Preliminary study of the Kouga River catchment

Farmers' water and land use and their perceptions on nature restoration and alien invasive species

Damian Baselmans

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Presence

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The cover shows the Kouga River at lat. -33.752224° long. 23.852627° on 5 May 2011.

Preface

This report is written by Damian Baselmans as my thesis for the study Bachelor of Water Management (Aquatische Ecotechnologie) at the University of Zeeland. For this thesis I stayed for roughly a half year (November 2010 – May 2011) with some very kind people at the PRESENCE Learning Village at the Kouga Dam, Eastern Cape, South Africa. After that, I finished writing back in the Netherlands.

It has been a very nice experience, though sometimes a bit of a personal challenge as well. Fortunately I could always count on the guidance and support of my supervisors, Marijn Zwinkels, Odirilwe Selomane and Carla Pesch, who all have been very patient with me. Additionally I would like to thank Bram Verkruysse who was my initial supervisor from the University, but he could not continue due to illness.

Furthermore I would like to thank friends and family, who have all supported me in many ways. Special thanks go to my parents, Merijn Koster and Huib Rekourt.

"There are those who said this day would never come, what are they to say now?"

Summary

Living Lands has been working primarily in the western Baviaanskloof in an intensive way with farmers and landowners through PRESENCE in the Baviaanskloof. It is their ambition to expand the PRESENCE programme to the Kouga River catchment by creating new partnerships and projects in that area. This internship will be a start for meeting that ambition.

To get answers for the research questions the approach of interviewing farmers was chosen, because that would provide the best practical information on the various topics from different sources. This way, the extensive knowledge a farmer has for his lands or geographical area could be accessed. It was also important to introduce the farmers to Living Lands and the PRESENCE network, as a first step towards creating new opportunities for cooperation.

The main outcomes of the interviews are:

Land use

- Less than 25% of the total land a farmer owns is being used for crops.
- Main produce is fruit, primarily apples and other deciduous fruit.
- Some livestock is farmed in the area, but usually with relatively small numbers and not for commercial purposes.

Irrigation

- Average irrigation water use is 5461 m^3/ha/year.
- Nearly all orchard surface areas are irrigated primarily with micro sprinklers and to a lesser extent with drip irrigation.
- Farm dams are the main source of irrigation water.

Alien invasive species

- Alien invasive species (AIS) are an issue according to all interviewed farmers.
- Some farmers are able to control the problem causing AIS.
- The problems that the alien invasive species cause are:
    1. They use much more water than indigenous species.
    2. It is harder to expand crops and orchards over AIS than over the indigenous vegetation.
    3. Some AIS inhibit flow of water in streams.

Nature

- Overgrazing is generally not a problem due to low numbers of livestock.
- Some nature conservation issues exist due to alien invasive species.
- Low usage possibilities of land make farmers admissible to initiatives for nature conservation.

Samenvatting

Living Lands werkt voornamelijk in het westen van de Baviaanskloof in een intensieve manier met boeren en andere grondbezitters via PRESENCE in de Baviaanskloof. Het is hun ambitie om het PRESENCE programma uit te breiden naar het Kouga River stroomgebied, door nieuwe partnerschappen en projecten in het gebied aan te gaan. Deze afstudeerstage is een begin om die ambitie te vervullen.

Er is voor gekozen om de boeren te interviewen om antwoorden voor de onderzoeksvragen te krijgen, omdat dat de beste praktische informatie op verschillende onderwerpen van verschillende bronnen oplevert. Op deze manier kan eenvoudig de uitgebreide kennis van een boer over zijn land en geografisch gebied achterhaald worden. Voor Living Lands was het ook belangrijk om de boeren met de organisatie en het PRESENCE netwerk kennis te laten maken, als een eerste stap naar nieuwe mogelijkheden om samen te werken.

De belangrijkste conclusies van de interviews waren:

Landgebruik

- Minder dan 25% van de totale oppervlake die een boer bezit wordt verbouwd.
- Het hoofdproduct van de streek is fruit, voornamelijk appels en andere bladverliezende fruitbomen.
- Er zijn wel een aantal boeren met vee, maar doorgaans zijn dat kleine aantallen en niet voor commercieel gebruik.

Irrigatie

- Gemiddeld waterverbruik voor irrigatie per boer is 5461 m^3/ha/jaar
- Bijna alle boomgaarden worden geïrrigeerd met individuele sprinklers en in mindere mate met druppel irrigatie.
- Dammen op boerenland zijn de hoofdbron van irrigatie water.

Alien invasive species

- Invasieve soorten zijn een probleem volgens de boeren.
- Sommige boeren lukt het om de invasieve soorten onder controle te houden.
- De problemen met invasieve soorten zijn als volgt:
    1. Ze hebben veel meer water nodig dan inheemse soorten
    2. Het is moeilijker voor de boeren om boomgaarden uit te breiden daar waar de invasieve soorten zijn dan waar de inheemse vegetatie staat.
    3. Sommige invasieve soorten blokkeren watergangen.

Natuur

- Overbegrazing is in het algemeen geen probleem in het gebied, vanwege de lage aantallen vee.
- Er zijn een aantal problemen op natuurgebied, veroorzaakt door de invasieve soorten.
- Aangezien boeren stukken van hun land toch niet kunnen gebruiken voor landbouw staan ze vaak positief tegenover natuurbeschermingsprojecten.

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1 Introduction

1.1 Project background and context

Living Lands has been working primarily in the western Baviaanskloof in an intensive way with farmers and landowners through PRESENCE in the Baviaanskloof. It is their ambition to expand the PRESENCE programme to the Kouga River catchment by creating new partnerships and projects in that area. This internship will be a start for meeting that ambition.

Farmers and other landowners are primary stakeholders in PRESENCE in the Baviaanskloof, so it is essential to introduce those kind of people in the Kouga River catchment to PRESENCE and look for opportunities of cooperation. This internship will focus on paving the way for future students and projects by collecting information in a survey from the farmers and landowners and gather available information on the catchment.

1.2 Aim and goals of the project

The main goals of this internship are:

1. To create an overview of available literature and projects on the Kouga River catchment.
2. To introduce PRESENCE and Living Lands to farmers in the Kouga River catchment.
3. To create a farmer's water analysis of the Kouga River catchment.
4. To investigate the current state of nature and as a part of this to investigate which alien invasive species are of highest concern for the farmers.
5. To measure which farmers are willing to participate in projects focused on nature restoration.

1.3 Main research questions

- What kind of farmers are in the Kouga River catchment and how do they use their land?
- How much water do the farmers use and from what sources?
- Is degradation of nature apparent in the Kouga River catchment and if so, are farmers willing to help restore it?

1.4 Methodology

The primary method of gaining new information was by interviewing farmers in the Kouga River catchment. Furthermore, a literature study was conducted to assess available information on the Kouga River catchment.

1.5 Report structure

Information on the organisations that were involved and on the study area can be found in Chapter 2 Background. Chapter 3 (Methodology) explains the used methods and approach to answering the research questions. Chapter 4 (Results) provides the results from the field work in South Africa. Chapter 5 (Discussion) puts the results in a critical light and discusses the results from this report with other literature. Finally, Chapter 6 (Conclusions and recommendations) presents the conclusions and recommendations from this research.

2 Background

2.1 Organisations

Living Lands/PRESENCE
Living Lands is a South African foundation initiated in 2008. They act as the secretariat and facilitator of the PRESENCE learning network. PRESENCE is a multi-stakeholder platform for catalysing capacity building initiatives, guiding transdisciplinary social-ecological research and supporting implementation (best management practices) aimed at restoring 'living landscapes' in South Africa.

With PRESENCE, Living Lands is committed to ensuring open and transparent communication and information flows between participating groups and to ensure that partnerships are not only mutually beneficial but work for the long-term future of the Eastern Cape Region.

One could see PRESENCE as the network that binds all the stakeholders and students that do their research for the network together, where Living Lands provide coordination and supervision for foreign students.

Working for Water
The fight against invasive alien plants is spearheaded by the Working for Water (WfW) programme, launched in 1995 and administered through the Department of Water Affairs and Forestry. This programme works in partnership with local communities, to whom it provides jobs, and also with government departments, research foundations and private companies.

WfW currently runs over 300 projects in all nine of South Africa's provinces. Scientists and field workers use a range of methods to control invasive alien plants. These include:

- Mechanical methods - felling, removing or burning invading alien plants.
- Chemical methods - using environmentally safe herbicides.
- Biological control - using species-specific insects and diseases from the alien plant's country of origin. To date 76 biocontrol agents have been released in South Africa against 40 weed species.
- Integrated control - combinations of the above three approaches. Often an integrated approach is required in order to prevent enormous impacts.

(Republic of South Africa Department of Water Affairs and Forestry, 2007)

The benefits of removing alien vegetation from selected areas and restoring indigenous vegetation there include increasing streamflow, increasing livestock carrying capacity, reducing fire hazard damage and preserving biodiversity. (Hosking, du Preez, 2004)

2.2 Project area

2.2.1 South Africa

South Africa is bordered by Namibia to the northwest, by Botswana and Zimbabwe to the north, and by Mozambique and Swaziland to the northeast and east. Lesotho, an independent country, is an enclave in the eastern part of the republic, entirely surrounded by South African territory. South Africa's coastlines border the Indian Ocean to the southeast and the Atlantic Ocean to the southwest. The country possesses two small subantarctic islands, Prince Edward and Marion, situated in the Indian Ocean about 1 900 km southeast of Cape Town.

The flows of all South African rivers are highly seasonal, and few offer a level-enough gradient and sufficient volume to allow navigation by even small craft for more than a few

miles from their mouths. With some exceptions, South Africa's soils are not characterized by high fertility, and those that are, (for example, in coastal KwaZulu-Natal) tend to be easily degraded.

Almost the entire country lies within the temperate zone, and extremes of heat and cold are rare. Its location next to a subtropical high-pressure belt of descending air produces stable atmospheric conditions over most of its surface area, and the climate generally is dry. (Encyclopædia Britannica, 2011)

Figure 1: Map of South Africa (Geology.com)

2.2.2 Area overview

The Kouga River catchment is part of the larger Gamtoos river system. The three rivers in the Gamtoos system are from north to south: the Groot River, the Baviaanskloof River and the Kouga River, which join in the region of the present Kouga Dam to form the Gamtoos River, known colloquially as "the roaring lion" due to its ferocious and unpredictable nature. The Gamtoos drains into the sea northeast of Jeffrey's Bay after passing through a long and winding floodplain south of the town Hankey.

The flow regime in the Gamtoos river system has been considerably altered due to extensive dam construction. The Beervlei dam (1957) and the Kouga Dam (1964) built at the confluence of the Kouga and the Baviaanskloof Rivers has altered the natural flow pattern, especially the flood regime. Only the Groot River delivers a freely flowing, albeit reduced,

volume of water to the Gamtoos system on a daily basis. (Department of Water Affairs and Forestry, 2008)

The Kouga Dam supplies irrigation water to the downstream agricultural lands and drinking water to the Nelson Mandela Bay Metropolitan Municipality (Port Elizabeth). It is foreseen that in the near future the already existing pressure on water resources will further increase. In combination with water shortages during dry periods, land degradation and extreme events, this will have further impacts on agriculture, domestic water users and ecosystems. (Jansen, H.C., 2008)

2.2.3 The Kouga River catchment

The Kouga River catchment is large (~110 km west to east, ~25 km from south to north) and varied both climatically and topographically. It starts in the Tsitsikamma Mountains; the range immediately adjacent to the sea, covers the Suuranys Mountains to the north and encompasses the Kouga Mountains that abut the Baviaanskloof. The Kouga catchment is adjacent (south) to the Baviaanskloof and shares a watershed in the Kouga Mountains. These east-west trending series of mountain ranges serve to reduce the amount of rain from south to north and from west to east.

In local vernacular the Kouga catchment comprises the Langkloof and the Bo- and Onder Kouga in the Kouga Mountains. In the west the catchment boundary is at 33° 23'S. In the east the boundary of the Langkloof is at Kromme Rivier Heights, and along the Suuranys watershed to the far east bordering the Diep river catchment. The proposed Baviaanskloof Mega Reserve falls across both catchments.

Catchment	Area of *Working for Water* control (ha)	Mean annual rainfall (mmy^{-1}) (MAP)	Mean annual runoff (mm) (MAR)	Fire fre-quency (years)	Fire cycle (years)	Post-fire age (years)	Indi-genous vegetation	Dominant exotic vegetation	Rate of spread ($\%y^{-1}$)
Kouga	158 678	547	255	8-15	12	1-12	Grassy fynbos	*Acacia* spp.; *Pinus* spp.; *Hakea* spp.	15

Figure 2: Information on the Kouga River catchment (Hosking, du Preez, 2004)

2.2.4 Settlements

From west to east, there are 9 settlements in the Kouga River catchment alongside the main access road to the area, the R62. These are:

- Haarlem
- Ongelegen
- Misgund
- Bruinklip
- Louterwater
- Krakeelrivier
- Joubertina
- Twee Riviere
- Heights

3 Methodology

To get answers for the research questions the approach of interviewing farmers was chosen, because that would provide the best practical information on the various topics from different sources. This way, the extensive knowledge a farmer has for his lands or geographical area could be accessed. It was also important to introduce the farmers to Living Lands and the PRESENCE network, as a first step towards creating new opportunities for cooperation.

However, the downside of choosing interviews as a main source of information is that the gathered information might not be as accurate as what is desirable. There is no sure way of checking or correcting this, but this internship was meant as exploratory research, so exact numbers are not required. Even so, an effort was made to get the most accurate information from the farmers as possible.

The formulation of the questionnaires was done in deliberation with Living Lands and taking into account another survey that was being performed in the adjacent Kromme River catchment. The questionnaire can be found in Appendix 8.2.

The selection of which farmers should be interviewed was done on two parameters:

1. The farmer's willingness to participate in an interview.
2. A selection of all farmers was made by Sam van der Merwe, Extension Officer from the Department of Agriculture in Joubertina.

The selection that Sam provided proved extremely helpful, since he knows the farmers in the area and whether they were busy with harvesting or not. Furthermore, he helped with getting a good sample of all types of farmers in the Kouga River catchment.

4 Results

4.1 Land use and farming practices in the Kouga River catchment

The biggest landowners in the Kouga River catchment are by far farmers who own private land for agricultural purposes. Second is government owned land, which is primarily for housing and future expansion of those areas. Then there are very small nature areas owned by smaller organisations and lands owned by stock farmers associations.

The farmers' main produce in the Kouga River catchment is fruit, specifically apples. This is especially true for the Langkloof part of the catchment, because of climate and geographical conditions. Other farmed fruits in the Kouga River catchment are pears and stone fruit. The term stone fruit is typically applied to fruit from *Prunus* trees. Peaches, nectarines, apricots and plums are farmed in the catchment from the *Prunus* genus.

Some farmers farm with livestock, but this is often not their main source of income. There are only two interviewed farmer that specialize in farming with livestock, all others specialize in fruit farming. Livestock is grazed in the areas where farmers cannot easily grow fruit trees (e.g. on slopes and mountainous areas).

All other produces that the interviewed farmers in the catchment farm are farmed on a relatively small scale. Only 23.6% of the total farmland is used for fruit and other produces. Other produces include grasses or lucerne for livestock fodder, potatoes and one farmer grows honeybush tea.

Certification requirements for GLOBALGAP, which stands for "Global Good Agricultural Practice," include limits on pesticide residue (how much is left on a fruit or vegetable after it's washed), a ban on nonessential animals around packing houses (including, to the annoyance of many farmers, dogs), and soil analyses to make sure farmers aren't using too much fertilizer. The standards increase shelf prices, contributing to global food inflation, but surveys and sales data show consumers will pay more for a promise of quality. (Source: http://www.globalgap.org/cms/front_content.php?idcat=44&idart=377)

All interviewed farmers use chemical fertilizer and chemical pesticides in accordance with GLOBALGAP requirements (see textbox on this page). These products are used as little as possible, not only because of GLOBALGAP requirements, but also to be as cost effective as possible. The optimal amount of fertilizer for fruit trees is calculated with soil and leaf samples and a specific programme is followed for the application of pesticides.

Pesticides are used preventively from the beginning of the growth season until 3 weeks before the harvest. For the South African growth seasons, see Appendix 8.1.

Generally farmers apply fertilizer around 3 times a year, starting from August before the growing season until just after harvest in March, although some fruits (e.g. Pink Lady apples) are harvested in early May.

All interviewed farmers are affiliated with a farmer's organisation and a local irrigation board, or at least have a scheme that details who can take water from the local water source at what time and for how long.

Table 1: Farmers' land use

Interviewee	Total land (ha)	Land farmed (ha)	Orchards (ha)	Fruit type	Livestock type	Livestock quantity
George Ferreira	430	50	0		cattle	n/a
Bremer Pauw	1 000	400	400	apples, pears	cattle, sheep	20 cattle, 100 sheep
William Johnston	603	53	30	apples, stone fruit	cattle	n/a
Hannes Stapelberg	1 400	200	200	apples		0
Cornelis Muller	1 400	195	195	apples, pears	cattle	n/a
Marius Vosloo, Johan van Dyk	2 300	168	168	apples, pears, stone fruit		0
Donald Strydom	580	180	180	stone fruit	sheep	n/a
Johan Kotze	800	800	800	apples	cattle	n/a
Tertius Kritzinger	700	150	7	pears	cattle, sheep, Boer goat	300 cattle, 1600 total
Jacobus de la Rey Rademeyer	200	160	160	apples, pears		0
Cornelius & Marius Strydom	2 200	200	200	apples, pears		0
Stefan Gerber	2 000	200	0		cattle, sheep	120 cattle, 220 sheep
Andries Stander	405	140	140	apples, pears, stone fruit	cattle	7
Bokkie Kritzinger	2 500	1 000	1 000	apples, pears, stone fruit	cattle	200
Totals	**16 518**	**3 896**	**3 480**			

4.2 Water analysis

4.2.1 Water sources

Boreholes

A borehole is a narrow shaft bored in to the ground to extract a resource from the earth, but only boreholes that are drilled to obtain groundwater are considered for this research. A borehole can be drilled hundreds of meters deep, but depths of much more than 180 meters to access groundwater are uncommon.

At the time of interviewing, eight farmers actively use boreholes. The farmers that do have boreholes do not always use them to irrigate their lands, but for example only to obtain water for household purposes or they may use them when there is a drought. Some farmers think boreholes are not a sustainable way of obtaining irrigation water, because they need to dig too deep to reach water, or because of the detrimental effect of boreholes on the groundwater table.

Generally speaking, boreholes contribute only a small amount to the total volume of water that is used for irrigation. One farmer has two boreholes, one of 15 m^3/hour and one of 30 m^3/hour, which he both uses for irrigation. There are a few other farmers that have boreholes as well, but all with a much lower capacity in the range of 0,5 m^3/hour to 1,25 m^3/hour.

Table 2: Borehole use of all interviewed farmers

Borehole use	Number of farmers
Domestic	5
Irrigation	3
Currently not in use	2
No boreholes	4

Tributary rivers to the Kouga River

There are various tributary rivers to the Kouga River from where farmers usually pump directly to their farm dams, especially in dry years if the farm dams do not fill up from precipitation. Tributary rivers to the Kouga River are used by farmers as a primary source for irrigation water. They may use small farm dams or weirs to collect the water, after which they can pump it to their fruit trees. It is illegal to use water from the Kouga River itself for irrigation. (pers. com. Velile Koyo, Project Manager of the Kouga area for Working for Water, see Appendix 8.3: Interview with Working for Water)

Farm dams

Farm dams are dams on the farmer's land that the farmer has built himself. They can be fed from surface runoff water directly (rainwater harvesting), or like mentioned above, can store water that is pumped from a river.

Every farmer has farm dams. They are not allowed by law to increase the storage capacity, because the water from the catchment flows to the Kouga Dam, where it is stored for the water stressed Nelson Mandela Bay Metropolitan area (Port Elizabeth). Therefore, the South African government is not willing to let landowners limit the potential flow of water available Port Elizabeth further. On the other hand, the farmers say that a lot of the water they cannot use goes to waste, because the Kouga Dam is not big enough to contain it all during floods.

On average, between the interviewed farmers, a farmer has 18 farm dams with an average capacity of 812 700 m^3. It should be noted that there is a very large discrepancy between the various farms, for example there is a farm with 3 and another with 54 farm dams. Total farm dam volumes vary a lot as well, with a range from 25 200 m^3 to 3 500 000 m^3.

4.2.2 Water uses

Irrigation

Irrigation water usually comes from farm dams or from a tributary river. The farmers that do have boreholes may not use them at all for irrigation, or only at times when there is not enough surface water available to them (for example when there is a drought).

Almost all farmers use exclusively localized irrigation for their orchards (see Table 3). Localized irrigation means that every tree is irrigated with low pressure from a separate point. The methods used by farmers in the catchment for localized irrigation are micro-sprinkler and drip irrigation. Another way of irrigation used in the Kouga River catchment is sprinkler or overhead irrigation. This makes use of larger sprinklers, which require higher pressure and can irrigate multiple trees from a single point. Only one farmer does not irrigate the whole surface area of his orchards and he is the only one to use overhead irrigation.

Generally farmers irrigate their orchards for half a year during the fruit growth season, depending on which fruit and variety they exactly grow. In South Africa, apples and pears grow from December till early May and stone fruit from October till February. See also Appendix 8.1.

Table 5 shows that the total volume used by all the interviewed farmers for orchard irrigation (20 154 417 m^3/year) is by far the biggest factor to their estimated total water use

(20 183 347 m^3/year). In fact, the volume of water used for orchard irrigation is 99,86% of the total water use of all farmers.

Table 3: Irrigation types

Interviewee	drip (ha)	micro sprinkler (ha)	high pressure sprinkler (ha)
George Ferreira	0	0	0
Bremer Pauw	n/a	n/a	n/a
William Johnston	30	23	0
Hannes Stapelberg	100	100	0
Cornelis Muller	97	98	0
Marius Vosloo, Johan van Dyk	0	168	0
Donald Strydom	2	178	0
Johan Kotze	120	700	0
Tertius Kritzinger	7	100	0
Jacobus de la Rey Rademeyer	0	160	0
Cornelius & Marius Strydom	0	200	0
Stefan Gerber	0	30	0
Andries Stander	0	86	4
Bokkie Kritzinger	125	125	0
Totals	**481**	**1 968**	**4**

Table 4: Annual irrigation volumes per hectare

Interviewee	orchard irrigation (m^3/ha/year)				
	average	dry year	wet year	apples/pears	stone fruit
George Ferreira	0				
Bremer Pauw	5 000			5 000	
William Johnston	n/a			n/a	n/a
Hannes Stapelberg	5 500	6 500	4 500	5 500	
Cornelis Muller	n/a			n/a	
Marius Vosloo, Johan van Dyk	6 000			6 000	6 000
Donald Strydom	5 300	6 600	4 000		5 300
Johan Kotze	6 250	7 000	5 500	6 250	
Tertius Kritzinger	n/a			n/a	
Jacobus de la Rey Rademeyer	5 000			5 000	
Cornelius & Marius Strydom	6 250			6 250	
Stefan Gerber	0				
Andries Stander	3 600			4 150	2 200
Bokkie Kritzinger	6 250			7 000	5 500
Averages	**5 461**	**6 700**	**4 667**	**5 644**	**4 750**

Note: 0 in this table means that there was 0 irrigation, n/a means that the figures were not available but the farmer did irrigate, an empty cell means either not applicable (e.g. because the farmer does not farm that type of fruit) or not available (e.g. because the farmer did not specify the irrigated volume difference between dry and wet years).

Table 5: Total annual water use per farmer

Interviewee	Orchards (ha)	Average orchard irrigation (m^3/ha/year)	Total water use for orchards (m^3/year)	Livestock quantity & type	Total water for livestock (m^3/year)	Total water use (m^3/year)
George Ferreira	0	0	0	cattle	n/a	n/a
Bremer Pauw	400	5 000	2 000 000	20 cattle, 100 sheep	913	2 000 913
William Johnston*	30	5 283	158 500	cattle	n/a	158 500
Hannes Stapelberg	200	5 500	1 100 000	0	0	1 100 000
Cornelis Muller*	195	5 600	1 092 000	n/a	n/a	1 092 000
Marius Vosloo, Johan van Dyk	168	6 000	1 008 000	0	0	1 008 000
Donald Strydom	180	5 300	954 000	sheep	n/a	954 000
Johan Kotze	800	6 250	5 000 000	cattle	n/a	5 000 000
Tertius Kritzinger*	7	5 417	37 917	300 cattle, 1300 sheep/goat	13 615	51 531
Jacobus de la Rey Rademeyer	160	5 000	800 000	0	0	800 000
Cornelius & Marius Strydom	200	6 250	1 250 000	0	0	1 250 000
Stefan Gerber	0	0	0	120 cattle, 220 sheep	5 336	5 336
Andries Stander	140	3 600	504 000	7 cattle	307	504 307
Bokkie Kritzinger	1 000	6 250	6 250 000	200 cattle	8 760	6 258 760
Totals	**3 480**		**20 154 417**		**28 930**	**20 183 347**

* For these farmers average orchard irrigation is calculated with averages from at least three other farmers who farm the same types of fruit.

Livestock
The quantity of water that is used for livestock is for most farmers negligible compared to irrigation water, because they only have a relatively small number of livestock (or none at all). Oftentimes, drinking water is not monitored as well as irrigation water. Because of this, when in Table 5 the figure for "Total water for livestock" is not available (n/a), it signals that the quantity is insignificant compared to other water uses according to the farmer. Furthermore, it is also possible that the farmer does not monitor the water used by his livestock.

According to the interviewed farmer that has the most livestock (Tertius Kritzinger), his cattle require 120 litres and his sheep and Boer goat 1 litre of water per day per animal. He has 300 cattle and 1300 sheep and Boer goats, so the annual volume of water required for cattle is 13 140 m^3/year and for sheep and Boer goat 475 m^3/year, which in total is 13 615 m^3/year.

This figure pales in comparison to the 6 250 000 m^3/year that the biggest fruit farmer (Bokkie Kritzinger) uses for irrigation water, in fact, it is only 0,2% of the volume that Bokkie uses. The calculation for how much water Tertius' livestock requires is applied to all other farmers with known numbers of livestock.

Domestic use
The amount of water used for domestic use is insignificant opposed to the amounts used for irrigation, probably even more so than water used for livestock. The primary sources of water for domestic use are boreholes. This is mostly due to the fact that boreholes produce relatively clean water, at any time of the year. In Krakeelrivier, farmers provide drinking water for the local community as well.

4.3 Alien invasive species

Every interviewed farmer indicates that there is a problem in the Kouga River catchment concerning alien invasive species. Fruit trees are not taken into consideration, even though they are alien species to the area, because they are not invasive and limited to only the farmers' orchards.

Some farmers are able to control the plants that cause problems on their land, for example by spraying them with herbicides, cutting the trees, or using heavy machinery to clear areas. Working for Water (WfW) supplies the farmers with poison to use as herbicide against the targeted alien invasive species, but some farmers indicate that a more intensive cooperation with WfW is desired, to improve effectiveness on at least keeping the aliens under control.

The problems that the alien invasive species cause are:

1. They use much more water than indigenous species (as much as 200 l/day for a big Black Wattle tree).
2. They take over land from indigenous vegetation and therefore can cause a problem when a farmer wants to expand his orchards or his crop or grazing fields.
3. Alien invasive species, especially Black Wattle, can inhibit the flow of water in streams. This is also a problem when the trees are cut, but not removed or chipped. An additional problem is that the blockages can cause flooding when they suddenly break.

On the other hand, some farmers express mixed feelings about alien invasive species, because they and the local communities use the trees for things as firewood and building material. Another inventive example to make use of alien invasive species is a farmer that uses Black Wattle trees as mulch for his orchards to lower evaporation.

Black Wattle (*Acacia mearnsii*) is, according to the farmers, the species that causes the biggest problems and is most abundant. Second is the *Hakea* genus (with *H. drupacea, H. gibbosa* and *H. sericea*), especially in areas that are more mountainous than the Black Wattle habitat, third is the *Populus* genus and fourth are various pine species (genus: *Pinus*), again especially in mountainous areas.

Other alien invasive species that are targeted by WfW but were not named in the interviews are: Port Jackson willow (*Acacia saligna*) and Rooikrans (*Acacia cyclops*).

4.4 Current state of nature

To get an impression of the current state of nature in the catchment and the farmers' impact on this, questions were asked whether farmers saw any degradation on their lands from their activities or otherwise. The orchards were not taken in consideration, because they were purposefully created and farmers control the soil in orchards very carefully.

There were only four farmers that stated they have some degraded lands on their farm. This is primarily because many farmers only have livestock in small quantities and for personal use only. Therefore, there are little signs of overgrazing in the catchment, which is an important factor for the degradation of land.

Comparatively, alien invasive species and floods or droughts cause much bigger problems for the farmers, especially financially. For example, lower fruit yields because of droughts, repairing broken farm dams because floods, or clearing alien invasive species from their farm lands.

4.5 Farmers' willingness to restore nature

The farmers use only a small portion of their total land for (intensive) agriculture (see 4.1). Currently, many of them do not have enough water to cultivate a bigger area of their land, or the terrain does not permit it. Therefore, most of the farmers are open to ideas and initiatives for nature conservation, because they cannot use the land for their own purposes in any case.

The farmers do have some concerns though, for example they expect payment or compensation if they are prohibited from using parts of their own land for their own purposes (e.g. livestock grazing). Another issue is keeping wildlife in and livestock out of a nature reserve. Currently, wildlife forages on the same lands that livestock does, but when an area becomes a designated nature reserve, it should be fenced off.

When there is an overarching idea or nature project in which the farmers are asked to participate, they are more likely to join than when asked to establish a lone nature reserve on their land. This is because a big nature reserve could boost tourism to the area, and because of this the farmers might make revenue in the tourist business. They also acknowledge the increased benefits for nature that a comprehensive project can have over separate smaller nature areas.

4.6 Issues raised by farmers in the catchment

During the course of the interviews farmers raised various issues that are important to mention in order to understand farmers' disposition towards various subjects. Some topics may have been mentioned before, but are included in this list to get a complete overview.

- Some farmers feel that their interests are not represented strong enough in the current South African government. Some feel that their voices are not being heard, although most farmers are very willing to share (local) knowledge, information and best practices for the benefit of all, for example on how to best tackle alien invasive species.

> *"The biggest problem with us nowadays is: our voice doesn't get heard a lot on national level. Nobody from South Africa has ever come to my farm and asked me the questions you have. They will never."*
> Farmer in the Kouga River catchment during an interview

- Farmers are prohibited of expanding their farm dams and thus how much water they can store and use for irrigation. This stresses the farmers in a way that they are not able to expand their business or struggle to obtain enough irrigation water, especially during droughts.
- Water for Port Elizabeth at the Kouga Dam that is lost when there is heavy precipitation for prolonged periods or a flood. The government should build a second dam to contain that water for the water stressed Nelson Mandela Bay Municipality, or allow farmers to use the water.
- Transport all water from the current Kouga Dam in pipelines and revise old existing pipelines, because according to the farmers there is a lot of water lost during transport.
- The need to address the alien invasive species problem on a bigger scale, with more resources and with better cooperation between all involved stakeholders (e.g. farmers, Working for Water, government, etc.).
- Erratic weather, floods, droughts and hail are climate related problems that the farmers have mentioned.
    - Floods used to occur roughly every 10 years, but the area experienced floods in 2006 and in 2007.

5 Discussion

5.1 Discussion of literature

Spillages of the Kouga Dam
On average 90 to 100 million m^3 of water flows annually over the surplus weir, with a peak spillage of 844 million m^3 in 1980/1981. This is more than the average volume of water that is released (in a controlled way) to the irrigation canal, which amounts to 70-75 million m^3 per year. (Jansen, H.C., 2008)

These figures support the comments made by farmers on that the South African government should first focus on containing the spillage water, instead of restricting the farmers in their ability to catch more rainwater with farm dams and other means.

5.2 Discussion of methodology and outcomes

5.2.1 Number of interviews

Because of some difficulties during the earlier stages of the project, not all active farmers in the Kouga River catchment have been interviewed. Therefore the choice was made to try to obtain the best sampling of farmers as possible, by interviewing farmers throughout the Kouga River catchment and by interviewing farmers with varying types of produce and livestock. Also Sam van der Merwe, Extension Officer from the Department of Agriculture in Joubertina, has been consulted on which farmers were most important to interview for a good sampling.

It is also worth mentioning that during the last few interviews it was almost possible to predict the farmer's answers to certain questions. Of course, this does not translate well into a parameter with which it is possible to measure how comprehensive the sampling has been, but it might be used as an indication. Furthermore, it shows how certain subjects transcend the level of a single farm and are present in a whole catchment.

5.2.2 Accuracy of gathered information

It is unknown exactly what information acquired from the interviews relies heavily on estimations, or what information is obtained as an exact number. Because the interviews were conducted in a relatively informal setting, the impression is raised that most information is based on farmers' estimates.

This is not necessarily a problem, since the goal of this research is to create more of an overview of land and water use rather than an in-depth view of a specific subject, although effort was made to obtain information that was as accurate as possible.

5.2.3 Length of interviews

While conducting an interview, it is only possible to ask a certain number of questions, because the farmers are generally very busy. Therefore the interview should not take too long. It is very important to estimate or get a feeling for how much time the interviewer can take with a specific interviewee, because this can vary greatly. Therefore, it might not be possible in every interview to ask all questions that might be relevant for the research, especially since this research is relatively broad and encompasses various subjects.

5.2.4 Calculation water use

The water requirements for other produce (e.g. honeybush, potatoes) and domestic use are difficult to calculate, because not enough information was obtained from the interviews on this subject. Therefore, the total water use off all interviewed farmers will likely be higher than what is calculated now, although every farmer has stated that the volume of water for

other produce and household use is insignificant compared to what they use for orchard irrigation and livestock. This means that the increase from calculated total water use to the real water use of all farmers should be insignificant as well.

6 Conclusions and recommendations

6.1 Conclusions

Here the conclusions of this research are presented, ordered by topic.

6.1.1 General land use in the Kouga River catchment

- Almost all the farmers own family lands that have been in the possession of the family for a few generations.
- Total farmland per farm varies greatly.
- Less than 25% of the total land a farmer owns is being used for crops.
- Main produce is fruit, primarily apples and other deciduous fruit.
- Some livestock is farmed in the area, but usually with relatively small numbers and not for commercial purposes.
- Other produce, for example vegetables or tea, are not commonly farmed.
- The farmers use chemical fertilizer and pesticides in line with GLOBALGAP standards.
- All farmers are members of the farmers' organisation and a local irrigation board.

6.1.2 Water/irrigation

- Average irrigation water use is 5461 m^3/ha/year.
- Nearly all orchard surface areas are irrigated primarily with micro sprinklers and to a lesser extent with drip irrigation.
- Farm dams are the main source of irrigation water.
- Tributary rivers to the Kouga River are used as an alternative to precipitation to fill the farm dams.
- Boreholes are only used to obtain water for household purposes or in times of drought.
- Farm dams are used extensively but are limited by the government.

6.1.3 Alien Invasive Species

- Alien invasive species (AIS) are an issue according to all interviewed farmers.
- Some farmers are able to control the problem causing AIS.
- Herbicide against the AIS is supplied by Working for Water.
- AIS use much more water than indigenous species.
- They form a competitor for the orchards or crops.
- The problems that the alien invasive species cause are:
    - They use much more water than indigenous species.
    - It is harder to expand crops and orchards over AIS than over the indigenous vegetation.
    - Some AIS inhibit flow of water in streams.

6.1.4 Current state of nature and farmers' attitude towards restoration.

- Overgrazing is generally not a problem due to low numbers of livestock.
- Some nature conservation issues exist due to AIS.
- Low usage possibilities of land make farmers admissible to initiatives for nature conservation.

6.2 Recommendations

In this chapter the recommendations and opportunities for Living Lands/PRESENCE that were found during this research are described.

Research opportunities

- To get a complete picture of all farmers in the Kouga River catchment, the farmers that were not interviewed could be approached as well, so there is no need to extrapolate any figures.
- Research measures needed (and the feasibility of those measures) to catch all the water from the Kouga River catchment. The demand on the catchment will only increase in the future from the Nelson Mandela Bay Municipality (Department of Environmental Affairs and Tourism, 1999), but also from citizens in the catchment itself. To add to that there are water stressed farmers in the catchment who, especially during dry years, struggle to obtain enough irrigation water. Furthermore, being prohibited of expanding their farm dams to catch and store more rainwater was consistently named in the interviews as one of the major problems farmers have to deal with.

Projects that could be executed/general advise

- More intensive cooperation between primarily Working for Water and the farmers would have a positive effect on the fight against alien invasive species.

7 Literature

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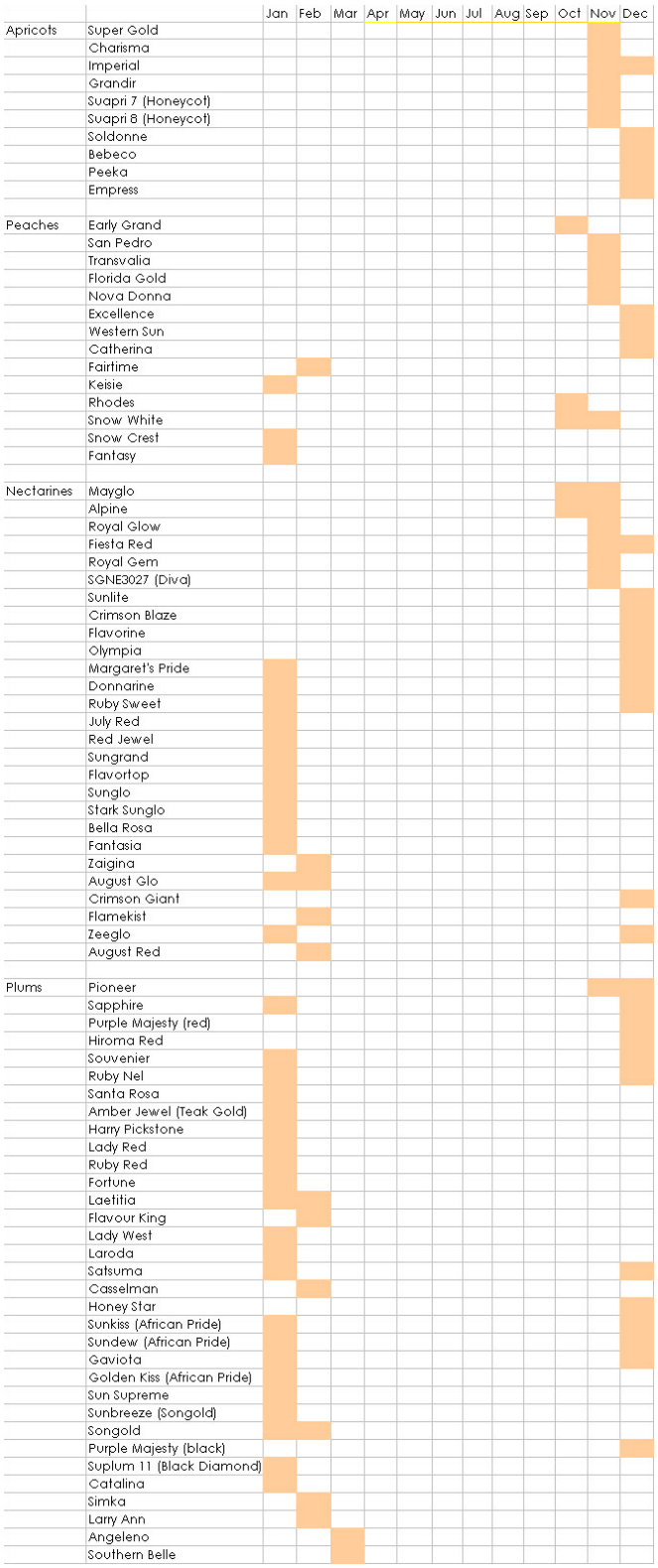
8 Appendix

8.1 South African growth seasons



		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Apricots	Super Gold												
	Charisma												
	Imperial												
	Grandir												
	Suapri 7 (Honeycot)												
	Suapri 8 (Honeycot)												
	Soldonne												
	Bebeco												
	Peeka												
	Empress												
Peaches	Early Grand												
	San Pedro												
	Transvalia												
	Florida Gold												
	Nova Donna												
	Excellence												
	Western Sun												
	Catherina												
	Fairtime												
	Keisie												
	Rhodes												
	Snow White												
	Snow Crest												
	Fantasy												
Nectarines	Mayglo												
	Alpine												
	Royal Glow												
	Fiesta Red												
	Royal Gem												
	SGNE3027 (Diva)												
	Sunlite												
	Crimson Blaze												
	Flavorine												
	Olympia												
	Margaret's Pride												
	Donnarine												
	Ruby Sweet												
	July Red												
	Red Jewel												
	Sungrand												
	Flavortop												
	Sunglo												
	Stark Sunglo												
	Bella Rosa												
	Fantasia												
	Zaigina												
	August Glo												
	Crimson Giant												
	Flamekist												
	Zeeglo												
	August Red												
Plums	Pioneer												
	Sapphire												
	Purple Majesty (red)												
	Hiroma Red												
	Souvenier												
	Ruby Nel												
	Santa Rosa												
	Amber Jewel (Teak Gold)												
	Harry Pickstone												
	Lady Red												
	Ruby Red												
	Fortune												
	Laetitia												
	Flavour King												
	Lady West												
	Laroda												
	Satsuma												
	Casselman												
	Honey Star												
	Sunkiss (African Pride)												
	Sundew (African Pride)												
	Gaviota												
	Golden Kiss (African Pride)												
	Sun Supreme												
	Sunbreeze (Songold)												
	Songold												
	Purple Majesty (black)												
	Suplum 11 (Black Diamond)												
	Catalina												
	Simka												
	Larry Ann												
	Angeleno												
	Southern Belle												

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Apples	Granny Smith												
	Golden Delicious												
	Braeburn												
	Royal Gala												
	Cripps Red												
	Cripps Pink												
	Fuji												
	Elegant												
	Starking												
	Royal Beaut												
	Starkrimson												
Pears	Rosemarie												
	Flamingo												
	Forelle												
	Abate Fetel												
	Beurre Bosc												
	Beurre Hardy												
	Conference												
	Concorde												
	Golden Russet Bosc												
	Williams Bon Cretien												
	Doyenne du Comice												
	Packham Triumph												
	Vermont Beauty												
	Sempre												
	Red Williams Bon Cretien												
	Red D'anjou												

Source: South African Fruit Farms, 2007

8.2 Questionnaire

Kouga River Catchment interview

Date: _____

Name interviewee & function: _____

Farm name: _____

Address:

E-mail address: _____

Telephone number: _____

Section 1: Introduction of Damian and Living Lands/PRESENCE

- Living Lands is a South African foundation based at the Kouga Dam.
- Secretariat and facilitator of the PRESENCE learning network.
- PRESENCE is a platform with various stakeholders who do research on social and ecological subjects.
- PRESENCE is supporting implementation aimed at restoring 'living landscapes' in South Africa.
- Living Lands and PRESENCE have been working for 4 years in the Baviaanskloof. Now looking for opportunities in Kouga River catchment.

- Damian is a Dutch student.
- Internship in South Africa for study Bachelor of Water Management.
- Research on land and water use and alien invasive species in the Kouga River catchment for the PRESENCE learning network.
- Asking organizations, farmers and other landowners questions to gather information on the area.

Section 2: Questions

1. Farm questions

1. How long have you (and perhaps your family) been farming in the Kouga River Catchment?
2. How many hectares is your farm?
3. What proportions are cultivated arable or uncultivated arable or unused?
4. What do you farm? (Fruit trees, livestock, etc.?) What are you producing?

2. Irrigation/water-use

1. Do you have any irrigation?
2. If yes, what type of irrigation system do you use and how many hectares do you irrigate?
3. Do you know how much water you use annually for irrigation and how much for livestock?

4. Where do you get this water? Boreholes/runoff/directly pumped from river/side tributaries, etc.?
5. Do you have any farm dams? How many and how big?
6. What is the biggest water related problem in this catchment? What is the cause of this?
7. Is water for irrigation purposes a constraint on your choice of crops or yield/ha with current crops?

3. Farming Practices

1. What fertilizers do you use?
2. How much and when do you apply it?
3. What pesticides/herbicides do you use?
4. How much and when do you apply it?

4. Financial & institutional

1. Is farming your main source of income/revenue?
2. If you had an additional hectare of arable land, but no extra water, how would you use it?
3. If you had the water to irrigate the extra hectare of arable land, how would you use it?
4. How many labourers work for you? How many are permanent/temporary?
5. What are your major capital costs/largest expenses?
6. What are your costs per hectare of production of;
    a. Crops
    b. Livestock, if any
7. What are the major problems you face as a farmer in this area? How have these changed over the years?
8. Are you in a farmer's organization or local water board?
9. If not, how would you feel about being in one of these kind of organizations?

5. Working for Water and alien invasive species

1. Do you have alien invasive species on your lands?
2. If yes, what are the alien invasive species that need most urgent attention on your lands?
3. What problems do these species cause?
4. Have you worked with WfW?
5. What do you think of WfW and their requirements from you?
6. Are you prepared to allow aliens cleared on your land, if it will increase the water flow for your neighbours downstream?
7. Do the wetlands provide you with any benefits? Have you noticed any effect on the river with and without wetlands/peatlands?
8. If you were managing PE's water board, would you try and get more water out of the Kouga? Or would you look elsewhere?

6. Restoration

1. Do you have lands that are degraded? (grazing pastures with severely lowered vegetation cover, increased erosion, less profitable fields to farm)
2. If yes, would you be interested in a project on your lands that restore degraded areas that have specific value for nature?

8.3 Interview with Working for Water

Interview with Velile Koyo from Gamtoos Irrigation Board/Working for Water

Function: Project Manager of the Kouga area for Working for Water
Date and location: 8 March 2011, Working for Water office, Joubertina

1. Introductions

Damian is a Dutch student who works on his internship in South Africa for his study Water Management in the Netherlands. Damian is doing research on land and water use and alien invasive species in the Kouga River catchment for the PRESENCE learning network.

Living Lands is a South African foundation (Section 21 NPO) initiated and set-up by EarthCollective professional members in 2008. Living Lands acts as the secretariat and facilitator of the PRESENCE learning network. PRESENCE is a multi-stakeholder platform for catalysing capacity building initiatives, guiding transdisciplinary social-ecological research and supporting implementation (best management practices) aimed at restoring 'living landscapes' in South Africa.

Working for Water is implemented by the Gamtoos Irrigation Board in the regions of the Kouga, Kromme en Baviaanskloof rivers and in the Grahamstown area. The programme was launched in 1995 and is administered through the Department of Water Affairs and Forestry. This programme works in partnership with local communities, to whom it provides jobs, and also with government departments including the Departments of Environmental Affairs and Tourism, Agriculture, and Trade and Industry, provincial departments of agriculture, conservation and environment, research foundations and private companies.

2. What is the biggest source of water in the Kouga River catchment?

- The Kouga River itself.
- The municipality provides filtered water to residents.
- Private owners, mostly farmers, extract groundwater for household purposes and for livestock drinking water.
- Water that is collected in smaller dams in the area is used for other purposes, such as irrigation.

3. What are the biggest and most urgent water related problems in the area?

The Kouga River catchment is a water scarce area. Working for Water is removing alien invasive species because they consume much more water than indigenous species do. Alien controlled species, like some fruit trees are causing no problems. The alien species that are of most concern in the Kouga area are:

- Black wattle
- Hakea
- Populus species
- Pine, various species
- Port Jackson willow (*Acacia saligna*)
- Rooikrans

All these alien species have a great effect on the groundwater table, because all are using more water than indigenous species. This is supported with reports of much more water in the rivers after the clearing of the alien species. This water can then be used by farmers and eventually flows to the Kouga Dam.

It is difficult to eradicate alien invasive species completely, because their seedlings spread very quickly to different areas.

4. What are the biggest landowners in the area?

- By far farmers who own private land for agricultural purposes.
- Government owned land, primarily for housing and future expansion of those areas.
- Very small nature lands owned by smaller organisations.
- Lands owned by stock farmers association.

5. What kind of fruit trees or livestock is primarily present in the area?

- For the fruit trees primarily apples, pears, apricot, plums and peaches.
- For livestock primarily cattle, sheep and goats.

All bigger farmers have fruit trees, but they do not all have livestock. Livestock is grazed on the patches of land where they cannot easily grow fruit trees (like on slopes).

6. Where do farmers get their water from?

Tributary rivers to the Kouga River are used by farmers as a primary source for irrigation water. They may use small dams or weirs to collect the water, after which they can pump it to their fruit trees. It is illegal to use water from the Kouga River itself for irrigation.
Groundwater is pumped up at a few boreholes by farmers, which are primarily used after rainfall has been low for a longer period.

7. What problems do alien invasive species cause in the area and which species are causing most problems?

Other than the effect the alien invasive plants have on the water table the alien species are prone to catch fire and create veldfires. If a veldfire happens, Working for Water does a follow up with chemicals to supress alien invasive plants that otherwise would start growing again in the same place.

Farmers invite Working for Water to work on their land to clear the alien invasive species, but Working for Water also actively searches for areas where alien invasive species grow that need to be cleared. The method they use in the Kouga River catchment is to work from upstream to downstream areas in cycles. This translates to working from west to east in this catchment and to start in the west again after a cycle is completed. This is done because the alien invasive species spread more easily to downstream areas. The first cycle consists of clearing big trees in an initial clearing. Thereafter smaller trees can be slashed or cut down and lastly herbicides can be used to treat even smaller plants.

The alien invasive species that are of highest concern are listed below question 3.

8. What programs against alien invasive species are being executed?

- As of 8 March 2011 Working for Water is clearing alien invasive species in Ongelegen. This is part of the continuing effort of clearing alien invasive species in the catchment. Methods used in this process are:
  - Herbicides against smaller plants.
  - Slashing and cutting bigger plants, like small trees.
- Purposefully burning of alien invasive species is never used in this area by Working for Water, although landowners can apply for a permit to burn alien invasive species after clearing has been performed on their land.
- Alien invasive species are used as material for creating fences.

9. Is there any other research on land and water use in this area that may be beneficial to this research?

If Velile comes across useful information, he will bring it to Damian's attention via e-mail.

10. Closure and exchange of contact information.

8.4 Interview with George Ferreira

23-03-2011

The farmer says that there should be more projects like WfW that improve the efficiency of water use in the area. For example, a lot of water is lost in the area by furrows that are not sealed, or, due to a lack of maintenance, are degraded and leaking. Plants also play a part in this, because their roots can grow in the furrows and block water flow and use the water themselves. Furthermore the sun evaporates water as well. This creates a situation where far less than 50% of the water that flows in a furrow comes through to the farmer.

The farmer recently changed produce from apple trees towards honeybush.

Not farming as big an area as he used to in the past.

Natural vegetation does not regrow on old farm lands because the soil is damaged by chemicals like fertilizer and pesticides, but also by physical damage like ploughing.

It is too warm on this farm for fruit trees.

Biggest water problem: flooding and drought. The furrow to the farm dries up very quickly. Floods used to occur every 10 years, but the area experienced floods in 2006 and in 2007, but no floods since then. Flooding can occur throughout the year.

Burning regime for Fynbos should not be extended from 7 to 11 years to 17 years, because it will hold back huge amounts of water when it grows big. Furthermore, when the Fynbos eventually burns, the fire will be much bigger and hotter.

Tourism is will play an important role in the future for this farmer. (Hiking, mountainbiking, etc.)

8.5 Interview with Bremer Pauw

23-03-2011

Not viable to have livestock on the area of the farm that is not used for fruit farming.

When there's enough precipitation in a year, the farm dams will fill up with the run-off, but in a dry year, the farmer pumps water from the Tweerivier, a tributary to the Kouga River, in his farm dams, to store it for when it's needed.

Generally, once every ten years there is a flood. During a flood a problem is that the farm dams can break.

8.6 Interview with William Johnston

6 April 2011

Land use
The farm has been in Haarlem for five generations, since 1860. Currently William is farming apples, plums, apricots, peaches and cattle on a total of 603 hectares of land. Of this land he has planted 30 hectares of fruit trees, 3 hectares of vegetables (which is a programme in connection with the Department of Agriculture for the farmer's workers and currently grows potatoes), 20 hectares of lucerne (alfalfa) as cattle fodder and around 250 hectares are Fynbos.

The rest are old wheat lands that are planted with natural occurring grasses and areas with natural vegetation. The grasses are planted because in the future William wants to farm more livestock, but the natural vegetation does not have much carrying capacity.

A few decades ago the farm had around a thousand sheep, but because of theft it was not viable to keep farming them. The last year they farmed sheep, 180 sheep were stolen, at the price of 1000 rand per sheep.

Water & Irrigation
Fruit trees get irrigated once a week, depending on the weather. Plums, apricots and peaches are drip irrigated and get water daily. Drip irrigation is used, because it uses a lot less water than micro irrigation. The potatoes are irrigated four or five times a year with sprinklers. Lucerne is irrigated only two or three times a year, but only after some rainfall so the roots of the plant grow lower than when it would be irrigate regularly. This also means that the lucerne can access water for longer periods when there is no rainfall.

There are no boreholes on this farm, because the farmer thinks it is not sustainable to use them, partially because in this area the groundwater table is at a depth of 100 or even 180 meters. Some farmers in the Haarlem area have decided together not to use boreholes. There are 4 natural springs on this farm and the effect of a borehole that was drilled 20 km away by another farmer was immediately visible on the natural springs on his lands by means of a lower flow rate. This is an important problem for the farmer, because there is no law preventing other farmers from drilling boreholes.

According to the farmer the only sustainable way of obtaining irrigation water on his farm is with farm dams (he has 10 farm dams), together with a communal dam that some farmers built together, funded by themselves. There is a permanent inflow of rainwater to this dam and this dam supplies a base flow for the river downstream, which improves the habitat for a small carp fish species. Before the dam was constructed, the river only carried water for 10 months of a year, but now it is a perennial river.

The communal dam catches water from a surface area of 2000 to 5000 hectares and supplies every farmer via a pipeline.

The farmers are not allowed to burn their fields anymore, which increases vegetation on those fields and the hazard of big fires. Furthermore, runoff from those fields is lower as well, because the vegetation now checks more water, so the farm dams do not fill up anymore.

For Global GAP (Good Agricultural Practices) surface water has been tested before and after the farm to prove that the farm has a low impact on water quality. The mineral content of water is a problem to farmers lower in the watershed, but not on this farm.

If there is a shortage of water, the farmer will focus his irrigation on the fruit trees and stops producing the lucerne and vegetables. Only when there is extra water available will the farmer invest in vegetables and lucerne again. This way of farming (instead of investing in more fruit trees) provides the farmer with some flexibility how to use resources.

Buffering water with dams is important, because rains are not reliable and can occur throughout the year. There is no specific month where it rains a lot, it could rain in any season.

To get more water for Port Elizabeth and the Nelson Mandela Bay Municipality out of the Kouga River catchment the farmer says it would be a good idea to build more large dams, because there is still water that flows to the sea that is left unchecked. Water should be put in a pipeline for transport to minimise losses.

Fertilizer and pesticides
The farmer used to farm organic, without using chemical fertilizer, but because of the financial crisis he is forced to start using chemical fertilizer again. He does not like to use chemicals, but because of the crisis using organic manure was too expensive. Still, because the chemicals are expensive as well, he only uses the minimal amount and says that no farmers in South Africa will waste fertilizer anymore.

Soil analyses are performed to determine how much fertilizer should be applied.

Pesticides and herbicides are used for the fruit trees and for the vegetables, but in exact amounts and are only applied when deemed necessary after analysing the situation. Previously, before Euro/Global GAP was established, the farmers used to spray herbicides that prevented weeds from developing. Now they only spray light burning chemicals (called chemical frost) that destroy only the weeds or grasses that have developed already.

To give an indication, the farmer used the chemical frost herbicides once this year, but had not sprayed for 7 years before that. Ten years ago, the farmers used to spray hundreds of litres of those chemicals, but this year the farmer only sprayed 20 litres on 600 hectares of land.

Finances
The farmer has 12 permanent workers and 11 seasonal workers, but he tries to provide work on his farm (by growing vegetables) or other farms for the seasonal workers the whole year round.

Current government legislation does not provide any way for the farmers to expand their business, for example by allowing them to build more farm dams. Furthermore, it is hard for the farmers to compete nationally against the subsidised and freely imported crops of European farmers, but also because they have to pay to export to Europe. The European Union has these export rules in place together with the subsidies to protect and stimulate its own farmers, but the South African government does not stimulate or protect its farmers in the same way.

The way the European Union helps its farmers also applies for other western countries. Even though farming (and especially fruit farming in the Langkloof) is a very large industry in South Africa, the government is not willing to stimulate this.

The farmer is a member of the local water board for the communal dam and of the farmers' organisation. The water board also supplies the residents of Haarlem with drinking water. The water board is supposed to change to a water users association, but this is taking very long to accomplish because of bureaucracy.

Alien invasive species (AIS)
On this farm Black Wattle is kept under control by the farmer, so it does not manifest itself as the biggest alien invasive species. Populus is a bigger problem, because there is no effective poison to kill it with. There are Hakea and various alien invasive shrubs on the farm as well.

Working for Water (WfW) came a few years ago to cut down the big alien invasive trees, but there has been no effective follow up or management plan, because now the farmer has even more but smaller alien invasive trees on his farm.

There is frustration towards WfW, because the farmer is willing to work with the programme to supply the personnel, knowledge and equipment needed to take an effective approach against the AIS, but WfW works on a contract basis and is not allowed to give the contract to the farmer himself. In the past there have been problems with the way the contractors have worked to try to eradicate the AIS.

The AIS use much more water than indigenous grasses or Fynbos vegetation. When Black Wattle is cleared it is not used for any purpose, which the farmer thinks is a waste, it could at least be used as firewood.

Nature and restoration
There are no wetlands on farm. Probably the only wetland that is left in the Kouga River catchment is around Heights. Before the land was used as a farm there was a wetland though, but after a flood in 1916 it became a river.

There is land that is degraded on this farm, especially steep parts that were ploughed two generations back. Currently those lands are naturally going back to indigenous vegetation since the last 30 years or so. There are also lands that were ploughed one generation back that are being put into grasslands. The farmer questions if it is possible to ever have Fynbos on the (previously) degraded lands again.

The farmer says he is interested in projects that increase value for nature on parts of his lands, but says he does not like the idea that he could not have cattle on the land for the whole year, because he would effectively give the land away, which would degrade his financial position. To keep cattle out of a nature area it should be fenced, but it is not easy getting the materials on location and it is expensive to buy and maintain the fence. The farmer thinks there is very little added value for nature, especially if it is a standalone area, and that tourism will not develop there, all at a high price.

Because of the Langkloof's economic value for the apple farming industry it would be better to set up protected areas in other places, for example north of the Langkloof in the Kouga Mountains.

8.7 Interview with Hannes Stapelberg

7 April 2011

Land use
Eve Brand Farms is an empowerment venture, where 50% of the farm is used commercially and 50% is used to empower the labourers working on the farm. The farm consists of 1400 hectares in total, of which almost 200 hectares are planted with fruit trees.

It would be possible to use the bigger area of the farm as grazing pastures, but at the moment there is no livestock.

The old orchards are replaced after a certain time with newer, better and higher yielding varieties that can be more densely placed in the orchard.

Water & irrigation
Of the total farm area there is an additional 200 hectares that could be planted with fruit trees, but the water allocation only allows for 70 more hectares of fruit trees. The farmer is planning on expanding his business so he can use the rest of the water that is allocated to him.

All the orchards are irrigated. The old part of the farm (100 hectares) uses a micro jet system for irrigation, while the newly developed part (the other 100 hectares) uses a drip irrigation system. In the future it depends on the location, water availability and soil condition whether the farmer will use drip or micro jet irrigation systems. Drip irrigation is more water efficient, and because water is scarce it has been applied to the new orchard although the farmer thinks that it might not be perfectly suitable.

Depending on the season and rains, around 4500 to 6500 m^3 per hectare for irrigation is needed within the six months of a year that the orchards are irrigated. Most of the water comes from a dam in the Misgund east river system in the mountains. This water is transported to all the farm dams of the Eve Brand farms. All those farms combined have 20 farm dams. It is not allowed by law to expand the farm dams or build new ones. Water gets pumped from the river further downstream as well.

There are also boreholes that were drilled during a drought because there was no other water available, but the volume of water that is used for irrigation now is low compared to water from the mountain dam. Generally the Eve Brand farmers do not use the boreholes when there is water from other sources readily available.

According to the farmer the biggest water related problem is the erratic rainfall. The last two years were problematic concerning irrigation water quantity. Even though, water isn't a constraint on the choice of crops for the farmer in a way that they have to change the type of crops they farm.

The farmer thinks it is not a good option to look for more water in the Kouga River system for Port Elizabeth.

Fertilizer and pesticides
Fertilizer is applied on all the orchards. They hire a consultant that does a soil and leaf analysis and then the farmer applies the minimum amount of fertilizer that is required to have an optimal production according to the analyses. The farmer doesn't feel like he should farm completely biological and stop applying fertilizer, but he will only apply what is required and will use organic fertilizer as well.

Pesticides and herbicides are applied to the orchards, but because Eve Brand Farms is Fairtrade accredited they have strict rules to adhere to. They try to apply the absolute minimum of chemicals in general and are not allowed to use “red band” chemicals, but only yellow and blue band. Even though the red band chemicals are cheaper and more effective, Fairtrade does not allow them to be used, because of the risks for farmers and workers that are associated with those chemicals.

Finances

In total there are around 90 permanent labourers working on the farms and in season they hire an additional 45 labourers.

The biggest capital cost is the development or replacement of the orchards, which costs between 130,000 to 140,000 rand per hectare.

The Global Financial Crisis is currently the biggest problem that the farmer has to face. When the farm started they projected an exchange rate of 16 rand for 1 euro and 12 rand for one American dollar, but at the time of this interview the rates were 9 and 7 rand respectively. This, of course, means that there is a lot less profit to be made exporting the fruits. A good alternative is to supply the local market, but still the farm has not made a profit for 4 to 5 years. This is also for a smaller part due to abiotic factors, because they had to cope with two floods, hail damage and a two years long drought spell.

The farmer is member of the local water/irrigation board, which governs the dam in Misgund east and of the farmers’ organisation Agri Eastern Cape.

Alien invasive species

The only alien invasive species (AIS) that is causing problems that the farmer is aware of, is Black Wattle. It grows so fast that it overgrows the farmer’s lands. According to the farmer the Working for Water (WfW) programme in this area is not ahead of the issue, they cannot keep up with rate that Black Wattle is spreading. There were veldfires last year and after that when the Black Wattle seeds germinate there is no competition by other plants that are fast enough to balance the growth of Black Wattle.

The farmer has not worked directly with WfW, but WfW worked on the farm two years ago to clear some AIS. WfW asks the farmer if they can clear the aliens on the farmer’s land, but has not cooperated more intensively with this farmer. The farmer however indicates that he is willing to cooperate further in the fight against AIS.

Nature and restoration

There are no wetlands on the farm, since the farm lies in a mountainous area. There are also no eroded lands on the farm, because there has been no livestock for years on those fields. Because they farm fruit trees the soil is very important to the farmer and therefore he will be careful with it.

The farmer is open for any suggestions and would appreciate any opportunities to create nature reserves or protected areas on his lands. A large portion of his farm’s lands go into the Kouga Mountains, so it is not possible to farm there with fruit trees and the farmer does not have the capital to develop those lands.

8.8 Interview with Cornelis Muller

7 April 2011

Land use
The Muller family has been farming in the Kouga River catchment for 40 years and Cornelis himself for 10 years. The total surface area of the farm is 1400 hectares of which 195 hectares are apple and pear orchards. The other 1205 hectares are uncultivated mountainous areas. The farmer does have some livestock, but in low numbers because it is only kept as a hobby and is not economically viable.

Water & irrigation
The orchards are irrigated with drip and micro sprinklers irrigation systems. The water comes from 3 farm dams, which have a total volume of 300,000 m^3. The farm dams are directly fed by streams. The farm is on the highest point of this part of the catchment. There are no boreholes on this farm, so they rely only on the farm dams.

The biggest water related problem is that the farmer is not allowed by law to build more dams to store more water. This means that the farmer cannot expand his orchards, because there would be no water to irrigate the new fruit trees, even though this farmer has more open land available that is suitable for new orchards. Hypothetically, if there is more water available to the farmer, he would plant more apple trees.

Another problem is the erratic rainfall. There are droughts as well as heavy rains in this catchment and generally annual precipitation is lower than it used to be. If it would be possible to store more water on the farm, the heavy rains would alleviate the droughts by storing all the water that falls in a short time.

The farmer also says that because of climate change the temperature is rising and the fruit trees need more water.

Because generally there is a flood in the Langkloof every decade it would be wise to build another dam in the Kouga River to capture all that water that currently flows to the sea when the Kouga Dam overflows. This way there should be enough water available for Port Elizabeth and the Nelson Mandela Bay Municipality. Another important point is that water loss from leaking pipes is bigger than the amount of water that is actually used by the whole Nelson Mandela Bay Municipality.

Fertilizer and pesticides
The farmer applies chemical fertilizer from October till January. By analysing soil and leaf samples an exact quantity and specific type of fertilizer (nitrogen, phosphorus, etc.) is applied.

In the same period that fertilizer is applied the farmer can choose to apply pesticides as well. Only if necessary will an orchard be sprayed with pesticides.

Finances
The farmer has about 200 permanent labourers working for him and employs an additional 100 workers in season.

The largest expenses for the farmer are labour and fruit packing material.

The farmer is a member of the local water/irrigation board and of the farmers' organisation Agri Eastern Cape.

Alien invasive species

On the farm lands Black Wattle and Hakea species are a problem, because they take over areas from the indigenous Fynbos vegetation. Once a year the farmer tries to clean the farm of the alien invasive species (AIS), even though this is not required by law.

The farmer has not worked with Working for Water (WfW), because WfW says the patches of AIS are relatively small on this farm and therefore are not a priority. However, WfW does supply the farmer with poison that can be applied on cut trees.

Nature and restoration

There are no wetlands on the farm, because the farm is too high in this part of the catchment.

There are no degraded areas on the farmers land, but he is interested in projects that would increase or secure the natural value of those areas, since they are mountainous and not profitable to farm.

8.9 Interview with Marius Vosloo and Johan van Dyk

7 April 2011

Farming since 1986 and one generation before that. The total surface area of the farm is 2300 hectares, of which 168 hectares are all types of deciduous fruit orchards. No livestock.

All orchards are irrigated with 6000 m^3/hectare/year of water via micro jets. This is, of course, additional to rainfall. All water comes from streams running from the mountains (from south to north) and is captured by 54 farm dams and transported via canals and the irrigation systems. There are no boreholes drilled.

There is no problem related to water, water is very clean, not much pollution. In the future the main problem with the Black Wattle will increase. The farmer would like to move away from chemical fertilizers to chicken manure, it is part of the farming policy. The vision is biological farming.

If he had extra land with no water, he would just leave it and do nothing with it. If he had water for it, he would use it for fruit, because the whole valley is mainly fruit because of the climate. Major problems over the last 3-4 years are nature (floods and drought, fires). From a business point of view there is no manpower enough to control Black Wattle.

He would look elsewhere for water. A lot of water is available from the east and the Orange River. Was a project to construct a pipeline but that was never finished. His area is competing with Port Elizabeth for water and he thinks there is not enough both stakeholders.

8.10 Interview with Donald Strydom

7 April 2011

He pumps his water out of the river into the dams in the winter. In the summer the river is dry. The farmer uses 10% of his water out of boreholes. Biggest problem is the lack of water. They haven't got a big dam like the Kouga Dam to buffer water. There are no problems with the quality of the water. If it rains they have to pump as quick as they can to get enough water. There is a flood about every 10 years. The last one was in 2006.

They use fertilizer after the harvest, in August and the end of November. Pesticides are used preventively from the end of October until 3 weeks before the harvest (November). They follow a program from the pesticide company for it according to diseases and pests. He harvests from January until March.

Additional land without water is not used. If there was water he would expand his fruit business. Major problems to farmer are labour and the production cost rising. The income from the product goes up 3% per year, compared with the increase of production costs, which is 7%. A problem with labour of local people is their unproductivity. He has a lot of people from Zimbabwe because of this problem.

The availability of water for irrigation limits the yield. Currently the farmer cannot expand because there is no additional water available to him. He would look elsewhere in the search for more water for Port Elizabeth, for example from the Orange River.

8.11 Interview with Johan Kotze

7 April 2011

The cooperation where the farmer is involved in has 9 farmers, units with 3 pack units. All the fruit of the 9 farms is packed in these 3 units. Land that is not used for fruit or cattle is kept mainly in its original state.

Water comes from irrigation through the river, dams and irrigation streams from the dams. The farmer has 3 boreholes that are used for domestic water. The biggest water related problem is drought and erratic rains. In 2007 they had a flood, 800 mm of rain in a short period. They cannot keep the water back and had too little storage capacity.

The fertilizer policy is to start using more compost in the future. Three times a year fertilizer is applied, during mid-October to mid-November and in March. Chemicals and pesticides are used from September until February. They use it preventatively and after problems occur with pests. They apply the pesticide according to the stadia of the insects.

Additional land without water is left as it is or used as grazing fields for cattle. Otherwise, it is used for fruit. The major problems he has as a farmer in the area is the climate, heavy rains and drought. He will allow alien invasive species to be cleared on his lands if it will increase the availability of water.

There are 3 water boards in the Langkloof. All are irrigation boards.

He would look elsewhere for additional water for Port Elizabeth (PE). There are other means to get water for PE. The legislation at the moment is that the farmers in the Kouga River catchment are not allowed to build more dams.

8.12 Interview with Tertius Kritzinger

4 May 2011

The farmer preferably irrigates 25mm every fortnight. He gets his water from the irrigation board into the farm dams. The biggest water related problems are water storage and the change in the water pattern. They now have in a shorter period more rain so the dams are quicker full and he cannot store more water, they don't get water as frequently as they used to due to the change in the weather pattern.

It is not allowed to increase the storage capacity by law. He has built a dam and could only fill it twice in 2 years due to the drought. If there was no water at all he could not keep his cattle. He is not able to utilize all of his land, only about 30% because of a lack of water.

They are switching from chemical fertilizer to manure from his cattle and sheep. Pesticides are only used for the pear trees, and only when needed. They follow the normal spray program, which is regulated by the Southern Fruit cooperation. If he had addition land with water he would use it for cattle.

The major problems for the farmer are labour costs, the social system costs and the overall attitude of the citizens. The social environment is going down. The people are not equipped with knowledge and proper education.

The wetlands provide benefits, because they control flooding, store water and slow the flow down. There is a person, Japie Buckle, who is restoring the wetlands. The boreholes are regulated because they form a problem.

He would definitely look elsewhere for more water for Port Elizabeth. The Langkloof needs a big dam so they can utilize the opportunity that the Langkloof needs for growing. There should be a big dam which constantly feeds the Kouga River.

8.13 Interview with Jacobus de la Rey Rademeyer

4 May 2011

The biggest water related problem is Black Wattle. It takes all the water out of the area and uses as much as 200 litres per day per tree. It also blocks streams. He uses chemicals from WfW to try to eradicate the species. The seeds can live for thousands of years, which makes it very hard to completely eradicate the species. The seeds get into the river and during the flood they are spread out over the land. You can get Black Wattle back after 10 years with a new flood.

He uses pesticides at certain dates. He monitors and then decides when to use pesticides.

Theft of the fruits is a big problem. He has 2 guards for 6 months to look after his crop. Water quality is not always good enough, because there is wastewater dumped in the river downstream.

Water for irrigation purposes a constraint of the choice of crops, yes, but not on the moment on his farm.

8.14 Interview with Cornelius & Marius Strydom

5 May 2011

They have a share in the irrigation board, every 11 days they get 40 hours to fill the dams with water. The biggest water related problem is the interference of the government. They cannot store enough water. Because of restrictions from the government the farmers are not allowed to build new farm dams. They cannot obtain any permit to build and store more water.

The weather is unpredictable. Due to the floods water is running to the sea and goes to waste. The dams are empty now and it will take a long time to fill them up. In 2009 and 2010 they had a great drought. There are not enough dams to manage the floods and during the floods many farm dams broke. Before they had time to repair them the drought came, so now the farm dams are empty. There is no support from the government in this area.

The farmer applies pesticides by monitoring during the season. They watch the insect movement. The use of fungicides is mainly to prevent fungi from growing.

If they have water to irrigate an extra hectare of land they would use it for more trees. The farmer cannot farm livestock because of theft. There are too many people in the area and also the land is not good for grazing.

The major problems in the area are the cost of labour, the poverty of the labourers, labourers' skill and labour laws by the government. Labourer alcoholism is a problem as well. The workers are the lowest class in the region, at the lowest costs, but it is difficult to motivate the people.

He can't expand because there is not enough water. The only thing they do is replacing orchards.

To get more water out of the Kouga River catchment the farmer would look elsewhere. The Orange River has potential for a dam, because a lot of water is just running to the sea.

8.15 Interview with Stefan Gerber

5 May 2011

His father and grandfather farmed apples, apricots, oranges, but he stopped farming fruit. The farmer is allocated time to get water out of the pipeline, which he pumps to his farm dam. The biggest water related problem is the responsibility for water levels in the stream. Farming is not his main source of income, he is a part time farmer.

An addition hectare of land without water will not be used for agricultural purposes, with water he would use it for cattle. It is hard to find reliable workers, alcoholism during weekends is a problem. The major problem is the access route from the tar road. He has to transport his cattle over the long dirt road. Because of the labour law he has to keep workers on the farm, even if they do not work for the farmer anymore.

Water is not a constraint to the current choice of crops.

Policy makers should look elsewhere instead of getting more water out of the Kouga River catchment for Port Elizabeth. There is not enough water in the catchment for both farmers and the metropolitan area.

8.16 Interview with Andries Stander

5 May 2011

Used to have 100 cattle, but since 15 years the farmer scaled down on the cattle, because he planted more orchards, which left too little lands for large numbers of livestock.

Water comes from the Haarlem Dam (build in 1991) (lat. -33.770683° lon. 23.317409°). There's no agricultural activity in the catchment of the dam, or any other human activity for that matter, so the water is very clean. The capacity is $4{,}5*10^6$ m^3. The irrigation board governs the dam, which provides drinking water as well.

The water from the Haarlem Dam is pumped to the farm dams, but other farmers that have lower lying orchards can irrigate directly from the Haarlem Dam.

The local catchment (the area around Haarlem) is managed by the Eastern Province Department of Water Affairs (DWAF), although the farm lies in the Western Province. This gives problems with who is responsible for clearing alien invasive species, especially Black Wattle. This is probably because Haarlem is the western most part of the Kouga River catchment.

DWAF took water samples of three places in the area from the river, but the results are not known by the farmer.

Farmer uses short irrigation intervals because of coarse soil structure, which drains water quickly and small quantities per interval.

Black Wattle mulch is used to control evaporation, but not as organic fertilizer. The farmer previously used chicken manure, but stopped applying this, because of the build-up of heavy metals. Also, antibiotics in the manure were harmful for soil organisms.

The farmer is expanding with a new nectarine and apple orchard, because he has plenty of water for irrigation.

More water for Port Elizabeth could be obtained from desalinisation of seawater as an alternative for the Kouga River catchment.

After the floods of 2006 and 2007, some farmers of the Langkloof could not repair their farm dams in time to catch enough water from the winter rains, so they experienced a lack of irrigation water within two years after the floods.

8.17 Interview with Bokkie Kritzinger

5 May 2011

Irrigation water is supplied by the Waboomsrivier Besproeiingsraad from the Tsitsikamma Mountain, and from the Krakeelrivier. Both rivers flow into the Kouga River. Once every 16 days the farmer is allowed to pump from the rivers.

Biggest water related problem is that since 1992 it is prohibited to build extra farm dams, because all the water must go to the Nelson Mandela Bay (NMB) metropolitan area. For the whole Langkloof, if the farmers were able to build more dams, there would be more work available, because the farmers would be able to farm bigger.

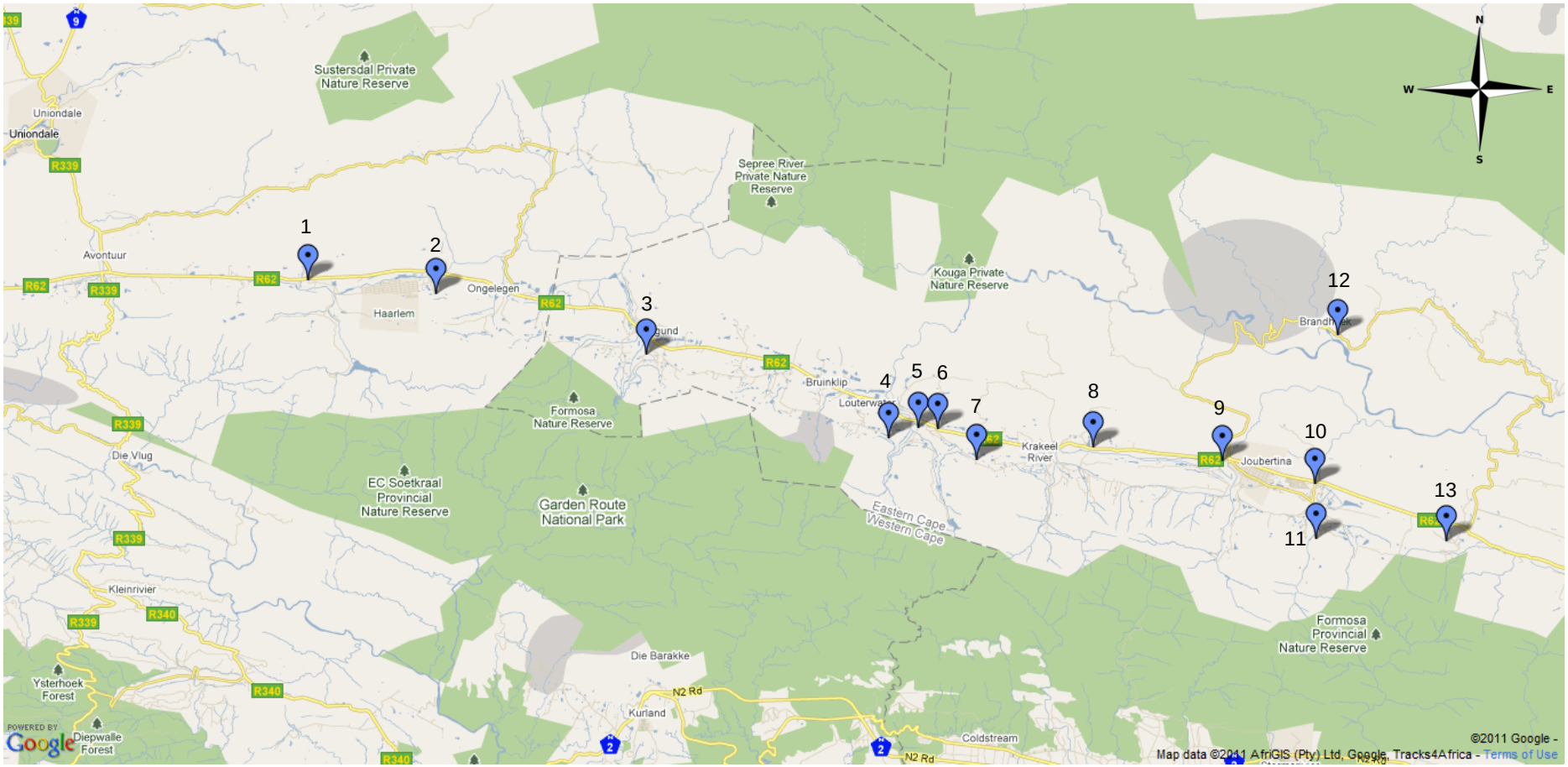
In wet years the Kouga Dam flows over and a lot of water that could be used in dryer years is lost. The farmer suggests building another dam after the current Kouga Dam that could contain the floodwater, so all water that falls in the Kouga and Baviaanskloof catchments is caught.

Other places to look for more water for NMB are the Orange and Fish Rivers, even though it is muddy. Transport loss form the Kouga Dam to the destination is an important factor as well and this could be improved so more water reaches its destination.

The farmer has enough water, so that it is not a constraint on his current choice of crops. However, if the farmer had another piece of land, but no extra water, he would only use it for cattle. If there was extra water available to irrigate the new piece of land, he would plant apple trees.

The Langkloof is known to have hail, heavy winds and droughts. 3 apple farms were nearly destroyed by hail and other extreme weather. The problem is ever bigger on the west side of the Langkloof.

8.18 Location of farmers



1: William Johnston, 2: Andries Stander, 3: Hannes Stapelberg, 4: Cornelis Muller, 5: Jacobus de la Rey Rademeyer, 6: Marius Vosloo, Johan van Dyk, 7: Cornelius & Marius Strydom, 8: Donald Strydom, 9: Bokkie Kritzinger, 10: Johan Kotze, 11: Bremer Pauw, 12: Stefan Gerber, 13: George Ferreira

8.19 Excel data interviews