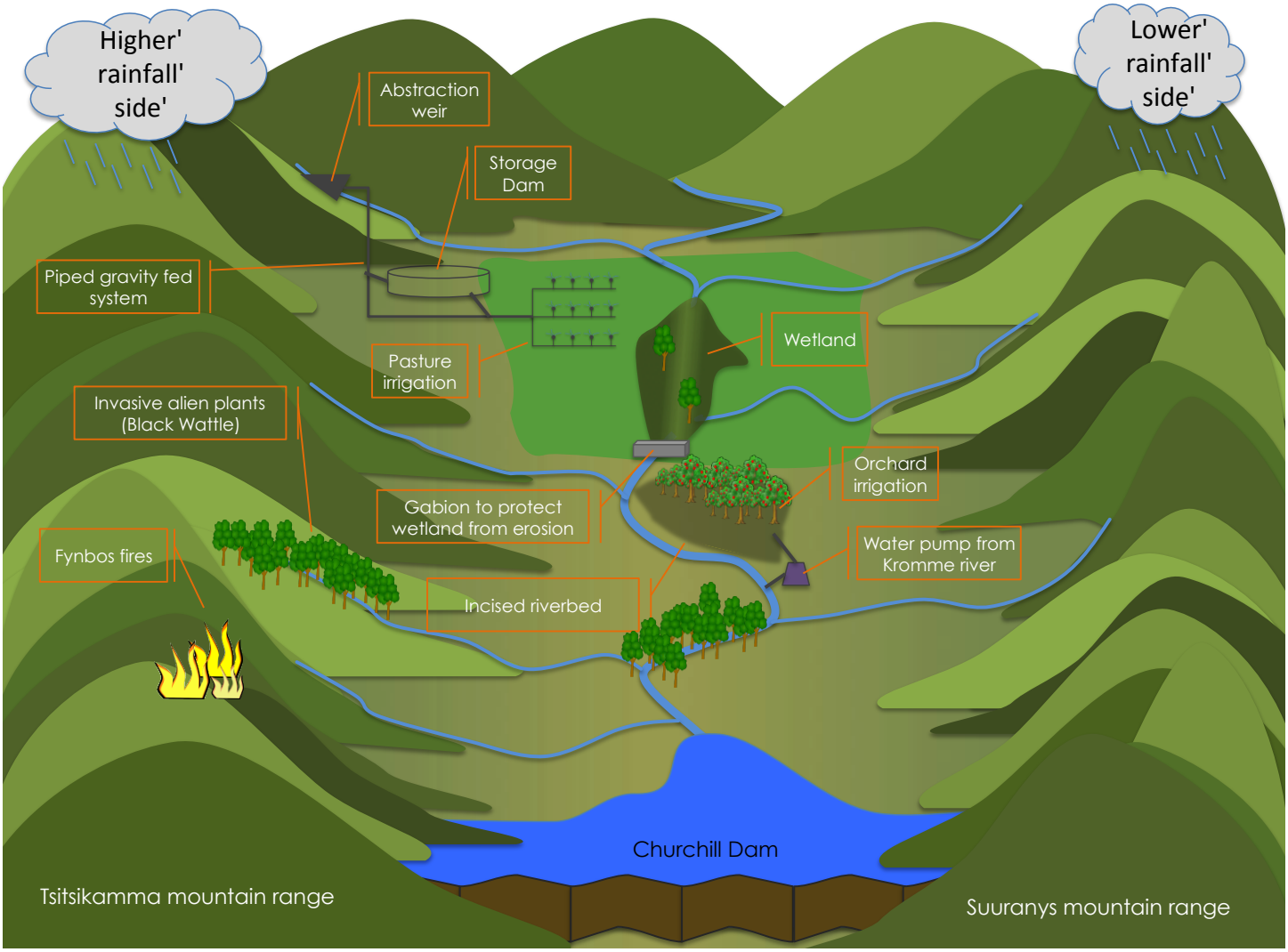

Figure 30: Schematic overview of the Upper Kromme River Catchment.

Showing:

- Trellis drainage pattern. Almost every tributary stream is developed with an abstraction weir as shown at the left top.

- Higher and lower rainfall side.

- Example of wetland with alien plant invasion, incised riverbed, gabion to protect wetlands from headcut erosion, and pastures / wetland interaction.

- Pump irrigation from main Kromme River for orchards.

- Invasive alien plants in Kromme River, side streams and catchment area.

- Fynbos fires in catchment area either naturally induced or man-made.

- Churchill Dam; water supply reservoir to NMBM

Annex VI. Water supply network to Nelson Mandela Bay Municipality

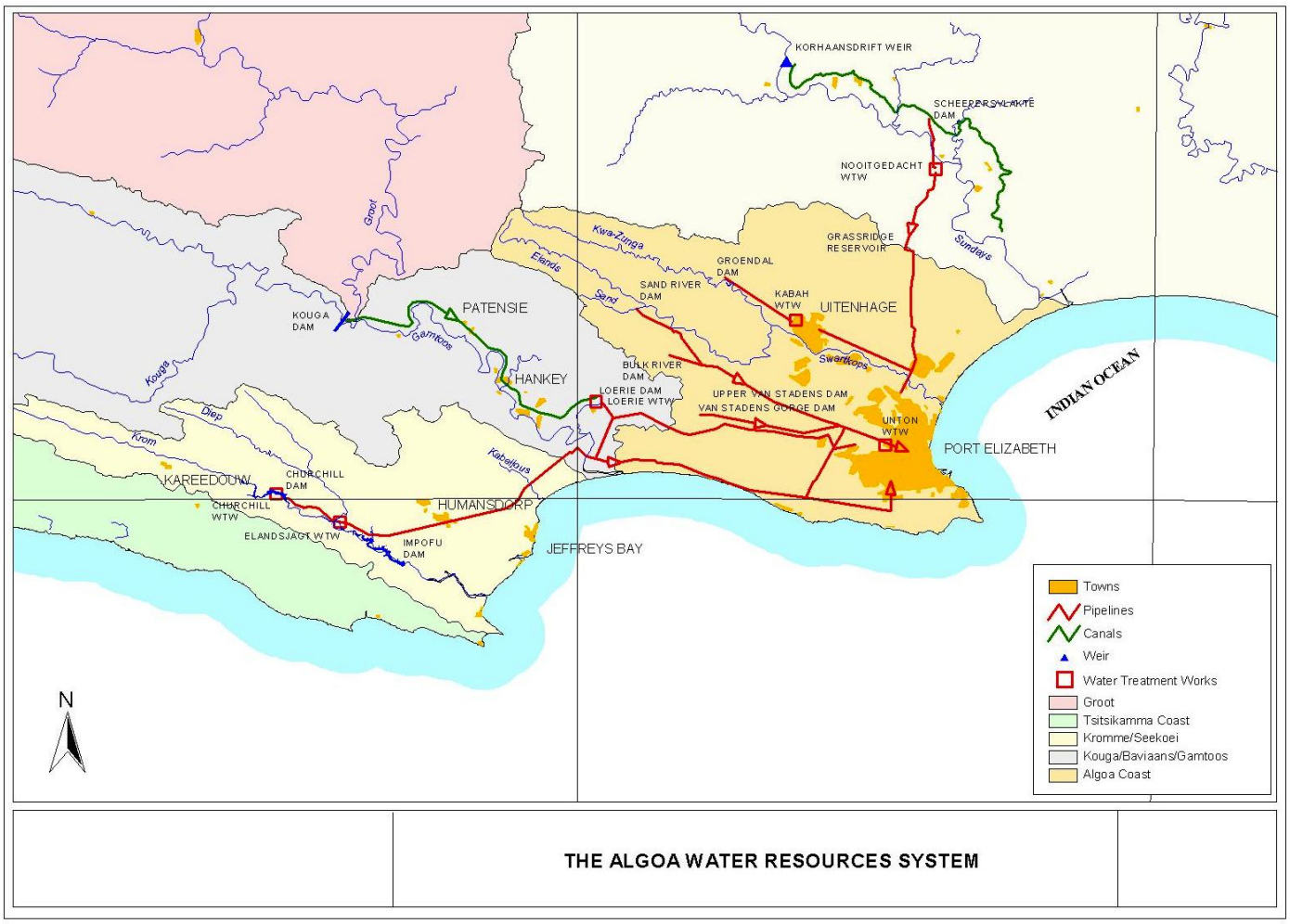

Figure 31: Source (DWAF, 2003)