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OPTIONS FOR A PAYMENT FOR WATERSHED SERVICES SCHEME: A CASE STUDY IN THE WESTERN BAVIAANSKLOOF, SOUTH AFRICA

By
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"OPTIONS FOR A PAYMENT FOR WATERSHED SERVICES SCHEME: A CASE STUDY IN THE WESTERN BAVIAANSKLOOF, SOUTH AFRICA"

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"There is no passion in playing small –in settling for a life that is less than the one you are capable of living".
Nelson Mandela

"Do you feel it in the sunshine?
Do you feel it in the rain?
Do you feel it in the ocean
When the waves are clean?
Do you feel it in the evening
When the moon is up?
Do you feel it in your bones
When she fills you up?
She breathes good luck
Mother Earth Mother Earth"
Xavier Rudd

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Summary

The study took place on the Baviaans catchment, located in the Eastern Cape, South Africa. The Baviaans catchment supply water to the Kouga dam, which in turn provides water to the Gamtoos valley -where intensive irrigated agriculture is practiced- and to the city of Port Elizabeth. Moreover, the Baviaans catchment hosts the Baviaanskloof Mega-Reserve, which includes a protected area and a patch of privately owned land, where extensive agriculture is practiced. In particular, this study focuses on the privately owned portion of land, located in the Western sector of the Baviaans catchment.

The Western Baviaanskloof is affected by land degradation problems created by human interventions on the catchment, and this has resulted in a loss of watershed services both on site and downstream. The Baviaanskloof Integrated Catchment Restoration program is being created by the PRESENCE network to address these issues.

Restoration would improve the delivery of watershed services downstream (i.e. to the Kouga dam and related water users) and this would give the chance of setting up a PWS scheme. From previous research, it is known that water users downstream, both in the Gamtoos valley and the city of Port Elizabeth, are willing to pay for an improved delivery of watershed services.

This study investigates landowners' willing to participate in the restoration program and related PWS scheme. The focus is on a specific type of intervention that is, the rehabilitation of tributary streams and related flood plain areas –locally known as keerwalle. From the point of view of private landowners, the implementation of this measure is expected to bring not only costs, in terms of restoration costs and increased flood risk exposure, but also benefits, since the on-site delivery of watershed services would be improved. Moreover, other variables (or criteria) might play a role in the household decision, such as for example environmental awareness or potential added value for tourism of a restored landscape. Therefore, the objective of this research is to indicate the most suitable type(s) of compensation for local farm households engaging in rehabilitation activities on their lands, by analyzing the decision problem faced by farm households with respect to the planned rehabilitation measure. Due to the complexity of the decision problem at stake, a Multiple Criteria Decision Analysis approach was chosen.

Although in the Western Baviaanskloof 16 landowners can be found, only 11 of them are actually living and farming in the area and are therefore water users, so they are also the sample of this study. The two main economic activities in the area are farming and tourism, with 6 landowners engaged mainly in farming and 5 engaged mainly in tourism; however, all households rely on both activities for its livelihood. Farming activities focus mainly on livestock keeping (goats, sheep) and, to some extent, cropping (with alfa-alfa as the main crop). Besides private landowners, a farm owned by several coloured shareholders (Sewefontein), a coloured church community (Zaimaanshoek) and the white-owned community farm of Tchnuganoo are also present in the area. Many community members from Sewefontein and Zaimaanshoek are employed on the white-owned farms as farm or household workers.

The decision problem was structured according to previous extensive consultations with local landowners, experts and other relevant stakeholders. A set of five policy scenarios, among which landowners had to choose, was created, as well as a set of nine economic, social and environmental

criteria against which the policy scenarios had to be compared and evaluated. The set of policy scenarios include a baseline scenario, where no restoration is carried out, a scenario in which restoration is carried out but no incentives are given to landowners, and three scenarios where restoration is carried out, combined to different types of compensation for landowners: financial incentives, the creation of an insurance fund against flood damages, and the creation and implementation of a marketing plan for tourism.

Whereas policy scenarios were established a priori –in fact, the analysis was aimed at investigating landowners' preferences on something which is being proposed to them- the criteria were formulated according to landowners' management goals in economic decisions concerning land use and livelihoods. These goals were also identified through previous consultations.

To carry out the analysis and investigate landowners' preferences in the MCDA, a value function approach was used. A separate template was filled in for each landowner, and then the results were aggregated calculating the mean final scores, in order to come up with an overall ranking of the policy scenarios. It was found that, perhaps not surprisingly, financial incentives is the most preferred policy scenario, followed by the creation of a tourism marketing plan. In general, a clear and neat preference for restoration emerged, even without incentives.

However, the results of the MCDA contains much more information than a simple general ranking of the proposed policy scenarios. For example, the weights assigned to the criteria can reveal important information about landowners' management priorities. According to the results, the most important goal pursued when taking an economic decision appears to be the stability of income offered by the available options (criterion 2), closely followed by their profitability. The environmental aspects involved in an economic decision, namely impact on landscape and conservation of water resources over time, are also considered very important, as they come just below the two criteria discussed above. Through the analysis it was also found that landowners' main economic activity –namely farming or tourism- has an influence on the priorities pursued in economic decisions. In fact, landowners engaged mostly in farming consider income stability and profitability as being their priorities, while landowners engaged mostly in tourism privilege environmental goals and community development over all other criteria.

In previous consultations with landowners it was found that their attitude towards risk was not clear, as on the one hand they stated that they could not do without the flood protection offered by keerwalle and other interventions, but on the other hand they did not consider floods to be a serious problem for them because it is an occasional event. In the MCDA, however, the criterion "risk involved" was the one which, on a general level, received the lowest weight: this indicates clearly that the risk involved in restoration is not a source of concern.

Although the policy scenario involving financial incentives performed generally better, the creation of a tourism marketing plan received the highest score with respect to community development. In fact, according to landowners, farming is unlikely to create new jobs, whereas tourism could play a major role in terms of economic development, job creation and, in last analysis, social development, especially regarding the coloured communities.

In conclusion, the most striking result of the MCDA is that landowners are almost unanimously in favour of restoration, even without incentives. Although it might be argued why

landowners should be given incentives at all, a few additional considerations indicate that a PWS scheme is in fact recommendable for the study area. First of all, it is proved that downstream water users are willing to pay for an improved delivery of watershed services, and hence this would allow the implementation of a PWS scheme and would create available funding for compensating upstream landowners. Furthermore, a PWS scheme would represent an unique opportunity to address socio-economic development in the area towards sustainability, in a way which harmonizes economic, social and environmental components at the same time. In the Western Baviaanskloof, land use and tourism activities are inextricably linked from the point of view of socio-economic development, as these are the two main sources of income. Restoration is related to both economic activities, as it would have an impact on water availability, landscape aesthetics and, to some extent, land use: it must be therefore be planned and implemented taking into account the broader economic picture, thus using a holistic approach. If after restoration landowners kept the same farming practices and used the same amount of water, then on the long run the system would be likely to be degraded again.

It is therefore suggested to address sustainable socio-economic development by designing an incentive scheme promoting income diversification in favour of tourism. This could represent a solution to the conflict between farming and a healthy environment, and could even create a more favourable ground for further restoration activities as well as enhance community development. Hence the major question to be answered while designing an incentive scheme is: how can an incentive scheme promote income diversification, and at the same time respond to landowners' preference for financial incentives? Some solutions are suggested, such as for example a combination of financial incentives and the creation of a tourism marketing plan, the provision of financial incentives aimed at financing tourism development projects, or the creation of a landscape labelling system.

In addition to this, sets of recommendations are also provided in this report with respect to (i) the implementation of the Baviaanskloof Integrated Catchment Restoration programme, (ii) the design of an incentive scheme, (iii) the members of the PRESENCE network and (iv) further research on the topic.

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Preface

This research is part of the Working for Food and Ecosystem program executed by the Dutch Government Service for Land and Water Management (DLG), Landbouw Economisch Institut (LEI)- Wageningen University and Alterra- Wageningen University, and it builds on the land and water assessment of the study area carried out by Herco Jansen (Alterra-WUR).

In 2005 FAO and the Government of the Netherlands organized the International Conference on Water for food and Ecosystems in The Hague, providing a high-level platform for 350 participants around the globe. The objective of this conference was to assist governments in identifying management practices, to present practical lessons learned and to create the necessary enabling environments leading to a sustainable water use at the river-basin level, as well as the harmonization of food production and ecosystem management, with a view to implementing already internationally agreed commitments.

As a follow-up of this conference and to implement new concepts for sustainable water management for food and ecosystems, partnerships between countries were established. The project "Water for food and ecosystems in the Western Baviaanskloof" is being executed in the framework of the Water Partnership of the Dutch Ministry of Agriculture, Nature and Food Quality (LNV) and South Africa.

Besides, the present project was conducted in partnership with the PRESENCE network, which facilitated the data collection process and it is currently coordinating the research and implementation of restoration projects in the Western Baviaanskloof.

PRESENCE is a multi-stakeholder networking initiative, hosted within LivingLands, an initiative of Earthcollective, active in forming mutually beneficial and synergistic partnerships for enabling landscape restoration in South Africa. It aims to secure additional investment and collaboration to ensure that its ambitious vision and objectives remain achievable into the foreseeable future. Current national and international partners include: the South African Department of Water and Environmental Affairs (DWAF); Gamtoos Irrigation Board (GIB); Council for Scientific and Industrial Research (CSIR); Rhodes University; Nelson Mandela Metropolitan University; WUR; South African National Biodiversity Institute (SANBI); DLG and LNV; and private sector and community-based organisations.

In particular, the PRESENCE network is currently coordinating the implementation of the Baviaanskloof Integrated Catchment Restoration program, involving different national and international universities and organizations, including DLG and Alterra-WUR.

The PRESENCE network also facilitated the following related research projects, which provide crucial complementary information to this report:

- Javed, H.A., 2008 *To investigate the institutional arrangements required to implement payment for environmental services (PES) for water in Eastern Cape, South Africa, focusing on Baviaanskloof and adjacent Cape catchments.*
- Van der Burg, L., 2008. *Valuing the benefits of restoring the water regulation services, in the subtropical thicket biome: a case study in the 'Baviaanskloof watershed', South-Africa.*

In Appendix I a schematic representation of the research context is provided, and a detailed description of the Baviaanskloof Integrated Catchment Restoration program is given in Annex V.

The time span of this project was 14 months including preparation (2), preliminary field research (5), field data collection (4), data analysis (1) and writing up (2); and it was started in July 2008 and was completed in July 2009.

1. Research Description

1.1 Project motivation

As a semiarid developing country, South Africa has historically experienced water supply constraints. In recent times, due to a fast-growing population and to increasingly erratic rainfalls, water is becoming more and more the limiting factor to development (Scholes, 2001, in Blignaut et al, 2007), as noted also by Daly (in Aronson et al, 2007):

"More and more, the complementary factor in short supply (limiting factor) is remaining natural capital, not manmade capital as it used to be. For example, populations of fish, not fishing boats, limit fish catch worldwide. Economic logic says to invest in the limiting factor. That logic has not changed, the identity of the limiting factor has".

In the past, a system of engineering supply solutions was set up to meet the rising demand for water, but this option is no longer viable since virtually all viable rivers are already being exploited (Blignaut et al, 2007). Therefore, there is an urgent need for alternative solutions, such as sound integrated water catchment measures which can best allocate and manage the existing water resources.

But a sustainable integrated catchment management does not only result in a more efficient exploitation of water resources. In fact, well-functioning watersheds provide a whole range of services which are essential for people's livelihoods and well-being (Le Maitre et al, 2007).

Especially in rural areas, economic activities such as farming and ecotourism are heavily dependent on watershed services (Scholes and Biggs, 2004). At the same time, land-use and land-use changes can have a huge impact on the delivery of ecosystem services, which in turn affects economic activities for various stakeholders both on site and in downstream catchments, in a vicious circle (LeMaitre et al, 2007).

1.1.1 The study area and the need for restoration

The phenomenon just described is precisely the case of the Baviaanskloof Mega-reserve, which includes a cluster of formal protected areas and privately owned land, as showed in Figure 1.1. The Baviaanskloof –"valley of baboons"- is located between the parallel Baviaanskloof and Kouga mountain ranges in South Africa's Eastern Cape Province. The area is one of outstanding natural beauty, with spectacular rock formations, high diversity of plants and vegetation types, and several wild animals species (Boshoff, 2005). This study focuses on the private land located in the Western Baviaanskloof, where crops and livestock keeping are the main land uses.

Although land owners have recently set-up ecotourism activities, large-scale, commercial agriculture has been the main activity in the valley since the 19th century. The Baviaans catchment is a highly dynamic and fragile system, and the exploitation of land and water resources has resulted in the degradation of the river system. Various land and water problems, such as erosion of stream banks and surrounding slopes, drying up of water sources and disappearance of wetlands, have already become manifest. Furthermore, climate change is expected to worsen the situation, as changes in rainfall patterns have already been measured (Jansen, 2008).

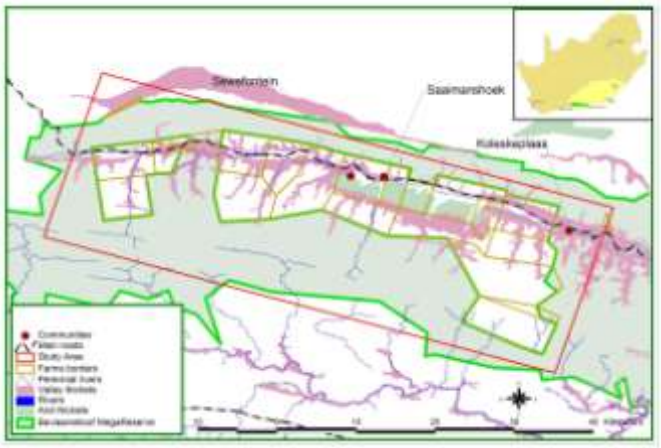

Figure 1.1- The study area and its location within South Africa

Land and water degradation in the Western Baviansklоof, however, is not only detrimental for the delivery of watershed services on site, since the area is part of a broader context.

As a water catchment, the Baviaanskloof plays a crucial role for the provision of clean water to downstream users. Both the Baviaans and Kouga catchment supply water to the Kouga dam. This dam, in turn, supplies irrigation water to the Gamtoos valley, where intensive commercial farming is the main economic activity, as well as drinking water to the fast growing city of Port Elizabeth (Jansen, 2008; van der Burg, 2008), as represented in Figure 1.2. Watershed services provided by the Baviaans catchment have strong implications for water provision to the Kouga dam (van der Burg, 2008), and hence economic implication for downstream users.

Figure 1.2- Schematic representation of the Baviaans, Kouga and Gamtoos catchment (from van der Burg, 2008)

Furthermore, the Western Baviaanskloof is part of the Baviaanskloof Mega Reserve, which makes ecosystem conservation and restoration a high priority in the area.

Farming activities in the valley are potentially in conflicts with the objectives of the Baviaanskloof Mega Reserve Project. For this reason, in 1997 the compulsory acquisition of all privately owned land in the Western sector was proposed (Clark, 1998, in Crane, 2006), but it met the fierce opposition of the local community (Roodt, 2003, in Crane, 2006). As noted by Crane (2006), "*the future of the reserve as a viable conservation area must take into account human communities and land use on properties adjacent to the Reserve*" (pp. 1039). This has been finally recognized with the creation of the Baviaanskloof Mega Reserve Project, with its underlying philosophy of "*keeping people on the land in living landscapes*" (BMRP, 2004, in Crane, 2006; pp. 1040).

1.1.2 Conflicts and constraints to catchment rehabilitation and possible solution

Although the restoration of the river system will undoubtedly bring benefits for human activities and ecosystems, both on site and downstream, it conflicts with the current land and water use and, ultimately, with the traditional livelihood strategies in the valley. The shift

towards sustainable land and water management practices might possibly involve trade-offs and conversion of cultivated areas into grazing land or conservation areas.

In particular, the Baviaanskloof Mega Reserve Project envisages a shift from stock farming to sustainable wildlife utilization and nature-based tourism, using a local conservancy as a model (Boshoff, 2005). However, a reduction in the scale of farming activities in favour of uncertain growth in eco-tourism raises concern among the local land owners about who will carry the risk (Crane, 2006). Crane also points out that "*in the context of the Baviaanskloof, just what it will take to persuade farmers to change their land use still seems poorly understood*".

Furthermore, it is often very costly to reverse and restore the watershed services that used to buffer and regulate water flows (Smith et al, 2006), and landowners are unlikely to be able to finance the full cost of rehabilitation: this calls up for a system approach involving the participation of all stakeholders and a proper sharing of costs and benefits (Le Maitre et al, 2007).

In recent years, these challenges to restoration have increasingly been addressed through incentive-based approaches to watershed management. These approaches recognize and estimate the economic value of watershed services, in order to promote investment and compensate private landowners involved in restoration activities for the services they provide (Smith et al, 2006). These mechanisms create positive economic incentives for land managers and natural resource users to behave in ways that improve, or at least maintain, certain ecosystem services (de Groot et al, 2007). Payment for Ecosystem Services, or Payment for Watershed Services, are the most common labels, although different compensation mechanisms have also been used (de Groot et al, 2007). In the context of the Baviaanskloof, restoration would bring benefits not only on site, but also downstream, such as for example increased water security and increased water availability all year round (Jansen, 2008, and van der Burg, 2008). The farmers of the Gamtoos valley and the city of Port Elizabeth would be the direct beneficiaries, and they are willing to pay for an improved delivery of these services (van der Burg, 2008). This would make it possible to establish a Payment for Watershed Services scheme, although some issues, such as for example the quantification of these services, must be addressed beforehand.

1.1.3 Purpose of the study

The purpose of this study is to provide useful and practical information contributing to the setting up of a Payment for Watershed Services (PWS) scheme aimed at boosting catchment rehabilitation in the Western Baviaanskloof, by focusing on private landowners and other residents in the study area, who are the potential services providers in the payment scheme.

1.2 Problem description

In order to reverse land and water system degradation in the Western Baviaanskloof, a set of rehabilitation measures has been suggested and the Baviaanskloof Integrated Catchment Restoration program is being set up. In particular, this study will focus on the rehabilitation of the tributary streams and related flood plain areas (locally known as keerwalle), which is seen by the experts involved in the program as having the highest priority.

From the point of view of private landowners, the implementation of this measure is expected to bring not only costs, in terms of restoration costs and increased flood risk exposure, but also benefits, since the on-site delivery of watershed services would be improved. The farm

households thus face a decision problem involving two alternatives with two different pay-offs, namely the "business as usual" scenario, with the farmers carrying on the current land and water management, and the after-rehabilitation scenario.

Therefore, it is suggested that the calculation of a fair compensation should take into account not only the costs involved in the rehabilitation measures, but also the benefits which would be enjoyed by the landowners themselves: the compensation should be in place where the costs exceed the benefits, and it should equal this difference.

However, an incentives scheme based on the balance between costs and benefits alone might not be fully effective at boosting catchment rehabilitation. It was pointed out, in fact, that one of the reasons why many PES/PWS scheme are not actually working might be found in the fact that those schemes did not properly address the risk perception and the rate of time preference (RTP) of the service providers, as these two aspects give a lot of information about needs and priorities of providers (Blignaut, pers. comm.). This aspect is also stressed by Kosoy et al (2008), who point out that *"needs and expectations of ecosystem services providers around PES should be carefully examined and compensations adjusted accordingly, hence improving the robustness of the incentive scheme*", and thus it must be taken into account while designing a payment scheme. Indeed, from previous consultations with local stakeholders discrepancies emerged between the perception of flood risk, the actual costs of the current land and water management and the expected benefits of the planned rehabilitation measure. Although most landowners recognize that the measures would be beneficial for their activities and the river system itself, they also point out that they could not do without the flood protection the measures provide. At the same time, when asked about the extent of flood damages in the past, most landowners stated that floods are not a big issue in the area, since major floods occur every 10-15 years and the damages are never so relevant. Landowners' risk profiles are likely to influence their decision on whether to engage in rehabilitation activities, and an insight is required in order to understand how an incentive scheme can address risk perceptions and influence households' decisions.

Moreover, other variables (or criteria) might play a role in the households' decision, such as for example environmental awareness or potential added value for tourism of a restored landscape.

For all these reasons, financial incentives might not be the best option to boost catchment restoration in the area: other alternatives such as the creation of an insurance fund against flood, or the implementation of a marketing strategy for tourism, might be more appreciated by local landowners and hence be more effective.

The purpose of a PWS scheme is to boost landowners engagement in catchment restoration in the most effective way. In this case, the decision problem faced by the landowner is quite complex, and many different elements or criteria play a role in the decision. A thorough understanding of landowners' preferences for the different criteria involved in the decision can give precious information about the landowners' final choice and on how to stir this decision in favour of restoration. Given the complex nature of the decision problem, a Multiple Criteria Decision Analysis (MCDA) approach will be used.

1.3 Objective

The objective of this study is to indicate the most suitable type(s) of compensation for local farm households engaging in rehabilitation activities on their lands, by analyzing the decision problem faced by farm households with respect to the planned rehabilitation measure.

1.4 Research Questions

Main research question:

What is (are) the most suitable type(s) of compensation for local landowners engaging in the planned rehabilitation measure under a PWS scheme?

Specific research questions

1. What is the context of the problem at stake?
2. How can the decision problem be structured?
3. What are the alternatives and criteria to be included in the analysis?
4. Based on the model's outcomes, which alternative(s) is (are) expected to be preferred by local landowners?
5. How can a PWS scheme influence, if needed, the expected household's decision in favour of restoration?

1.5 Methodology

This study combines desk and field research, and a triangulation of primary and secondary sources of data was used.

The data collection was carried out for the total local farming population of the Western Baviaanskloof. Currently in the area 15 landowners can be found, but only 11 of them are actively farming and therefore are active water users: for this reason, they have been selected as the sample for this research.

In order to analyze the decision problem faced by local landowners, a Multiple Criteria Decision Analysis (MCDA) approach was used. MCDA is an umbrella term used to describe different formal approaches aimed at helping individuals or groups to take decisions taking into account multiple criteria (Belton and Stewart, 2002). Decision analysis does not, and it must not be expected to, "give the right answer" (Belton and Stewart, 2002): in fact, multi-criteria decision making is a human task, and it can never be replaced by tools, techniques or algorithms; at the same time, it provides valuable information about and guidance throughout the decision problem (Stewart, 1991). As stated by Zeleny (1982, in Belton and Stewart, 2002, pp. 4), "*the decision unfolds through a process of learning, understanding, information processing, assessing and defining the problem and its circumstances. The emphasis must be on the process, not on the act or the outcome of making a decision".* Indeed, the main objective of decision analysis is to provide a structure to thinking, a language for expressing concerns of a group and a way of combining different perspectives (Phillips, 1990, in Belton and Stewart, 2002). For this reason it is particularly

suitable for this study, where the purpose is not to determine exactly what the landowner will choose, since this is not possible, but rather to gain an understanding of the elements involved in the decision in order to figure out the best ways to stir this choice in favour of restoration. Moreover, a thorough understanding of preferences, concerns, issues and priorities of local stakeholders is crucial when catchment restoration is seen as an interactive process involving continuous communication between stakeholders, researchers and implementers.

The present study follows the four basic stages of Multiple Decision Criteria Analysis, as indicated by Belton and Stewart (2002) and presented in Figure 1.2. The same stages were followed in the formulation of the Specific Research Questions listed in section 1.4.

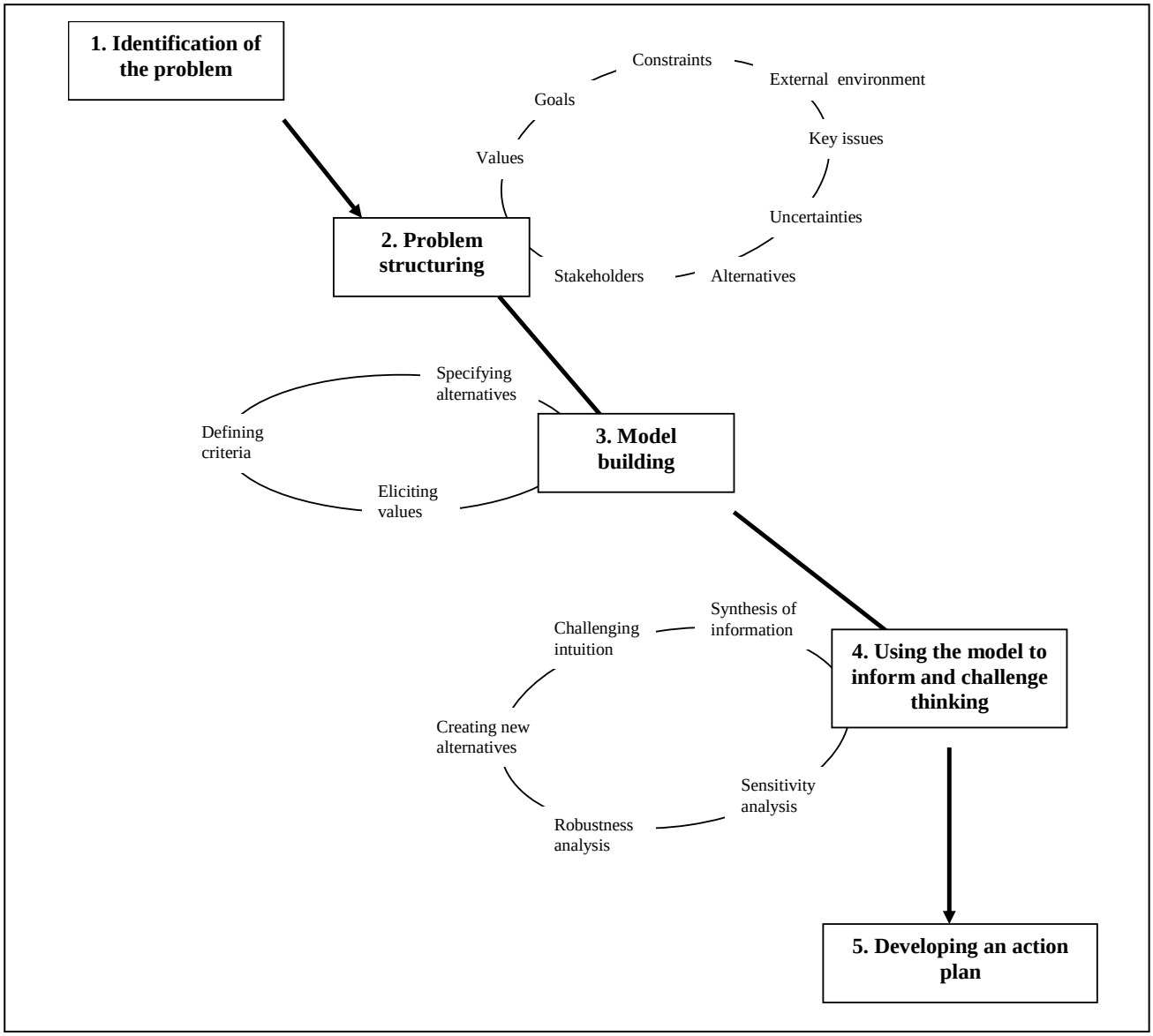

Figure 1.2- Stages in MCDA (from Belton and Stewart, 2002)

1. Problem identification

The problem identification can be seen as the starting, "given" point of the analysis. In this study, the problem at stake was presented in section 1.2, while specific research question 1 refers to the context in which the problem was observed.

2. Problem structuring

Much of the literature on MCDA focuses on stage 3 and 4, taking as a starting point a well defined set of alternatives and criteria. In practice, it is very unlikely that any real problem will present itself in this form to the analyst (Belton and Stewart, 2002). The problem structuring phase calls for divergent thinking, with the aim of opening up the issue and capturing the complexity (Belton and Stewart, 2002). This phase involves the definition of the alternatives and the identification of objectives and preferences through the direct involvement of the relevant stakeholders (Joubert et al, 1997), and it is therefore an integral part of the MCDA process. The essence of the issue must be extracted and represented in a way which allows a detailed and precise evaluation (Belton and Stewart, 2002). The aim is to identify the different alternatives available to the decision makers and to "translate" objectives and preferences into measurable attributes or criteria (Joubert et al., 1997). In short, this phase can be well described by the sentence "*Through complexity to simplicity"* (Belton and Stewart, 2002). Once the criteria have been determined, the stakeholders are then asked to assess the alternatives based on each criterion separately (Joubert et al., 1997).

3. Model building

The determination of a set of alternatives and a set of criteria allows to synthesize the information in the decision model, such as for example a decision matrix (see e.g. Korhonen et al., 1992). Several approaches can be used to carry out the analysis of decision makers' preferences: value or utility based approaches, goal programming and reference point techniques, outranking approaches (ELECTRE and PROMETHEE) and descriptive methods (e.g. multivariate statistical analysis) (Stewart, 1992).

4. Using the model to inform and challenge thinking

The application of the model allows for a systematic exploration of the decision to be taken, as well as its thorough understanding; this process can also give way to the identification of new alternatives which were previously not considered (Belton and Stewart, 2002). The outcomes of the model are also used to explore and negotiate the decision with the stakeholders in an informed way (Joubert et al., 1997).

5. Developing an action plan

Based on the model and the interactive evaluation of the different alternatives, an action plan can then be set up. In the present study, recommendations on the way forward will be given, rather than a specific action plan.

1.6 Scope and delineation

The main focus of this study is to acquire an insight on the economic behaviour of local stakeholders. The aim is, first of all, to understand whether a compensation scheme is needed to boost catchment rehabilitation, and in that case to provide an indication of the preferred type of compensation (monetary or in-kind).

The present thesis project followed an internship period in which preliminary research on catchment rehabilitation, watershed services provided by the Baviaans catchment and local landowners' perceptions was conducted. During the internship, the main constraints to

catchment rehabilitation were identified, and this thesis project has been designed to address these issues. The outcomes of the preliminary research were presented in an internship report with the title "River system restoration for a sustainable land and water management in the Baviaanskloof Mega-Reserve: Preliminary assessment of the opportunities and challenges to the creation of a Payment for Watershed Services Scheme", and are summarized in this report (Chapter 3) as they provide the necessary background information to the current study. At the same time, the findings of the preliminary research phase will also be used to structure the decision problem.

1.7 Outline of the report

The following chapters will attempt, at first, to provide a context for this research, and then to answer the specific research questions listed above. In chapter 2, the relevant literature is reviewed in order to support the use of MCDA with the necessary theoretical background; in addition, the concepts of watershed services and their value, as well as Payment for Watershed Services (PWS) schemes, are defined. Chapter 3 describes the context of the decision problem, including socio-economic information about the area, the need for restoration and the planned intervention, and a preliminary assessment of landowners' willingness to get involved in the restoration programme. This background information is subsequently used in Chapter 4, where the decision problem at stake is formally structured in order to be analyzed by the chosen MCDA technique. In Chapter 5 the MCDA method used and the elicitation of preferences are first described, and these preferences are therefore modelled and the general results described. In chapter 6, the results of the MCDA are analyzed in detail and interpreted: the aim here is to try to go beyond a simple ranking of different options by extracting and reflecting upon the precious pieces of information contained in the results of the MCDA. Chapter 7 is then aimed at making the point of this reflection, by (i) discussing the limitations of this study; (ii) drawing conclusions on the results; and (iii) providing recommendations on the way forward.

2. Literature Review

2.1 Introduction

This studies is compounded by two main issues: Multiple Criteria Decision Analysis is the tool used to carry out the research, or in other words the "box" containing the object of the study, that is the options for the setting up of a Payment for Watershed Services (PWS) scheme. The following sections are thus aimed at defining the theoretical basis of this study, by giving an overview of some of the existing literature related to these two issues.

Before going into detail of MCDA, however, a quick glance will be given to decision analysis as a whole, in order to set the basic principles which are in fact common to all decision analysis techniques.

In the same way, it is useful to spend a few words on the concepts of environmental (and watershed) services and their valuation, and to provide a context and a rationale for the payment schemes.

2.2 Decision analysis

Decision analysis is a broad discipline, and it embraces a whole family of methods which have been developed to attempt to rationalize and assist choice in an uncertain world (Hardaker et al, 2004). In his overview of decision analysis, Keeney (1982, pp. 806) suggests two different, but equally appropriate, definitions of decision analysis:

"Decision analysis can be defined on different levels. Intuitively, I think of decision analysis as a 'formalization of common sense decision problems which are too complex for informal use of common sense'. A more technical definition of decision analysis is 'a philosophy, articulated by a set of logical axioms, and a methodology and collection of systematic procedures, based upon those axioms, for responsibly analyzing the complexities inherent in the decision problem'"

In practice, decision analysis provides tool aimed at quantitatively analyzing decision problems involving uncertainty and/or multiple objectives, i.e. a systematic quantitative approach to help making better decisions (Corner and Kirkwood, 1991). As Howard (1988, in Corner and Kirkwood, 1991, pp. 207) described it, decision analysis focuses on "*transforming opaque decision problems into transparent steps*", and it also "*offers the possibility to a decision maker of replacing confusion by clear insight into a desired course of action*". It is also the main focus of the broad field of Operation Research.

Operation research deals with decision problems which have some fundamental aspects in common, namely (Keeney, 1982):

- A perceived need to achieve some objectives;
- Choice among several available alternatives;
- The different alternatives lead to different consequences;
- The consequences of each alternatives are characterized by uncertainty; and

- The possible consequences are not equally valued.

Moreover, decision problems share some other characteristics: high stakes are involved in the decision; problems have a complicated structure; because problems are usually cross-cutting several issues, no overall experts are available to solve them; and the decisions taken may need to be justified in front of shareholders, government, public, or oneself (Keeney, 1982).

In order to guide and inform a solution to the decision problem, decision analysts, economists and other scientist have been providing mathematical models and theories, attempting to explore how people make choices among desirable alternatives. The bulk of these theories is represented by the notion of subjective value, or utility, of the available alternatives: assuming that the decision maker is rational, he/she will choose in such a way as to maximize utility (or expected utility) (Edwards, 1954). The concept of subjectivity is central in decision analysis: a 'good' decision is seen as the one decision consistent with decision maker's preferences for the alternatives and their possible consequences, and with his/her beliefs about the uncertainty surrounding the decision. This also implies that a 'good' decision does not necessarily leads to a positive outcome (Hardaker et al, 2004).

The basic principle of decision making, as mentioned above, underlies the several and diverse techniques which have been developed. Within these techniques, Bell et al, 1988, distinguish three perspectives (in Smith & von Winterfeldt, 2004):

i. Normative perspective: this approach focuses on rational choice. Normative models are developed on basic axioms considered as providing logical guidance to people in their decisions. The most influential rational choice models were developed by von Neumann and Morgenstern (1944, expected utility model) and Savage (1954, subjective expected utility model), and they deal with decision making under risk or uncertainty. Probability theory and Bayesian statistics provide the normative foundation in the domain of judgements and beliefs.

ii. Descriptive perspective: people often deviate from the normative ideal of the expected utility models. Thus descriptive models deal with actual people's thinking and behaviour and, although descriptive approaches can use models of behaviour, these models are evaluated by the extent to which their predictions matches the actual choices made by people. The best-known descriptive model of decision making under uncertainty is the Prospect Theory model developed by Kahneman and Tversky (1979, 1992).

iii. Prescriptive perspective: this approach "*focuses on helping people make better decisions by using normative models, but with awareness of the limitations and descriptive realities of human judgement*" (pp. 562). In fact, prescriptive models are evaluated pragmatically, in order to find out whether decision makers find them useful and whether they are actually useful in helping people make better decisions.

Earlier approaches, in general, often imply that an objective function, or an utility function, must be optimized: although they present the advantage of resulting in well-formulated mathematical problems, they are not always effective in representing reality. In fact, "*the comparison of several possible decisions is rarely made according to a single point of view and the preferences on a point of view are in many cases only modelled with difficulty by a function*" (Roy and Vincke, 1981, pp. 207)). According to the same authors, the advent of MCDA allowed decision analysts to overcome this pitfall of operation research, as it will be shown in the next section.

2.3 Multiple Criteria Decision Analysis

Belton and Stewart (2002, pp. 2) define MCDA "*as an umbrella term to describe a collection of formal approaches which seek to take explicit account of multiple criteria in helping individuals or group explore decision decisions that matter*", as it was mentioned in chapter 1. Over the past three decades, MCDA has evolved into a discipline in its own right (Stewart, 1992). More specifically, MCDA approach started with the development of goal programming by Charnes and Cooper (1961, in Korhoenen at al, 1992) and with the development of the theory and method for multiattribute decision making by Keeney and Raiffa (1976), and it has become "*one of the most active, international, and interdisciplinary fields of research in management science and operation research*" (Korhoenen et al, 1992, pp. 361).

While chapter 1 gives a general definition of MCDA, and sets the steps in the analysis as a framework for this study, it is now appropriate to have a thorough look at the theoretical basis on which MCDA is built.

2.3.1 Principles, definitions and goals

The shift from conventional decision analysis methods to MCDA also meant that the field of application of quantitative management science moved from operational problems with well-defined objectives to a higher level managerial planning and decision making, where the famous 'messes' –as Ackoff defined them- took the place of the well defined problems (Stewart, 1992). Hence decision making goals have become increasingly imprecise, and "*the key philosophical departure point of MCDA as a formal approach to types of problem solving (or mess reduction) lies in attempting to represent such imprecise goals in terms of a number of individuals (relatively precise, but generally conflicting) criteria*" (Stewart, 1992, pp. 569).

The fact that a multicriteria problem is usually not well defined mathematically can represent an inconvenience but also an advantage. The models used in MCDA are, on the one hand, built from necessarily restrictive mathematical hypotheses, but also from information provided directly by the decision maker: therefore the decision maker is no longer replaced by a model, but he/her is rather helped to construct his/her solution by describing his/her possibilities (Roy and Vincke, 1981).

Indeed, according to Roy and Vincke (1981, pp. 207) "*the objective of MCDA is the study of decision problems in which several points of view must be taken into consideration*". It is worth noticing that this definition uses the words "study", and does not mention that the goal of MCDA is to provide solutions to a problem. This is a major concept behind MCDA, as explained very effectively by Keeney and Raiffa (1972, in Belton and Stewart, 2002, pp. 3):

"Simply stated, the major role of formal analysis is to promote good decision making. Formal analysis is meant to serve as an aid to the decision maker, not as a substitute for him. As a process, it is intended to force hard thinking about the problem area […]. Furthermore, a good analysis should illuminate controversy –to find out where basic differences exist in values and uncertainties, to facilitate compromise, to increase the level of debate and to undercut rhetoric".

But how is a MCDA problem structured and formally defined? Several authors provide definitions (e.g. Roy and Vincke, 1981, Korhonen et al, 1992 among others). Here we follow the definitions presented by Stewart (1992.). A is defined as the set of alternatives from which the decision maker (DM) has to make a selection of an $a \in A$ –it must be stressed that the

identification of the set A is not a simple task, and it might be that it is not pre-defined at the beginning of the analysis. The elements in A must be compared with respect of a set of criteria: Bouyssou (in Stewart, 1992, pp. 570) defines a criterion as "*allowing comparison of alternatives according to a particular significance axis or point of view*". Each criterion, in turn, can be represented by some measurable attribute of the consequences stemming from the implementation of any particular alternative. It is also assumed that a vector of attributes $z_a = (z_a^1, z_a^2, \ldots z_a^p)$, is associated with each alternative $a \in A$, where p is the number of criteria and z_a^i is the attribute representing the outcome of the decision alternative a as it affects criterion i. It must be supposed that attributes are defined in an increasing sense, and thus that the DM prefers larger to smaller values of each z_i, all other things being equal.

Using this problem structure, it is then possible to rank the various alternatives according to this principle: "*if for two alternatives a and b, $z_a^i \geq z_b^i$ for all $1 \leq i \leq p$, then we say that the alternative represented by z_a dominates z_b. Alternatives which are not dominated by any other are also termed Pareto optimal or efficient*" (Stewart, 1992, pp. 570). This is the basic principle underlying the whole MCDA discipline.

2.3.2 MCDA techniques

In order to solve MCDA problems, three main classes of preference models, or approaches, have been developed: value or utility based approaches, goal and reference points and outranking methods (Belton and Stewart, 2002, Stewart, 1992). This section aims at providing a general overview of the basic principles behind the three approaches, and it is by no means exhaustive.

The value or utility based approaches are built in the value measurement theory and its extension, the multiattribute utility theory developed by Kenney and Raiffa (1976). The basic hypothesis behind is based on the fact that any decision problem implies a valued function U defined on A which the decision maker wishes to maximize (consciously or not). This function aggregates the vector of attributes $z_a = (z_a^1, z_a^2, \ldots z_a^p)$ for each alternative $a \in A$, and the role of the scientist is to determine this function (Roy and Vincke, 1981). In other words, these techniques are aimed at associating a real number (or 'value') V (a) with each alternative, therefore producing a preference order on the alternatives consistent with decision maker value judgments (Belton and Stewart, 2002). More specifically, these group of techniques seek to build a *value function* for every alternative, based on the sum of the scores representing goal achievement according to each criterion: in this way, the process is given some objectivity, and allows for the defusing of emotional aspects in group decision making (Stewart, 1992; see also chapter 1). As the present study is based on this approach, a thorough explanation of the theoretical basis of value based approaches will be given in Chapter 5.

Goal programming approaches are the operational implementation of the satisficing heuristic model suggested by Simon (Belton and Stewart, 2002). According to Simon (1976, in Stewart, 1992, pp. 576), "*the natural decision making heuristic is to concentrate initially on improving what appears to be the most critical problem of the area (criterion) until it has been improved to some satisfactory level of performance. Thereafter, attention is shifted to the next most important issue, and so on*". The earliest goal programming model was developed by Charnes and Cooper (1961, in Stewart, 1992).

Both the value function and goal/references point approaches contain two assumption: (i) there is always some form of 'compensation' between attributes (a sufficiently large gain in a less

important attribute will eventually compensate for a loss in a more important attribute), and (ii) it is possible to truly 'order' the alternative in a way that is representative of the decision maker preferences. The outranking approach, developed by Roy and Bouyssou, was created in order to avoid this assumptions (Stewart, 1992). An outranking method includes two different stages: the construction of the outranking relation between alternatives, and the exploitation of this relation (Roy and Vincke, 1981). This concept has been rendered operational through the ELECTRE group of approaches (see Roy, 1991 for an overview and explanation) and the PROMETHEE techniques (described in Vincke and Mareschal, 1986).

2.4 Payment for Watershed Services schemes

If the previous sections deal with the theoretical and methodological basis of this research, it is now time to gain an insight in the object of the MCDA. As the decision problem concerns catchment restoration, and preferences for different types of incentives, an overview of the topic will be given in the following paragraphs. First of all, the concepts of watershed services and their values will be briefly made clear, and then payments for watershed services, as well as types of incentives, will be explored.

2.4.1 Watershed services

Watershed services are a subset of ecosystem services, and they are defined in the Millennium Ecosystem Assessment (2003) as "the benefits people obtain from ecosystems in a watershed" (Smith et al, 2006). Four categories of watershed services can be distinguished, as illustrated in Table 2.1.

Provisioning services *Services focused on providing food and non-food products from water flows*	**Regulating services** *Services related to regulating flows or reducing hazards related to water flows*
• Freshwater supply • Crop and food production • Livestock production • Fish production • Timber and building material supply • Medicines • Hydroelectric supply	• Regulation of hydrological flows (buffer runoff, soil water infiltration, groundwater recharge, maintenance of base flows) • Natural hazards mitigation (e.g. flood prevention, peak flow reduction, landslide reduction) • Soil protection and control of erosion and sedimentation • Control of surface and groundwater quality
Supporting services *Services provided to support habitat and ecosystem functioning*	**Cultural and amenity services** *Services related to recreation and human inspiration*
• Wildlife habitat • Flow regime required to maintain downstream habitats and uses	• Aquatic recreation • Landscape aesthetics • Cultural heritage and identity • Artistic and spiritual inspiration

Table 2.1- The main watershed services provided by ecosystems (Source: Smith et al., 2006)

Although watershed ecosystems provide a range of marketed goods (e.g. crop production, fish production), they also provide several functions which are essential for human survival and well-being, such as for example regulating services: unfortunately, these services are seldom experienced directly by resource users. Watersheds also provide cultural and amenity services, linked to the human enjoyment of the surrounding environment, and for example land use in a

watershed has a fundamental role in providing intermediate goods for tourism (Hackl and Pruckner, 1997). As human beings benefits from ecosystems, it is appropriate to attach a value to the services provided (National Research Council, 2004). To achieve this, several approaches to valuation have been developed, but in the context of this report it is useful to focus on the economic valuation of watershed services. Economic valuation of watershed services is based on the widely used framework of Total Economic Value (TEV), which disaggregate value into use values –including direct and indirect use, and option value- and non-use values –deriving from the benefits which are not related to any form of human use of the services (Smith et al, 2006). The TEV framework is presented in Table 2.2.

Total Economic Value				
Use values			**Non-use values**	
Direct Use Value Resources used directly	**Indirect Use Value** Resources used indirectly	**Option Value** Our possible future use	**Existence Value** Rights of existence	**Bequest Value** Future generation possible use
Provisioning services e.g. Water supply, food and crop production **Cultural & amenity services** e.g. Recreation	**Regulating services** Natural hazard mitigation Hydrological regime Purification Erosion protection Sediment control	**All services** Biodiversity Conserved habitats	**Supporting services** Habitats Endangered species	**All services** (including supporting services)

Table 2.2- Total Economic Value of watershed services (Source: Smith et al, 2006)

A thorough understanding of the Total Economic Value of watersheds, and thus a sound economic and financial analysis, are the basis for decision making on investment and development in watersheds (Smith et al, 2006).

2.4.2 PWS schemes: a description

Misspecification of property rights, market failures (such as public goods and externalities), perverse incentives and lack of information have been identified as the drivers of degradation and destruction of natural capital, and more in general are the reason why environmental services are typically undersupplied. Incentives schemes, or payment for watershed services schemes, have been developed in recent years as a way to address these issues, as they create positive economic incentives for users of natural capital to manage natural resources in a way that increase or maintain certain environmental functions (de Groot et al., 2007).

Payment for environmental services schemes, or financing mechanisms as some authors call them (e.g. Meijerink et al, 2008) are flexible mechanisms adaptable to various situations (FAO & REDLACH, 2004). Verweij (2002, in Meijerink et al, 2008, pp. 5) defines these mechanisms as "*an institutional arrangement that results in the transfer of new or increased financial resources from those willing to pay for sustainably produced goods and/or forest ecological services, to those willing to provide these functions in turn*".

More specifically, Wunder (2005, pp. 3) describes a payment for environmental services scheme as having the following characteristics:

I. "*A voluntary transaction where*
II. *A well defined environmental service (or a land use likely to secure that service)*
III. *Is being bought by a (minimum one) environmental service buyer*
IV. *From a (minimum one) environmental service provider*
V. *If and only if the environmental service provider secures environmental service provision (conditionality)*".

Although PES schemes can take on different forms, and be applied in diverse situations, they all include some key components. Mayrand and Paquin (2004) list those characteristic contributing to the well functioning of a PES scheme:

- The link between land use and service provision is based on clear and consensual scientific evidence;
- The environmental services to be provided are clearly defined;
- Contracts and payments are flexible, ingoing and open-ended;
- The transaction costs involved in the scheme do not exceed potential benefits;
- The scheme is sustained by multiple sources of revenues delivering money flows in a sufficient and sustainable way;
- Compliance to the scheme, land use changes and service provision are regularly monitored; and
- The scheme is flexible enough to be able to adjust to changing conditions, as well as to allow adjustments.

Information flows, knowledge and good communication among the parties involved are also fundamental elements contributing to the implementation of a payment system. In fact, the recognition of ecosystem services, and the awareness about their importance for human life and economic activities, determines whether individuals are willing to pay or the maintenance and improvement of these services, or in other words to the availability of funding for ecosystem management (Meijerink et al, 2008). The same authors also point out other elements playing a crucial role in the design and implementation of incentives schemes, namely: the existence of a well functioning governance regime, with well defined property rights; reasonable transaction costs, and; a well functioning institutional environment. In particular, it has been suggested that the ideal institution managing the PES scheme should be a multi-actor organization, including government representatives, private institutions and NGOs, in a way that ensures transparency and impartiality (FAO-REDLACH, 2004).

2.4.3 Types of incentives

Several types of incentives have been devised in PES schemes. The first distinction to be made is related to the source of funding. Sometimes, PES schemes are arranged and organized spontaneously by private actors through self-organized private market arrangements, such as for example transfer payments, land purchases, cost-sharing arrangements, low-interest credit, purchase of land-development rights, and direct payment schemes. In other situations, as it is often the case, conservation and restoration interventions are funded through voluntary private, non-market funding mechanisms, such as for example private donations and philanthropic funds. Governments can also facilitate the creation of a market for environmental goods and services by setting up property right mechanisms and tradable quotas, or can implement

financial mechanisms themselves through payment, taxation, and/or subsidization mechanisms (de Groot et al, 2007).

Another classification is suggested by Casey et al (2006), who developed an exhaustive taxonomy of the existing incentives based on a socio-economic perspective, which is summarized in Table 2.3.

Category of incentives	**Examples**
Regulatory and economic disincentives	Government regulation, conservation compliance, financial charge/penalty
Voluntary incentives	
Institutional innovation	Legal/statutory, safe harbour, candidate agreements, regulatory relief
Property rights innovations	Conservation easements, covenant and deed restrictions, stewardship exchange agreements
Market oriented institutions	User fees, eco-tourism, ecolabelling and certification, Mitigation banking, conservation banking, tradable development rights
Financial incentives	Compensation programs, cost-share incentives, land and water leases, conservation contracts, debt forgiveness, insurance
Public tax incentives	Income tax incentives, property tax incentives, estate tax incentives
Facilitative incentives	Education, information and technical assistance, administration and organization, recognition

Table 2.3- Overview of existing incentive types categorized according to socio-economic criteria (from Casey et al, 2006)

A detailed description of all the possible incentive types is out of the scope of this report, but it is useful to present an overview because the definition commonly used –payment for environmental services- might be misleading, as it is suggest the idea of financial payments only. Actually, incentives can be developed in innovative and creative ways, such as for example the Adopt and Acre of Rainforest initiative in Cocobolo Nature Reserve, Panama: a local NGO provides training to local communities on sustainable agricultural techniques, which do not involve for example slash and burn practices; funding is provided by people all around the world, who become 'guardians' of an acre of rainforest in the Reserve (Meijerink et al, 2008). On the other hand, also financial incentives can take different and innovative forms: for example, funding could be provided to ad-hoc community-based organizations for the creation of a landscape labelling system, identifying and promoting landscapes providing intact or improved environmental services (Ghazoul et al, 2009).

The type of incentives used in the PES scheme is not an irrelevant aspect. On a psychological level some theoretical and empirical evidence shows that economic behaviour is shaped by a range of motivations. In particular, people often contribute to the maintenance and/or provision of a public good moved by an intrinsic altruistic motivation, which can be crowded out by monetary rewards, and once the so-called "warm glow", or the social approval, is separated from an activity, it may be difficult to recover (Reeson and Tisdell, 2006). Therefore, the same authors suggest that environmental policy design could benefit from a better understanding of existing voluntary behaviour and motivations, as good incentives can crowd in intrinsic motivation,

especially when combined with a greater consultation and information flow among the relevant stakeholders; in conclusion, it is observed that in incomplete markets the promotion of a pro-social behaviour will yield the best results. The role played by motivation as a fundamental component of participation in PES schemes is further highlighted by Kosoy et al (2008): *"it is important to look beyond the idea of 'incentives' to move towards that of 'motivation'. Involvement is PES may not then be a matter of compensating for opportunity cost, [...] but rather a question of how non-monetary individual and collective motivations [...] can be further strengthened and supported through PES programmes"*.

The relevance of this arguments will appear clear in the following chapters, as the objective of this research is to understand the economic behaviour of local landowners with respect to catchment restoration, as a basis for the design of a payment for watershed services in the study area.

3. Context of The Decision Problem: Socio Economic Background, Catchment Restoration and its Socio-Economic Implications

3.1 Introduction

The problem described in Chapter 1, presented in its simplest form, was actually identified and isolated through an extensive exploration of the socio-economic background and the issues related to land and water management in the study area. In fact, it is just the "top of the iceberg" in a much more complex situation as well as context-specific. Situations in which there are many interrelated issues to be faced, a whole range of possible definitions of what is going on, and some level of disagreement are defined by Ackoff as "messes" (in Pidd, 2003). The various links between the separate issues revolving around the mess makes it necessary for the analysts to pay attention to both, as the links might be important as the issues themselves; moreover, oversimplification of the mess must be avoided at all cost (Pidd, 2003). For this reason, it is of crucial importance to give an overview of the context in which the decision problem was found. In fact, many of the information collected during the exploration phase will be extremely useful in the problem structuring phase, when the management goals (or criteria) of the decision maker (the landowner), as well as the alternatives, will be formally identified and formulated.

Before describing in detail the socio-economic background of this study, however, it is useful to have an overview of the physical settings of the Baviaans catchment, as feature such as rainfall and evapotranspiration are heavily influencing the hydrologic phenomena, as well as the suitability of the area for farming and hence its economic potential –in fact, as explained later on in the chapter, farming is the main economic activity of the Western Baviaanskloof. A summary of the relevant physical settings is given in Table 3.1

The Baviaans Catchment	
Location	23°35'S to 24°25' and 33°30'S to 33°45'S (South-East of Willowmore and approx. 100 km North-West of Port Elizabeth, Eastern Cape, SA)
Topography	Very rugged and deeply folded area, with the exception of the fairly flat floodplain on the valley bottom. Very steep mountains: two thirds have a slope of more than 30% Elevation of the valley floor: from 700 to 300 m +MSL
Average Maximum Temperature	Range: 32° in January/February - 20° in June/July
Average Minimum Temperature	Range: 16° in January/February - 5° in July
Average Annual Rainfall	~300 mm Non seasonal, although approx. 2/3 of the annual rainfall often falls in summer Rainfall is also characterised by a large inter-annual temporal variability
Average Annual Evapotranspiration	~1125 mm

Table 3.1- Overview of relevant physical settings of the Baviaans catchment (from Jansen, 2008)

The information presented in this chapter draws mainly from semi-structured interviews and field visits with the landowners; questionnaires were also distributed to landowners in order to

gather more quantitative information about their economic activities and to estimate their willingness to get involved in restoration (see Annex II). Other sources of information, such as interviews and consultations with experts and previous studies carried on in the area, will be used when necessary. Most of these activities were carried out during the internship period. The present chapter itself is an adaptation from the final internship report "River system restoration for a sustainable land and water management in the Baviaanskloof Mega-Reserve".

3.2 People and livelihoods in the Western Baviaanskloof

The local community of the Western Baviaanskloof is compounded by 16 large Afrikaaner landowners, a farm owned by several coloured shareholders (Sewefontein), a coloured church community (Zaimaanshoek) and the white-owned community farm of Tchnuganoo. In particular, this research focuses on the 11 large landowners (see list in the Annex III) who are living and farming in the valley, since they are the main water users as well as the main stakeholders involved in land and water management. The other landowners bought the land for holidays and recreational purposes and live elsewhere in the country (e.g. Johannesburg). At the present stage, farming activities in Sewefontein are still facing constraints and challenges and have not yet reached a large scale, thus were not included in the area since they make limited use of water resources compared to large farmers.

It is important to notice that many people from Sewefontein and Zaaimaanshoek are employed as farm workers, and other coloured families are spread over the whole valley as farm labourers and dwellers. Indeed, large landowners are still the main job providers in the valley, employing people from the coloured communities as farm labourers and domestic work, as well as in tourism activities. Since watershed restoration might have an influence on the scale of farming activities, it might also have employment implications, which means that the coloured community might be affected. Hence, although large farmers are the main focus of this research, the impact on local coloured communities of restoration will also be mentioned.

3.2.1 Large landowners

Although landowners in Western Baviaanskloof are identified and treated in previous studies as a unique stakeholder group (see for example Noirtin, 2008), they form quite a heterogeneous group and this diversity can be quite relevant for the purpose of this research. The extent to which every landowner is involved in farming activities is highly variable, and this has a fundamental influence on the extent of water use and land and water system degradation on the farm, as well as on the plans for the future and the attitude towards restoration. Nevertheless, it is useful to have a general picture of the main economic characteristics of the farming population in the area, as illustrated in Table 3.2.

Landowners of the Western Baviaanskloof- Main economic characteristics		
General information	Number of landowners	15
	Number of actual water users*	11
	Average property size	2900 ha (Range: 560-7500 ha)
Land uses	Livestock	Angora goats, sheep, ostriches, cattle
	Crops	Alfa-alfa, other fodder, maize, wheat and others
Economic activities	Farming (average % of total income)	54%
	No. of landowners engaged mostly in farming	6
	Tourism (average % of total income)	35%
	No. of landowners engaged mostly in tourism	5
	Other activities (average % of total income)	11%

**sample of this research*

Table 3.2- main economic characteristics of landowners of the Western Baviaanskloof

In the same way, for easiness of description it is useful to classify landowners in two main categories, while of course keeping in mind the high individual variability.

Some landowners can be considered actual farmers, since they are mostly involved in farming activities. They were typically born and bred in the area, and their families have been living in the valley for generations. With a few exceptions, they are all between 30 and 40 years old, they have kids about the same age and they form quite a compact group. They are the most relevant group with respect to this research, since they are big water and land users, and the most serious cases of river system degradation were found on their farms. Moreover, although they are all involved in tourism to some extent, they get most of their income from farming, and thus the reduction of farming activities would have a big impact on their livelihood.

Other landowners are mostly involved in tourism accommodation and catering, although some of them carry on some farming, often more for personal pleasure than for real necessity. Most landowners in this group are "newcomers" in the valley and they bought the properties because they love that kind of lifestyle and not really because of farming. Nevertheless, their sources of income are extremely diverse: tourism is the bulk of income only in two cases, while the others base their livelihood on a combination of farming, tourism and other businesses (for example, building contracts). In the latter case, some landowners are still deriving most of their income from farming, although they are planning to gradually reduce the extent of farming in favour of tourism.

3.2.2 Opportunities and challenges facing local landowners

At present, landowners are faced with diverse challenges, pressures and opportunities which they are obliged to consider when taking decisions on livelihood strategies. Farming activities still represent the main source of income for local residents, although they are becoming less and

less profitable, as input costs are fast increasing and sale prices for end products stay more or less the same. On the other hand, tourism is still a new business and hence it has a huge potential which has not been developed yet.

Being agriculture the main economic activity, water is a crucial resource. While on the one hand water is getting scarcer, and rainfall are becoming increasingly unpredictable (Jansen, 2008), the demand for water downstream (Gamtoos valley and the town of Port Elizabeth) is increasing. Since the Baviaanskloof is a strategic catchment for water provision to the Kouga dam, all these issues and claims represent an additional pressure on local inhabitants.

In addition to this, private land is surrounded by the Nature Reserve, and this means that there is a strong interest in conserving and restoring the natural landscape. This is both a pressure and an opportunity for farmers. In fact, on the one hand the Reserve managers are trying to promote more sustainable land and water management and restoration activities on private land, which can also mean a reduction in farming activities and/or water consumption; on the other hand, these activities would improve the natural landscape and therefore further enhance the tourism potential in the valley.

3.2.3 The vision for the future

Quite interestingly, almost all landowners share a common vision for the future of the Western Baviaanskloof, regardless of their different livelihood strategies. This vision includes farming activities on a smaller scale, but more intensive, in favour of a growth in the tourism business, which in turns implies that portions of land will be taken out of production to be part of the natural system. A substantial increase in the number of tourists is expected, although many local inhabitants agree that tourism should keep its current "*niche*" character, since mass tourism would disrupt the wild and peaceful atmosphere of the valley.

With few exceptions, however, landowners got engaged in the tourism business a few years ago, as a way to create additional income, and hence in many cases farming is still providing the necessary capital to run tourism accommodation. As pointed out by a farmer, "*you can't jump into tourism and make a profit out of it during the first years. There must be a period of overlap of farming and tourism, because farming feeds tourism at the beginning –in fact, tourism takes some time to pick up and become profitable*", and this is quite a common feeling in the valley.

It has to be pointed out, however, that a reduction of farming activities in favour of tourism would not be socially costless. Farming, in fact, is more labour-intensive than tourism, and an expansion of the latter business might imply less job opportunities for the coloured communities, whose members are currently massively employed as farm labourers.

3.3 Agriculture as the largest land and water user

As mentioned before, at the present stage agriculture is still the largest economic activity in the area. Most of the agricultural land is used for livestock grazing, and it also includes a portion of irrigated pastures. A smaller area is used for crops, with alfalfa as the most common crop – used both for fodder storage during winter months and for direct grazing. Other crops such as maize (in summer) and wheat (in winter) are also grown, together with onion seeds, beans, carrots and pumpkins (this results are in line with Jansen, 2008).

Crops are grown on the large and fertile floodplains, while grazing lands (the "veld") can be found both on the floodplains and on the surrounding hills. Altogether, 35% of the Baviaanskloof area is used for agriculture (Jansen, 2008).

Livestock keeping uses most of the land devoted to agriculture, and Angora goats, sheep, ostriches and, to a lesser extent, game farming represent the main source of income (de la Flor, 2008; Jansen, 2008). Grazing, and specifically overgrazing in the past, is the major driver for the extensive degradation of the original subtropical thicket vegetation on the north-facing slopes. The degradation of the natural vegetation interests the whole valley, although its extent is highly variable, since some landowners have taken measures to reverse the process in the past decades with visible improvements. On the other hand, in some locations degradation is so intense that the soil is bare on a large percentage of the total area: this makes it impossible for the vegetation to recover naturally (Turpie et al., 2003), since the top soil is lost, but it also means that those areas are lost to livestock grazing. Yet, it would be a mistake to blame only the present farmers for allowing overgrazing: in most cases, in fact, the degradation is the result of overgrazing in the past, generally during the 1930's and 40's, and the subtropical thicket regenerates very slowly.

Although livestock grazing is by far the largest land use in the area, water consumption by livestock represent only a small portion of the total water used in the area, estimated to be around 24,116 m3/year (de la Flor, 2008). Irrigation, both for crops and grazing land, is by far the largest responsible for water consumption in the area –domestic use is almost irrelevant, being around 1,642 m3/year (de la Flor, 2008). According to this study, licences for irrigation water cover a total area of approximately 395 ha, although this is likely to be an underestimation, since a few landowners did not answer this question –in Jansen, 2008, an estimate of 300-500 irrigated hectares is reported, according to DWAF data. In terms of water consumption, total water use for irrigation in the Western Baviaanskloof is estimated to be between 1.75 millions m3 and 2 millions m3 (Jansen, 2008, and DWAF, 2004, in Jansen, 2008). A summary of the different water uses in the area is presented in Table 3.3

		Volume (m^3)
Water uses	Irrigation	1.75 – 2 millions
	Livestock	24,116
	Domestic consumption	1,642
	Total water use	1,775,758 – 2,025,758

Table 3.3- Water uses in the Western Baviaanskloof (source: de la Flor, 2008; Jansen, 2008)

The most common water management measures are furrows and pipelines to channel water from sources and fountains to the irrigation dams; most of "lifestyle farmers" do not have any other water management measure.

All kind of irrigation systems, such as flood irrigation, sprinklers and pivots can be found in the valley. The type of irrigation system is directly related to water consumption: flood irrigation is undoubtedly the less efficient method, followed by sprinklers and pivots, which is the most efficient one.

Water supply comes from different type of sources, namely howls and pits (holes in the ground close to the river bed, hence exploiting the underground water table) and natural springs, often located in the lateral valleys. Every farm has its own water source, and servitudes on other

properties are quite common. It also happens that water sources are shared among different landowners. The assignment of water sources to every property was established long ago, through informal or written agreements, and only recently landowners had to apply for a license, in order to comply to the National Water Act (1998). Although the process of licensing is still on-going, it is expected that the licensed water rights will be in line with the previous arrangements.

Besides irrigation infrastructures, in more intensively cultivated farms measures to protect crops from floods are also very common. These measures are usually in the form of weirs built on the banks of the main river and keerwalle built to deviate the natural course of tributary streams: both interventions have the aim of controlling the water flow during heavy rains and to prevent overflow on the surrounding areas. These measures appear to be successful against floods, but they also brought major changes to the river system, as the next section will show.

3.4 Watershed services provided by the Baviaans catchment

The Baviaans catchment provides most of the existing watershed services. Unfortunately, human interventions and farming activities in the valley have affected the well functioning of the system and therefore the provision of watershed services, both on site and downstream (see also Jansen, 2008).

Obviously, the loss or disruption of watershed services implies issues and costs for human well-beings and economic activities, both on site and downstream. As the costs downstream are not the object of this research, and they are dealt with in great detail by van der Burg (2008), this section focuses only on the economic consequences of degradation in the Western Baviaanskloof. The main economic consequences of river system degradation is summarized in the following chapters, which draws from interviews with local landowners, consultations with experts and Jansen's study (2008).

Loss of water retention capacity

The lack of retention capacity is seen as the major problem in the catchment by many landowners, since during heavy rainfall events only a small portion of the water is kept in the valley, while the rest just flowing fast to the Kouga dam. A healthy system, in fact would be able to buffer and retain water during heavy showers, contributing to the water table and benefiting natural vegetation and water availability on the farms. This also affect storage in the Kouga dam, as in periods with high rainfall the water inflow might exceed the storage capacity, resulting in water losses through spillage. The current situation thus implies a loss of precious water which might be avoided through an improved catchment management.

The implications of a lower water table and loss of silt deposition

In 1981 a subsidy program promoted the construction of embankments ("keerwalle") and overflow furrows with the aim of deviating the waterflow of tributary streams away from crops and grazing land located on the floodplain. This has resulted in fast-flowing streams during heavy rains and hence a deep incision of waterways. For this reason, the water table has lowered and silt deposit is no longer possible, thus reducing water availability and soil fertility of the natural grazing land and its grazing capacity as well. Indeed, according to a landowner, who has

a similar measure on his property, "*the construction of these channels was the biggest mistake ever made in the valley*".

The consequences of drought

Form the results of the interviews with landowners, it is not clear whether the degradation of the river system, and the consequent reduction of drought mitigation capacity, has actually resulted in an increased drought strength. None of the farmers noticed an increase in the effects of the current drought compared to other dry periods in the past –although the effects of the system degradation are likely to become evident over the long term. This also means that, being a common phenomenon in the valley, farmers are used to face the problems and have developed coping mechanisms against droughts, such as for example irrigating only the most profitable crops at the expenses of others.

Flood damages

Although floods were expected to be a major problem in the valley, according to landowners this is not a big issue. In fact, if it is true that these events bring some damages, on the other hand they occur only every 10-15 years and the economic damages are never so relevant. Among damages, the most important one is the loss of crops, since some farmers experienced soil losses where crops were washed away, but the affected area was always in the range of a couple of hectares. Floods also cause damages to fences and, to a lesser extents, farm roads, while livestock losses, when occurring, are never serious. When crops are washed away that portion of land is lost for the whole season, and replacing the soil is expensive, but in general floods have no long-term consequences and it takes from 1 to 6 months to repair the damages. However, the financial effects of a flood can represent a problem: according to a landowners, *"you do not feel the consequences right away, you feel the financial effects in 1 year. Fixing the damages is not in the normal budget, so you try to spread the expense over time"*.

3.5 Baviaanskloof Integrated Catchment Restoration program

During the first consultations with farmers, experts and other relevant stakeholders, the need for catchment restoration emerged abruptly, together with the willingness of researchers, implementers and farmers to get involved in the process. This realization prompted the setting-up of a collaboration between several organizations, including DLG, Alterra-WUR and LivingLands, which gave birth to Baviaanskloof Integrated Catchment Restoration Project which will be operating starting from 2009 (see Annex V for the complete program overview). This project is now a partnership between GIB, DWEA, WWF, SANBI, CSIR, R3G and Rhodes University.

The following sections draw from the outcomes of the River System Restoration Field Trip held in November 2008 and organized by the PRESENCE network, as well as from other expert interviews and Jansen's land and water assessment (2008) where necessary.

In order to reverse, if not to stop, the degradation of the Baviaans catchment, a set of measures has been identified together with priorities for the implementation, as presented in the following paragraph.

3.5.1 Rehabilitation of tributaries streams and related floodplains

The rehabilitation of tributaries stream is seen as the first priority in the area –an example of the consequences of human intervention is illustrated in Figure 3.1.

Figure 3.1- Example of degradation caused by human interventions on tributary streams

It involves the closure of the channels deviating the water directly into the main river, and the removal of keerwalle thus re-opening the natural water ways: this would allow water to flow over the floodplain again, feeding the now dried-up land and depositing silt. According to various experts and implementing agents, this kind of intervention is simple and inexpensive, but it is likely to yield excellent results and to release a lot of pressure from the system, since it would slow down the water flow to a great extent.

3.5.2 Rehabilitation of the natural vegetation on hill slopes

The loss of vegetation cover over large areas of the catchment (Figure 3.2) puts a lot of pressure on the river system because of the high runoff and poor infiltration rate. Replanting pilot projects –part of the Subtropcal Thicket Restoration Programme (STRP)- in small areas have tried to restore the subtropical thicket cover in the past, by planting spekboom, a pioneer specie.

Figure 3.2- Serious degradation of the original subtropical ticket due to overgrazing

Due to the extent of the degraded area, however, replanting might not represent a viable option, since it is expensive and time-consuming –although very effective. For this reason, an alternative method, known as brush-cutting, was suggested. This intervention and the rehabilitation of the tributary streams might be implemented at the same time; in any case the restoration of the hill slopes is a high priority and it should not be done after step 3, since it also releases a high degree of pressure from the river system.

3.5.3 Rehabilitation of the main channel

As a last step, human interventions on the main channel and their negative effects must be addressed and reversed. First of all, weirs channelling the river to control the water flow and protect the crops must be removed, allowing water to flow freely on the floodplain. At the same time, this alone is not enough to reverse the serious erosion affecting the river bed: to address this problem, small retention structures must also be built where necessary. These structures slow down water and allow sediment deposition on the river bed, thus stopping and reversing incision, a common problem of which an example is given in Figure 3.3. Moreover, during field visits some sites were discovered where wetlands were in the past: wetlands must also be restored since they play a fundamental role in the regulation of water flow. The rehabilitation of the main channel is undoubtedly very expensive and time-consuming, as it was

Figure 3.3- Incision on the Baviaans river bed

pointed out by Pierre Joubert (Gamtoos Irrigation Board), who is currently implementing wetland restoration in the Kromme catchment through the Working for Wetlands program. However, this is not the only reason why restoration of the main river must be the last step. In fact, interventions on the main channel are extremely vulnerable to flood events, since they might be easily washed away, and the previously mentioned interventions would be highly beneficial in slowing down the water and releasing pressure from the system, thus reducing the risk of these measures being washed away.

3.6 The willingness to restore

As mentioned before, the involvement and consensus of local communities in the restoration process is essential for the success of a restoration programme and for a successful establishment of a Payment for Watershed Services scheme. Therefore, a thorough understanding of landowners' willingness to restore and the trade-offs involved is the necessary background needed to identify the most suitable ways to promote and market restoration, as well as to identify the issues and needs which must be addressed by an incentive scheme.

Before trying to evaluate the attitude toward restoration, it is useful to assess which land and water problems are perceived by landowners at the single farm level. Indeed, every farm is a different case, and different land and water problems can manifest in different farms; furthermore, the existence of a problem does not necessary mean that this is considered an issue by the interested landowner. Respondents were confronted with various land and water problems found in the valley, and they were asked to indicate whether each of them represented a problem on their property.

The results show clearly that the functioning of the catchment, as well as the watershed services provided by it, are well understood by farmers, as well as the consequences of watershed degradation and the need for restoration.

From this rapid preliminary assessment, it appears that river system restoration is quite welcome in the valley. Landowners showed a high awareness of the needs and reasons for restoration, as well as the beneficial effects that the measures would have for the catchment and for their own farming activities too. It also appears that the awareness and the general interest towards the natural environment and its restoration have improved over the years, as proved by the enthusiastic participation of some landowners to the activities organized by the PRESENCE network.

The picture emerging from this rapid survey is indeed pretty encouraging, and it can be explained by various factors. First of all, it was previously shown that the economy of the valley turns around agriculture, and therefore it heavily depends on water supply and watershed services at large. In fact, many regulatory services have an influence not only on water availability, but they also allow the sound functioning of the system sustaining agriculture, tourism and human life in general. Therefore, the high level of interest, care and concern towards the health of the system and its restoration shown by farmers is not surprising.

However, this explanation alone does not give the complete picture, since it would put landowners' awareness and willingness to restore under a mere financial perspective, and it

would overlook other important altruistic motivations. During interviews and informal chats, in fact, it turned out that landowners are not willing to restore only out of economic interest, but also because of a deep rooted love for the valley they are living in and for the land they are farming. All landowners stated, in one way or the other, that they could not live anywhere else. In addition, for all of them farming is not just a way like another of earning an income, but it is their passion and they will never quit it completely, even if it will turn out to be an unprofitable activity.

3.7 The costs and benefits of restoration from the landowners' perspective

For the purpose of implementing a restoration program, complemented by a PWS scheme, landowners' willingness to get involved is obviously a crucial matter to be investigated beforehand, but it is not the only information needed. In fact, to build the case for a PWS scheme, the balance between costs and benefits of restoration on site must also be carefully identified and valued, because in case the benefits exceed the costs there would be no scope for compensating landowners.

Since the purpose of this study is to investigate the decision problem faced by landowners when deciding to get involved in the restoration programme in the context of PWS scheme, such costs and benefits have not been quantified and valued, but at the same time the information collected allows for a general overview and for some preliminary considerations.

First of all, it is believed that the challenge to a successful payment scheme is to determine the balance of costs and benefits case by case, or better farm by farm, and see if and how incentives can play a role. The assessment should be done at the very local scale, because every farm is different and therefore the balance between costs and benefits might also differ. In fact, it might happen that in some cases the benefits of restoration outweigh the costs, and thus there would be no need for incentives. In other farms, rehabilitation measures might have adverse effects on crops or grazing land –for example, the restoration of the river bed might cause the loss of productive land on the floodplain- and in this case these losses should be compensated. The guiding principle to this way of thinking is that landowners' income should not be affected by restoration.

An investigation of the costs and benefits after restoration, as compared to the current land and water management, was conducted for a selected study site. The site is Gannaland Kloof, a tributary of the Baviaans river located on the farm Zandvlakte. Due to time constraints, the information collected for that site is highly incomplete; it makes it possible, however, to give e general overview of the possible costs and benefits of restoration, as illustrated in Table 3.4, even though it must be kept in mind that the listed costs and benefits may not be realized in all farms and at the same time.

Benefits
Increase of grazing capacity on hills and floodplains
Increased water availability, especially in dry periods
Reduced flood damages
Possibly, reduced pumping costs
Possibly, land tax reductions
Added value for tourism, in terms of improved landscape
Added value for eco-tourism initiatives

Costs
Possible loss of crop areas on floodplains
Possible loss of grazing areas on floodplains
Restoration costs

Table 3.4- Overview of expected costs and benefits of catchment restoration at the farm level.

3.8 Conclusions

As the following chapter will deal with the problem structuring phase, it is useful to summarize the information contained in this chapter following the guideline suggested in the theoretical framework (Chapter 1, from Belton and Stewart, 2002). It was stated there that the problem structuring phase is a process "from complexity to simplicity", and it requires an insight on the following elements: identification and description of the relevant stakeholders, goals and values, uncertainties, external environment, key issues and constraints.

The relevant stakeholders in the decision problem at stake are local landowners in the Western Baviaanskloof. For this reason, the rest of the above elements will be considered from landowners' point of view, and the focus will be on the elements with an influence on the farm household's economic decisions. Although some of them are predominantly tourism-oriented, farming is still the main source of income for the majority of farmers. It is worth noticing that, from a broader perspective, they are not the only stakeholders involved in water management and catchment restoration, but they were chosen as focus of this research because a detailed analysis of their willingness to get involved in rehabilitation, and at which conditions, was needed. At this stage, some information is already available: in general, farmers are quite favourable towards restoration, but they also indicated issues and concerns which can be best explored by a MCDA approach.

All local farmers share common goals, first of all the need of a stable source of income for their families. On the long term, a reduction in farming activities in favour of tourism is envisaged. Besides, they all wish to address the common problems of water scarcity and land degradation. One of the main drivers behind farming, besides economic considerations, is passion for this activity. Further more, they all share a love for the land they live in and they all want to keep living and farming in the area.

Local landowners are currently facing key uncertainties regarding their economic activities and catchment restoration as well. Although it was not mentioned in the present chapter (see Chapter 1), a big uncertainty is represented by climate change: although some projections are available –rainfall is expected to become increasingly erratic, with rain more concentrated during summer and longer dry periods (Jansen, 2008)- at this stage it is not possible to know what it is

going to happen. The future climate patterns are likely to influence, or even affect, both farming activities and the consequences of restoration measures.

Other key uncertainties facing local landowners are economic uncertainties, like fluctuations in livestock and crop prices and the growth of the tourism sector in the area.

Besides uncertainty, landowners also have to deal with the external environment, which confront them with both opportunities and constraints. The growing national and international interest in the Baviaanskloof is fuelling the growth of the tourism sector, which represents an attractive alternative source of income to farmers.

The private land in the Western Baviaanskloof is also part on the Baviaanskloof Mega-Reserve, and it is surrounded by the protected area, where nature conservation is the priority. This represents a pressure (but also an opportunity) for farmers, as they are encouraged to manage their land in a more sustainable way. Moreover, the relatively recent opportunity of starting a catchment restoration program in the area is also a stimulus and a pressure for farmers to harmonize their management style to the natural environment.

In these complex circumstances, farmers are obviously confronted with several issues and constraints when taking economic decisions. If on the one hand tourism seems a promising sector, on the other hand it is not financially viable to convert to tourism as a main income source, at least on the short term. It must be also taken into account that a major shift to tourism is likely to involve a reduction of job availability in the valley. It is also true, however, that farming is becoming less and less profitable, and this calls for alternative solutions. Water availability is also a big constraint for farming activities. Widespread land and water system degradation worsen the situation both in terms of profitability (e.g. decrease in carrying capacity of natural grazing land) and water availability. Catchment restoration would undoubtedly bring beneficial effects to water availability and soil fertility on grazing land, but it might also involve costs in terms of adverse consequences for crops, among others.

It is therefore evident that engaging in catchment rehabilitation is not a simple decision for landowners, as it interacts with the overall socio-economic and environmental context of the Western Baviaanskloof. In particular, it is clear here that many issues are revolving around the seemingly simple decision problem –to restore or not to restore?- analyzed in this research, and that these issues are interrelated to each other in quite a complex way. In order to organize and structure the multitude of factors involved in this decision problem, a formal approach will be presented in the following chapter.

4. Problem Structuring

4.1. Introduction

In the previous chapter, the decision problem and the issues involved has been investigated in great detail. Due to its complex nature, it is now necessary to organize and structure this problem in order to develop a meaningful MCDA model. Some definition of the problem must be developed, paying attention to the relationship between this problem and other things: this is the idea behind the concept of problem structuring (Pidd, 2003). In other words, problem structuring is the process of making sense of an issue, since "*a problem well structured is a problem half solved*" (Belton and Stewart, 2002, pp. 35). It is worth stressing, at this stage, that "*the validation of a model of human values is a different prospect to that of a physical system, as there is no external reality against which it can be compared. Indeed, we view the process as constructive, helping decision makers to understand and to define their preferences, rather than descriptive, describing what they do and seeking simply to elicit their preferences*" (Belton and Stewart, 2002, pp. 35). This quotation highlights the importance of the problem structuring phase in the MCDA process, and it also justifies the need for extensive consultations with the stakeholders aimed at a thorough exploration of the problem to be tackled.

Several steps and related techniques have been developed in order to aid problem definition (see for example Belton and Stewart, 2002, or Pidd, 2003, for an overview). The steps and tools used in this study were chosen and applied with the help of professor Theodor Stewart, who provided guidance and feedback throughout the whole problem structuring phase. The first step is the identification of the policy scenarios, or the decision alternatives to be examined and compared. Then a formalized decision support structure, based on the problem to be solved, was developed following the 4 steps indicated by Stewart et al (in press). First of all, the correlations between all concepts and issues related to the problem are identified with the help of a causal map. This will allow the identification of stakeholders' management goals, which are consequently summarized and organized in the value tree. This whole process eventually brings to the formulation of criteria, which together with the selected policy scenarios constitutes the final formalized decision support structure, as this chapter will show.

4.2 Identification of policy scenarios

In order to identify the possible alternatives involved in my MCDA problem, a scenario-based framework was chosen, based on Stewart and Scott, 1995. According to the authors, a policy scenario is "*a statement of a particular policy and its likely consequences*" (pp. 2835). The scenarios are described only to a level of detail necessary to provide a clear picture to the parties involved (in this case, to the farmers).

More specifically, the scenario-based approach involves the identification of all possible "policy elements" (that is, the policy instruments that can be utilized to reach the stated objective) and, in turn, all possible combinations of the different policy elements. This lead to the identification of a "Background Set" of options. Among these alternatives, a small number of viable alternatives, called "Foreground Set", will be selected: the aim is to produce "*a small*

number of policy scenarios that both illustrates the richness of options available and allows the different groups to express their values in a meaningful manner" (Stewart and Scott, 1995, pp. 2837).

This approach was chosen because it is a useful tool to organize concepts and ideas, and it structures the identification of viable options. In this study, the policy elements to be considered are first of all whether the rehabilitation is implemented or not, and secondly the possible incentives that could be given to farmers.

The policy elements relevant to this research, and therefore the foreground set, have been identified as follows:

- Rehabilitation: it makes sense to include one scenario in which rehabilitation is not carried out (baseline scenario), to explore farmers' preferences; in all other scenarios, restoration is undertaken. As funds are available to implement the rehabilitation measures, it is assumed that the restoration costs are covered by the implementing agent;
- Flood insurance: the creation of an insurance fund, to cover for possible flood damages occurring in the restoration sites, is seen as a promising alternative to financial incentives and as a way to address the common concern for increase of flood damages after restoration;
- Financial incentives: this kind of incentive is meant to cover the opportunity cost of restoration (in case land use after restoration is less profitable than current land use) and the potential time-delay of the benefits brought by rehabilitation;
- Tourism marketing plan: considering the increasing economic importance of tourism in the area, farmers might appreciate the setting-up and implementation of a marketing plan instead of economic incentives.

The policy elements described above were then combined following a precise logic: every type of incentives will be evaluated singularly in the MCDA, although combinations of the above would be in principle possible. The combination of different types of incentive, however, would complicate the analysis and could even be confusing. It is believed, in fact, that analyzing landowners' preferences for the single incentive can provide precious information about their economic behaviour and their priorities for the future. The resulting policy scenarios, or alternatives, are presented in Table 4.1.

Scenarios / **Policy elements**	**B**	**R**	**IF**	**F**	**TM**
1. Rehabilitation	No	Yes	Yes	Yes	Yes
2. Flood insurance	No	No	Yes	No	No
3. Financial incentives	No	No	No	Yes	No
4. Tourism marketing plan	No	No	No	No	Yes

Table 4.1- Selected policy scenarios

Legenda: B= baseline scenario (no restoration)
R= restoration
IF= restoration and creation of an insurance fund
Fi= restoration and financial incentives
TM= restoration and tourism marketing plan

Inclusion of uncertainties

Uncertainty is a common element of most decision situations, and it can take different forms which can be dealt with in correspondingly different ways (Belton and Stewart, 2002). In chapter 3, climate change, agricultural prices and tourism growth were identified as being key uncertainty with respect to the decision problem at stake. In particular, this study is dealing with what Belton and Stewart (2002) define external uncertainties, and in particular with uncertainties about the environment.

In the decision problem analyzed here, climate change is a crucial uncertainty: rainfall could stay the same as they are now, but as predicted they could also become more erratic and unpredictable, with longer dry periods and more intense and concentrated precipitations during the rainy season (Jansen, 2008). On the other hand, economic uncertainties (agricultural prices, tourism growth) are a kind of uncertainty which is embedded in the agricultural and tourism sectors. These are dynamic variations going on all the time, so there is no need for including them formally in the MCDA model, as they can be captured by standard procedures such as for example standard deviation (Stewart, pers. comm.).

Among the different available ways to include uncertainty about the environment in the analysis, the so called "scenario planning" (van der Heijden, 1996, in Belton and Stewart, 2002) was adopted here. This approach consists of modelling uncertainty scenarios relevant to the decision context (Belton and Stewart, 2002): these uncertainty scenarios are scenarios external to policy scenarios (Stewart, pers. comm.). It is relevant to point out that the likelihood of uncertainty scenarios happening is not supposed to be explicitly modelled: alternative actions are just summarily evaluated for each of these scenarios (Belton and Stewart, 2002).

As in this case the only relevant uncertainty is climate change, landowners' preferences for the five policy scenarios identified above must be evaluated under two different external –uncertainty- scenarios:

1. Unvaried climatic conditions
2. Climate change: Rainfall gets more erratic and unpredictable.

The idea here is that farmers' preferences for the five are likely to vary more or less considerably under the two uncertainty scenarios (Stewart, pers. comm.).

4.3 Causal map

The causal or cognitive map is a "*problem structuring tool used to represent subjective knowledge about a phenomenon, that is, a discourse about perceived causes and effects and about the perceived links between those causes and effects"*, with the objective of identifying which options are more influential on decision maker's goals (Montibeller and Belton, 2006, pp. 780). Its aim is to represent the problem or issue as the decision maker perceives it, structured in the form of a network of means and ends: since the purpose is to represent problem's perception in the most comprehensive way, maps can include several hundred ideas and concepts (Belton and Stewart, 2002).

A causal map for this study was built using an approach inspired by Stewart et al (in press). First of all, a brainstorming session was used to capture perceptions of the problem and goals according to what emerged during the extensive consultations with local landowners. To help the brainstorming, the following set of questions was used:

- What does farming mean to local landowners?
- What are the drivers behind farmers' land and management practices?
- What are the pressures coming from the external environment?
- What are the goals pursued by landowners when taking economic decisions?
- Which constraints do farmers face?
- Why do farmers think these elements are important? What influences what?

The various concepts resulting from the brainstorming session were connected by arrows, based on the causal relationships between the elements according to farmers. The map coming out of this exercise was then "pruned", eliminating repetitions and concepts irrelevant for the analysis and keeping the "core" concepts. For practical reasons, the causal map is not illustrated here, as the outcomes will be discussed and used in the following sections.

It is worth noticing that Stewart (pers. comm.) suggests a different methodology to develop this problem structuring tool. In Stewart et al (2009), for example, stakeholders' perceptions of the problem were captured during formalized brainstorming session using "post-its". All the concepts and ideas were subsequently grouped into clusters and the causal map was developed. Eventually, the causal map was presented back to stakeholders in order to get a confirmation that the perception of the problem was captured correctly. During this research instead, the idea of using a MCDA approach came about after the consultations with landowners and other experts, and therefore it was not possible to feed back the causal map to farmers due to a time constraints. Nevertheless, the preliminary results (as included in chapter 3), on which the problem structuring is based, were presented to landowners during the PRESENCE Information Day, and their reactions confirmed that the information presented was indeed consistent with reality and their perception of the problem and issues at stake.

4.4 The identification of management goals

The organization of concepts and thoughts in a causal map allows the analyst to identify the central themes, the driving forces and the management objectives involved in the problem at stake (Stewart et al, in press, and Stewart, pers. comm.). More specifically, the driving forces are represented as "tails" in the map (concepts with no incoming arrows), while the management goals are represented as "heads" (concepts with no outgoing arrows, or with predominantly incoming arrows) (Stewart et al, 2009). It is also possible, however, that some key concepts are identified as management goals even though one or a few outgoing arrows are present: it is the task of the analyst to determine whether this is the case (Stewart, pers. comm.)

From the causal map the following elements were distinguished, with the assistance of T. Stewart:

- Central theme
  The central theme, which is also the ultimate goal pursued in farmers' decisions, is to expand nature-based tourism at the expenses of farming on the long term, which can be translated into a more general goal of more sustainable land and water management

practices. A broad concept of sustainability is adopted here, according to the definition included in Perman et al (2003, pp. 86): "*a sustainable state is one in which resources are managed so as to maintain production opportunities for the future, [...] in which the natural capital stock is not declining over time, [...] and in which resources are managed so as to maintain a sustainable yield of resource services*".

- Driving forces
  The driving forces in this system can be identified as: farming as a passion, farming practices learnt long ago, need for nature conservation, willingness to keep land in good conditions and land degradation.
- Management goals
  The landowners' management goals emerging from the causal map are as follows: provide a stable income for the family, avoid risk, willingness to keep farming and efficient land and water management.

4.5 The value tree

Although the causal map is a very useful problem structuring tool, the development of a MCDA framework "*requires greater formality in identifying operationally meaningful criteria by which goal achievement (...) can be measured, i.e. measures which are understandable to all participants and for which relevant data can be obtained within time and resource constraints*" (Stewart et al, in press). In other words, the central theme or ultimate goal includes a hierarchy of more detailed, specific and measurable goals (Joubert et al, 1997). Therefore the fundamental objectives must be unpacked into operationally meaningful criteria: this can be achieved through the application of another tool, the value tree, which allows a hierarchical representation of decision criteria (Stewart et al, in press).

In this particular case, the management objectives identified in the causal map represent indeed sufficiently detailed and measurable criteria, and can be grouped into three broader categories, namely economic, social and environmental goals, which in turn all concur to the achievement of the ultimate goal, sustainable land and water management. The resulting hierarchical structures of goals at the various level is represented by the value tree in Figure 4.2. Although most of the relevant issues were captured in the causal map, based on the available information about the problem some further detail was deemed to be needed, and hence some additional criteria have been included in the value tree (see for example Stewart et al, 2009, for a similar procedure).

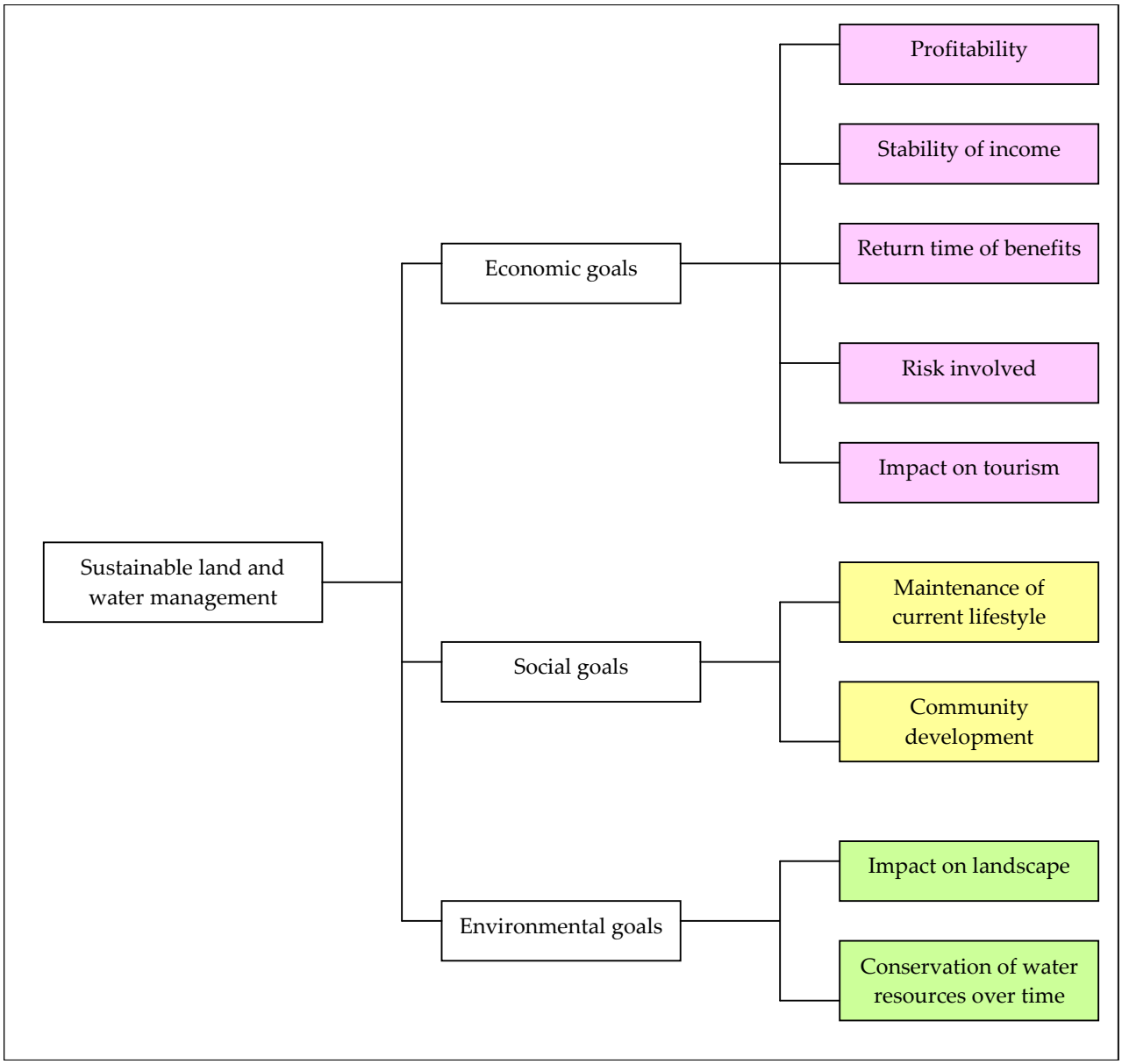

Figure 4.2- Value tree

The lowest-level objectives (on the right-hand side of the value tree) will be used in the MCDA against which the five policy scenario must be evaluated by local landowners. The nine criteria can be explained as follows:

1) Profitability: this criterion is quite straightforward, but is nevertheless worth noticing that it is obviously meant to measure landowners' perceptions (as it is the case for all criteria) about the profitability of the different policy scenarios;
2) Income stability: although a particular scenario might be profitable, this does not say anything about its impact on income stability over time, which must therefore be measured separately;
3) Return time of benefits: as restoration is expected to realize the full benefits on the medium term, it is important to assess farmers' preferences for the five alternatives from this poit of view;

4) Risk involved: this criterion refers primarily to flood risk, as it was the major concern expressed by landowners, but it can also involve other kinds of risk (e.g. economic risk related to tourism activities);
5) Impact on tourism: rehabilitation can, in principle, have a positive impact on tourism –for example, rehabilitation interventions in a farm can have a positive image return and attract tourists with environmental concerns;
6) Maintenance of current lifestyle: landowners stated in several occasions that they love life in the valley and they want to keep farming and living there, so it is meaningful to investigate the perceived impact of the five policy scenarios on their lifestyle;
7) Community development: a restoration program is likely to have an impact on the socio-economic equilibria of the Western Baviaanskloof, such as for example job creation and relationships between community members;
8) Impact on landscape: landscape beauty of the Baviaanskloof can be considered a fundamental local asset;
9) Conservation of water resources over time: water resources are a crucial limiting factor in an area where the average annual precipitation is around 300 mm; besides the economic importance of water availability, the conservation of water resources over time has a major impact on the health and well-functioning of the catchment.

4.6 MCDA template

The problem structuring phase has made it possible to identify two external scenarios, five policy scenarios requiring an evaluation, and nine criteria against which the policy scenarios can be evaluated –that is, nine perspectives from which landowners must express their preferences for the different scenarios. The very last step is the merging of scenarios and criteria in the final MCDA template (see Table 5.2 in the next chapter).

The application of this template, involving preference modelling and elicitation of preferences, will be dealt with in the next chapter.

5. *Multiple Criteria Decision Analysis Model*

5.1 Introduction

In the problem structuring phase a set of five policy scenarios has been generated, together with a set of nine criteria against which the policy scenarios can be evaluated and compared. The next step is the construction of a model representing landowners' preferences and value judgements, in order to explore their likely reactions and perceptions about catchment restoration and incentives to restore. Modelling is in fact aimed at constructing a view or perception of decision makers', in order to gain an understanding of what they really want to do and what can best satisfy their aspirations in the long term (Belton and Stewart, 2002).

As explained by Belton and Stewart (2002), this preference model includes two main components: preferences in terms of each individual criterion and an aggregation model allowing inter-criteria comparisons (trade-offs) and the aggregation of preferences across criteria. The concept of trade-off is of central importance in a multiple objective decision problem: complex decision problems, in fact, involve multiple conflicting objectives, and often there is not a dominant alternative that is better than all other options in terms of all these objectives, because in general it is simply not possible to maximize several objectives simultaneously (Keeney and Raiffa, 1976).

In this chapter, a brief description of the preference model used is given, and then an insight will be gained in its practical application –the elicitation of preferences and the resulting synthesis of information gained.

5.2 Preference model used: the value function approach

For the purpose of this study, a value or utility based approach was used, in its simplest form. In fact, it has been pointed out that, in order to get a clear insight in the decision makers' preferences, the simplest possible model is often the best choice (Belton and Stewart, 2002, and Stewart, pers. comm.).

In the value function approach, every policy scenario is rated using a value function based on a simple addition of scores representing goal achievement according to each criterion, as follows:

$$V(\mathbf{z}) = \sum_{i=1}^{p} v_i(z_i)$$

Where $v_i(z_i)$ is the score associated with a level of performance for criterion i represented by the attribute value z_i. In particular, it is useful to represent scores as follows:

$$v_i(z_i) = w_i u_i(z_i)$$

Where: $u_i(z_i)$ is a marginal utility function (or partial value function) assessed separately for each criterion and normalized to some convenient scale (e.g. 0-100); and w_i represents a weight associated with the importance of the criterion i (Stewart, 1992).

The simplicity of this method is particularly appealing, although some assumptions are required on order to justify this additive aggregation, namely (from Belton and Stewart, 2002):

- Preferential independence: in simple words, the preferential independence condition prescribes that the trade-offs that a decision maker is willing to accept between any two criteria should not be dependent on any other criteria. The nine criteria used in this case were checked for preferential independence through an exercise suggested by Stewart (pers. comm.). Considering one criterion at a time, the author tried to imagine situations in which each policy scenario could perform both satisfactorily and unsatisfactorily, while also trying to understand whether the good or bad level of performance could depend on a criterion other than the one under examination. Through this exercise, it was possible to determine that the nine criteria used in this analysis are in fact independent from each other.
- Interval scale property: in constructing partial value function models, equal increments in $v_i(z_i)$ should represent equal trade-offs with other criteria; in practice, these values must be assessed on a scale on which the difference between points is the important factor.
- Weights as a scaling constant: the weight parameters w_i have a very specific algebraic meaning, that is they are scaling constants which render the different value scales (the partial value functions) commensurate, thus relating the scores on that criterion to scores on all other criteria.

The value function method allows for a synthetic assessment of the performance of policy scenarios against individual criteria (inter-criterion information), together with inter-criterion information, reflecting the relative importance of these criteria and resulting in an overall evaluation of each policy scenario against all criteria. However, the numerical results should not be seen as the end point, or final answer of the analysis, as the learning and understanding resulting from engaging in the analysis process are far more important and meaningful (Belton and Stewart, 2002).

This method was selected for various reasons. First of all, its relative simplicity makes it extremely suitable for practical application, but not only: it also allows for associating numerical scores and values to every available option, making the choice for the optimal policy scenario almost automatic (Stewart, 1992). This particular aspect makes the value function technique particularly suitable for the country where this study is located: generally speaking, in South Africa ad in this part of the world in general decision makers expect clear indications from the analyst (Stewart, pers. comm.). Furthermore, since the decision maker –the landowner- is expected to make utility-maximising decisions, it makes sense to rate the different scenarios in this fashion.

5.3 Elicitation of preferences

In this study, landowners –the decision makers- were approached individually: therefore, preferences were elicited on an individual basis, and the revealed preference model built for this analysis was applied to every landowner giving thus eleven distinct results. This procedure was chosen for two reasons. First of all, the participation in the restoration program is expected to be on a voluntary basis, and each farmer will be free to decide independently whether to participate: the decision problem is thus faced by each individual household. Moreover, although the elicitation of preferences is often carried out at the stakeholder group level, personal interviews are the best options, as they allow a much more accurate understanding and representation of the

decision making process (Stewart, pers. comm.). The MCDA model used in this study was constructed following the personal guidance offered by prof. Theodor Stewart and the guidelines outlined in Belton and Stewart (2002).

At this stage, it is important to explain more in detail the kind of information landowners were provided with, as this is likely to have influenced landowners' perceptions and preferences. As mentioned in previous chapters, the problem structure was designed based on the information provided by landowners during extensive consultations, so at the moment of the elicitation of preferences they were already familiar with the interviewer. Moreover, during the months before the interviews, landowners participated to several activities organized by the PRESENCE network, namely:

- River System Restoration Field Trip (Figure 5.1): . the event engaged experts and landowners in participatory mapping and planning exercises for establishing strategies integrated water catchment restoration. Furthermore, the results of the Land and Water Resource Assessment in the Western Baviaanskloof (Jansen, 2008) were presented to landowners by Herco Jansen (WUR) and Josefien Oude Munnik (DLG);
- PRESENCE Information Day: the preliminary results of the consultations with landowners (as presented in chapter 3) were presented to landowners, together with the preliminary results of the other research projects going on in the area at the same time. The results of the Land and Water Assessment in the Western Baviaanskloof (Jansen, 2008) were also presented by Josefien Oude Munnik for the second time, as almost all landowners were present to this event, and a long discussion on these outcomes followed;
- Rhodes University Field Trip: a group of 15 Honours students from Rhodes University, led by Prof. Fred Ellery and Prof. Kate Rowntree, spent a week in the Western Baviaanskloof studying the geomorphology of the Baviaanskloof fluvial system; in particular, they also focused on floodplains and on the rehabilitation of keerwalle. At the end of the field trip, the preliminary results were presented to farmers and discussed.

Figure 5.1- Some of the activities carried out during the River System Restoration Field Trip

Besides these activities, members of Earthcollective and the authors of this report participated to some of the monthly meetings of the local farmers' association, and in a couple of occasion the progresses of the present study were presented and discussed.

It is therefore clear that at the moment of the elicitation of preferences landowners had a clear idea of the topic under discussion, as they had the chance to integrate their personal knowledge on the functioning of the river system with the available scientific information.

As according to the procedure, the elicitation of preferences focused on two types of information: intra-criterion information (scores of the different policy scenarios against the single criteria) and inter-criterion information (weights assigned to each criterion). Before starting with

the actual elicitation, an explanation was given on the two external scenarios (current climate and climate change scenario) and the 5 policy scenarios or alternatives, as well as the elicitation method.

5.3.1 Intra-criterion information: Elicitation of scores

Scoring is the assessment of the partial value functions $v_i(a)$ or, in other words, the process of assessing the value derived by the decision makers from the performance of policy scenarios with respect to the selected criteria (Belton and Stewart, 2002).

In this study a direct scoring method was used, as suggested by Stewart (pers. comm.): landowners were first asked to rank the policy scenarios against a particular criterion, and they were then asked to assign scores to the policy scenarios based on their preferences. In order to standardize the scoring system across criteria, the policy scenario which did best on a particular criterion was arbitrarily assigned a score of 100, and the one which performed worst was given a score of 0: landowners had then to assign intermediate scores to the other policy scenarios which reflected their performance relative to these end points (Stewart, pers comm., also in Stewart, 1992, and Belton and Stewart, 2002). This scoring technique ensures that equal score differences correspond to equal strengths of preferences across criteria (Stewart, 1992). To make this process more intuitive for landowners, a set of five cards representing the five policy scenarios, and two ordinal scales (one for the current climate scenario and one for the climate change scenario) were created. Thus the preferences in terms of each criterion were asked twice, and farmers had to order the cards from their most to the least favourite one, and then they had to place them on the ordinal scale hence assigning values to each policy scenario. The set of cards used are illustrated in Annex VI.

5.3.2 Inter-criterion information: elicitation of weights

Weights are the expression of the trade-offs between different objectives involved in the decision problem, as well as a measure of the subjective importance assigned to each objective by the decision maker (Stewart, 1992; Belton and Stewart, 2002).

In this study, a direct weighting procedure was used, as suggested by Stewart (pers. comm.). At the end of the interview, landowners were presented with all the nine criteria and asked: "When you take an economic decision concerning your farm and your household in general, which of these elements (or goals) are more important for you, and which ones are less important?". Thus they had first to rank them from the most to the least important, and then to assign a numerical weight. Again, to standardize the weights a value of 100 was arbitrarily assigned to the most important criterion, and a value of 0 was arbitrarily assigned to the least important one: farmers then had to assign a score to the criteria in between. A set of cards was created for the criteria as well, to help landowners with the weighting process, and one of the ordinal scale used for scoring was also used; the set of cards is presented in Annex VI. Although a 0-100 value system was used, as it was more intuitive for landowners to compare criteria against the two extreme weighted 0 and 100, it is common practice to normalize weights before carrying out the analysis, in such a way that their sum is 1 or 100 (Belton and Stewart, 2002); in this study the weights have therefore been normalized to sum to 1. The normalized weight gives information about the percentage contribution of a weight on the total importance weight, and it also allows for obtaining final aggregated scores for each policy scenario in a 0-100 range.

5.4 Synthesis of the information gained

The last step of the model building phase is the aggregation and synthesis of the information elicited so far: to do this, each policy scenario must be evaluated by first multiplying the score on a particular criterion for the weight of that criterion, and then summing the values obtained in this way for all criteria. The end result is the overall ranking of the policy scenario based on their total value (Belton and Stewart, 2002).

5.4.1 Overall ranking of the policy scenarios

As previously mentioned, the model was replicated eleven times (one for each landowner), and therefore the final overall ranking of alternatives was also carried out on an individual basis. Table 5.1 gives an example of the individual result; the eleven outcomes resulting from the analysis are included in Annex VII.

	Criteria	1	2	3	4	5	6	7	8	9	Results	
	Elicited	90	90	20	0	60	70	80	70	100	Value	Overall
	Normalized	0,16	0,16	0,03	0,00	0,10	0,12	0,14	0,12	0,17	Function	Ranking
	Policy Scenarios											
Unvaried climatic conditions	B	0	0	0	0	0	0	0	0	0	0	5
	R	50	50	50	20	80	50	50	80	80	61,89655	3
	IF	70	80	90	40	40	60	40	50	30	54,48276	4
	F	100	100	80	100	60	100	100	100	90	93,44828	1
	TM	90	90	100	50	100	90	90	90	100	93,10345	2
Climate change	B	0	0	0	0	0	0	0	0	0	0	5
	R	50	50	50	60	50	70	80	80	80	65,34483	4
	IF	70	80	80	80	80	90	50	70	30	65,68966	3
	F	100	100	100	100	90	100	100	100	90	97,24138	1
	TM	90	90	90	70	100	80	90	90	100	91,55172	2

Table 5.1- One of the individual MCDA results obtained in this study.

In Table 5.1 is possible to distinguish the scores assigned to the policy scenarios against each criterion, as well as the final value of each policy scenario and their overall ranking. It is possible to notice, for example, that although policy scenario F (restoration with financial incentives) is the first-best option in both external scenarios, its score is very close to the score of policy scenario TM (restoration with a tourism marketing plan as an incentive) in the "unvaried climatic conditions" scenario: in fact, policy scenario TM was rated as first best option against several criteria, such as time return of benefits, impact on tourism and conservation of land and water resources over time. The situation changes when it comes to the climate change scenario, as policy scenario F is preferred to policy scenario TM in a stronger way. These comments are just examples of the vast range of considerations and insights that it is possible to gain from the results of the model. This study, however, seeks to generalize the results and come up with conclusions applicable to the whole valley, and therefore the single tables will not be analyzed in detail: it is believed that it is in fact more meaningful to find a way to aggregate these preferences and interpret the results at the valley level. For example, it is interesting at this point to have an overview on the overall evaluation and ranking of policy scenarios of all eleven landowners, as presented in Table 5.2..

Results												
		Value Function										
	Respondent	1	2	3	4	5	6	7	8	9	10	11
Policy Scenarios												
Unvaried climatic conditions	B	0,00	88,94	0,00	21,31	0,00	0,80	1,73	0,00	0,00	7,58	0,00
	R	61,90	10,64	93,24	24,59	81,17	43,80	17,88	64,67	64,92	64,70	49,15
	IF	54,48	17,87	44,73	82,62	21,33	82,40	31,54	77,33	76,27	59,39	70,85
	F	93,45	18,72	63,38	82,79	94,50	96,00	38,85	100,00	95,59	93,94	47,02
	TM	93,10	35,32	92,43	59,02	66,67	45,00	70,00	60,00	78,64	84,39	63,83
Climate change	B	0,00		0,00	18,36	0,00	0,80	1,73	0,00		7,58	0,00
	R	65,34		87,84	24,59	81,17	45,60	17,88	67,50		64,70	49,15
	IF	65,69		62,43	79,67	21,33	89,60	31,54	78,17		59,39	70,85
	F	97,24		71,62	80,82	94,50	94,20	38,85	100,00		93,94	47,02
	TM	91,55		91,08	63,93	66,67	52,20	70,00	58,00		84,39	63,83
		Overall Ranking										
	Respondent	1	2	3	4	5	6	7	8	9	10	11
Policy Scenarios												
Unvaried climatic conditions	B	5	1	5	5	5	5	5	5	5	5	5
	R	3	5	1	4	2	4	4	3	4	3	3
	IF	4	4	4	2	4	2	3	2	3	4	1
	F	1	3	3	1	1	1	2	1	1	1	4
	TM	2	2	2	3	3	3	1	4	2	2	2
Climate change	B	5		5	5	5	5	5	5		5	5
	R	4		2	4	2	4	4	3		3	3
	IF	3		4	2	4	2	3	2		4	1
	F	1		3	1	1	1	2	1		1	4
	TM	2		1	3	3	3	1	4		2	2

Table 5.2- Overall value function and ranking of alternatives of all 11 landowners.

From Table 5.2 it is possible to have an overview of the most preferred policy scenarios, as illustrated in Figures 5.2 and 5.3.

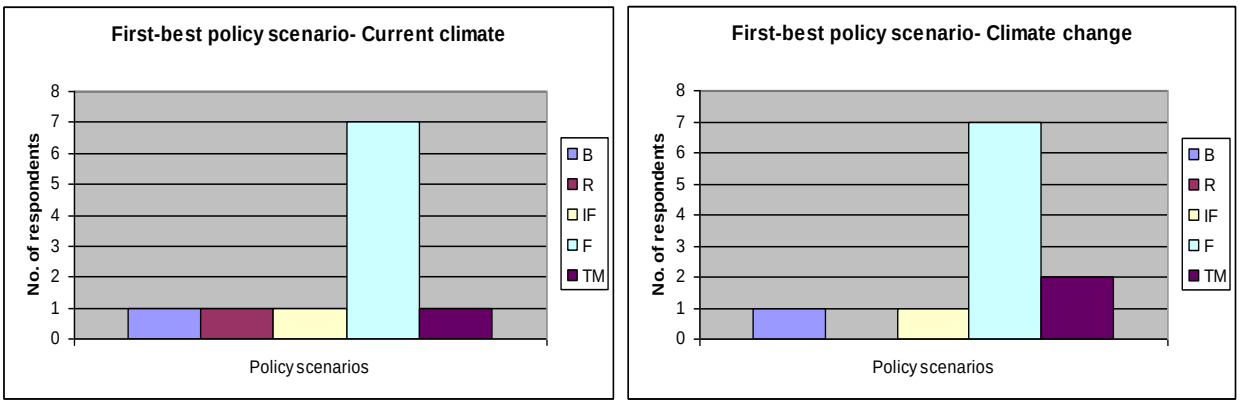

Figure 5.2- Most preferred alternative sorted by number of respondents.

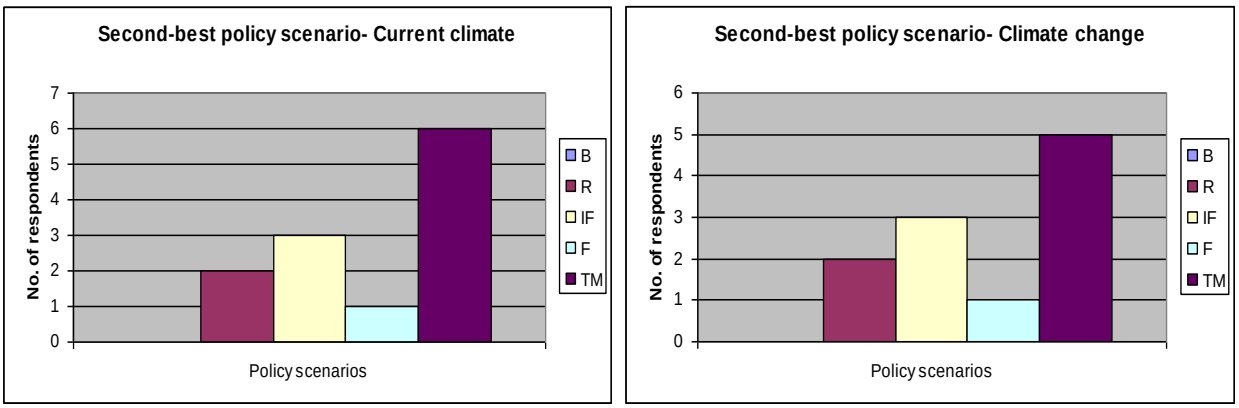

Figure 5.3- Second-best alternative sorted by number of respondents.

Quite a clear picture emerges from the two figures: perhaps not surprisingly, the majority of landowners ranked policy scenario F –restoration coupled with financial incentives- as the most preferred one; in the same way, a significant portion of landowners ranked policy scenario TM –a marketing plan to promote tourism activities in the area- as the second-best alternative. For practical reasons, however, it is useful to work and comment on a general ranking of policy scenarios based on their mean final scores, calculated across all respondents, as presented in Table 5.3 and Figure 5.4.

		Descriptive Statistics				Overall Ranking (mean scores)
		Mean	Standard deviation	Minimum	Maximum	
Policy Scenarios						
Unvaried climatic conditions	B	10,94	26,66	0,00	88,94	5
	R	52,42	26,15	10,64	93,24	4
	IF	56,26	24,26	17,87	82,62	3
	F	74,93	28,32	18,72	100,00	1
	TM	68,04	18,37	35,32	93,10	2
Climate change	B	3,16	6,21	0,00	18,36	5
	R	55,97	23,81	17,88	87,84	4
	IF	62,08	22,41	21,33	89,60	3
	F	79,80	22,79	38,85	100,00	1
	TM	71,30	14,35	52,20	91,55	2

Table 5.4- Descriptive statistics of the final scores assigned by the 11 respondents to the policy scenarios under examination: mean values, standard deviation, minimum and maximum scores, and overall ranking based on the mean values.

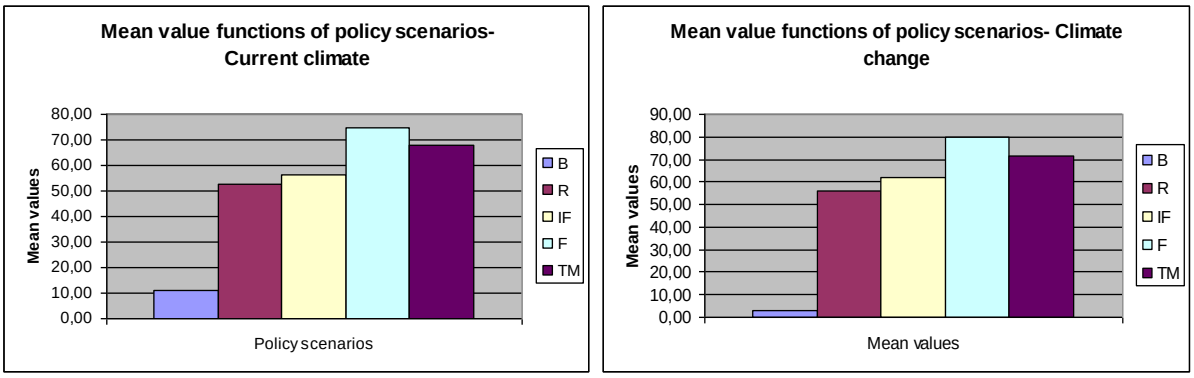

Figure 5.3- Overall ranking of the alternatives based on mean final scores

Looking at the above figures, two observations come immediately to the attention. First of all, the eleven individual results present a high degree of internal differences, as shown by the high standard deviation on the mean final scores and the minimum and maximum score of each policy scenario. Secondly, the use of mean values to describe landowners' preferences levels down the differences in the final scores assigned to each alternative: for example, policy scenarios R and Fl have very similar mean values, and the difference is small enough to seem not significant. Nevertheless, the overall ranking of the policy scenarios based on the mean final scores is quite representative of landowners' preferences, as presented for example in Figure 5.2 and 5.3.

Another striking feature of these aggregated results is that landowners are almost unanimously in favour of restoration, regardless of whether incentives are given or not. In fact, policy scenario B –no restoration- scored very low in almost all models, and in fact it is ranked as the worst option by 10 farmers out of 11.

5.4.2 Sensitivity analysis

Sensitivity analysis was carried out in order to test the robustness of these results. In fact, in the present analysis weights were elicited directly from respondents, and thus the results are likely to be influenced by subjective considerations related to the specific moment in which the interviews were carried out –for example, it is not farfetched to imagine that the elicited weights could have been different, if asked for example two weeks or one month later. It was therefore necessary to test the robustness of the results, and in particular to check whether the final ranking of policy scenarios is dependent on the weights assigned to the criteria: if this was the case, in fact, the results would not be reliable, i.e. representative of landowners' preferences.

As the weights assigned to each criteria differ across respondents, the sensitivity analysis was performed on the individual outcomes by changing the weights assigned to selected criteria, focusing on one criterion at a time, and then the outcomes were aggregated in order to check whether the overall ranking was affected by the different weights. The mean weights assigned to the criteria by all respondents were calculated, as presented in table 5.4, and the criteria with the highest mean weights were then selected for the sensitivity analysis, as they were deemed to be more influential in the decision process.

	Descriptive Statistics				Overall
	Mean	Standard deviation	Minimum	Maximum	Ranking (mean sc.)
Criteria					
1	78,18	29,60	20	100	2
2	81,82	26,76	20	100	1
3	53,64	30,42	0	90	6
4	35,45	41,56	0	90	8
5	61,82	24,42	20	90	5
6	52,73	30,69	0	90	7
7	63,64	25,80	0	90	4
8	74,55	23,39	30	100	3
9	74,55	29,11	0	100	3

Table 5.4- Descriptive statistics on the weights assigned by each respondents to the criteria under examination: mean values, standard deviation, minimum and maximum values and overall ranking of criteria

According to these figures, the most important criteria involved in landowners' economic decisions regarding land use are, in order: stability of income, profitability and, at the same level, impact on landscape and conservation of water resources over time. Consequently, the sensitivity analysis was carried out for these four criteria, with the addition of criterion 7 –community development- as this appeared to be relevant according to further data analysis (see chapter 6).

Although some criteria appear to be sensitive in a few isolated individual models, across all respondents changes in the weight of one criteria do not cause changes in the overall ranking of the policy scenarios. Thus it can be inferred that the results are satisfactorily robust and representative of the collective preferences of local landowners.

5.5 Conclusions

In the results presented in the previous section a clear collective preference emerges, as well as a very sharp willingness to get involved in catchment restoration on the landowners' side. The quite neat preference for restoration coupled with financial incentives is in line with intuition, and probably it would have been possible to predict this outcome before performing the analysis.

Therefore, the whole usefulness of this analysis might be questioned: however, although this is of course the most straightforward and eye-catching information resulting from the results of the model, much more information is actually enshrined, even hidden in the results of the MCDA. In fact, as previously mentioned, MCDA is not aimed at finding the " right answer", but rather at helping decision makers to learn about and get a better insight on the problem they face, their own values and priorities (Belton and Stewart, 2002). In this study, MCDA is also meant to provide implementers with a thorough understanding of the local socio-economic background they are dealing with, as well as perceptions, issues and needs of local landowners, with the aim of identifying strategies to boost catchment restoration in the area. The following chapter will thus attempt to analyze the results from this perspective.

6. Landowners in the Socio-Economic and Natural Environment: Perceptions, Attitudes And Behaviours

6.1 Introduction

The methodology presented in chapter 1 indicates that, after modelling decision maker's preferences and establishing the final ranking of alternative, the model must be used to inform and challenge thinking, as the model must not be interpreted as a normative tool but rather as an information support on decision makers' preferences and attitudes.

Indeed, the synthesis information presented in the previous chapter leaves many questions unanswered. For example, what do the results of the model tell us about the economic behaviour of local landowners with respect to land use and diversification of income? What are their needs and priorities? What is their perception of risk? Are they really as risk-averse as it appeared during the previous consultations? How do landowners perceive and value the environment surrounding them? And how do they perceive the people and the community of the Western Baviaanskloof? For example, the models point out clearly that financial incentives are the most preferred option, followed by a marketing plan for tourism activities, but this preferences are caused by specific reasons, and they can give indications on what landowners think about economic development in the area. The present chapter will provide a thorough analysis of the information contained in the MCDA model and will try to answer the above questions.

6.2 Landowners' perceptions on the proposed MCDA model

Before the actual elicitation of preferences, the model and the method were explained to the interviewee, and feedback on it was requested –when not spontaneously provided by the landowner. Opinions and comments on the model were given, and it is interesting to give an overview as they include useful general suggestions for the implementation of catchment restoration and the design of a PWS scheme. In particular, whereas the criteria were defined according to the management goals implicitly or explicitly stated by the landowners themselves, the two external scenarios and the policy scenarios were given by the researchers, since the aim was to investigate landowners' preferences about the planned interventions. Therefore, the most interesting comments concern these two components of the model, and in the following sections some insight will be given on landowners' perceptions on climate change and the suggested policy scenarios.

6.2.1 Landowners' perceptions on climate change

Landowners' perceptions on climate change are the most diverse, and range between two extremes. At one end of the spectrum, a farmer declared to be little worried, because according to him the rainfall patterns in the area have always followed cycles, so even though during the time-span of the field work a prolonged drought was going on, this was not necessarily due to climate change but most probably to the high rainfall variability over the years. A the opposite, according to another landowner climate change is already manifesting its effects, and actually the "Current climate scenario" does not represent the current conditions anymore, but rather the climatic conditions twenty years earlier.

The rest of landowners expressed views in between these two extreme positions. Two of them decided not to score the alternatives in the "Climate change" scenario, since they held that climate change is too vague a scenario to be taken into account, and its effects are too unpredictable. Another landowner argued that a climate change scenario would make no difference with respect to water management and catchment restoration: in fact, the current problems are created by heavy rains, and heavy rains are expected in both scenarios. Hence he gave alternatives the same scores in both scenarios, as did two other landowners although the latter did not give specific reasons for this choice.

The rest of the farmers recognize that climate change is likely to have effects on the local rainfall patterns, and they generally trust the predictions presented by Jansen. In particular, a landowner suggested that if climate change will result in dryer conditions, the area will lose part of its landscape beauty, but as it will also become more unfavourable to farming then tourism will be the most suitable source of income in the valley. It was also suggested by another landowner that, as climate change is likely to bring about longer dry periods, the overall availability of clean water will decrease, with a consequent increase of the willingness to pay for it downstream (e.g. the metropolitan area of Port Elizabeth).

However, as it was also seen in the previous chapter, there are no significant differences in the final ranking in the two external scenarios. Therefore, for simplicity and ease of exposition, in the following paragraphs only the results regarding the "current climate" scenario will be presented, as the results regarding the "climate change" scenario are almost the same in all cases.

6.2.2 Landowners' opinions about the proposed policy scenarios

As it is also evident from the synthesis results presented in the previous chapter, almost all landowners are in favour of restoration, and most of them declared very clearly that "something must be done". In particular, a landowner even declared that he would be willing to restore without incentives, since farmers will benefit anyway, either directly or indirectly. Nevertheless, there is a common concern among farmers that if restoration is not done properly their land can be damaged for example during floods. Furthermore, some respondents also stressed the need of combining restoration interventions with a good water management plan.

Some of the farmers observed that the local environment is currently so degraded that further development of farming activities is seriously hampered, and for this reason it is realistic to envisage the creation of new jobs only if restoration is carried out. On the other hand, another landowner warned that restoration can benefit the local coloured communities only if local labour force is hired for the interventions –a feature which is actually part of the Baviaanskloof Integrated Restoration Programme.

A high level of concern also emerged about the credibility of an incentive scheme, because according to many respondents the country does not have the necessary institutional capacity to manage it: there is therefore a general feeling that incentives will never happen in practice or, if they will, they will be managed in an inefficient way. In particular, financial incentives and the creation of an insurance fund against flood damages are seen as the most difficult ones to be realized in practice.

The creation of an insurance fund to cover for flood damages on restoration sites was suggested as a response to concerns expressed during the initial consultations with landowners: in

fact, farmers declared to be quite worried about the possible increase in flood damages after, for example, the removal of keerwalle. Whereas this policy scenario did not score well in most MCDA models, in the same way landowners were quite critic about this option when it was described to them. One of the farmers was doubtful about its usefulness and its ability to actually buffer the damages, since after a flood it usually takes a long time to get the land back to its previous state. Another respondent observed, quite pertinently, that an insurance fund is a good idea when there is something to insure. For example, during the fieldwork the whole area was going through a prolonged drought, and the cultivated area was much smaller than usual: in such conditions, damages to crops would be obviously minimal, so this option is not as convenient as for example financial incentives.

Financial incentives, as seen previously, met a great appreciation on the farmers' side, besides the doubts about institutional management of such an option. In particular, a landowner observed that, as restoration is unlikely to benefit in his lifetime, financial incentives are the only way he can benefit from it.

The creation and implementation of a marketing plan for tourism activities in the area was also greeted with favour by respondents, and many considerations on its effects on the community were made, which will be discussed later on in the chapter. At this stage, it is important to report a remark made by a landowner, according to whom a marketing plan would be a great idea provided that it is specifically targeted at the individual farms, and the facilities that each of them can offer, rather than at the whole area in general. In fact, the local municipality is already promoting tourism in the area in such a fashion, without promoting any specific tourism facility, while this promotion would indeed be very useful and welcome. On the other hand, one landowner pointed out that, at the moment, his farm would not really benefit from a marketing plan, because the facilities they can offer would not allow them to have more guests than they already have: in order to increase the part of income coming from tourism, financial incentives would be more appropriate, as the money could then be invested in enlarging the existing tourism facilities.

6.3 Priorities, main goals and attitudes in the decision process

In the MCDA analysis, the criteria were defined according to the management goals defined by landowners themselves during extensive consultations; moreover, importance weights were also elicited for each single model, so that the partial scores assigned to the policy scenarios could be aggregated according to the relative relevance of every criteria, accordingly to the MCDA theory. However, the importance weights assigned to each criteria contain also precious information about the management priorities of landowners, as they were explicitly asked to rank and score the criteria based on what they consider more or less important when taking an economic decision about land use and diversification of the household's income.

In order to come up with an overview of the priorities of the whole population, the mean weight were calculated, as mentioned in chapter 5 and illustrated in Figure 6.1.

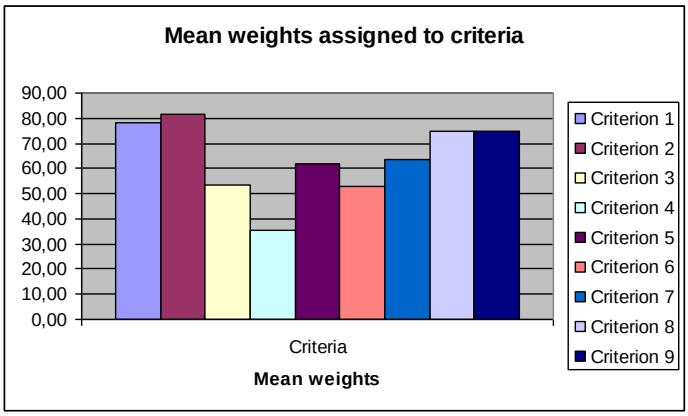

Figure 6.1- Mean weights assigned to the criteria over the whole population of respondents

According to these results, the most important goal pursued when taking an economic decision appears to be the stability of income offered by the available options (criterion 2), closely followed by their profitability. This finding is not at all surprising, as it is in line with intuition as well as common sense. What it is interesting to notice is that the impact on income stability of an economic choice is valued more than its profitability: in fact, this shows a certain far-sightedness on landowners' side, as it means that the first priority for landowners is to guarantee a stable lifestyle for themselves and their families, rather than invest in activities which are potentially very profitable but do not necessarily assure the same level of profit over the long run.

The environmental aspects involved in an economic decision, namely impact on landscape and conservation of water resources over time, are also considered very important, as they come just below the two criteria discussed above. This outcome mirrors the preliminary findings of the informal consultations, as in those occasions respondents stressed the high value they put on the environment around them, and the tight liaison they feel with the place they live in. In particular, when it comes down to conservation of water resources over time, it is also worth noticing that in such a difficult and dry environment a sound management and protection of water resources is almost imperative in sustaining life and farming in the valley.

Social considerations and impact of a decision on tourism also received quite high scores, meaning that these aspects are valued to some extent, but they do not appear to be the main priorities of landowners. As the social aspects will be discussed in detail later on in the chapter, at this stage it is worth to pay some attention to criterion 5, impact on tourism. Although tourism is the second economic activity in the valley, this outcome suggest that it does not enjoy the same level of consideration as farming do: this might be explained by the fact that tourism activities are still quite new in the valley, and tourism facilities are mostly managed by landowners' wives. The MCDA was carried out by eliciting farmers' preferences, who are not so involved in tourism and therefore is probably not the main focus of their attention.

6.4 Influence of landowners' main economic activity on priorities and preferences

During the data analysis, it was also investigated whether the main household's source of income –namely, farming or tourism- has an influence on landowners' priorities and main goals in the decision process. Respondent were therefore split in two categories –six of them belonging to the first group, and five in the second group- according to the information provided in the

questionnaires on their sources of income, and the mean weights assigned to the criteria were recalculated separately for the two groups. The results are presented in Figure 6.2.

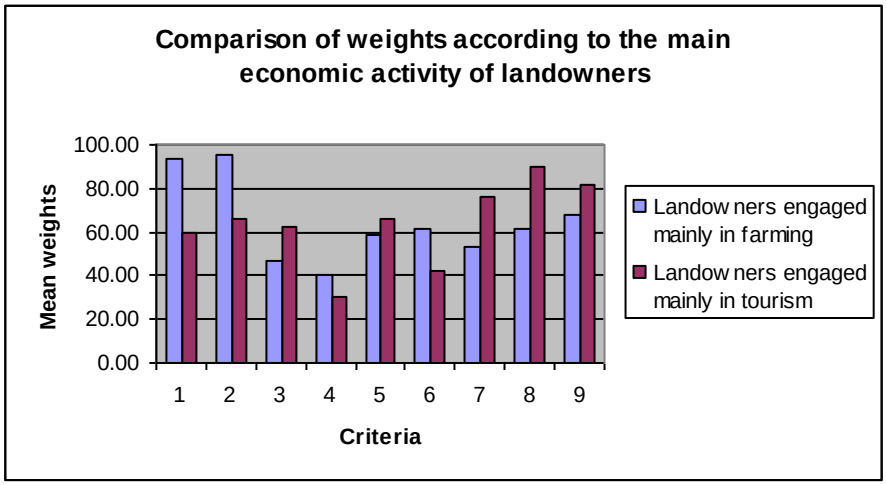

Figure 6.2- Mean weights assigned to the criteria by the two groups (landowners engaged mainly in farming and landowners engaged mostly in tourism)

Quite some differences emerge from the above graph. The first striking difference in weights can be seen on the first two criteria, profitability and income stability: these criteria are valued as the most important one by landowners engaged mainly in farming, while they are not the priorities of landowners engaged mostly in tourism. To explain this, it must be pointed out that in the second group two respondent out of five are "outsiders" and their weights might have influenced the mean value: they are not born and bred in the valley, one of them is a retired professional and the second one does not live on the farm and has economic activities elsewhere; they can be defined as pure 'lifestyle farmers", as they bought the farm because they love the place and they like the lifestyle they can enjoy there, and do not depend on farming or tourism for their livelihood.

This explanation may appear inconsistent when looking at the men weight assigned to criterion 6, maintenance of current lifestyle: in fact, landowners engaged mainly in farming value it more than landowners busy mainly with tourism, which also include the above-mentioned pure lifestyle farmers. It must also be considered, however, that the "actual farmers" spent most of their life in the area, and in many cases they were even born there, so it is not improper to infer that they are more attached to their lifestyle than newcomers can be.

To conclude, it is also worth spending a few words on the last three criteria, as the differences in the mean weights of the two groups are quite significant. Community development is the third most important goal pursued in economic decisions of the second group of landowners, while it is not so much valued by the "actual farmers"; thinking about all possible motivations behind it, however, it was not possible to find a convincing explanation to this difference. Besides that, two criteria appear to be the most important objectives driving the economic behaviour of the second group of landowners, namely impact on landscape and conservation of land and water resources over time –although these two criteria were assigned quite high weights by the other group as well. This might perhaps be explained by the fact that a healthy environment is the major attraction the area has to offer, so landowners engaged mostly in tourism are more concerned about it. Moreover, this group includes the "lifestyle" farmers mentioned before, who bought a farm in the Western Baviaanskloof precisely because of the beautiful wild landscape, so they are

presumably more concerned about environmental aspect of the decisions they take with respect to land use.

The main landowner's source of income is likely to have an influence not only on the importance assigned to each criterion, but also on the final ranking of the policy scenarios and therefore on their preferences. The same procedure used with the weights was applied to the final scores of each policy scenario: the mean values of the final scores were calculated separately for the two groups, and the results are illustrated in Figure 6.3.

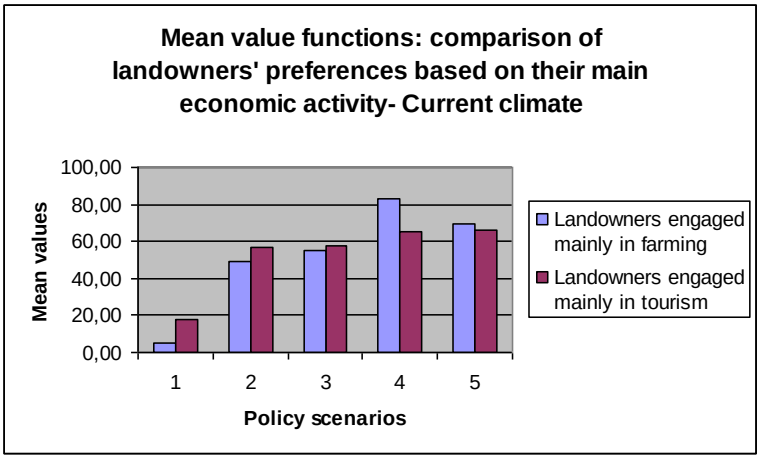

Figure 6.3- Comparison of landowners' preferences (mean final scores assigned to policy options) based on their main economic activity in the current climate scenario

Although the differences between the two groups do not appear to be that significant, Figure 6.3 offer a few points worth discussing. Landowners engaged mostly in farming have quite a neat preference for policy scenario F, that is restoration combined with financial incentives. This neat preference, in contrast, can not be observed in the group of landowners engaged mainly in tourism: in fact, although the most preferred policy scenario is restoration coupled with a tourism marketing plan as an incentive –and this result could be perhaps predicted beforehand- the final score performed by this scenario is not significantly higher than the scores totalized by the other policy scenarios involving restoration, including restoration without incentives. This can be explained by noticing that farmers engaged mostly in tourism are likely to have less crops, especially on the flood plain areas, and in case of heavy flood they would experience much less damage as compared to the "actual farmers": this might limit the need for incentives.

In this respect, landowners' preferences toward restoration are likely to be influenced by the land use on the flood plain areas –i.e. whether they are growing crops on the flood plain areas, which are more prone to be flooded. Therefore, the total population was again split in two groups, this time according to land use on the floodplain areas. This information was detected on the questionnaires and on the records of the preliminary consultations: according to this, 7 respondents are growing crops in these areas, while 4 respondents are not. The results are presented in Figure 6.4.

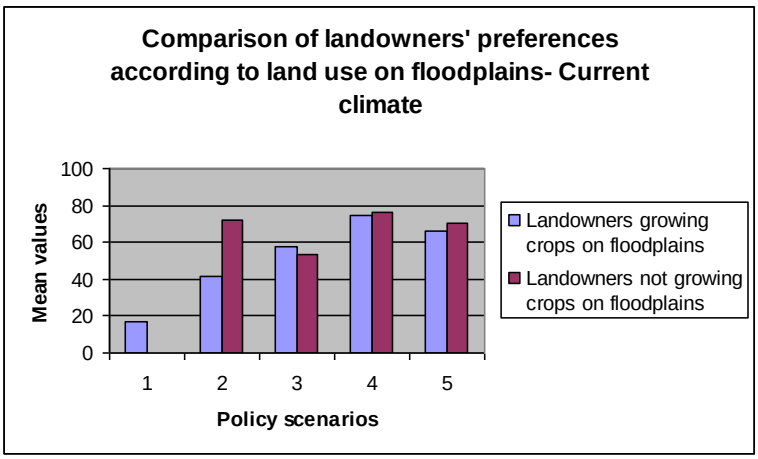

Figure 6.4- Comparison of landowners' preferences according to land use on the floodplains in the two climatic scenarios

The most significant difference among the two groups regards policy scenario R, restoration without any kind of incentives: landowners who are not growing crops on floodplain areas, in fact, assigned a much higher score than the other group, and this option is even preferred to policy scenario IF, which includes an insurance fund against flood damages as an incentive. This outcome is, again, quite in line with intuition: in fact, if no crops are grown on the areas prone to flood damages, the restoration of keerwalle is totally beneficial for the land, as it does not involve any cost associated with crop losses. Besides that, it is also interesting to notice that, while landowners growing crops on the floodplain areas expressed a neat preference for policy scenario F, in the second group the four alternatives involving restoration got similar scores and the differences are not that significant, although policy scenario F is still the most preferred one.

6.5 Risk aversion and its influence in the decision process

The present study was designed, among other thing, in order to address and get more insight a discrepancy in landowners' statements about the potential risk involved in the restoration of the keerwalle. As explained in chapter 1, during the preliminary consultations farmers showed a high level of recognition of the potential benefits of such interventions, but at the same time declared to be unfavourable to it as keerwalle provide them with protection against floods. At the same time, when asked about flood damage in the past and their perception of flood damage, they appeared not to be concerned too much about these potential damages.

For this reason a specific criterion, namely "risk involved", was included in the MCDA analysis, and it was expected that this criterion would have been decisive in the overall results of the analysis. In contrast, in the MCDA model the mean weight associated to this criterion is actually the lowest, meaning that for local landowners it is the least important element to be considered in an economic decision regarding land use. Although surprising, this outcome also give a clear answer to the initial "puzzle" which confronted the researcher in the first phase of this study. Furthermore, some sort of explanation can be attempted. The MCDA model used in this study is meant to establish the preferences on five alternatives, and three of them involve the provision of economic incentives to landowners engaging in restoration: perhaps these incentives are considered as a sufficient way to cover for the possible flood damages involved, so that the risk is no longer so important compared to the combined advantages of restoration itself and the incentives.

On the other hand, an alternative possible explanation was offered by one of the landowner, who declared that if the catchment is not restored farmers will get no benefits at all, and in this light this is the only financially risky prospect. In fact, the degradation of the system is already impairing the suitability of the land for farming, and hence probably landowners are becoming aware of the risk of further degradation and further decrease of water availability.

6.6 Environmental perceptions and awareness

Criteria 8 and 9, namely impact on landscape and conservation of water resources over time, were included in the analysis because a high level of environmental awareness seemed to emerge from the preliminary interviews and questionnaires. In fact, as seen in a previous section, in general these criteria were assigned very high weights, and that shows a high environmental concern on landowners' side. In order to get a better insight on this aspect, the partial scores obtained by the alternatives on these two single criteria were calculated for each individual model, and then the mean values were also calculated in both cases. The results are illustrated in Figures 6.5 and 6.6.

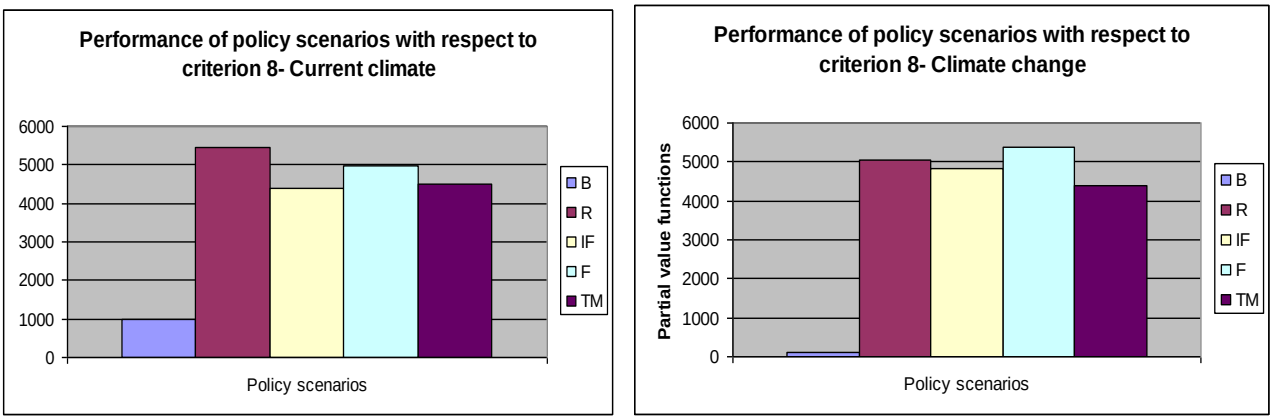

Figure 6.5- Performance of alternatives with respect to criterion 8 based on the mean scores over the whole population

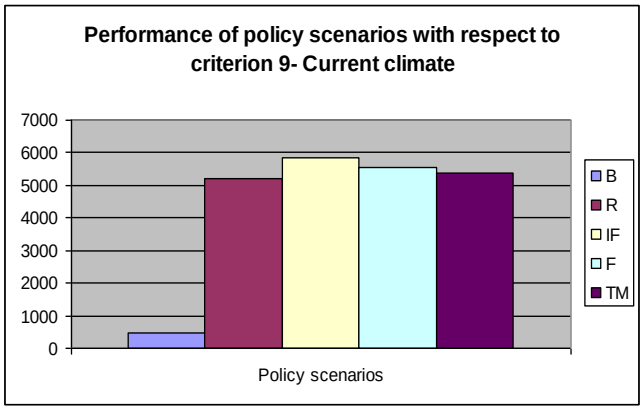

Figure 6.6- Performance of alternatives with respect to criterion 9 based on the mean scores over the whole population

Impact on landscape

In terms of impact on landscape, the four policy scenarios involving restoration present similar scores, as the differences between them are very small. This can mean, arguably, that according to landowners it is restoration in general which can have the best impact on landscape beauty,

although other elements could be involved. The most interesting feature, however, regards the different ranking of policy scenarios in the two climatic scenarios –and for this reason the graphs regarding both external scenarios have been included. In the current climate scenario, policy scenario R is ranked as the best option, followed by policy scenario F, whereas in the climate change scenario it is the other way around. A tentative explanation might reside in some level of concerns about the effects of climate change –either an increase in flood strength, with damage to the landscape, or more severe droughts, also affecting landscape beauty, can not be determined- and its negative effects, which could be buffered by an increased cash availability to invest in buffering interventions.

Conservation of water resources over time

With respect to conservation of water resources over time all four policy scenarios involving restoration perform pretty well, as the differences between their partial mean scores are not really significant. It is interesting to notice, however, that policy scenario IF, which was ranked as third in the overall model, under this criterion is the one which gets the best score in both climatic scenarios.

6.7 Tourism as a promising alternative to farming and an engine to promote community development in the area

Restoration coupled with a marketing plan to promote tourism in the area was ranked as second-best option in the overall MCDA model, after policy scenario F which involves financial incentives. The absolute preferences for a monetary reward is not at all surprising, and it could be expected beforehand, but it should not mislead the interpretation of the results. In fact, the good performance of policy scenario TM contains an important sign of the growing relevance of tourism as an economic activity in the Western Baviaanskloof. This policy scenario is even preferred to scenario IF, which according to common sense would probably be a better option for farmers.

Furthermore, during the elicitation of preferences, a very interesting aspect of tourism activity emerged, in the form of qualitative comments on this specific policy option. A good portion of landowners remarked the crucial role that tourism can have in the valley in terms of economic development, job creation and community development, especially regarding the coloured communities. According to one respondent, a the farming sector cannot realistically be expected to grow, and thus it will not create new jobs. In contrast, a growth in the tourism sector will bring about a new job availability for the coloured communities, and this is quite a common feeling in the area.

As these opinions were expressed informally at the beginning of the elicitation procedure, it was interesting to check whether they are reflected by the outcomes of the model, and thus the same procedure used in section 6.6 was applied to analyze the performance of policy scenarios with respect to criterion 7, community development, as shown in Figure 6.7.

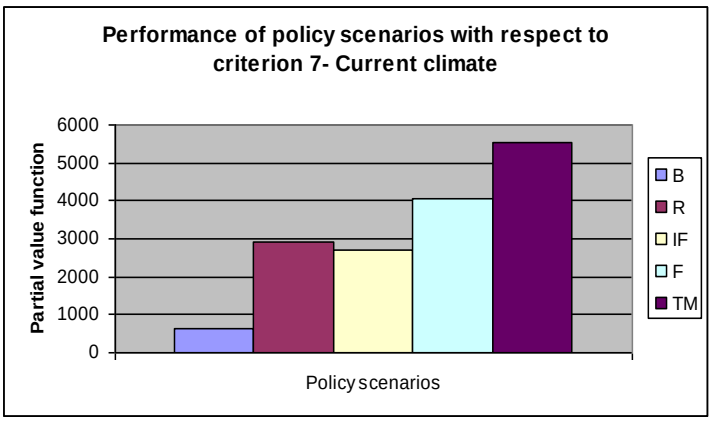

Figure 6.7- - Performance of alternatives with respect to criterion 9 based on the mean scores over the whole population

Actually, these outcomes are perfectly in line with the verbal declarations of landowners: in fact, restoration coupled with a marketing plan for tourism as an incentive is considered to be by far the best way to stimulate community development in the area, especially with regards to the coloured communities.

From a social perspective, however, tourism could also have a negative impact, as commented by two respondents. They are both concerned that a growth in the tourism sector could bring about a radical change in the current landowners' lifestyle, as too many visitors would not allow them to have time for themselves, especially during week ends which are now devoted to leisure and social activities.

6.8 Conclusions

The analysis of the results highlighted some important elements of landowners' perceptions about restoration, as well as their vision on the socio-economic development of the Western Baviaanskloof.

In short, the main objectives pursued in economic decisions concerning land use and diversification of income have been identified as economic goals, such as income stability and profitability, and environmental goals, namely impact on landscape and conservation of land and water resources over time. The risk involved in each alternative, in contrast, is considered as the least important criteria, thus suggesting an answer to the discrepancy on the perceptions of risk presented in chapter 1 and partially motivating this research. The main source of income of each households, namely farming and tourism, showed to have an influence in landowners' preferences about the different policy scenarios, as well as the type of land use on floodplain areas, prone to flood damages. From a social point of view, the outcome of this model, as well as several informal remarks brought about by respondents, indicate that according to landowners tourism growth would bring the largest benefits to community development, especially with regard to the coloured communities.

These findings give quite a clear and interesting picture of the economic behaviour of landowners, as well as their decision style. However, it must not be forgotten that this decision analysis was carried out with the precise aim of providing relevant information for the design and implementation of a PWS scheme, and therefore the ultimate questions are: what does this

information mean when it comes down to implementation of catchment restoration? Which recommendations can be drawn from these results? The following chapter will attempt to answer these questions.

7. Conclusions and Recommendations

7.1 Introduction

In the first chapter, the development of an action plan has been indicated the last step of the MCDA process, as well as its natural conclusion (Belton and Stewart, 2002). Indeed, after having presented, analyzed and interpreted the results of this study, it is now time to explore their practical implications, or in other words to translate landowners' preferences and perceptions in practical and realistic recommendations for implementers. Before doing that, however, it is worth considering first of all the shortcomings of this study; moreover, some crucial conclusions can also be drawn from the findings presented in the previous chapters.

7.2 Limitations of the study

The evident limitation of this research is the small population size, as only eleven landowners are living and farming in the valley. This implies that results can by no means be generalized to other cases, in South Africa or elsewhere. On the other hand, this is an applied study, specifically tailored for the case study under consideration, therefore it does not wish to provide general information but rather to provide implementers with practical and useful information which they can use in the design of the Baviaanskloof Integrated Catchment Restoration programme and the related PWS scheme.

As mentioned earlier in this report, individual landowners' preferences present a high internal variability, and thus the use of mean values to describe the whole population implies a loss of richness of information. At the same time, it was a practical necessity to come up with a general picture applicable to the whole valley.

Another important drawback of this research, which also extends to the setting of the Baviaanskloof Integrated Catchment Restoration programme, relates to the fact that, whereas the decision of getting involved in restoration is supposed to be taken at the individual level, restoration on one farm is likely to benefit downstream farms as well. This mean that the choice to restore would create a positive externality for landowners who do not want to participate to the program. This is an issue that must be addressed, and later in the chapter some suggestions will be given.

7.3 Conclusions

The most striking result of the MCDA is that farmers are almost unanimously in favour of restoration, even in the absence of incentives. Landowners are fully aware of the benefits that catchment rehabilitation will bring to the environment and their economic activities as well, and even though they expect some costs -in terms for example of flood damages- these are perceived as being outweighed by the benefits. Therefore, it might be argued why landowners should be given incentives at all: however, in the author's opinion a PWS scheme could and should still be

implemented, and two different and complementary reasons can be brought on the table to support this idea.

First of all, restoration in the Western Baviaanskloof is likely to deliver benefits downstream, to the Kouga dam and the related water users. Downstream water users are willing to pay for an improved delivery of watershed services (van der Burg, 2008), and hence a PWS scheme could be implemented and would create available funding for compensating upstream landowners.

This explanation alone, however, would not be enough to justify the creation of a PWS scheme to compensate service providers. A PWS scheme would represent in fact as a great opportunity to address socio-economic development in the area harmonizing the economic, social and environmental components at the same time. The MCDA reveals that landowners' preferences for catchment restoration are strongly related to economic activities, and are heavily influenced by economic, social and environmental considerations. Actually, in the context of the Western Baviaanskloof, land use (and farming) and tourism activities are inextricably linked from the point of view of socio-economic development of the area, as these are the two main sources of income for residents. Restoration is related to both economic activities, as it would have an impact on water availability, landscape and, to some extent, land use. Therefore, the planning and implementation of a catchment restoration program must take into account the broader socio-economic picture –thus using a holistic approach- and it is indeed an opportunity to address and stimulate a sustainable and environmental-friendly socio-economic development. If this did not happen, then even the long term benefits of restoration would be in danger: in fact, if after restoration landowners kept the same farming practices and used the same amount of water, then in a 20-year time the system would be likely to be degraded again, thus invalidating the effort done to rehabilitate the system and the investment made.

How could this be achieved through an incentive scheme? Kosoy et al (2008), in their analysis of participation to the Mexican PES scheme, suggest that the promotion of income diversification through PES scheme might address this issue, while acting as a driver to participation at the same time. This might be the case in the Western Baviaanskloof as well, where the promotion of income diversification (in favour of tourism) can represent a solution to the conflict between farming and a healthy environment, and that can even create an more favourable ground for further restoration interventions as well as enhance community development. This argument will be further developed in the following section.

7.4 Recommendations

The results of the MCDA and the above considerations allow for the formulation of a set of recommendations. These can be categorized as (i) recommendations for the implementation of the Baviaanskloof Integrated Catchment Restoration program and the design of a PWS scheme; (ii) recommendations for the design of an incentive scheme; (iii) recommendations for the PRESENCE network, especially regarding communication with the Baviaanskloof farming community; and (iv) recommendations for further research on the topic.

7.4.1 Recommendations for the implementation of the Baviaanskloof Integrated Catchment Restoration program

- Several landowners stressed the importance of combining restoration with a catchment management plan in order to "keep up with the good work" after the interventions are made.

7.4.2 Recommendations for the design of an incentive scheme

- Several landowners are concerned about the country's lack of institutional capacity to implement and manage an incentive scheme. Therefore, the incentive scheme should be implemented and managed by an external party which enjoys the trust of landowners and other relevant stakeholders. Based on the knowledge of the local dynamics and institutions acquired during the field work, it is suggested either that such organization is created ex-novo within the PRESENCE network, or that a trusted existing agent belonging to PRESENCE, such as for example Gamtoos Irrigation Board, is appointed for this task. It must be pointed out, however, that the creation of a new responsible agent is likely to increase the transaction costs of the scheme.

- As pointed out in Chapter 1 and also suggested by Kosoy et al (2008), the robustness of an incentive scheme is enhanced if needs and expectations of ecosystem services providers are carefully taken into account and compensations adjusted accordingly. The main priorities of local landowners in the Baviaanskloof have been identified as (i) income stability, (ii) profitability, (iii) conservation of water resources over time and (iv) impact on landscape. Since (iii) and (iv) are likely to be positively addressed by the restoration measures themselves, the incentive scheme should address the need for (i) and (ii), and especially for income stability. Farming activities in the area are getting less and less profitable, with rising costs but fairly stable revenues; moreover, the degradation of the system and the climatic variations are decreasing water availability in the area. For these reasons, a growth in the tourism sector at the expenses of farming is seen as a promising way of addressing the need for income stability and overcome these constraints, as well as strengthening the benefits brought by restoration over the long run: thus again, an effective incentive scheme should promote income diversification. Moreover, as seen in the previous chapter, according to most landowners tourism growth would give an important contribution to community development, which in turn would also enhance social capital and cooperation, creating a more favourable environment for the restoration program.

- The objective of an incentive scheme, as formulated in the previous paragraph, brings about a crucial challenge: how can an incentive scheme promote income diversification –and therefore tourism growth, while at the same time responding to the clear preference for financial incentives expressed by landowners? The simplest solutions could be the design of an incentive scheme combining both financial incentives and tourism marketing plan, which are the two favourite policy scenarios: in this case, the landowners would receive a partial financial compensation, with the rest of the funding available for incentives being invested in a tourism marketing plan. Another option could be the provision of financial incentives aimed at stimulating tourism growth and investment in this sector: for example, financial

incentives can be given after an investment plan in new tourism facilities is presented by landowners –however, no examples of such mechanisms were found in the literature.

- Alternatively, incentives could be provided in the form of funding for the creation of a landscape labelling system, as suggested by Ghazoul et al (2009). The author suggest that "PES may be undermined by a lack of inclusivity, leading to societal conflicts over land use". For this reason, they propose that landscapes delivering ecosystem services are awarded a landscape label identifying products derived from these landscapes –in the Western Baviaanskloof, the tourism offer could be labelled in this fashion, as well as agricultural (e.g. meat) or other local products (e.g. honey). This would grant the area a specific market recognition, secure premium payments, and gain access to niche markets; it would promote the generation of new livelihood opportunities (growth of the tourism sector among others) and provide incentives for a constant sound management of the landscape aimed at meeting the criteria required for the certification. Under such scheme, PES would be administered to ad-hoc community-based organizations for investment in community and social projects (hence on a landscape, collective basis), and thus this would enhance cooperation in the community and enhance social cohesion.
  Although this system has never been implemented and its conception is very recent, it could be a particularly appropriate scheme for the Western Baviaanskloof, as it allows for the harmonization of several objectives: landowners' preferences for financial incentives would be satisfied, and at the same time tourism growth would be promoted. The most interesting aspect, however, resides in the fact that payments would be administered to the community and not to the individuals, thus enhancing the sense of belonging to the community, creating new positive synergies and enhancing the existing ones. It must be stressed at this stage that in fact, local landowners are part of a tightly knitted community, where all relevant decisions are discussed together either in the farmers or tourism associations' meetings. Such system could also promote the involvement of coloured communities in the collective decisions regarding the area, which at the moment are often left out.
  Moreover, the collective dimension of this PES scheme could in turn probably enhance community's motivation in getting involved in the restoration program and in the economic development of the area as a whole. As noted by Kosoy et al (2008), the extent to which an incentive scheme can stimulate both non-monetary individual and collective motivations can have a significant influence on involvement in the scheme. More specifically, Reeson and Tisdell (2006), reviewing behavioural experiment, observe that mutual cooperation often appears to be more stimulating than defecting, even when the latter is more profitable: this suggests that cooperating with others can be inherently rewarding, due to the "warm glow" feeling generated by cooperation. In their experiment of the influence of formal institutions in the contributions to public goods, they found out that incentives often crowded out voluntary contributions: therefore, incentives schemes and related policies must be carefully designed, in order to stimulate intrinsic motivations. In conclusion, although the idea of a landscape labelling scheme must be further developed and studied –and in particular with regard to the specific context of the Western Baviaanskloof- it seems a promising way to enhance the intrinsic motivation component of the involvement in the restoration programme.

7.4.3 Recommendations for the members of the PRESENCE network: communication between the scientific and farming components of the network

- In previous studies, landowners in the Western Baviaanskloof are usually considered and treated as a unique homogeneous group, or at best they are categorized according to their main economic activity –farming or tourism. However, the high level of variability in the individual outcomes of the MCDA model suggest that landowners are quite different from each other in term of preferences, priorities and perceptions on economic and environmental development. Therefore, a good communication style and strategy should first of all take into account individual differences and characteristics, and this is of course helped by the good personal relationships and knowledge established by the PRESENCE coordinators throughout the years.

- Landowners already perceive, to some extent, the intimate connections between farming, tourism, restoration and social aspects, although it is quite a new concept. The PRESENCE network is already conducting research on all these aspects, but according to the author of this report a clear holistic view on a sustainable socio-economic development of the area, and its connections with catchment restoration, has not been developed yet. For example, besides the provision of watershed services such as water availability and regulation services, the role of land use in providing intermediate goods for tourism (e.g. Hackl and Pruckner, 1997) should be taken into account more than it currently is. This "holistic approach" should be also highlighted and explained to landowners, in order to promote sustainable development and the concept of "keeping people on the land in living landscapes".

- As an incentive scheme should address landowners' priorities, as highlighted by MCDA, the same applies to the communication strategy used with landowners. The benefits of restoration, in terms of impact on landscape and conservation of water resources over time, are already quite clear to landowners, although "repetita juvant". It is suggested, in particular, to reassure landowners about the effects of restoration –and, in the future, of an incentive scheme- on income stability and profitability of land use. Basically, the suggestion here is to keep up with the good work done so far with events such as field trips and PRESENCE information day, as well as the participation to farmers and tourism associations meetings.

7.4.4 Recommendations for further research on the topic

- At the moment, a quantification of the benefits provided by catchment restoration, both on site and to downstream users, is not yet available and the issue is still unclear. A quantification of the impact of the removal of keerwalle, as well as the related benefits on site, was attempted during the course of this study, but it was dropped because of the extreme difficulty in finding reliable data on the hydrological and vegetation impacts of such interventions, and because of time constraints. Such quantification is fundamental for the monetary valuation of benefits; in turn, the monetary valuation would allow for an estimation of the funding available for a PES scheme, as this funding should ideally be provided by services users downstream.

- The actual design of an incentive scheme is likely to require more research on the topic.

- Further research on tourism is also likely to be needed, in order to complement the work which is currently being done on the topic. In particular, a market research on the demand side and the design of a sound development plan for the area would be useful. In general, it would be a good idea to focus research efforts on the overall economic development of the area, in order to find a way to synchronize tourism development, farming activities, restoration efforts and environmental protection towards a common goal of sustainable development –among other things, this would also be an opportunity to offer an unique "product" to tourists.

Figure 7.1- A view of the Baviaanskloof

"It always seems impossible
until it's done".

Nelson Mandela

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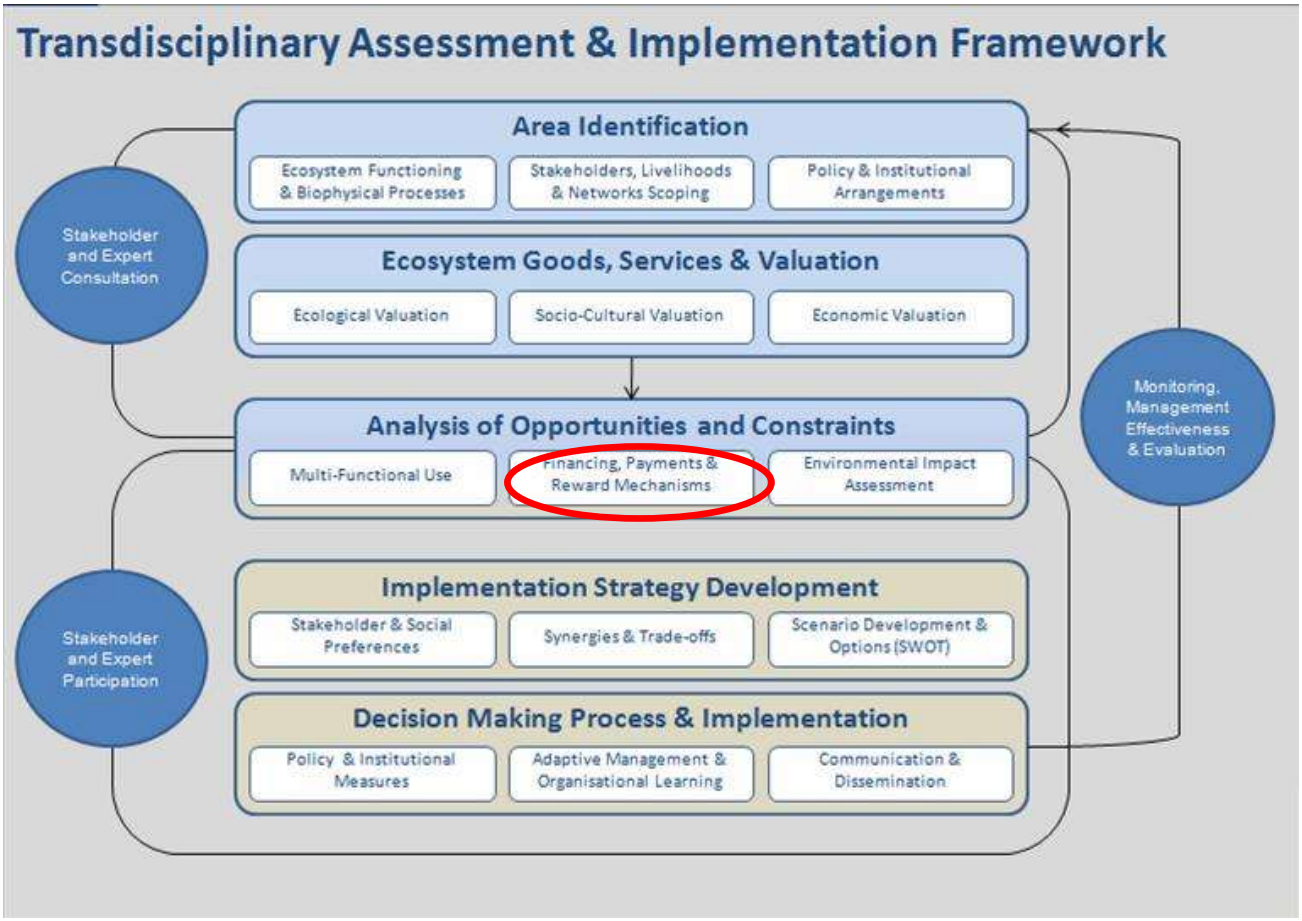
ANNEXES

Annex I- PRESENCE Transdisciplinary Assessment and Implementation Framework



(Source: Zylstra & van den Broeck, 2008)

As mentioned in the main text, the present study is part of the broader PRESENCE Transdisciplinary Assessment and Implementation framework, and in particular is included in the Analysis of Opportunities and Constraints with respect to Financing, Payments and Reward Mechanisms, as indicated in the above figure.

Annex II- Questionnaire distributed to landowners

RIVER SYSTEM RESTORATION IN THE WESTERN BAVIAANSKLOOF

QUESTIONNAIRE

Please find below a few questions about the costs and benefits of river system restoration in the Western Baviaanskloof. The required information will be crucial for the development of my research, and I will be mostly grateful if you can answer these questions. All information will be treated in an absolutely anonymous way, and will be used for the purpose of my research only –hence, I will not spread your personal information to third parties.

Thanks for you cooperation!

Gloria

Respondent name: ……..

Property name: …….

Water rights

1. According to your license, how many hectares are you entitled to irrigate? ……..ha
2. How much do you pay for irrigation water every year (per hectare)? ……../ha

Seasonality of farming activity and water supply

3. What crops do you grow in winter, and what crops do you grow in summer?

Summer				
Crop	Area (ha)	Total input costs R/ha/year	Water requirements gallons/ha/year	Gross yield Tons/ha/year
Winter				
Crop	Area (ha)	Total input costs R/ha/year	Water requirements gallons/ha/year	Gross yield Tons/ha/year

Consequences of the current dry period

4. What is the maximum storage capacity of your dams? And the current storage (as a percentage of the maximum storage)?

Dam	Maximum storage capacity	Current storage capacity (%)

5. What is the maximum discharge of your water source(s) (in gallons/hour)? And the current discharge (as a percentage of the maximum storage)?

Source	Maximum discharge	Current discharge (%)

6. Is the water currently available in your farm enough to carry out the usual farming activities?
    - Yes: Which percentage of the available water do you use? ……%
    - No: which activities have you had to reduce/give up?

Crops	Usual area	Current area
Livestock	**Usual number of animals**	**Current number of animals**

7. Are you thinking about investing in new water infrastructure?
    - No
    - Yes, what kind of infrastructure? ……..

River system restoration

8. In the list below, can you please indicate whether the followings represent a problem in your farm?

	Not a problem at all	Little problem	It is a problem	Big problem
Erosion of the river bed				
Erosion of water ways coming from the 'kloofs				
Floods				
Water scarcity all year round				
Water scarcity in summer				
Water scarcity in winter				
High runoff and loss of water during good rains				
Decrease of water supply over the years				
Changes in rainfall				
Decrease of groundwater availability				

9. Would you be willing to restore the river bed on your farm?
   - Yes, I am already doing it
   - Yes
   - Yes, if I am given incentives
   - No, I do not think it is needed
   - No, I am not interested:
     Why?.....

10. According to you, what would be the effects of restoring the river bed? (You can tick more than one answer)
    - Less erosion
    - Increase of groundwater availability over the year
    - More flooding and more damages to farmland, houses and/or roads
    - Less runoff and more water kept in the 'kloof
    - Loss of crops
      Please specify……
    - More silt would deposit on the veld
    - Loss of veld area currently used for grazing
    - Improvement of landscape and hence benefit for tourism in the valley
    - Others, please specify …….

11. Would you be willing to restore the water ways coming from the 'kloofs on your farm?
    - Yes, I am already doing it
    - Yes
    - Yes, if I am given incentives
    - No, I do not think it is needed
    - No, I am not interested:
      Why?.....

12. According to you, what would be the effects of restoring the water ways coming from the 'kloofs? (You can tick more than one answer)
    - Less erosion
    - Increase of water availability over the year
    - More flooding and more damages to farmland, houses and/or roads
    - Less runoff and more water kept in the 'kloof
    - Loss of crops:
      Please specify……
    - More silt would deposit on the veld
    - Loss of veld area currently used of grazing
    - Improvement of landscape and hence benefit for tourism in the valley
    - Others, please specify …….

13. Do you think that your farm would benefit from river system restoration?
    - No
    - Yes: which measures would you like to take? (You can tick more than one answer)
        - Gabions on the river bed
        - Small weirs to slow down water and stop erosion on the river bed
        - Wetland restoration on the river bed
        - Removal of weirs on the banks of the main river
        - Little bridge where farm road crosses the main river or the lateral water ways, to slow down water and stop erosion
        - Small weirs to slow down water and stop erosion on the lateral water ways
        - Removal of artificial channels deviating the water from the lateral 'kloofs
        - Replanting on degraded veld to slow down runoff

Hypothetical scenarios

14. Suppose your usual water supply is reduced by 10%: would this impact your activities?
    - No
    - Yes:
        - What activity would you reduce or give up?

Activity	Reduction (%)	Costs of losses R

        - How many farm workers do you have on your farm? …….How would this change when giving up activities? ……
        - Would you be able to maintain your livelihood as it is now?
            - No
            - Yes
        - Would you substitute the reduced/lost activity with another activity?
            - No
            - Yes: what activities?

Activity	Set-up costs (R)

15. Suppose your usual water supply is reduced by 30%: would this impact your activities?
    - No
    - Yes:
        - What activity would you reduce or give up?

Activity	Reduction (%)	Costs of losses R

- How many farm workers do you have on your farm? …….How would this change when giving up activities? ……
- Would you be able to maintain your livelihood as it is now?
  - No
  - Yes
- Would you substitute the reduced/lost activity with another activity?
  - No
  - Yes: what activities?

Activity	Set-up costs (R)

Economic activities

16. What are your sources of income?

Activity	% of family income

Annex III- Landowners of the Western Baviaanskloof who participated to this research

Name	Property name
Nico Smith	Uitspan
Boetie Terreblanche	Rietrivier
Linden Booth	Matjiesfontein
Pete Hatting	Speekhout
Willie van Rensburg	Verloenrivier
Quentis Bezuidenhout	Bokloof
Thys Cilliers	Sederkloof
David Smith	Kleinpoort
Runè van Rensburg	Damsedrif
Chris & Barend Lamprecht	Doringkloof, Rus en Vrede
Piet Kruger	Zandvlakte

Annex IV- Experts and stakeholders interviewed

Name	Organization	Role	Date	Location
Blignaut, James	University of Pretoria	Professor	04/08/2008	Outsdoorn
Buckle, Japie	SANBI, Working for Wetlands	Regional Manager	12/09/2008 3-4/11/2008 2-9/02/2009	Port Elizabeth-Western Baviaanskloof
Ellery, Fred	Rhodes University	Professor	3-4/11/2008 2-9/02/2009	Western Baviaanskloof
Eloff, Gareth	ECPB	Reserve manager	28/09/2008	Western Baviaanskloof
Eloff, Lindie	ECPB	Technical service	28/09/2008	Western Baviaanskloof
Erasmus, Andries	Department of Agriculture	Agricultural engineer	02/03/2009	Graaff-Reinet
Erland, Wayne	ECPB	Regional manager	05/09/2008	Patensie
Illgner, Pete		Private consultant	3-4/11/2008	Western Baviaanskloof
Jansen, Herco	Alterra/WUR	Hydrologist	June 2008 22/08/2008 3-4/11/2008	Wageningen-Western Baviaanskloof
Joubert, Pierre	GIB	C.E.O.	09/09/2008 3-4/11/2008	Patensie-Western Baviaanskloof
Moore, Edwill	GIB	Manager	October 2008 3-4/11/2008	Patensie-Western Baviaanskloof
Nel, Jeanne	CSIR	Wetland ecologist	17/10/2008	Cape Town
Oude Munnik, Josefien	LNV/DLG		27/09/2008 3-4/11/2008	Knysna-Western Baviaanskloof
Stewart, Theodor	University of Cape Town	Professor Emeritus	4-5/03/2009	Cape Town

Annex V- Baviaanskloof Integrated Catchment Restoration Programme overview

Extract from: PRESENCE network, 2008. PRESENCE in the Baviaanskloof: A strategy for integrated catchment restoration Programme plan

Overall Objective

Guide the socio-ecological restoration of 'living landscapes' in the Baviaanskloof Mega-Reserve. Through a holistic approach that sustains healthy ecosystems, stakeholder participation, economic viability, social values, biocultural diversity and institutional feasibility whilst empowering pro-environmental behaviour to support resilient and sustainable rural livelihoods.

Activities

Restoration plan

A report will be developed which presents a restoration plan in accordance with SANBI format and included in the so-called Rehabilitation Plan. As soon as the restoration measures are defined, the Basic Environmental Impact Assessment - EIA will be developed by SANBI experts, in terms of the size and extent of the potential impacts. Field visits are intended to be undertaken in order to substantiate and motivate changes in the measures featured and mitigation of the impacts and a report will be written. A public consultation prior to the finalization of the implementation plan will be conducted in order to assure stakeholder contentment and scientific relevance.

Restoration implementation

The restoration implementation will be achieved by carrying out a number of measures. As determined in late 2008, the restoration measures will be defined in three "locations" of the catchment: tributary streams and related floodplains; natural vegetation on adjacent hill slopes and the main river channel (De Paoli, 2008). Some of the measures expected to be taken are briefly outlined below, and still require further prioritization by the project partners. It is proposed to structure the implementation in phases, where a set of measures are implemented at a time, and defined as pilot projects (see section "Planning").

- Removal of man-made berms ('keerwalle') in tributaries;
- Removal of these berms in the main channel;
- Removal of man-made channels to the main river channel bed of the Baviaanskloof River;
- Construction of weirs in river beds/tributaries;
- Re-planting of slopes with indigenous plants to reduce erosion and enhance infiltration;
- Possible other measures to rehabilitate natural flow;
- Execution of an Environmental Impact Assessment when needed.

The implementation will be supported by research outcomes and a feasibility check by Gamtoos Irrigation Board (GIB). Activities related to data collection, reporting, plan elaboration, technical advising of implementers and farmers, among others will be taken at this stage. A restoration programme based on tourism is currently being developed by one of the Wageningen University (WUR) Master students called RESTOURES (restoration through tourism though restoration). The intention is to engage tourists in the restoration (e.g. planting trees) and accomplishing the goal of environmental education and at the same time.

Operational monitoring system

Based on the measures to be implemented (*a priori* and *a posteriori* measurement), related extent of its impacts (and benefits) and advice reported by the EIA, a monitoring system will be defined. The main objectives of the monitoring plan will be on: assessing (cost-)effectiveness of measures; adapt measures if unwanted impacts are reported; generate information for up scaling of the proposed restoration measures; evaluate impacts on biodiversity; and generate information for the application of restoration measures in other catchments where similar problems are experienced. In order to establish an effective operation monitoring system, measuring equipment will be installed in some locations and local stakeholders will be engaged to assist with the data collection.

Stakeholder consultation

Ensuring the participation, engagement and acceptance of the local stakeholders is crucial for the long-term sustainability of the project. Interviews, field trips, meetings and workshops are planned for stakeholder consultation activities.

Research

All activities mentioned in this section will be supported by the development of research projects by the assigned institutions (see section "Collaborative Agencies" - under "Researchers"). As proposed by the Cowling et al (2008) operational model (Figure 4), the restoration strategy will entail biophysical, social and valuation assessments; which will be undertaken by the researchers of the various partnering academic institutions. Ongoing research within the programme highlights key linkages between ecosystem services (i.e. the benefits people obtain from ecosystems) and livelihoods and regional well-being. This forms the basis for integrated catchment restoration, and might elucidate the cost-benefits of the catchment restoration initiative.

Overview of opportunities for optimizing use of ecosystem services

Understanding the services provided by the ecosystem and assessing its uses by the local inhabitants will provide support for defining priority restoration strategies. Assessing and ensuring that the current uses (resources and locations) are not contradictory to the restoration plans is crucial for keeping consistency to the project (Jansen, 2008b).

Capacity building and awareness raising

Capacity building will be employed in order to effectively engage local residents, ECP, municipalities and other stakeholders with the restoration activities by establishing a participatory programme and transferring co-management responsibility (over measures) to stakeholders, assuring the sustainability of the restoration initiative. Activities related to skills development will not only boost employment opportunities but also increase knowledge, understanding and appreciation of key ecosystem services and a range of related ecological, social-economic and socio-cultural issues which simultaneously seek to empower local and regional stakeholders. Activities are envisaged to consist of: courses, workshops, field trips (participatory mapping), economic opportunities/employment and other social events.

Landscape auction and 'water neutral' scheme

Considering the fact that the BMR management (Eastern Cape Parks) affects and is affected by the catchment restoration (i.e. water and biodiversity) it is crucial to assure that management is sustainable and reflects livelihood interests. Additionally, the responsibility of conserving and restoring living landscapes extends beyond managers jurisdiction and may incorporate individuals, the private sector and governments. It is a common situation that nature organisations struggle for financial support, whereas people, business, and policy makers have in recent history assigned greater value to nature conservation and are now willing to spend on conservation. This opens up a direct opportunity to enlist private sector commitment and action for financing the elements of conservation management which are critical to the future success and viability of the Baviaanskloof Mega-Reserve. The strategy proposed is to engage people to conserve, maintain and/or restore the diverse elements by the development of Landscape Auctions and Water neutral Scheme; respectively an initiative of Triple E Knowledge Centre and WWF, for

creating an innovative vehicle to finance restoration. Landscape Auctions are physical auctions of 'green elements' that have been identified to be put up 'for auction'. Some of the possible elements eligible to be auctioned are initiatives as: management of 'green elements' (i.e. bushes, trees, square metres of restored land, sensitive wetland areas, walking tracks) by supporting farmers, nature organisations and other land owners; restoration of degraded land, which could include reforestation and channel stabilization or other measures to enhance and restore the natural value of land (e.g. fencing, gabions, labour). Water Neutral scheme is based on the concept of Water Neutrality, based on its carbon equivalent, was first coined during the World Summit on Sustainable Development in 2002. Here we define the term 'water neutrality' to imply a voluntary process whereby participants seek to quantitatively balance their water use accounts by both reducing their water usage and investing in projects which increase supplies of clean fresh water. Water neutrality therefore implies balancing the demand and supply of water through a deliberate intervention by the water user. Activities required in order to launch a Landscape Auctions and Water Neutral scheme include: engagement of stakeholders; defining and quantifying the elements; market research; and marketing and advertising. These activities will be carried out in partnership with Triple E and WWF-SA.

Programme coordination

The coordination of the programme's activities, planning and monitoring are the responsibility of Living Lands (Secretariat to PRESENCE network) This coordination is to be adapted according to the prevailing concept of a 'Learning Organization', i.e. high participation of the network members. On ground facilitation, stakeholder engagement, relevance of research and activities coordination will comprise the main roles and responsibilities although key implementation decisions will be based on shared vision developed by the network.

Products

Web-based portal

A web based portal will be developed by Living Lands in order to provide the network with an easy to access communication platform. The portal will be composed of various interactive tools including online discussion forums; downloadable documents and reports; and an interactive online map which facilities stakeholder participation in identifying, describing and visualising perceived priorities for restoration.

Learning Village

The Learning Village will be a critical output of the PRESENCE network (in the Baviaanskloof) and will extend itself to other conservation and educational initiatives. The establishment of physical facilities in the valley will bring researchers, implementers, managers and local communities closer together, creating a dynamic transdisciplinary environment. The ultimate intention of the Learning Village is to create and support: national & international universities and research centres to collaborate in research teams; build north-south collaboration to increase knowledge, expertise and technology; transfer the acquired knowledge and experience to manager and implementers of restoration and conservation programs; to build local capacity that employs and implements the acquired knowledge, expertise and technology and finally to monitor the success of the initiative; and offer community-based education and awareness activities linked to nature restoration.

Publications

It is expected that the PRESENCE in the Baviaanskloof team will produce published material, aiming at various target groups and for diverse purposes. For educational purposes, materials such as reports, maps and booklets will be developed in non-technical language. Some of this material can be adapted to children, as some school activities are being proposed. Scientific publications are expected to be developed and will be available/distributed for the network. Authorship needs to consider agreed network agreements. All the above mentioned publications will be available on the PRESENCE online

portal and, in some cases, hard copy versions will also be produced (mainly for the stakeholders in the Baviaanskloof valley with limited internet capability).

Best Management Practice
Booklets will be developed illustrating and explaining Best Management Practices to mainstream restoration and catchment management.

Collaborative Agencies

Coordination: **Living Lands**
PRESENCE and Living Lands have been established by EarthCollective - a global network active in catalyzing positive initiatives which strengthen links between nature and human well-being. EarthCollective receives institutional support through the Dutch-based Foundation for Sustainable Development.

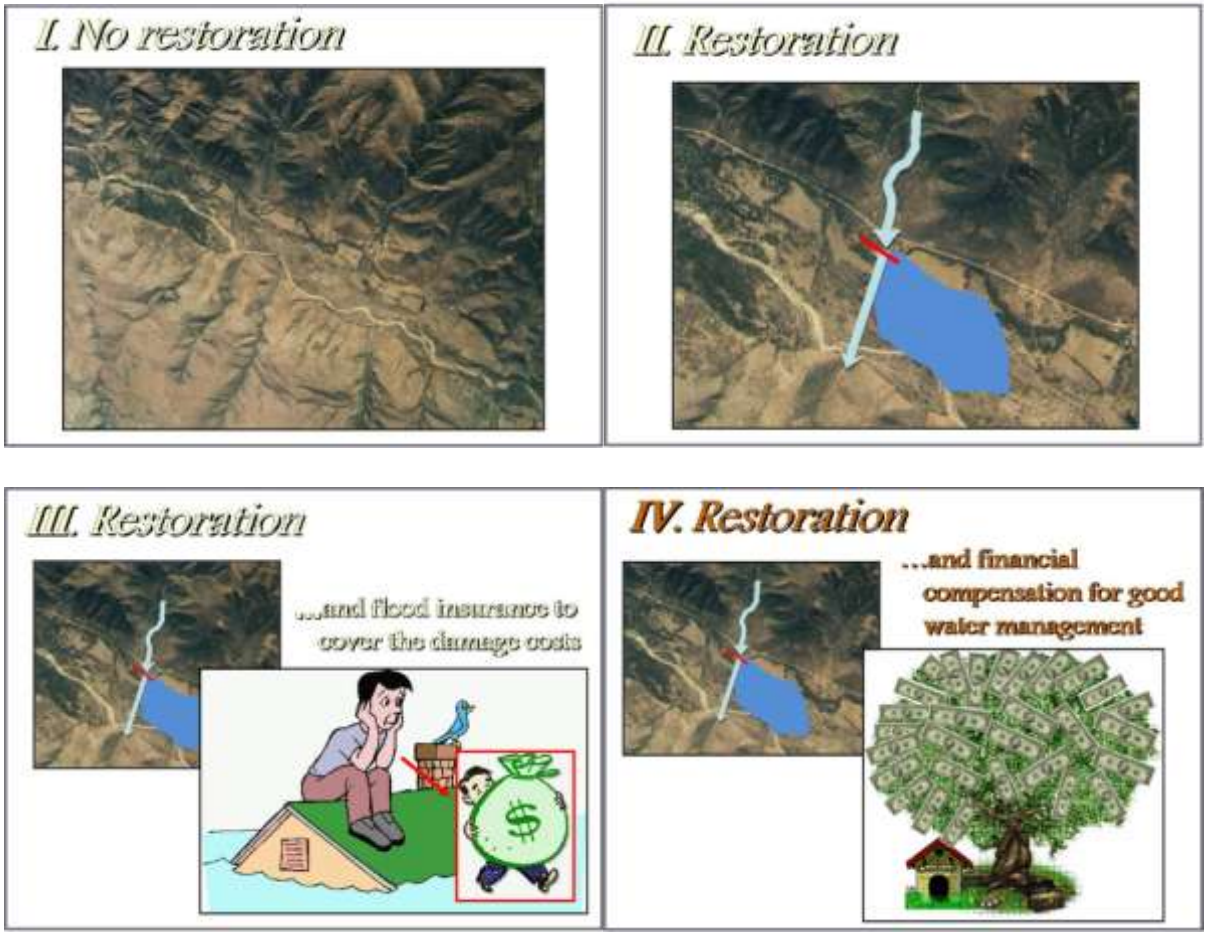
Founder and co-funders: DWAF – Department of Water Affairs and Forestry – Implementation;
DLG – Government Service for Land and Water Management; SANBI - South African National Biodiversity Institute /Working for Wetlands; WWF – SA - World Wide Fund for Nature (South Africa); GIB – Gamtoos Irrigation Board

Researchers: WUR - Wageningen University & Research Centre/ Alterra-IWRM; SELS – WUR Spearhead for Ecosystem Landscape Services; CSIR – Council for Scientific and Industrial Research; RU - Rhodes University / Environmental Science Department and Geography Department; R3G - Restoration Research Group

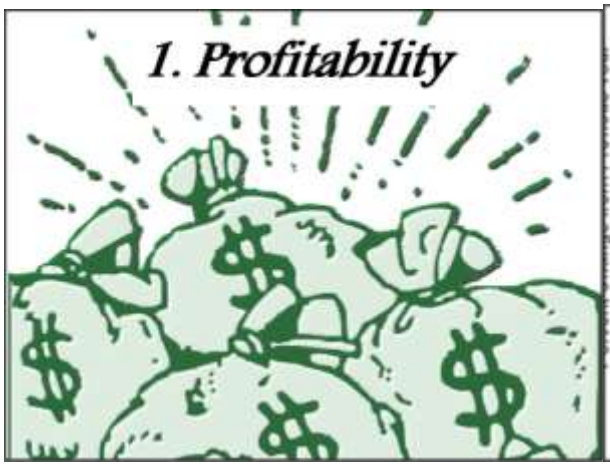
Providers and Beneficiaries: ECP- Eastern Cape Parks; local landowners.

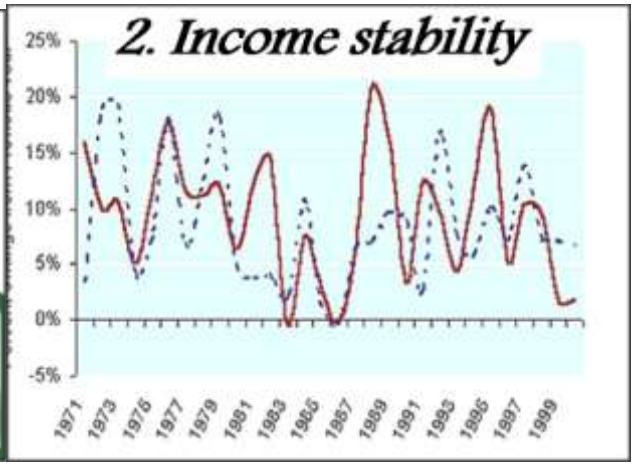
Annex VI- Cards used for the elicitation of intra- and inter- criterion preferences

1. Policy Scenarios


I. No restoration
II. Restoration
III. Restoration
...and flood insurance to cover the damage costs
IV. Restoration
...and financial compensation for good water management
V. Restoration
...and the design and implementation of a tourism marketing plan

2. *Criteria*


1. Profitability


2. Income stability
25%
20%
15%
10%
5%
0%
-5%
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999


3. Return time of investment


4. Risk involved


5. Impact on tourism


6. Maintenance of current lifestyle


7. Community development


8. Impact on landscape


9. Conservation of water resources over time

Annex VII- Individual results of the MCDA

	Criteria	1	2	3	4	5	6	7	8	9	Results	
	Elicited	90	90	20	0	60	70	80	70	100	Value	Overall
	Normalized	0,16	0,16	0,03	0,00	0,10	0,12	0,14	0,12	0,17	Function	Ranking
	Policy Scenarios											
Unvaried climatic conditions	B	0	0	0	0	0	0	0	0	0	0,00	5
	R	50	50	50	20	80	50	50	80	80	61,90	3
	IF	70	80	90	40	40	60	40	50	30	54,48	4
	F	100	100	80	100	60	100	100	100	90	93,45	1
	TM	90	90	100	50	100	90	90	90	100	93,10	2
Climate change	B	0	0	0	0	0	0	0	0	0	0,00	5
	R	50	50	50	60	50	70	80	80	80	65,34	4
	IF	70	80	80	80	80	90	50	70	30	65,69	3
	F	100	100	100	100	90	100	100	100	90	97,24	1
	TM	90	90	90	70	100	80	90	90	100	91,55	2

	Criteria	1	2	3	4	5	6	7	8	9	Results	
	Elicited	20	20	20	0	80	60	70	100	100	Value	Overall
	Normalized	0,042553	0,042553	0,042553	0	0,170213	0,12766	0,148936	0,212766	0,212766	Function	Ranking
	Policy Scenarios											
Unvaried climatic conditions	I	100	100	90	100	100	100	100	100	50	88,93617	1
	II	0	0	0	0	0	0	0	0	50	10,6383	5
	III	20	20	10	50	30	0	0	0	50	17,87234	4
	IV	30	30	10	50	30	0	0	0	50	18,7234	3
	V	100	100	100	80	70	0	0	0	50	35,31915	2
Climate change	I											
	II											
	III											
	IV											
	V											

	Criteria	1	2	3	4	5	6	7	8	9	Results	
	Elicited	100	100	90	0	90	90	90	90	90	Value	Overall
	Normalized	0,14	0,14	0,12	0,00	0,12	0,12	0,12	0,12	0,12	Function	Ranking
	Policy Scenarios											
Unvaried climatic conditions	I	0	0	0	0	0	0	0	0	0	0,00	5
	II	95	100	100	100	90	60	100	100	100	93,24	1
	III	10	60	10	90	50	40	60	40	90	44,73	4
	IV	100	90	10	90	50	60	60	40	90	63,38	3
	V	90	90	90	90	100	100	100	80	90	92,43	2
Climate change	I	0	0	0	0	0	0	0	0	0	0,00	5
	II	100	100	100	100	90	60	100	50	100	87,84	2
	III	60	60	60	90	50	40	60	80	90	62,43	4
	IV	80	90	60	90	50	60	60	80	90	71,62	3
	V	80	90	90	50	100	100	100	80	90	91,08	1

	Criteria	1	2	3	4	5	6	7	8	9	Results	
	Elicited	90	100	0	70	60	80	60	70	80	Value	Overall
	Normalized	0,15	0,16	0,00	0,11	0,10	0,13	0,10	0,11	0,13	Function	Ranking
	Policy Scenarios											
Unvaried climatic conditions	I	0	0	0	100	60	30	0	0	0	21,31	5
	II	30	30	30	0	0	0	30	50	50	24,59	4
	III	100	70	70	100	80	50	60	100	100	82,62	2
	IV	70	100	100	70	100	100	80	70	70	82,79	1
	V	50	50	50	30	50	80	100	60	60	59,02	3
Climate change	I	0	0	0	100	30	30	0	0	0	18,36	5
	II	30	30	30	0	0	0	30	50	50	24,59	4
	III	100	70	70	100	50	50	60	100	100	79,67	2
	IV	70	100	100	70	80	100	80	70	70	80,82	1
	V	50	50	50	30	100	80	100	60	60	63,93	3

	Criteria	1	2	3	4	5	6	7	8	9	Results	
	Elicited	90	100	80	90	70	60	60	50	0	Value	Overall
	Normalized	0,15	0,17	0,13	0,15	0,12	0,10	0,10	0,08	0,00	Function	Ranking
	Policy Scenarios											
Unvaried climatic conditions	I	0	0	0	0	0	0	0	0	40	0,00	5
	II	80	100	80	80	100	80	60	50	80	81,17	2
	III	20	30	20	30	20	20	10	10	0	21,33	4
	IV	100	90	100	100	100	100	70	90	60	94,50	1
	V	40	50	50	60	80	90	100	100	100	66,67	3
Climate change	I	0	0	0	0	0	0	0	0	40	0,00	5
	II	80	100	80	80	100	80	60	50	80	81,17	2
	III	20	30	20	30	20	20	10	10	0	21,33	4
	IV	100	90	100	100	100	100	70	90	60	94,50	1
	V	40	50	50	60	80	90	100	100	100	66,67	3

	Criteria	1	2	3	4	5	6	7	8	9	Results	
	Elicited	100	90	50	80	20	30	0	60	70	Value	Overall
	Normalized	0,2	0,18	0,1	0,16	0,04	0,06	0	0,12	0,14	Function	Ranking
	Policy Scenarios											
Unvaried climatic conditions	I	0	0	0	5	0	0	0	0	0	0,80	5
	II	50	40	60	0	60	40	50	50	70	43,80	4
	III	70	60	80	100	90	90	100	100	90	82,40	2
	IV	100	100	100	90	70	100	90	90	100	96,00	1
	V	20	20	40	50	100	50	60	60	80	45,00	3
Climate change	I	0	0	0	5	0	0	0	0	0	0,80	5
	II	50	50	60	0	60	40	50	50	70	45,60	4
	III	70	100	80	100	90	90	100	100	90	89,60	2
	IV	100	90	100	90	70	100	90	90	100	94,20	1
	V	20	60	40	50	100	50	60	60	80	52,20	3

	Criteria	1	2	3	4	5	6	7	8	9	Results	
	Elicited	90	100	80	0	60	50	40	30	70	Value	Overall
	Normalized	0,17	0,19	0,15	0,00	0,12	0,10	0,08	0,06	0,13	Function	Ranking
	Policy Scenarios											
Unvaried climatic conditions	I	0	0	0	0	0	0	0	30	0	1,73	5
	II	10	10	10	10	10	10	10	100	30	17,88	4
	III	20	20	20	100	20	20	30	20	100	31,54	3
	IV	30	100	30	20	30	30	20	10	10	38,85	2
	V	100	30	100	30	100	100	100	0	20	70,00	1
Climate change	I	0	0	0	0	0	0	0	30	0	1,73	5
	II	10	10	10	10	10	10	10	100	30	17,88	4
	III	20	20	20	100	20	20	30	20	100	31,54	3
	IV	30	100	30	20	30	30	20	10	10	38,85	2
	V	100	30	100	30	100	100	100	0	20	70,00	1

	Criteria	1	2	3	4	5	6	7	8	9	Results	
	Elicited	100	90	90	90	50	0	60	60	60	Value	Overall
	Normalized	0,17	0,15	0,15	0,15	0,08	0,00	0,10	0,10	0,10	Function	Ranking
	Policy Scenarios											
Unvaried climatic conditions	I	0	0	0	0	0	0	0	0	0	0,00	5
	II	80	50	70	70	70	70	50	70	50	64,67	3
	III	70	80	80	80	80	80	70	80	80	77,33	2
	IV	100	100	100	100	100	100	100	100	100	100,00	1
	V	50	80	60	50	50	50	80	50	60	60,00	4
Climate change	I	0	0	0	0	0	0	0	0	0	0,00	5
	II	80	80	70	70	50	70	50	70	50	67,50	3
	III	80	80	80	80	70	80	70	80	80	78,17	2
	IV	100	100	100	100	100	100	100	100	100	100,00	1
	V	50	50	60	50	80	50	80	50	60	58,00	4

	Criteria	1	2	3	4	5	6	7	8	9	Results	
	Elicited	40	80	50	0	90	60	70	100	100	Value	Overall
	Normalized	0,07	0,14	0,08	0,00	0,15	0,10	0,12	0,17	0,17	Function	Ranking
	Policy Scenarios											
Unvaried climatic conditions	I	0	0	0	0	0	0	0	0	0	0,00	5
	II	80	40	30	40	50	40	50	100	100	64,92	4
	III	50	90	70	80	50	60	60	100	100	76,27	3
	IV	100	100	100	100	100	80	80	100	100	95,59	1
	V	40	60	50	60	50	100	100	100	100	78,64	2
Climate change	I											
	II											
	III											
	IV											
	V											

	Criteria	1	2	3	4	5	6	7	8	9	Results	
	Elicited	100	90	50	0	80	80	80	90	90	Value	Overall
	Normalized	0,15	0,14	0,08	0,00	0,12	0,12	0,12	0,14	0,14	Function	Ranking
	Policy Scenarios											
Unvaried climatic conditions	I	0	0	100	100	0	0	0	0	0	7,58	5
	II	40	70	80	0	40	40	50	100	100	64,70	3
	III	50	80	0	40	60	60	60	70	70	59,39	4
	IV	100	100	90	10	100	100	90	90	80	93,94	1
	V	90	90	50	20	80	80	100	80	90	84,39	2
Climate change	I	0	0	100	100	0	0	0	0	0	7,58	5
	II	40	70	80	0	40	40	50	100	100	64,70	3
	III	50	80	0	40	60	60	60	70	70	59,39	4
	IV	100	100	90	10	100	100	90	90	80	93,94	1
	V	90	90	50	20	80	80	100	80	90	84,39	2

	Criteria	1	2	3	4	5	6	7	8	9	Results	
	Elicited	40	40	60	60	20	0	90	100	60	Value	Overall
	Normalized	0,09	0,09	0,13	0,13	0,04	0,00	0,19	0,21	0,13	Function	Ranking
	Policy Scenarios											
Unvaried climatic conditions	I	0	0	0	0	0	0	0	0	0	0	5
	II	40	20	20	50	70	50	30	100	40	49,14894	3
	III	100	30	100	100	70	100	30	60	100	70,85106	1
	IV	90	100	40	20	40	90	30	50	40	47,02128	4
	V	80	50	60	80	100	70	100	30	40	63,82979	2
Climate change	I	0	0	0	0	0	0	0	0	0	0	0
	II	40	20	20	50	70	50	30	100	40	49,14894	3
	III	100	30	100	100	70	100	30	60	100	70,85106	1
	IV	90	100	40	20	40	90	30	50	40	47,02128	4
	V	80	50	60	80	100	70	100	30	40	63,82979	2