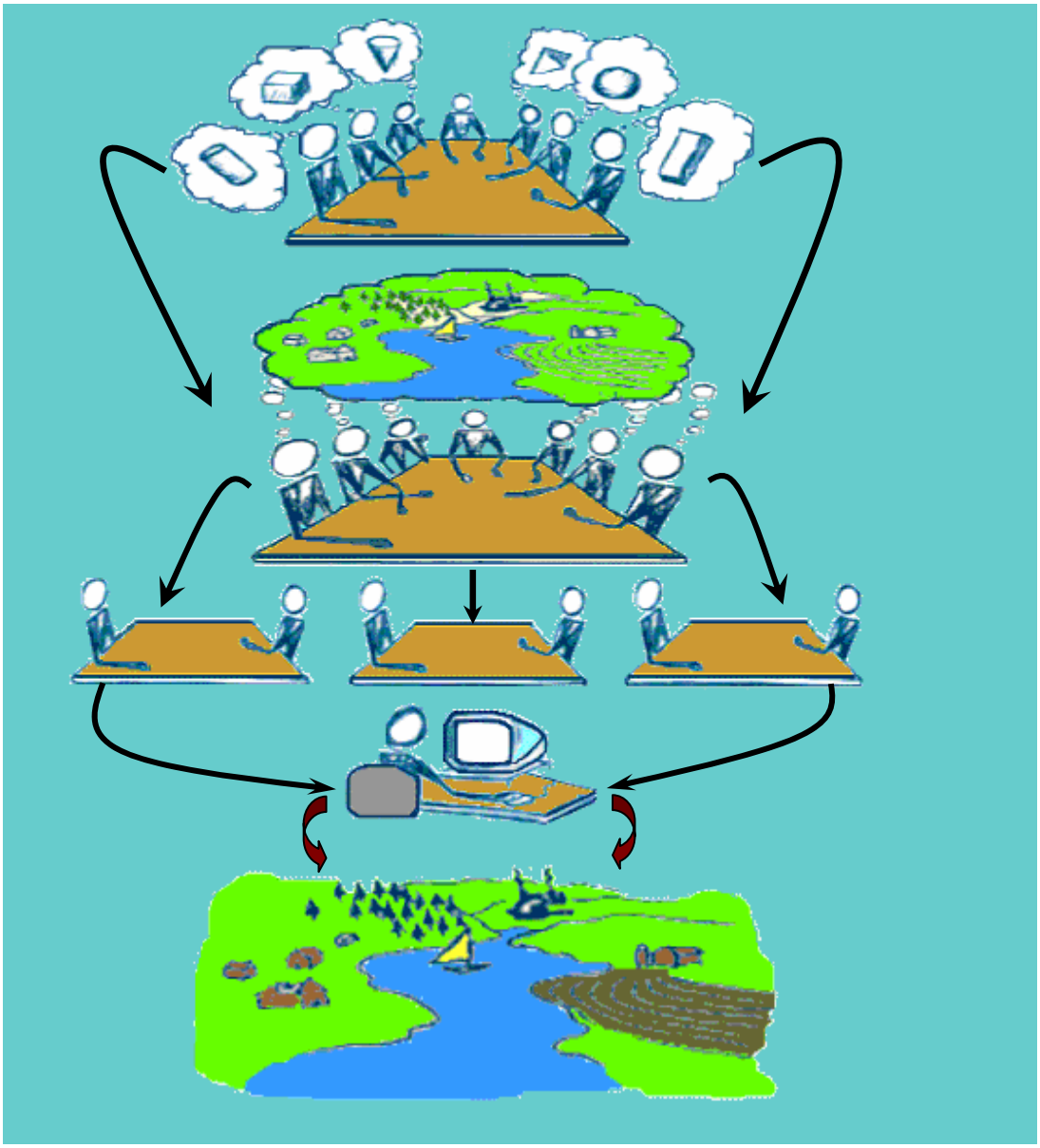

Increasing social support for environmental decision making by discursive ordinal multi-criteria valuation

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Increasing social support for environmental decision making by discursive ordinal multi-criteria valuation

Thesis submitted in fulfilment of the requirements
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To my wife Shakiba and
To my daughter Hasti
Who mean everything to me

Dutch translation of the title:

Versterken van de maatschappelijke steun voor mileubesluitvorming door deliberatieve ordinale multicriteria waardering

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Kamran Zendehdel

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While there may be no "right" way to value a forest or a river, there is a wrong way, which is to give it no value at all.

(Hawken, 1993)

General introduction

Problem statement and objectives

Introduction

The demand on natural resources is continuously increasing due to population growth and rising agricultural, industrial and domestic needs causing pressure on them across the globe. This pressure has mainly influenced rangelands based on their wide distribution and diversity of services and usages (Perrings and Walker, 1997; Arntzen, 1998; Fleischer and Sternberg, 2006; Quaas et al., 2007). Rangelands are one of the Earth's major ecosystems. Estimates show that the amount of earth's land surface covered by rangelands vary from 18% to 80% (Lund, 2007). The variation is due to differences in bases (earth surface, land surface, ice-free land surface, etc.), sources (ground surveys and inventories, remote sensing, climatic or soils maps, etc.), and the definitions used (Lund, 2007). Rangelands are an important renewable resource because of their vital ecological functions such as nutrient cycling, decomposition of organic matter and infiltration of rainfall (Costanza et al., 1997; Perrings and Walker, 1997; Arntzen, 1998; De Groot et al., 2002; Fleischer and Sternberg, 2006; Quaas et al., 2007). Moreover, a variety of economic goods and services including animal production, fibre, medicinal plants and recreational activities are provided by rangelands. In addition, traditional animal production provides people in developing countries with food, manure (for fuel and fertilizer), wool, hides, draft power, transportation, added security, and the possibility to accumulate capital (Batabyal, 2004; Abule et al., 2007b). Rangelands' contributions to other ecosystems such as forests, farmlands and deserts are also very important (Perrings and Walker, 1997). For example, water filtration through rangelands provides fresh water

for farmlands and deserts. Rangelands being a habitat for many pollinators and useful insects that absence of this would result in harmful effects for orchards and farmlands.

By realizing the importance of rangelands and their contributions to other ecosystems, the concept of rangeland management has changed dramatically (Azadi et al., 2007; Higgins et al., 2007; Lund, 2007). In this regard, policies have recently altered from just focusing on conservation of the economic benefits of rangelands to a sustainable development of economic, ecological and social criteria of rangelands. However, policy makers face a lot of difficulties to formulate a sustainable rangeland policy due to the diversity of rangelands' services, uncertainty of information related to their services and presence of multiple social groups with different interests. It is well understood that policy makers need to be informed about stakeholders' preferences towards rangeland services in order to be able to establish a sustainable rangeland decision (Arntzen, 1998; Batabyal, 2004; Higgins et al., 2007).

Stakeholders' intensities of preferences towards environmental criteria are a key element to guide policy makers to adjust environmental decisions. In this regard, since the last decades, different environmental valuation approaches have been introduced to elicit stakeholders' intensities of preferences towards environmental criteria (Winkler, ; Howarth and Norgaard, 1992; Wilson and Howarth, 2002). Environmental valuation approaches such as Contingent Valuation Method (CVM) are mainly based on the neo-classical economic theory (Spash, 2001; Farber et al., 2002; Vatn, 2004a) or based on deliberative democracy (Habermas, 1984; Jacobs, 1997; Sagoff, 1998; Spash, 2001; Dryzek, 2002; Spash, 2007) such as deliberative valuation. Both methodologies have received a large number of criticisms in the way that they elicit and aggregate stakeholders' intensities of preferences. The CVM as a monetary approach has stimulated an extensive debate (Kahneman and Knetsch, 1992; Kahneman et al., 1993; Diamond, 1996; Jacobs, 1997; Sagoff, 1998). For most of these critics, the neo-classical economic value theory underlying CVM is overly restrictive and the methodology is too unrealistic (Kahneman et al., 1993; Diamond and Hausman, 1994; Sagoff, 1998). The method holds an assumption of commensurability between environmental criteria that is inconsistent with the nature of stakeholders' preferences (O'Hara, 1996; O'Neill, 1997; Sagoff, 1998;

O'Connor, 2000; Spash, 2007). The deliberative approaches are also under scrutiny because of their paternalistic and authoritarian structure, which fail to respect people's actual and unconsidered preferences (Cookson, 2000; Tompkins, 2003; Vatn, 2004a). In presence of complex environmental services and multiple social groups with lexicographic preferences towards environmental services, existing valuation methodologies have difficulties to respect stakeholders' actual preferences.

Lexicographic preferences are deeply present in developing countries where people are highly dependent on the natural resources and these resources are a source for religious beliefs and cultural symbols. These elements make monetary valuation approaches inappropriate. To be able to reduce protest responses towards valuation approaches there is a need to introduce new valuation methodologies. The central attention should be towards limitation of trade-offs and problem of commensurability between environmental services and market products. Spash (2001) writes that stakeholders' protest responses towards environmental monetary valuation approaches are a function of lexicographic preferences. To eliminate the protest responses and to be able to incorporate stakeholders' intensities of preferences in a tractable way into the policy making process, this dissertation establishes a discursive ordinal multi-criteria valuation approach. We applied the methodology in a rangeland area (Lar rangeland) in Iran. The rest of this dissertation will explain the different steps of the methodology.

An overview about natural resources in Iran

Iran, with a total land area of 1,648,195 square kilometres, lies between 25º 00´ and 39º 47´ N and 44º 02´ and 63º 20´ E. The country is located in the arid zone of the earth, which some 85% of it has an arid, semi-arid or hyper arid environment. The peculiar features and location cause the country to receive less than one third of the world average precipitation. Only the Caspian Plain in the north receives more than 1,000 mm of rain annually. Two major mountain ranges affect the country's climate: the Zagros chains in the west and the Alborz in the north. Most humid clouds come from the west but mountains prevent clouds reaching the central, eastern and southern parts. So, the central and southern lowlands and eastern parts of the country receive very little precipitation

(ranging from 50 mm to 250 mm during a year) (Kardavani, 1995). Due to this geographical location, from the total land area, some 90 million hectares of the country (54.6%) are rangeland, 12.4 million hectares (7.5%) are forests, 34 million hectares (20.6%) are deserts and 18.5 million hectares (11.2%) are cultivated of which 8.5 million hectares are irrigated and 10 million hectares are rain-fed (Badripour et al., 2006).

In any arid regions on the earth such as Iran, rangelands are the most important renewable resource (Kardavani, 1995; Badripour et al., 2006; Lund, 2007). In Iran, beyond the importance of rangelands in provision of livelihood for some 3 million families (around 24% of total population based on census 1996) and raw material for different industries such as medical and food industries, the rangelands provide a large number of ecological and social services (Badripour et al., 2006). Nutrient cycling, decomposition of organic matter, infiltration of rainfall, soil conservation and provision of a habitat for wildlife are some ecological services. Moreover, rangelands are a source for writers, painters and scientists who are working on social and ecological phenomena, national symbols, religions, architectures and advertising (Kardavani, 1995; Lund, 2007). This diversity of services has attracted different social groups who hold different preferences and ethical motives towards rangelands' services. The diversity of rangeland services and presence of multiple users have faced policy makers with strong obstacles in the way to formulate a sustainable policy to manage this resource. As a consequence of not being able to establish a desirable policy, rangelands are dealing with an ongoing degradation that in long term this will be the cause of economic, ecological and social crisis.

Rangeland sustainable development

The term of 'sustainable development' has been prominent in discussions about environmental policy since the mid- 1980s (Baker, 2006) page 6). Following the United Nations (UN) commission 'Brundtland Commission' (1984-7) and its report 'our common future (WCED, 1987), it has appeared with increasing attention in scientific studies and in government reports (Kroll and Kruger, 1998; Azadi et al., 2007; Papadakis et al., 2007). The Brundtland's report shows mainstream thinking about the relationship between environment and development. Sustainable development is a dynamic concept

that tries to make a balance between the three dimensions of economy, ecology and society (Figure 1).

Promoting sustainable development is about steering social change at the interface between:

1- The social: this relates to human tradition and values, relationships and institutions.
2- The economic: this concerns the allocation and distribution of scarce resources.
3- The ecological: this involves the contribution of both the economics and the social and their effect on the environment and its resources (Baker, 2006), page 7).

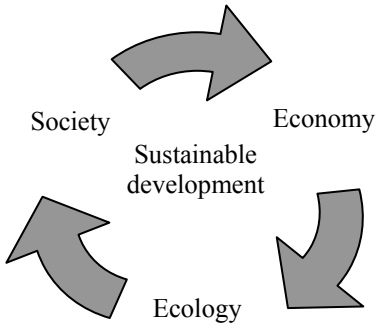

Figure 1. Sustainable development: Linking economy, ecology and society

In Ekins (2003), environmental sustainability is defined as the maintenance of important environmental functions, and hence the maintenance of the capacity of the capital stock to provide those functions. Recently, a fourth dimension is added to the other dimensions, which is 'institutional'. This new dimension concerns mechanisms that help policy makers to support the other dimensions by considering stakeholders preferences to shape conditions of land use, social norms and allocational efficiency (Azadi et al., 2007).

According to the importance of rangeland in Iran, construction of an appropriate institution to protect rangeland services needs an urgent action. In order to do so, the new institution should be able to appreciate stakeholders' preferences towards the three economic, ecological and social dimensions of environmental services. A key element in the environmental sustainable policy making in Iran is the sustainability of rangelands

(Kardavani, 1995). The concept of sustainability in rangeland management allows policy makers to look beyond economic growth and provides a three dimensional development. The ecological sustainability of rangeland is related to social and economic functions of rangeland. In other words, sustainability is an interdisciplinary concept and one cannot meet a sustainable ecosystem without having stability between the economic, ecological and social dimensions (Ekins and Simon, 2003; Ekins et al., 2003).

Environmental valuations and their failure to shed enough light to the policy making process

Environmental valuation studies have shown that in any complex environment with a diversity of environmental services, stakeholders have difficulties to follow a monetary valuation to make trade-offs between different environmental services and market products to express their payment towards the environmental improvement (Tompkins, 2003; Vatn, 2004a). Stated preference methods such as the Contingent Valuation Method (CVM) have been criticised for their individualistic format and assumptions of commensurability between environmental criteria and market products (Jacobs, 1997; Sagoff, 1998; Smith, 2003; Vatn, 2004a; Spash, 2007).

Recently, Choice Experiments (CE) and Deliberative Monetary Valuation (DMV) have been introduced to elicit stakeholders' intensities of preferences towards environmental criteria (Ruto and Garrod, 2004; Spash, 2007). Although these methods have some advantages over the CVM for the construction and elicitation of respondents' intensities of preferences, they still require respondents to make trade-offs between environmental criteria and market products (Slovic, 1995; Vatn, 2004a). Even though CE is a stated preference method that does not need a direct trade-off between environmental criteria, it does entail an indirect trade-off by asking stakeholders to make their choice between different levels of attributes (Ruto and Garrod, 2004; Vatn, 2004a). However, the concept of value pluralism in environmental valuation, related to 'incommensurability and incomparability of environmental values', restricts making any trade-off between environmental criteria (O'Neill, 1993; Liljas and Lindgren, 2001; Smith, 2003; Tompkins, 2003; Vatn, 2004a).

An additional liability of monetary approaches, which assume peoples' preferences towards nature are cardinal, is that those preferences are in fact ordinal. It means that people do not use quantitative indicators to express their preferences among bundles of goods in comparison (Diemer and McKean, 1978; Cook and Kress, 1985; Liljas and Lindgren, 2001; Smith, 2003; Vatn, 2004a). More precisely, the problem with using a cardinal scale is that it can misleadingly induce the respondents to assume the presence of interval or ratio scale properties. These are elements that a researcher should take into account when he wants to choose a valuation method among different methods to estimate stakeholders' preferences.

Role of ecosystem valuation in rangeland sustainable decision making

Although rangelands are an important natural resource on earth, very little research include rangeland valuation (Arntzen, 1998). The valuation literature is most often concerned with the development of techniques to monetize changes in the level of ecosystem services or amenities. Within the economics literature this usually involves making estimates of people's willingness to pay for different levels of different environmental services (Farber et al., 2002). More generally, ecosystem valuation studies are an extensive line of research within ecological economics (Gowan et al., 2006) and the case is often made that such monetization is essential for balancing environmental gains and loss. It is understood that environmental valuation methodologies are a tool to provide policy makers with values that people attach to environmental services (Pearce, 1993; Costanza et al., 1997). In this regard, policy makers will be able to adjust the environmental policies based on people's monetary trade-offs and preferences.

In 1997 two important studies challenged policy makers by bringing light into the existence and importance of non-market environmental services. The first study is done by Costanza and his colleagues (1997). In this study Costanza and his colleagues estimate that at the current margin, ecosystems provide at least US$33 trillion annually that is 1.8 times more than the global economy. Within this estimate grasslands and rangelands provide US$232 per hectare per year to the global economy. They also mentioned that the majority of the value of natural services that they identified is outside the market system,

which motivates policy makers to look for valuation methodologies to attach monetary values to non-market environmental services. The second study was a book, edited by Gretchen Daily, called Nature's Services: Societal Dependence on Natural Ecosystems (1997). This book discusses ecosystem services, their valuation, and provides several case studies.

Although estimate of Costanza and his colleagues has received a lot of criticisms from different angles, it is a raw estimate that has motivated policy makers to pay more attention to natural resources as well as rangeland around the globe. In Iran, these two studies have stimulated researchers to find social willingness to pay towards different ecosystem services. For example, Mirzaei (2000) apply a Contingent Valuation Method (CVM) in a dry rangeland in central part of Iran (Ghom province). He estimates that the rangeland services in the area have a value equal to US$187.5 per hectare per year. Zare-Maivan (1999), using the recommended average value of Costanza, estimates an annual value of some functions and ecosystem services of the Shadegan wetland by about US$4480.2 per hectare (prevention of soil erosion, US$56.2; water regulation and pollution control, US$3273; gas regulation, US$123; recreation, US$48; habitat function, US$850; food and raw materials, US$130). Some other researchers used the CVM and by taking into account the estimated value of Costanza et al. attached the annual value of Mangrove and Zagros forests in Iran as about US$9908 and US$832 per hectare, respectively (Zare-Maivan, 1999; Zare-Maivan and Mojard-Ashenabad, 1999).

As shown, based on the difficulties that stakeholders have with monetary approaches and making trade-offs between environmental services and market products (as it is already explained in earlier pages), resercahers have adopted Costanza's estimated values as an anchor to estimate some values for different ecosystem services. Although these studies provided monetary estimates for some non-market environmental services, they did not hold stakeholders' preferences towards above services. In this regard, valuation approaches have failed to support policy makers to formulate an informative policy towards conservation of environmental services. This brings a need to provide a new valuation approach that does not need to aks people to make trade-offs between environmental criteria and private goods. This method should increase stakeholders'

satisfaction and trust towards preference elicitation, which in turn improve social supports for the policy making process.

To be able to apply a valuation approach in a consistent way with structure of stakeholder' preference, complexity of environmental services and plurality of environmental values, a discursive ordinal (qualitative) multi-criteria valuation method is proposed. The methodology has a discursive structure to enable stakeholders to come together and to discuss on environmental problem in a specific area (Lar rangeland in Iran). In this step stakeholders do not need to reach a consensus on social payment or a social preference towards environmental services under the discussion. The discursive step helps stakeholders to depart from their actual preferences on environmental services under the discussion towards an informative preference (O'Neill, 1993). The outcome of this step will be a list of environmental criteria and alternative plans, which the stakeholders assume that they can support the criteria. To elicit these constructed preferences, the stakeholders will first be asked to attach a qualitative weight to each environmental criterion and make a rank order of impacts of the proposed plans on each single criterion. Therefore, each stakeholder will make a rank order of Alternative Impacts (AIs) on each criterion. This step is an individualistic procedure and eliminates group dynamic (De Keyser and Peeters, 1994; Tompkins, 2003). Then, to elicit the stakeholders' intensities of preferences a qualitative process will be used to enable the stakeholders to express their intensity for each pair of AIs on the constructed rank order (it should be mentioned that in this study we consider qualitative information as ordinal value). Consideration of environmental criteria separately (no trade-offs between the criteria), will decrease stakeholders protests responses.

The aggregation of stakeholders' preferences in our methodology will be done through multiple steps. First, a social rank order of alternatives should be established based on the Condorcet criterion. In this regards, we consider the majority rule as an important element to meet social support. Then, stakeholders' intensities of preferences will be incorporated to the social rank order on each single criterion taking stochastic monotonicity into account. To be able to hold stochastic monotonicity as a sign of consistency between distributions of social intensities of preferences a mathematical

approach, Ordinal Stochastic Dominance Learner (OSDL) will be used. In the next step, a median value among all expressed weights for each criterion will be taken as a social criterion weight. In the second part, an outranking method (ARGUS, Achieving Respect for Grades by Using ordinal Scale only) combines the social intensities of preferences and social criterion weights in a tractable way along all criteria to establish a rank order of the proposed alternative plans. We assume that the final decision (the best plan based on the rank order) will meet the social support as it is formulated based on all stakeholders' preferences. Moreover, regarding the qualitative structure of the methodology, stakeholders are able to find their input and to understand the aggregation process. This feature will increase social support towards the outcome.

Research questions, objectives and hypotheses

Research questions

Several research questions came up during application of the new methodology such as:

- What is the best way to construct a list of stakeholders in the Lar rangeland to apply group discussions?
- What is the best environment for stakeholders to shape their preferences towards environmental decisions?
- How can we reduce stakeholders' protest responses during the application of a valuation study?
- What is the best way to specify environmental criteria and alternative plans for a specific area?
- How can we use the stakeholders' experiences to formulate their preferences towards environmental criteria?
- How can we construct an individual preference function in a realistic way?
- How can we elicit the stakeholders' intensities of preferences based on stakeholders' experience?
- What is the best way to aggregate the stakeholders' intensities of preferences?
- To what extent the aggregated intensities of preferences can inform policy makers about the stakeholders' opinion and preferences on environmental criteria?

- How can one bring a social intensities of preferences into the environmental policy making process?

Objective of the research

With all these questions in mind, the following general and specific objectives have been identified.

General objective

The methodology aims to test and formulate a framework combining advantages of existing valuation methods to minimise the stakeholders' protest responses and to maximise their satisfaction towards group decision. Additionally, we want to test the usefulness of applying the valuation study for establishing a sustainable range management plan in the Lar rangeland to support all different, economic, ecological and social criteria.

Specific objective

To see to what extent stakeholders can be involved into the methodology.

a) To show the usefulness of a qualitative valuation approach to figure out respondents' intensities of preferences towards environmental services.
b) To introduce an qualitative aggregation approach that can incorporate stakeholders' intensities of preferences into group decision in a tractable way that results in minimum opposition of stakeholders towards the final output.

Hypotheses

Four central hypotheses have been formulated, which will be tested in the development of this doctoral dissertation.

- Qualitative articulating institution is a consistent way to use stakeholders' experience and knowledge to construct their preferences towards environmental criteria.

- A qualitative valuation approach is not only able to construct an ordinal utility function (rank orders), but also it can be used to express intensities of stakeholders preferences among each pair of alternative impacts.
- Combining a discursive and ordinal multi-criteria approach can help stakeholders to deal with the bounded rationality and decompose environmental complexity.
- By aggregating stakeholders' intensities of preferences rather than their individual decision, one can be able to draw a reliable group decision that is transparent and easy to understand. This process will increase social support towards the group decision.
- As the methodology (MCDA part) processes the data on all criteria to reach the outcome, small changes in inputs will not make differences in its output.

Dissertation outline

This dissertation is subdivided into 8 different chapters preceded by this introductory chapter and concluded with a conclusion chapter.

Chapter I is entitled: Environmental valuation theories and their limitations. This chapter gives information about the valuation literatures and existing assumptions in environmental valuation. Moreover, this chapter provides existing criticisms to conventional valuation methodologies.

Chapter II is entitled: Theoretical and conceptual framework. This chapter provides an appropriate conceptual framework based on the difficulties related to existing valuation methodologies and sheds insight into establishment of a tractable environmental policy formation.

Chapter III is entitled: Case study and problem sitting. This chapter gives detail information about the Lar rangeland and its complexity.

Chapter IV is entitled: Methodology: A discursive ordinal multi-criteria decision aid to environmental valuation. This chapter describes the different steps of our methodology and provides preliminary information about each step of the methodology.

Chapter V is entitled: Stakeholder analysis, group discussion and formulation of an impact matrix. This chapter explains the first step of the methodology, which include stakeholder analysis, group discussion, preference construction, establishment of

environmental criteria and alternative decisions and finally establishment of an impact matrix.

Chapter VI is entitled: Qualitative valuation of environmental criteria through a group consensus based on stochastic dominance. This chapter provides information about elicitation of stakeholders intensities of preferences and aggregation of preferences on each single criterion based on a mathematical approach (OSDL).

Chapter VII is entitled: Tractable group decisions based on social intensities of preferences. This chapter explains how ARGUS will combine aggregated intensities of preferences and criteria weights in a tractable way into a group decision.

Chapter VIII is entitled: Results and interpretation. This chapter provides all results through the application of the methodology in the Lar rangeland. Then a discussion on the result is provided.

The thesis is finally concluded with conclusions and further recommendations.

We cannot avoid the valuation issue, because as long as we are forced to make choices we are doing valuation.
Costanza and Folke, in Daily, 1997, page 50.

Chapter 1

Environmental valuation theories and their limitations

Abstract

Environmental management is a complex issue because of the diversity of environmental criteria and the involvement of multiple social groups who have conflicting preferences over environmental services. To be able to satisfy different social groups, one needs to know stakeholders' preferences towards environmental services. In this regard, environmental valuations have recently been used to estimate stakeholders' values and intensities of preferences to increase the acceptability of environmental decisions. Although there is no doubt about the importance of environmental valuation in the policy making processes, there is a lot of discussions about valuation theories. Broadly speaking valuation approaches can be divided into three main branches. The first group are valuation methodologies that build based on individualistic rationality and use the neo-classical economics value theory, such as Contingent Valuation Method (CVM). The second category of valuation approaches are group based valuation methods that use deliberative democracy as their core element. The third group of valuation approaches are a combination of both valuation methods. In this category either the deliberative part is the core element or the non-deliberative part. For the latter approach for example, one can use a Multi-Criteria Decision Aid (MCDA) as a main part and a deliberative method either before or after the MCDA to support it. In this chapter we will discuss the three valuation approaches and describe difficulties related to these methods in presence of a complex environmental issue and multiple social groups.

1.1 Introduction

In the General introduction we explained the necessity of environmental valuation as a tool to incorporate stakeholders' preferences into the environmental decision making. In this chapter, we will focus on existing environmental valuation methods and will explain difficulties that hinder policy makers to elicit and to aggregate stakeholders' preferences to establish a sustainable environmental decision.

Economic valuation of environmental features is mainly based on the well-known set of axioms which constitute the neo-classical theory of consumer behaviour. The assumption of the neo-classical approach is that the market is the best indicator of individual preferences and well-being, based on the self- interest and the satisfaction of wants and desires within constraints. By summing these individual preferences a measure of societal preference and hence societal welfare is possible (O'Neill, 1993; Moulin, 2003; Gaertner, 2006). However, concern on environmental damage involves ethical and moral principles which are determined independently of any economic use (Jacobs, 1997; Sagoff, 1998). The neo-classical economic value theory underlying Cost Benefit Analysis (CBA) and Contingent Valuation Method (CVM) for environmental valuation has been the subject of a large number of criticisms (Hausman, 1992; O'Neill, 1993; O'Hara, 1996; Jacobs, 1997; Sagoff, 1998; O'Connor, 1999; Spash, 2000; Perkins, 2001; Smith, 2003; Vatn, 2004; Munda, 2004; Vatn, 2004; Wilson and Howarth, 2006). The assumptions underlying the theory are considered too narrow to properly describe the environmental values people hold, the process of preference construction and the way that individual values are aggregated into a social value (Jacobs, 1997; Sagoff, 1998; Brouwer et al., 1999; Zhang and Li, 2005). Monetary approach as applied in valuation methods such as CVM requires a definition of environmental goods in a way fundamentally identical to marketed goods and services. The essential assumption of this method is that individuals are able and willing to exchange one bundle or combination of goods for another and can do so without affecting their welfare level. However, numerous real world studies have shown that people do not agree to make trade-offs between environmental services and market products (Sagoff, 1988; Meyerhoff, 2006 Kahneman et al., 1993; O'Neill, 1993; Sen, 1995a; O'Hara, 1996; Jacobs, 1997; Sagoff, 1998; Brouwer et al., 1999; O'Connor, 2000;

Perkins, 2001; Wilson and Howarth, 2002; Smith, 2003; Vatn, 2004b; Zhang and Li, 2005; Howarth and Wilson, 2006)

Kahneman (1993) demonstrates that stakeholders' reaction to a monetary valuation approach can be assumed as a charitable contribution rather than purchasing the supply of a public good. Kahneman continues:

> "In an economic framework, it is natural to assume that respondents adopt a purchase model, in which their task is to determine how much a particular environmental good is worth to them. A psychological plausible alternative is that many respondents adopt a contribution model, treating the protection of the environment as a good cause that needs supporting".

Another problem that may come up during a monetary valuation is that some stakeholders hold lexicographic preferences towards environmental services. These preferences cannot be transformed into a monetary value. Spash (2000b) shows that protest bids in monetary approaches often are a function of lexicographic preferences. Thus, WTP has been described as the purchase of moral satisfaction rather than a trade or exchange value and this has been linked to a contribution model of WTP (Kahneman et al., 1993; Spash, 2000b).

The second group of environmental valuation is group based or deliberative valuation method (Jacobs, 1997; Sagoff, 1998; Spash, 2001; Spash, 2007). This method has recently been received a lot of attentions. Citizen Jury (CJ), Advisory Committee (AC) and Consensus Conference (CC) are some of group based methods that have applied to provide a microcosm of their society and introduce a social preference (Hill and Zammit, 2000; Kontoleon et al., 2002). These methods are based on deliberative democracy and provide a deliberative environment for a small group of participants. The main idea of a deliberative approach is to motivate participants to come together and to discuss on problem. In this regard, people will depart from their initial preference and are able to reach an informative preference towards the concept under the discussion (O'Neill, 1993). Based on the informed preferences and common understandings, it is assumed that the group members are able to reach a consensus on social goal (O'Neill, 1993; Jacobs, 1997;

Sagoff, 1998). However, group valuation methods are also under scrutiny for their necessity of reaching a consensus and limitation of stakeholders' to act freely (De Keyser and Peeters, 1994; Cookson, 2000; Tompkins, 2003; Vatn, 2004a). In presence of a diversity of interests among social groups, expectation of reaching a consensus can marginalize the group discussion and result in a biased group consensus (De Keyser and Peeters, 1994; Cookson, 2000; Tompkins, 2003; Vatn, 2004a).

The third valuation approach is a combination of deliberative approach with monetary or MCDA approach to eliminate environmental valuation difficulties (Stirling, 1997; Spash, 2001; Proctor and Drechsler, 2003; Stagl, 2003; Munda, 2004; Spash, 2007). Although combined valuation methods such as Deliberative Monetary Valuation (DMV) (Spash, 2001; Spash, 2007) or a Multi-Criteria Evaluation (MCE) (Proctor and Drechsler, 2003) further simplifies complexity of environmental system and eliminates the bounded rationality that limit stakeholders' cognitive capacity, they mostly use numerical values to elicit and aggregat stakeholders' preferences. These procedures are not consistent with structure of stakeholders' preferences and make the method a black box for stakeholders (Diamond and Hausman, 1994; Liljas and Lindgren, 2001; Tompkins, 2003; Vatn, 2004a; Diamond, 1996).

To be able to analyze the environmental valuation methods and their pros and cons, this chapter first provides basic information about environmental services and conventional valuation methods.

1.2 Definition of ecosystem goods and services

There are different definitions for ecosystem services, particularly in relation to environmental processes and functions. Daily (1997, P.3) defines ecosystem services as: "the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfil human life". Here, services include functions and processes. Costanza (1997) define functions as "the habitat, biological or system properties or processes of ecosystems". Services, then, are the benefits humans derive from these functions. Here, functions include processes, which provide the services. Another interpretation of ecosystem services is provided by De Groot et al. (2002). They

call what Costanza et al. (1997) called services, environmental functions. De Groot et al (2002) define functions as "the capacity of natural processes and components to provide goods and services that satisfy human needs". For them, processes lead to functions, which lead to services[1].

To be able to describe in a simple way relationships between natural assets, environmental services and ecosystem goods, Figure 1.1 is provided. The figure shows the first transformations of natural assets into products that are valued economically or in other ways by people living in an environmental area. It is developed as a way to simplify ecological complexity and to centralize people's attention to the relationships between natural capital (natural assets), ecosystem goods and other commodities, and the services that emerge through transformations between assets and products. In this framework, ecosystem services contribute to the economic and social well-being of people in two ways:

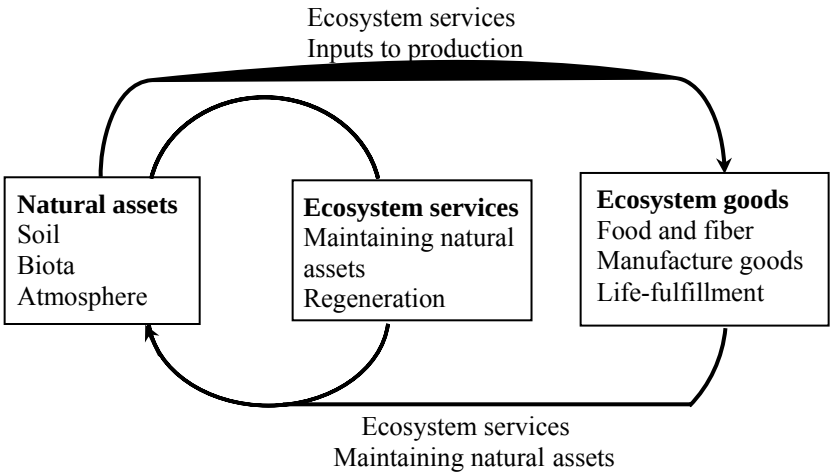

Figure 1.1. Conceptual framework defining ecosystem services, (Cork et al., 2001)

1- Through the use of natural assets to provide an input to production. For example, forage production in rangeland is dependent on the service of pollination, which in turn is

[1] For those readers who are interested in having more information on definition of environmental services and functions, De Groot et al. (2002) provide a useful typology for the classification, description and valuation of ecosystem functions, goods and services.

dependent on the natural asset of biota to provide insect pollinators. Similarly, crops are dependent on the service of nutrient cycling, which uses the natural asset of soil.

2- By maintaining natural assets through regenerating the assets (e.g. maintaining soil health through nutrient recycling) and through the assimilation of by-products arising from production processes or from consumption of goods (e.g. assimilation of carbon dioxide from industry by vegetation or detoxification of chemicals by soil micro-organisms).

1.3 The concept of value for ecosystem services

Resources economists have developed a variety of techniques to estimate the monetary value of non-market environmental goods and service such as hunting, fishing, outdoor recreation and water quality. In this way, ecological economists have applied valuation approaches such as CVM to estimate the economic value of various ecosystem services (Costanza et al., 1997; Krieger, 2001; De Groot et al., 2002). Economists assume when a good or service is valuable if it increases human well-being (Daily, 1997; Costanza, 1998). This implies that goods and services have no value in their own right. The economic concept of value does not imply, however, that an ecosystem's ability to add to monetary wealth is the only way in which ecosystem goods and services should be used. Many people have received pleasure from non-consumptive use of ecosystem goods and services. So many people value environmental services even though they have never seen them such as conserving Amazon forests or North pole (bequest values) (Figure 1.2). The figure shows that economists divide the values into two broad categories, use and non-use (passive use) values (Costanza et al., 1997; Krieger, 2001; Birol et al., 2006; Brander et al.). These values are further divided into different branches as they are seen in the figure.

Critics have argued that the economic concept of value is inherently imperfect when applied to environmental resources and thus should have no place in the environmental decision making (Kontoleon et al., 2002; Smith, 2003). The main idea is that people simply don't have values for environmental services in the way that economists define them and so that the values of environmental resources cannot be defined in economic terms (Smith, 2003). Moreover, the economic concept of value that is well defined in

neo-classical economic theory should not dominate the other kind of values such as ecological and social values that people hold toward the environment (O'Neill, 1997; Martinez-Alier et al., 1998; Trainor, 2006).

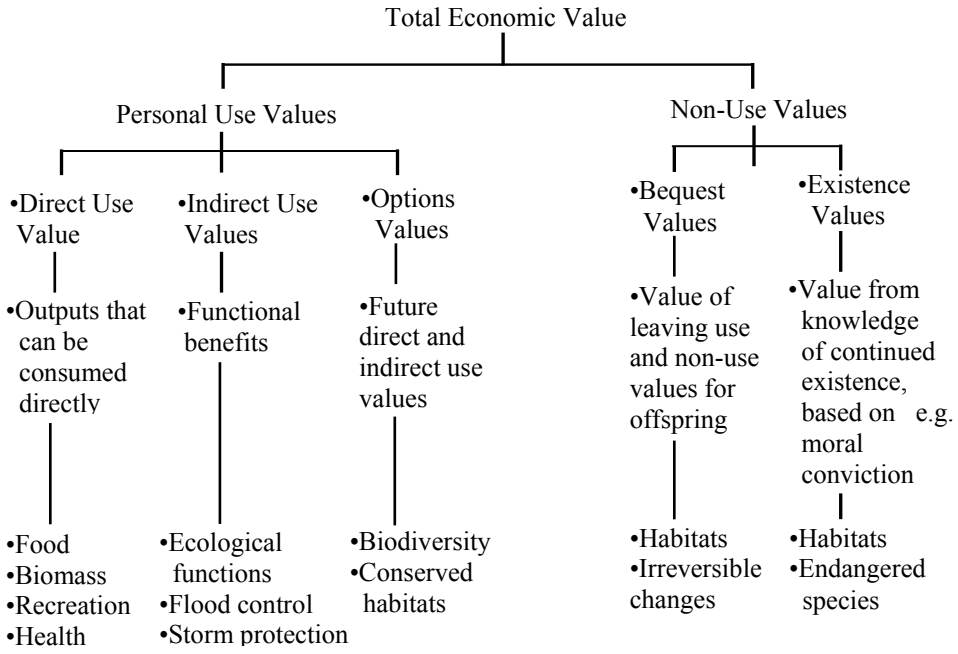

Figure 1.2. Diffrent noation of values (Kontoleon et al., 2002)

1.4 Environmental valuation methods, definition and classification

Broadly speaking, valuation techniques can be divided into three main categories (Table 1.1). The first category is individualistic valuation method, which uses neo-classical economic theory as underlying assumption (Brouwer et al., 1999; Hill and Zammit, 2000;

Table 1.1. Spectrum of environmental valuation methods

Environmental Valuation Methods							
Individual Based Valuation Techniques					**Group Based Valuation Techniques**	**Combined valuation methods**	
Valuation Techniques		**Pricing Techniques**			**Participator**	**Combining MCDA and Deliberation**	
Revealed Preference	**Stated Preference**	**Market prices techniques**	**Value of actual expenditure**	**Value of potential expenditure**	**Pure Participatory Approaches**	**A combined method when MCDA is the core element**	**A combined method whendeliberation is the core element**
-Travel cost method -Hedonic Pricing	-Contingent valuation method -Choice experiments -Contingent ranking	-Change in productivity approaches -Opportunity Cost approaches	-Cost effectiveness -Preventive expenditure approaches	-Replacement cost approaches -Shadow price approaches	-Citizen juries -Citizen advisory committee -Consensus conferences -Focus group -Committees scenario workshops	- Social Multi-Criteria Decision Analysis (SMCDA) - Deliberative multi-criteria evaluation	- Deliberative monetary valuation -Multi-criteria deliberative -Deliberative mapping

Spash, 2000a). The second category includes group based approach that use deliberative democracy as underlying assumption (Wilson and Howarth, 2002; Spash, 2007). The third category is a combination of deliberative or monetary approaches with MCDA methods (Table 1.1) (Stirling, 1997; Stagl, 2003; Vatn, 2005).

1.4.1 Individualistic valuation methods

Valuation approaches under individualistic valuation category have divided into two sub-groups, valuation techniques and pricing techniques.

1.4.1.1 Valuation Techniques

Under the Valuation Techniques, there are Revealed and State Preferences techniques (Table 1.1) (Kontoleon et al., 2002). Revealed Preference Technique includes: Travel Costs Method (TCM) and Hedonic Pricing (HP), which are methods that rely on

information from individual consumption behaviour occurring in markets related to the environmental resource in question (surrogate markets) (Carson et al., 1996; Huang et al., 1997; Hill and Zammit, 2000; De Groot et al., 2002). The price differential of the good (purchased in the surrogate market), once all other variables that affect the price have been controlled, will reflect the purchaser's valuation of that particular level of environmental quality (Venkatachalam, 2004).

Stated Preference Techniques include Contingent Valuation Method (CVM), Choice Experiments (CE), and Contingent Ranking (CR). These techniques are used in situations where both use and non-use values have been estimated and/or when no surrogate market exists from which environmental (use) value can be deduced (Table 1.1) (Garrod and Willis, 1999; Kontoleon, 2002; Garrod, 2004). These techniques use questionnaires to develop a hypothetical market through which they elicit stakeholders' willingness to pay (both use and non-use) for the environmental good under investigation. The technique presents a maximum amount that people are willing to pay to obtain the environmental improvement and in the same way it can elicit the minimum amount that people are willing to accept to forgo the environmental improvement. Stated preference techniques do not suffer from the same technical limitations as revealed preference approaches and can also be applied to non-use values (Venkatachalam, 2004; Wiser, 2007). The CE is another stated preference method that is also increasingly applied in the environmental valuation literature (Garrod and Kenneth, 1999; Ruto and Garrod, 2004). The CE refers to a family of survey-based methodologies used for modelling preferences for goods, where such goods are described in terms of their attributes and of the levels of these attributes. Respondents are presented with various alternative descriptions of the good, characterised by a set of independent attributes and differentiated by variations in the levels of these attributes, and are asked to provide information on their preference for the various alternatives (Ruto and Garrod, 2004). Thus, respondents may be asked to rank alternatives, to rate them individually using a numeric scale or, most commonly, to choose their most preferred alternative.

Table 1.1 also lists three categories of environmental pricing techniques, which fall; however, outside the scope of this dissertation as they can only be applied when real or

potential costs are involved. Interested readers can find more explanations about the pricing techniques in Garrod and Kenneth, 1999 and Kontoleon, et al., 2002.

1.4.2 Group based valuation approach

Citizen Jury (CJ) is a form of deliberative approaches that has been used on several occasions in the U.S. and Europe (Brown et al., 1995; Jacobs, 1997; Huitema, 2003). A randomly selected group of about a dozen jurors designed to represent a microcosm of their society to study a specific local or regional public policy issue (Abelson et al., 2003; Huitema, 2003). The jurors deliberate through a procedural stage where no preliminary decisions have been made. Thus, its scope is not restricted to the final decision but can include the definition of goals and constraints (Kontoleon et al., 2002). Citizen Advisory Committee (CAC) have also been used in the US and Canada (since the early 1980's) to provide advice to federal, state and local government on implementing environmental law, promulgating regulations, and issuing permits and for planning of potentially polluting facilities (Kontoleon et al., 2002).

1.4.3 Combined valuation approach

There are also some evolving initiatives concerning towards combining valuation methods. There are two valuation approaches under this category. In the first category, Multi-Criteria Decision Aid (MCDA) is the core element and a deliberative method helps the stakeholders to be involved into the study. In the second category, the deliberative method is the core and MCDA supports the stakeholders to come up with the final decision.

1.4.3.1 MCDA is the core element

Recently different researchers used a combination of a deliberative approach and an MCDA (Proctor and Drechsler, 2003; Munda, 2004). In this approach, the output of the deliberative approach that is a consensus among participants on different criteria under the discussion will be entered into an MCDA to provide a group decision. Proctore and Drechsler (2003) use this method to provide some recommendation for tourism activities

in Australia. In this way, the MCDA is the core part and the deliberative step helps people to understand the difficult environmental concept and to be informed about others' perspectives. Stagl (2003) documents a study where a deliberative process to review the UK energy policy was supported by a rather simple form of multi-criteria evaluation. She suggests that the MCDA not only supports verification, but also supports the participants in clarifying what they mean about the various issues.

1.4.3.2 Deliberation is the core element

The second kind of the combined valuation method is where deliberation is the core part and for example, a monetary approach is used to elicit the group's preferences. Deliberative Monetary Valuation (DMV) is the method that recently received a lot of attentions in environmental valuation studies (Spash, 2001; Spash, 2007). This method has been developed as an alternative to the CVM (Spash, 2007). The method could possibly avoid some of the limitations of the CVM while allowing a platform for individual preferences to feed into environmental decisions (Jacobs, 1997; Sagoff, 1998; Spash, 2007). The purpose of DMV is to reach an agreement on what should be valued by or on behalf of society as a whole (Wilson and Howarth, 2002). By exposing participants' initial preferences to one another through 'reasoned debate', the logic goes that preferences may change and in this way, be brought closer together (Spash, 2007). Even though this may not result in a complete convergence of values, compromise will still need to be achieved through a dialogue between competing judgments of the best interests of society as a whole, not a simple aggregation of individual preferences.

1.5 Difficulties related to neo-classical economic value theory

Historically, neo-classical economic theory has assumed that individual preferences, which determine the demand for goods and services, are fixed in the short-term and change only over the long-term (Jacobs, 1997; Sagoff, 1998; Wilson and Howarth, 2002; Vatn, 2004a; Spash, 2007). This assumption holds reasonably well and is the basis for brand development. Psychologists and philosophers suggest that individual preferences are in fact flexible and sensitive to external influence, including manipulation by

exogenous forces, such as business advertisers or the government (Tversky et al., 1988; Gregory and Keeney, 1994; Norton et al., 1998; Sagoff, 1998; Fischhoff, 2000). Consideration of a few concepts suggests that this is the case. What is an 'acquired taste' if not a constructed preference that is generated because of trying something repeatedly and developing a modified opinion towards it with each attempt? In addition, how does a preference suddenly exist for a new good or service that has just been invented and introduced into the market? In such a situation, an individual's preference may evolve through absorbing advertising information and through discussions with friends or acquaintances who have used the product. But the literature on preference reversal in the field of environmental economics valuation suggests that people's preferences should not be assumed to be fixed, but are context and information dependent, see for example (Gregory and Slovic, 1997). More recent environmental economics literature supports the assumption of constructed preferences, notably through the identification of preference reversals within the CVM experiments (Norton et al., 1998). A preference reversal occurs when an individual prefers good $\mathcal{A}$ to good $\mathcal{B}$ under one method of measurement but prefers good $\mathcal{B}$ to good $\mathcal{A}$ when a different measurement tool is used. The preference reversal phenomenon has been reported by Grether and Charles (1982). Irrespective of whether preferences are fixed or evolving, another problem arises, as not everyone is capable of expressing their preferences. If individuals are asked to state which evaluation criteria should be the focus of decision making, there is the potential problem that individuals may be unable to articulate their preferences in terms of a standard unit, such as a monetary value (Sagoff, 1998). In one experiment, through an assessment of the CVM in focus groups, it was found that individuals experienced significant difficulties in determining their own monetary values for environmental conservation (Clark et al., 2000). There has also been other evidence of the refusal to accept compensation for trading environmental quality regardless of the amount. For example, in a CVM study Jansen, (1973) found that 50% of respondents refused compensation for the noise impacts of a new Dutch airport via a lower house purchase price, no matter how low the price. Similarly, Rowe et al., (1980) found evidence to support the view that respondents reject the concept of 'being bought off to permit pollution' in a CVM study. In this case, slightly over 50% of the sample 'required infinite compensation or refused to cooperate.

In the neo-classical economic theory, any process of valuation seems to rely on money as a natural common measurement unit (Chiesura and de Groot, 2003). In this way, economic efficiency is a superior criterion that dominates other realms of values (Trainor, 2006). In the standard neo-classical economic approach, valuing the environmental goods and services is understood within a microeconomic model of institutional structure (Sagoff, 1998; Wilson and Howarth, 2002; Wilson and Hoehn, 2006). In this way, people should try to maximize their utility by making their choice among a bundle of ecosystem goods and services (Arrow, 1951; Sen, 1970; Moulin, 2003; Saaty and Vargas, 2005; Bateman et al., 2006; Gaertner, 2006). Then the valuation approaches will elicit this utility mostly by a monetary approach (Figure 1.3). The figure shows that individuals should be prepared to make trade-offs between different bundles of environmental services and market products to come up with a WTP value as an economic value for environmental changes. The individual WTP or utility function should be aggregated through mathematical approaches by simply calculating a mean value among all values to build a social willingness to pay (Jacobs, 1997; Sagoff, 1998; Wilson and Howarth, 2002; Spash, 2007).

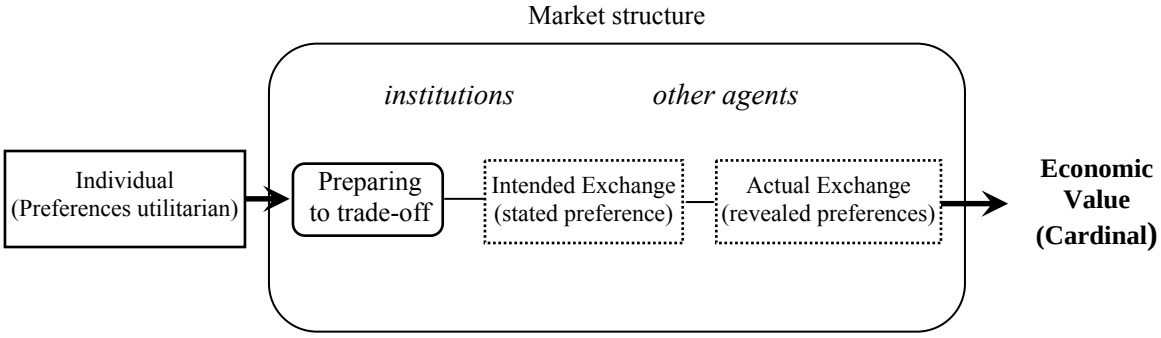

Figure 1.3. The economic process of valuation, adapted from Spash, (2007)

In this method, individuals are assumed to make choices via expression of preferences in a hypothetical market. The environmental valuation under CBA borrows directly from the market process (Vatn, 2000). Individuals are expected to be able and willing to express a preference over any environmental change. These preferences are generally regarded as existing preferences. A CVM survey or choice experiment aims to obtain a stated preference, while observations of actual markets can be used to infer or reveal preferences, as under HP or TCM. These assumptions behind the monetary approaches as

a general theory of environmental valuation have also led to the revelation of a range of problems (O'Neill, 1993; Trainor, 2006; Spash, 2007).

1.6 Difficulties related to the individualistic valuation methods

Environmental valuation practitioners have faced with some inherent difficulties that are attached to environmental issues. In previous sections, we generally explained the methodological difficulties that valuation approaches are faced with. In this section, we will discuss these difficulties in detail.

1.6.1 Public good and private questions

In economies where markets work reasonably well, market prices are a good indicator of the marginal value individuals attach to incremental units of a good or service. However, widespread market failure makes the connection between market prices and preferences weak or unreliable for many major problems (MacMillan et al., 2006). An important issue in the absence of reliable market data, then, is how to obtain useful information on public priorities and preferences that can be used in decision making for environmental management. Market prices may not be an accurate reflection of value due to market failure (externalities, transaction costs etc.) or government intervention (agricultural subsidies) (MacMillan et al., 2006).

Most of environmental valuation is based on people's WTP, an amount of money in order to avoid environmental degradation, or their willingness to accept (WTA) compensation in exchange for environmental impacts incurred (Damigos, 2006). Environmental valuation has been used in the US since the 1960s, and was further established in Europe and other countries during the 1980s and 1990s (Munda, 2004; Munda, 2006). The increasing desire to incorporate monetary values for environmental impacts originates from ''market failure'', which means that the market place does not reflect the true social worth of the environment. In order to come up with more informed and fair choices, economic valuation seeks to internalize the environmental impacts that have been traditionally viewed as externalities. The challenge is therefore twofold: firstly, it is necessary to identify ways in which environmental change affects the well-being of

individuals and secondly, to estimate the value of these changes through a variety of direct and indirect valuation techniques (Pearce, 2000). Consequently, the accuracy of economic valuation depends on the identification and quantification of the environmental change as well as the estimation of people's preferences for, or against, this change.

The main difficulty with environmental valuation is that most environmental services are public goods and a private question cannot satisfy stakeholders' liability towards these services.

Jacobs (1997) writes:

> "Where public goods are at issue, the appropriate kind of value-articulating institution is not a private survey, but some kind of public forum in which people are brought together to debate before making their judgment. That is, the institution should be deliberative in character".

He argues that the deliberative democracy is the normative political theory behind deliberative value articulation. It can likely encourage people to be involved in the public good thinking.

1.6.2 Complexity of environmental criteria and social groups

Complexity is one of the important characteristics of the environment. This obvious observation has important implications for the way in which the valuation approach and decision-making is framed (Munda, 2004). A system is complex if the relevant aspects of a particular problem cannot be captured by using a single perspective (Limburg et al., 2002; Munda, 2004). In addition, human rationality is bounded based on difficulty of reaching and analysing information due to the limitation of people cognitive capacity (Simon, 1972). The fact is that people imaginations and calculation abilities are limited and fallible (Simon, 1972; Smith, 2003). It is demonstrated that people's minds have natural limitations in processing more than 7±2 items at the same time while maintaining consistency in their judgments (Miller, 1955; Saaty and Ozdemir, 2003). Even if we occupy the highest place in the animal kingdom, we have to accept that limitation is a non-separable characteristic of humankind. Miller (1955) in his famous paper writes:

> "My problem is that I have been persecuted by an integer. For seven years, this number has followed me around, has intruded in my most private data, and has assaulted me from the pages of our most public journals. This number assumes a variety of disguises, being sometimes a little smaller than usual, but never changing so much as to be unrecognizable. The persistence with which this number plagues me is far more than a random accident . . . what about the magical number seven. Seven Wonders of the World, seven seas, seven deadly sins, seven daughters of Pleiades, seven ages of man… Perhaps there is something deep and profound behind all these sevens, something just calling out for us to discover. . . For the present, I propose to withhold judgment." (Miller, 1955).

The complexity of a valuation study will increase when a multiple social groups with a diversity of interests are involved. In this regard, the first step for any environmental valuation approach is to decompose and translate the environmental complexity into a more limited number of functions and attributes (economic, ecological (structures and processes) and social) and to provide a fair opportunity for all stakeholders to be able to introduce their attitudes (Keeney et al., 1990; De Groot et al., 2002; Limburg et al., 2002).

The individualistic valuation methodologies have different approaches to deal with environmental complexity. For example, it is argued that the CVM offers a rational institution for resolving conflicts between competing values and interests, and communities that articulate those values and interests (O'Neill, 1997), by assuming all environmental criteria comparable on a unitary scale (O'Connor, 1999). As the CVM is dealing with one valuation scale (economic) it simply neglects the other environmental criteria (social and ecological) (Diamond and Hausman, 1994). Consideration of commensurability between environmental criteria in monetary valuation approaches is a wrong way of simplification of the environmental complexity. It results in protest responses of stakeholders (Spash, 2007). Urama and Hodge (2006) report that 25% of respondents in southeastern Nigeria had difficulties with the complexity of information that was provided through a CVM. The stakeholders were unwilling to commit money to

an irrigation project that had different environmental aspects. In another study, Christie et al., (2004) show that 63% of a UK sample did not know what the word "biological diversity" meant. It should be mentioned that qualitative analysis suggests that the inherent complexity of science information often used in valuation experiments limits comprehensive economic valuation (Urama and Hodge, 2006).

The individualist valuation approaches do not deal with the concept of social complexity. In other words, as these methods take stakeholders separately and applying a simple aggregation process to establish a social value, they easily neglect facing with problem of social complexity.

1.6.3 Plurality of environmental values

A recent trend in the environmental valuation literature is toward a pluralistic conception of value. Just as we are starting to acknowledge and accept the diversity and complexity of natural systems and processes, it may also be time that we begin to accept and embrace the diversity and the complexity of the nature of humanity and our interdependencies with the natural world (Smith, 2003; Munda, 2004). O'Neill (1997) argues that an irreducible pluralism of values raises problems of value incommensurability (O'Neill, 1997). The argument that values are incommensurable in natural resource policy and decision making is thus, in a sense, an appeal to acknowledge and formally legitimate other realms of value, other forms of value expression, and other decision criteria, or covering values. This way, value incommensurability challenges the dominance of economic rationality and utilitarian reasoning in natural resource policy, insisting that rational decisions can be made without a common cardinal metric or a single decision criterion (Fleischer and Sternberg, 2006). Those who defend strictly the utilitarian calculus of neo-classical economics and the self-interested model of rational choice that justifies this economic theory often dismiss the significance of these many realms and expressions of value beyond their attempted translation into individual preferences or willingness to pay. By accepting the philosophy of value pluralism, we accept the irreducibility of values to a single super-value (happiness, pleasure, utility). By accepting the conception of value pluralism, we can become more tolerant of the methodological

comprehensiveness necessary for valuation, including multiple motivations of values and multidisciplinary approaches to valuation (Munda, 2004). Smith (2003) writes:

> "Value pluralism will be offered as a more effective framework within which [one is] to understand the variety of environmental values and better appreciate the value conflicts that arise when deliberating about the environment".

People have moral values toward the environment and moral commitments belong to another class of values and they can hardly be transformed into monetary representations without causing confusion for respondents (Cook and Kress, 1985; Springael and De Keyser, 2004; Vatn, 2004a; Trainor, 2006). Opponents of neo-classical value theory believe that the CBA has misunderstood the nature of human preferences and privileges allocational or economic efficiency over other principles. Decisions that draw heavily on the use of CBA will misrepresent our environmental values and commitments (Jacobs, 1997; Spash, 2000b; Sagoff, 2003; Smith, 2003; Howarth and Wilson, 2006). Typically, environmental economists believe that biases within the CVM can be eliminated, given more research and greater sensitivity in surveying. However, these biases may in fact be a misunderstanding of the nature and diversity of values that we associate with the non-human world (Smith 2003). People may have a wide range of desires and preferences, which are influenced by their particular moral outlooks. The utilitarian view resolves these conflicts by the neutral and impersonal rule that of all the policies available to government, the one that is the most likely to achieve the greatest amount of desired satisfaction is the course that should be chosen (Vatn, 2004).

Individual preferences are shaped by a number of factors that will affect either behaviour in existing markets or responses in valuation approaches. They include the availability of information and the social and economic constraints. An individual may not be in an economic or social position to act on information (one of the limitations of hedonic pricing method) or to see how it is possible to make trade-offs between different environmental criteria (one of the limitations of stated preference methods) (Smith, 2003). Aesthetic and ethical considerations are qualitatively different from economic valuation. Economists generate a monetary value that is unquestionable; what precisely that value represents is another matter. Obligations, duties and commitments to the

environment are judged by other criteria than utility. CBA is an excellent example of an aggregation technique that prioritises economic efficiency. Nevertheless, according to value pluralism, efficiency is just one out of a diversity of values that might guide policy decision. Conditions need to be created in political institutions to make sure that a diversity of what may be incommensurable and incompatible values, goods or decision rules in judgments can be appealed to, and alternative policy options that emerge assessed (Sagoff, 1998; Smith, 2003).

1.6.4 Ordinality of stakeholders' preferences towards environmental services

The aim of any valuation approach is to estimate stakeholders' preferences over a set of environmental changes. However, measuring stakeholders' preferences is not always straightforward. It may be that respondents are not sure about their preferences, unable to state them exactly, or even unaware of them. Furthermore, the respondents may act inconsistently and give conflicting statements about their preferences. The main problem facing the monetary valuation approaches is the ordinality of stakeholders' preferences towards different courses of action (Cook and Seiford, 1984; Cook and Kress, 1985; Liljas and Lindgren, 2001; Vatn, 2004a). Stakeholders do not have a numerical system to construct quantitative preferences that most valuation approaches aim to elicit them (Liljas and Lindgren, 2001). It means, people do not use numerical indicators to express how much more desirable one bundle of goods is in comparison with another (i.e. differences in desirability) (Diemer and McKean, 1978; Cook and Kress, 1985; Liljas and Lindgren, 2001; Smith, 2003; Vatn, 2004a). People are not consistent with using numbers to show the difference among alternatives. General limitations on human performance are very familiar in the literature of psychology (Miller, 1955; Saaty and Ozdemir, 2003; Jarrold and Towse, 2006). CBA and all monetary valuations that rely on making trade-offs between different environmental criteria might have a major problem in their methodology because of cognitive limitation of human (Garrod and Kenneth, 1999; Munda, 2006). People need to have a good knowledge of calculation to come up with a WTP value in CVM or a preferred choice among alternatives in CE method. Urama and Hodge (2005) applied a valuation study to environmental services in Nigeria. They found that 42.9% of the respondents refused to respond to the WTP question and 14% of those

who were willing to bid indicated that they did not know how to value the resources in monetary terms. Stakeholders' protest responses to monetary approaches are a strong reason to reject forcing people to make trade-offs between environmental criteria (Kahneman and Knetsch, 1992; Kahneman et al., 1993; Diamond and Hausman, 1994; Diamond, 1996; Fischhoff et al., 1999; Kahneman et al., 1999; Liljas and Lindgren, 2001). Psychologists claim that people do not behave according to the dictates of utility theory that assumes people are rational in the sense of having preferences that are complete and transitive and in the sense that they choose what they most prefer (Slovic, 1995). Utility theory, when applied to untraded environmental goods and services, has also been criticised for making the artificial/hypothetical assumption that there are markets within which consumers can make trade-offs between different goods and services they choose to consume (Sagoff, 1998). In utility theory, preferences are treated as data of the most fundamental kind. Value, in the economic sense, is ultimately derived from individual preferences (Randall, 1981; Sagoff, 2003). Here the differences in the preferences are not because of their worthiness or reasonableness, but simply defined on the basis of their intensity as measured by a willingness to pay (Sagoff, 2003).

In monetary valuation such as CVM, the nature of information can profoundly affect WTP estimates. According to the neoclassical position, CVM presumes that people have individual-specific, well-defined preferences over different states of the world. The empirical evidence seems to be at odds with these assumptions for three reasons (Vatn, 2004a): 1- Preferences may have to be learned, they have a social dimension. 2- Preference may be ordered in classes and thus trade-offs may be blocked; and 3- preferences may be anchored on the status quo distribution of goods (Vatn, 2004a).

Slovic (1990) concludes that people only have well-defined preferences for goods that they are familiar with. Since the respondents in environmental valuation are often faced with issues that are unfamiliar to them, they seem to be looking for clues that can help them to handle the problem at hand under more familiar classes of issues. One would expect that this problem would increase as the good becomes more complex, and respondents often lack experience with them (Vatn, 2004a). Therefore, it is rational to admire the structure of stakeholders' preferences and try to adopt valuation approaches in

such a way that enables policy makers to elicit stakeholders' ordinal preferences without needing to change their scale.

1.7 Difficulties related to the group based valuation approach

1.7.1 Deliberative valuation process

In deliberative approach, valuation of environmental services is a social process and not an individualistic one. Sagoff, (1988) shows that expecting individuals to behave as a consumer rather than citizen in regard to questions of environmental protection is a "categorical mistake". Indeed, different studies have shown that respondents' concerns to WTP surveys are more based on their citizens' characteristics than their wants as consumers. It shows that people are less affected by considerations of their own well-being than by ethical and altruistic concerns or motivations (Sagoff 1998).

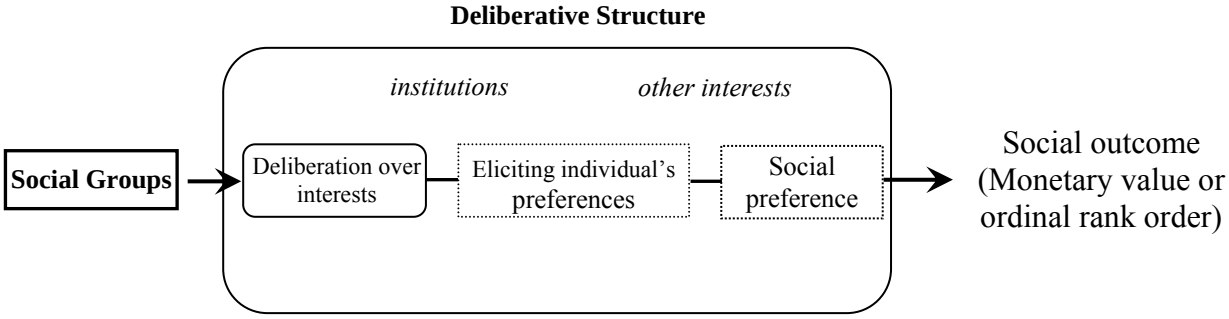

Figure 1.4. The social process of valuation, adapted from (Spash, 2007)

The social process of valuation is summarized in Figure 1.4. As the figure shows, stakeholders' preferences are constructed according to the deliberation. The result of a deliberative approach is a social preference over all stakeholders' preferences. This result can be a social WTP (monetary value) or an ordinal value such as an ordinal rank order of environmental alternative decisions. Such values may be described as social norms. Social psychologists have developed the term subjective norm for the extent to which an individual conforms to what they believe others will think of their actions.

1.7.2 Consensus and individual opinions

A deliberative valuation can likely encourage people to be involved in the public good thinking for three reasons (Vatn, 2004a). First, those who are looking to satisfy themselves in an individualistic environment will express their attitude in a way that can satisfy other people (laundering of preferences). Second, a deliberative structure gives participants a wider range of views on environmental services. Finally, the act of deliberation with others tends to create a community amongst the participants. Although we support these reasons for advancing a deliberative institution, the evidence shows that deliberation can also increase protest behaviour against making trade-offs between environmental criteria and attaching monetary value to environmental services (Slovic, 1995; Smith, 2003; Vatn, 2004a). As the work of Frey (1997) shows, offering monetary solutions to social problems can crowd out civic virtue.

Successful deliberation might be expected to result in serious questioning of the financial terms of reference imposed by the analyst. This could lead to either dubious outcomes or the rejection of any pricing request (Lenman, 2000; Spash, 2001). Preferences that deny making trade-offs (e.g., lexicographic preferences) require serious attention, since motives to act can include social altruism and biospheric orientations (Spash, 2001).

One of the main ideas in a group deliberation is the ability of reaching a consensus on the concept under the discussion. This may raise this question that how one can be sure that the consensus that is reached based on the group discussion is the best option among individual choices (Tompkins, 2003). In reality, different groups of society value the diversity of environmental aspects differently. In this situation, reaching a consensus is possible, but the result would be extremely awkward (Cookson, 2000; Tompkins, 2003). At the same time the outcome of a deliberative forum depends on the negotiation power of different groups or individuals and their ability to manipulate other people's opinions (Smith, 2003; Tompkins, 2003; Springael and De Keyser, 2004). Strategic behaviour may become more problematic for deliberative valuation approaches than an individualistic approach. This is because these approaches provide the financial impetus for strategic behaviour and a process whereby a strategy can be developed and other people recruited.

However, the greatest scope for strategic manipulation of the process lies with the organisers (Smith, 2003). Where participants are overwhelmed by the process they may feel obliged to meet the expectations of the organisers.

It seems that the most important advantage of a deliberative approach is its possibility to facilitate participants to reach an enlarged mentality rather than provision of a consensus for policy makers (Smith, 2003). As no single individual is privately able to oversee the diversity of environmental values, a deliberation procedure can help participants to collect enough information. As Smith (2003, 25), with reference to Hannah Arendt, writes:

> "And this enlarged way of thinking, which as judgment knows how to transcend its own individual limitation….. cannot function in strict isolation or solitude; it needs the presence of others in whose place it must think, whose perspectives it must take into consideration, and without whom it never has the opportunity to operate at all".

1.7.3 Deliberative valuation approach and environmental and social complexity

Deliberative valuation approaches have a strong incentive to eliminate both environmental and social complexity. The group discussion enables the stakeholders to minimise the bounded rationality that in turn helps them to understand the other people's perceptions for the problem at hand (Spash, 2001). This is an important feature as stakeholders have an opportunity to discuss and convince other stakeholders to come to a closer opinion. However, a difficulty comes up as expectation of reaching a consensus can hinder stakeholders to freely discuss and share their information. For example, social choice theorists such as Van Mill (1996) argue that complete consensus is dubious (van Mill, 1996). More substantive is the argument that a deliberative consensus is likely to be an oppressive one (Kuran, 1998).

It should be mentioned that the difficulty might rise as empirical evidence from social psychology, however, suggests that small groups may not be very efficient at pooling unshared information, thereby leading to sub-optimal results (Stasser and Stewart, 1992; Wilson and Howarth, 2002). It is reported that sometimes a small group of participants

are not able to share their information and this results in failing to achieve full decision making potential (Stasser and Titus, 1985; Stasser et al., 1989; Stasser and Stewart, 1992).

1.7.4 Minority group and voting outcome

The final aim of deliberative approaches is to reach a consensus between participants on a social concept. However, it is possible that a group of stakeholders are not able to reach a consensus. In this case, a question comes up towards the group outcome. As Jacobs (1997) explains, in the case of having difficulty to reach a consensus, a group can apply a voting system to reveal the majority opinion. In this case, the majority opinion will be supposed as the social view and it is legitimized. Therefore, participants should vote for their best option. In absence of any paradoxical condition such as Condorcet paradox, the group will be divided into two parts, majority and minority groups. Obviously, the minority group should follow the majority. However, in many cases the minority will not support the outcome, as their view did not take into account. In this regard, the decision will not entirely meet social support on the ground. If policy makers want to establish a sustainable environmental plan, they more likely need to apply a valuation method that appreciates the majority's as well as the minority's opinion. However, voting system will present a majority (if it was possible) among multiple social groups, which is not convincing to fully support the majority point of view (Craven, 1992). Although, in a democratic society voting is a normall way to indicate social leaders, it is not very strong in environmental arena (based on needing a long run support and environmental complexity) when policy makers aim to establish a sustainable plan. This criticism makes a voting result not always easy to follow (Spash, 2007). In Chapter 6 and 7, we will provide more information about the difficulties related to voting systems.

1.8 Combined valuation method and environmental valuation difficulties

Combined valuation methodologies are a response to the environmental valuation difficulties. For example, a social multi-criteria method can strongly eliminate the bounded rationality and enable stakeholders to understand a complex environmental issue. MCDA approaches are useful tools to decompose complexity and help decision makers with shedding light into the bounded rationality (Gregory and Wellman, 2001; Proctor and Drechsler, 2003; Munda, 2004). Moreover, MCDA provide the possibility focusing on one dimension of the problem at hand without needing to consider all dimensions commensurable (Bana e Costa, 1990; Brans and Mareschal, 1994; Springael and De Keyser, 2004; Prato and Herath, 2007). The only problem that the combined valuation methods have, relates back to the way that they handle stakeholders' preferences. In other words, all combined valuation methods either use numerical indicators to elicit stakeholders' intensities of preferences or they use an ordinal scale but they cardinalize the elicited data during the aggregation step to be able to provide a social value. As we explained about the difficulties related to using cardinal scale, these methods will add complexity to the valuation procedure and reduces stakeholders' confidence towards the process and in turn the final outcome will not fully meet the social support.

1.9 Conclusion

Environmental valuation is a key tool to provide policy makers with a value associated with environmental services, which in turn improve the environmental policy making. Improving market failure to efficiently allocate public goods and services is the main aim of environmental valuation (Howarth and Norgaard, 1992; O'Neill, 1993). However in order to do so, environmental valuation methods are dealing with different difficulties to elicit stakeholders' intensities of preferences and incorporating these intensities into the environmental policy making process. Presence of stakeholders' protest responses towards valuation methods show that these approaches have difficulties to consistently elicit stakeholders' intensities of preferences for a complex environmental issue (Tompkins, 2003). Incommensurability of environmental criteria, diversity of social

groups, ordinality of stakeholders' preferences and plurality of environmental values make it difficult to apply a monetary or a deliberative monetary approach to elicit stakeholders' intensities of preferences. Consideration of a common scale to elicit stakeholders' preferences is one of the main criticisms towards existing environmental valuation approaches (Vatn, 2004a).

During the last decades, policy makers and people have realized the importance of environmental non-market services for supporting human life on earth. Clean air and water, biodiversity, aesthetic services and the availability of natural resources for future generations have become the major concern for current societies. This new concept of value that rejects the severity of economic criterion as a super criterion, promotes researchers to move away from the neo-classical economic value theory and look for new institutions such as deliberative democracy (Sagoff, 1998). To be able to elicit stakeholders' preferences in a consistent way, and to incorporate these preferences into the policy making process in a tractable manner, we propose a new conceptual framework. The framework enables the policy maker to take environmental and social complexity, plurality of values and structure of stakeholders' preferences into account to come up with a social preference. Further it introduces a procedure to use the social preference to establish a social choice (group decision) that will more likely meet the social support.

Many of the more exacting problems of the contemporary world, ranging from famine prevention to environmental preservation, actually call for value formation through public discussion (Sen, 1995b).

Chapter 2

Theoretical and Conceptual framework

Abstract

Elicitation of stakeholders' preferences towards environmental services is the main aim of a valuation study. Stakeholders' preferences are key elements to formulate sustainable management decision. In order to do so, valuation practitioners should take into account two important groups of characteristics, viz. first, complexity, diversity and incommensurability of environmental criteria and second, plurality and ordinality of stakeholders' preferences. The complexity and diversity of environmental services create a plurality of stakeholders' values that are strong obstacles towards making trade-offs between the services. Stakeholders have no cardinal value towards environmental services. Monetary valuations are, however, often faced with protest bids as a function of lexicographic preferences. Stakeholders will be shown to hold ordinal preferences towards nature and these preferences foster the application of an ordinal valuation approach. Additionally, the environment is a multi-dimensional system, which raises a need for a multi-criteria approach to valuation. However, a multi-criteria approach cannot provide a communication forum for stakeholders to discuss and to construct their preferences towards environmental services. Therefore, in order to provide a valuation method able to handle complexity, incommensurability and diversity of environmental criteria on the one hand and bounded rationality of stakeholders on the other, we propose a discursive, ordinal, multi-criteria framework, to provide stakeholders with a communicative forum in which to construct their preferences. Thus, the multi-criteria approach will help the researcher to elicit and aggregate stakeholders' preferences in an efficient and tractable way.

2.1 Introduction

There are a lot of discussion about the value that people attach to environmental services. The consensus seems to be that it is not possible to develop a single unifying definition of such a value. It is more constructive to recognize and understand the different perceptions within society and how they relate to one another. Economic value is seen as just one of many values that nature can have, while other argue that properly carried–out economic valuations summarize all societal values. Some researchers suggest that applying economic valuations to the environment enhances rather than slows its degradation. Yet, others declare that both the causes and solutions to environmental degradation lie in economic assessments. With respect to ecosystem services, the choice of which services to value is in itself a value judgment, usually made on the basis of economic and social values .

Most economic analyses are based on markets, which are a mechanism to "reveal" to what extent people will pay for tradable goods and services (Arrow, 1963; Sen, 1970; Sen, 1995a; Sen, 1995b; Gaertner, 2006). Some environmental services contribute directly to the productions of goods that have an established market value (e.g., food, raw material). The goods themselves can be valued by existing techniques, but valuing the ecological processes that contribute to the market products requires detailed information. This is often not available in such detail as required by monetary approaches or there is no willingness to consider the value of processes that are regarded as common property and therefore available free to all.

Existing valuation methodologies have difficulties to present people's preferences towards environmental services. These difficulties are more related to the assumption of preference construction and their scale (the way that stakeholders express their preferences) that stakeholders can express. This shortcoming of the valuation approaches is particularly obvious when a high diversity of economic, ecological and social values is involved. In any community, ecological services are a source of moral and religious beliefs. This assumption seems stronger when the community has some kind of moral and religious beliefs towards the environment. In this regard, it is difficult for people to

consider environmental services identical with market products and to use a monetary approach to value them.

To provide a remedy to this problem, we combine a discursive structure with an ordinal Multi-Criteria Decision Analysis (MCDA). This conceptual framework includes a discursive forum in which the stakeholders can discuss the three dimensions of environmental criteria. The idea is that the discursive theory will enable stakeholders to eliminate the bounded rationality and provide an opportunity for stakeholders to construct their preferences towards environmental services. Secondly, the ordinal MCDA will help stakeholders to take into account incommensurable environmental criteria. Moreover, the ordinal structure of this method is consistent with people's experiences. It helps them to easily follow the different steps of the methodology. This combinatory framework enables policy makers to elicit stakeholders' preferences consistent both with the environmental characteristics as with the stakeholders' abilities to process information.

2.2 Theoretical framework in environmental valuation

Valuation approaches have mainly developed based on a recognition of the importance of environmental services. The stakeholders' early attention of towards environmental services was focused on the use values of natural resources such as raw material and food production. In this regard, different valuation approaches such as benefit transfer, opportunity cost, cost effectiveness, preventive expenditure and replacement costs were applied. However, policy makers later understood that people's motivation to support environmental decisions are not just based on the economic benefits that they receive. This is the concept of environmental ethics. Environmental ethics aims to move away from this human-centred or anthropocentric understanding of the world that has dominated our relations with the environment, and that tends to value nature simply as a commodity. Here again we come back to the concept of value pluralism that will be offered as a more effective framework within which to understand this variety of environmental values. This concept helps us to better appreciate the value conflicts that arise when society wants to decide about the environment. Figure 2.1 shows a group discussion, which enables stakeholders to consider a diversity of environmental views

and helps them to construct informed preferences towards environmental services (O'Neill, 1993). As shown, the environmental criteria are interdependent on each other, which results in complexity and diversity of environmental preferences. The diversity of environmental criteria initiates plurality of environmental values that will be developed in a group discussion. The group discussion eliminates the bounded rationality and introduces the concept of environmental valuation.

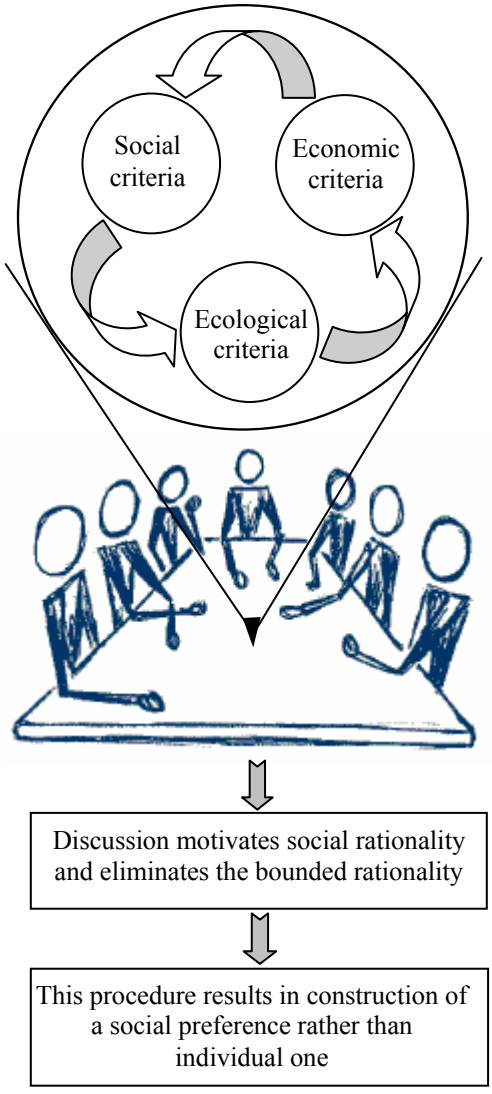

Figure 2.1. A theoretical framework for a discursive valuation, adapted from Emily Faalasli

The level of diversity, interdependency and complexity of environmental criteria influence the way that a valuation approach can elicit stakeholders' preferences. In other words, the chosen valuation approach should be able to capture the diversity and plurality of environmental values that stakeholders hold towards the environmental dimensions. In this regard, a valuation approach should be able to consider three important concepts:

- Social rationality
- the Ordinality of stakeholders' preferences and
- the Complexity of environmental services

The next section will give more information about these three concepts.

2.3 Three critical dimensions of an environmental valuation approach

Given the discussion in Chapter 1 and particularly in the previous section, there is a strong belief that an environmental articulating institution should appreciate the social aspect of preferences, the ordinality of people's preferences and the complexity of environmental criteria (Figure 2.2) . It should be realized that these three dimensions are highly interconnected and one cannot simply discuss them separately without taking the others into account.

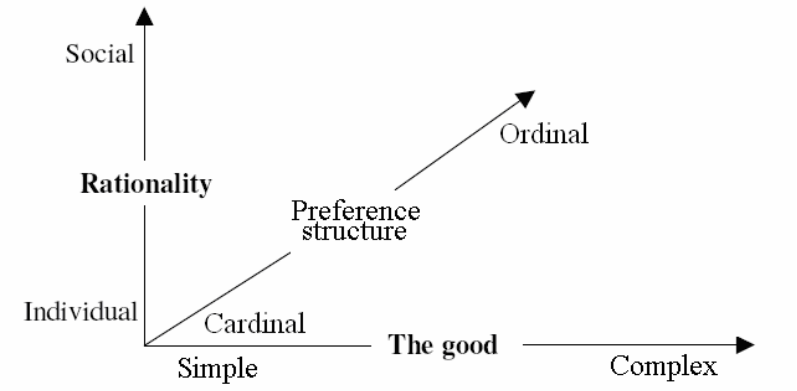

Figure 2.2. Three core dimensions of a value articulating institution, adapted from (Vatn, 2004b)

The first dimension of environmental valuation is rationality. Figure 2.2 shows that rationality has two directions, individual and social. In the absence of the two other

dimensions one can simply consider the individual rationality as an appropriate direction to elicit stakeholders' preferences. Individual rationality relates back to the neo-classical economics theory that aims to maximize stakeholders' utility (Sagoff, 1998; Vatn, 2004). However, in the presence of the two other dimensions, moving away from individual rationality seems a right direction (Sagoff, 1998; Vatn, 2004b). Stakeholders in a valuation study act as citizens rather than consumers of environmental services. Additionally, according to the concept of communicative theory, the construction of stakeholders' preferences towards public goods occurs during a discursive action and not during an individualistic process. People learn through discussion and communication.

To communicate with other people, the second dimension (ordinality of preferences) turns out to be very important. People use their experiences to discuss about any decision problem. Literature shows that people do not hold cardinal preferences to express their willingness to pay towards environmental services. There is no market to make trade-offs between environmental services and market products. As a result, people have no experience how to express their willingness to pay towards these services. Therefore, it is not rational to ask people to value environmental services in the same way as market products. Using a cardinal scale (numerical values) to apply an environmental valuation implies three initial requirements: certainty, simplicity and ability to make a precise estimate about the amount that one is willing to pay (Vatn, 2004a). In practice, none of these three attributes are present.

The third dimension of environmental services is complexity. Complexity is an inherent attribute of nature. The environment is a complex system because of the diversity of relations between the different environmental criteria. Here we should refer to the concept of the bounded rationality, which impose the limitation of human cognitive capacity towards a complex concept. Therefore, simplification of the environmental complexity should be another target of an environmental valuation approach.

A result from the above discussion is that one should consider a communicative format as a key element in a valuation study. Valuing the environment in an individualistic way not only decrease individual satisfaction, but also hinders people in being informed about

other people's opinion (Sagoff, 1998). Value formation is a communicative concept rather than an individualistic one . It is well understood that without having a discussion among stakeholders, the three dimensions of environmental services cannot be captured. Additionally, the application of a discursive valuation framework will provide stakeholders with a large number of benefits in the policy-making process. The next section elaborates on these.

2.4 Advantage of having a discursive valuation

As explained, an environmental valuation is a tool to enable policy makers to formulate sustainable environmental policies. The following sections give more information about the advantage of having a discursive framework.

2.4.1 Educating the public

Public education is increasingly important to a well-functioning environmental management. Knowledge about environmental issues allows the public to carry out the role in major environmental policy making and applying community pressure to enforce environmental laws. It is also critical for ensuring that the technical complexity of the issues does not hamper the public's ability to participate in the decision making.

2.4.2 Incorporate public values and preferences into decision making

While the first goal focused on educating the public, this goal and the next focus on educating public agency. Differences over values, assumptions and preferences need to be discussed in a process that fosters mutual education and ideally, results in analyses and decisions reflecting the public perspective. In order to give the widest range to discussions about values, assumptions, and preferences, all of the affected stakeholders should be involved in the process.

Arguing that participatory processes should facilitate the incorporation of public preferences into decision making does not presuppose what those preferences should be. Indeed, it is a basic principle of a pluralist democracy that there is no objective "common

good" but that a relative common good arises out of the free deliberation and negotiation among all relevant interests, fairly represented. There is no guarantee that public preferences will support environmental criteria. While this may be a fundamental weakness of participatory decision making in the environmental arena, at least for the more discursive forms of public participation it is a necessity.

2.4.3 Increase the substantive quality of decisions

The public is not only a source of values, assumptions, and preferences, but it is also a source of facts and innovative alternatives. In some case, the contribution of participatory efforts to the substantive quality of decisions may be explicit. Public participation can add useful substantive knowledge or ideas that would not have been available otherwise. These might include: identifying relevant factual information, discovering mistakes, or generating alternatives that satisfy a wider range of interest.

2.4.4 Foster trust in institutions

The percentage of people that can trust governmental decisions has dropped dramatically, due to wrong decisions made by public authorities over years . However, it is also symptomatic of what some claim to be a general decline in the norms of civil society. As trust in the institutions responsible for solving complex environmental problems decreases, the ability to resolve those same problems is seriously restricted. Three characteristics of many environmental issues (the long time horizon to realize benefits and costs, the absence of clear feedback on the success of management efforts, and the scattered nature of benefits) make agency trustworthiness particularly important. It should be mentioned that rebuilding trust is an easier task for participatory decision making than other individualistic methods.

2.4.5 Reduce conflicts among stakeholders

Resolving conflict is often regarded as one of the major achievements of participatory processes that bring stakeholders together for face to face discussion, such as mediations and negotiation (Smith, 2003). The literature is full of successful cases that have balanced

the environmental, economic and social conflicts among different social groups. Conflict reduction, however, is by no means guaranteed.

2.4.6 Cost effective decision making

The goal of cost effectiveness addresses the appropriate use and scope of public participation mechanisms. Certainly, not every environmental decision justifies an active public participation program. Few can support the extensive process that many observers would like. The goal of cost effectiveness can therefore be considered the goal that constrains the achievement of the first five goals. It is obvious that in the short run a participatory approach is time consuming and costly compared to methods preferred by the state, but its advantages of preference construction and trust building are worth considering a participatory approach as an appropriate methodology to construct stakeholder preferences.

2.5 A three-dimensional valuation framework

Taking into account the difficulties related to environmental valuation approaches on the one hand and the three dimensions of environmental values on the other hand, we have established a conceptual framework that is a combination of a discursive method with an ordinal (qualitative) MCDA (Figure 2.3). As the figure shows, the proposed conceptual framework has three parts. 1- First, stakeholders formulate an environmental problem through a discussion.

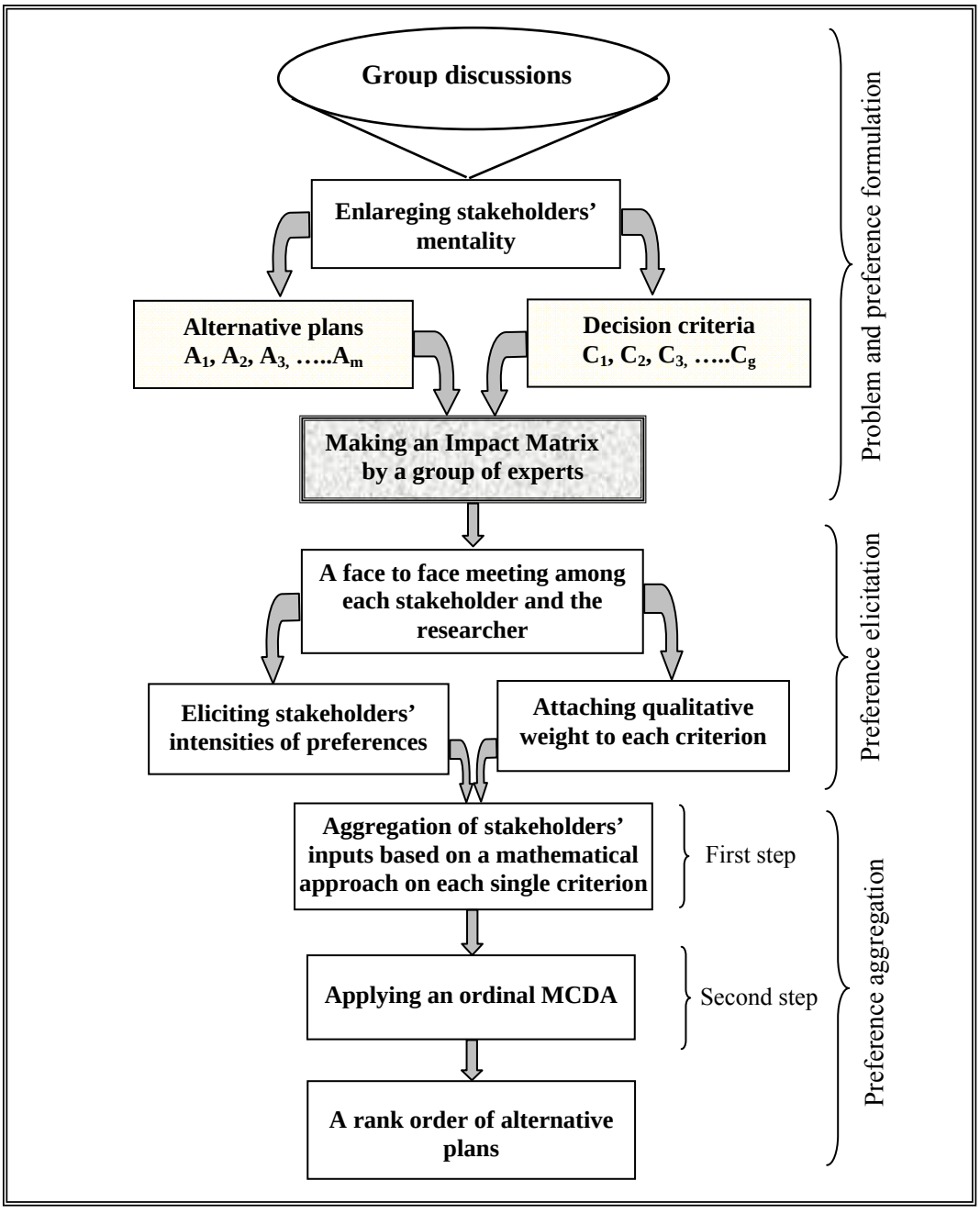

Figure 2.3. A Conceptual framework to reach a social rank order of alternative plans based on social intensities of preferences and social weights

Being involved in the discussion helps the stakeholders to construct their preferences towards environmental criteria related to the problem at hand 2- Second, the policy maker elicits the constructed preferences through qualitative steps and 3- finally, the stakeholders' preferences are aggregated through several steps and entered into an ordinal

multi-criteria decision aid. This will establish the social choice as the best plan to maximize stakeholders' satisfaction based on their preferences and wishes. In contrast to the neo-classical economic value theory, we try to shape stakeholders' preferences via a discursive forum. The discursive structure is chosen as a response to the social rationality. Moreover, this structure provides an opportunity for stakeholders to discuss and to improve their knowledge, which in turn reduces environmental complexity. As one can see, the proposed framework holds in the first place a discursive forum among a group of participants. Regarding the criticisms towards a process of reaching consensus, we will not ask stakeholders to reach a consensus, but focus instead on a fair discussion between the stakeholders. This results in an enlargement of stakeholder mentality. We will continue the procedure through an individualistic approach to provide enough freedom for stakeholders to present their preferences. Therefore, the elicitation part will be an individualistic step rather than a group procedure. We believe that during the group discussion, stakeholders will be reached to the point that are able to express their wishes and do not need to receive assistance from other participants. Moreover, when there are conflicts between stakeholders, group consensus is not truly representative of stakeholders' interests as it is based on interpersonal dependency.

To respect the ordinality of stakeholders' preferences and the incommensurability of environmental services, we propose to use an ordinal scale in which the stakeholders can utilize qualitative labels to express their preferences on each single environmental criteria. This is in line with stakeholders' experiences in their daily lives. In this way, stakeholders do not need to use a common scale (money) for all criteria to express their preferences. The ordinal value does not in any way change the character of the scale of criteria. It should be mentioned that stakeholders rank alternative impacts on each single criterion and then use five qualitative indicators to express the intensity of their preferences through pairwise comparisons. Although the ordinal scale intensity does not have any meaning as it does in a cardinal concept, we named the proposed methodology ordinal as it does not use numerical values in any of its steps. We will provide more detail in Chapter 6 below.

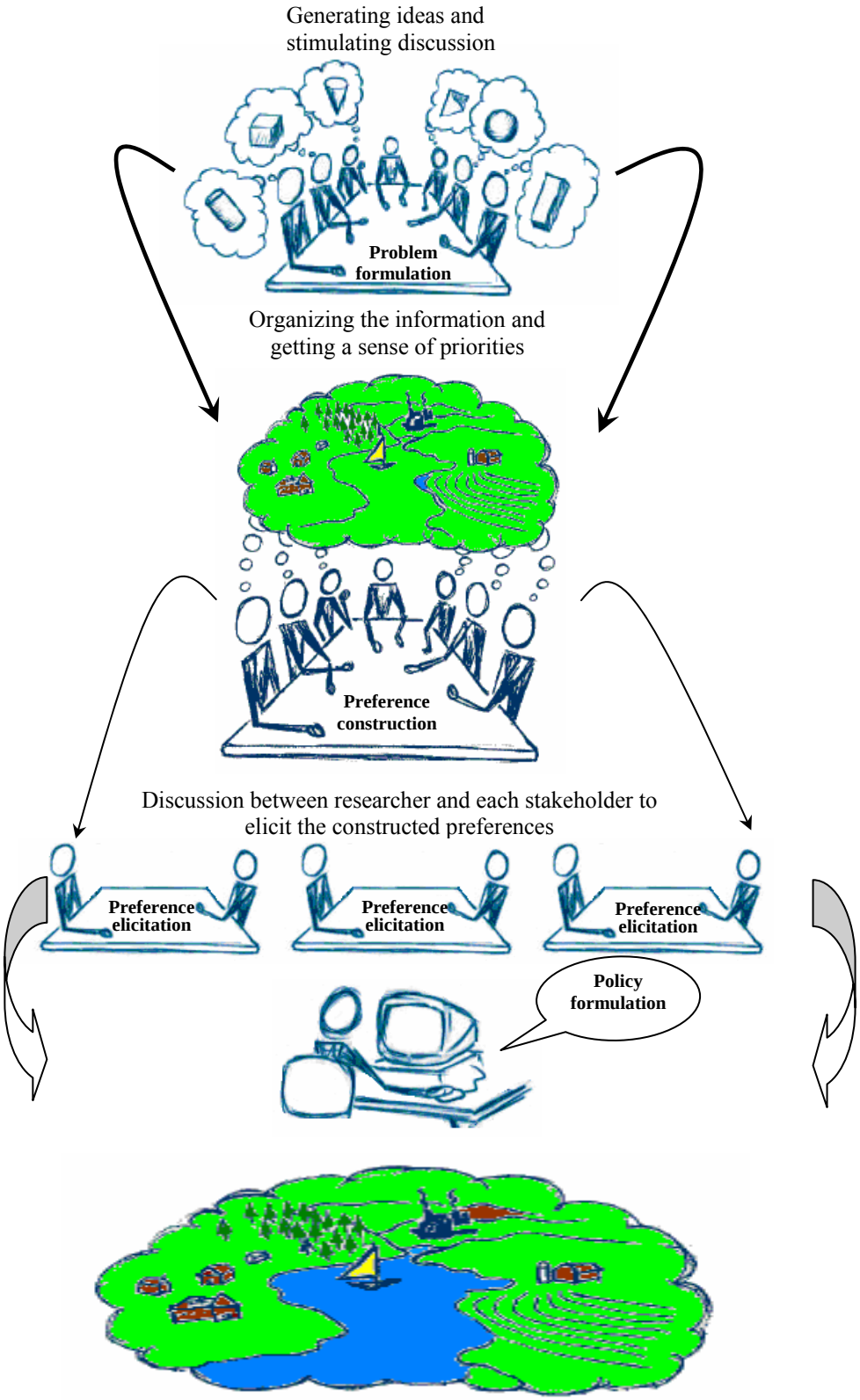

Figure 2.4. A simple representation of a discursive ordinal multi-criteria valuation Method, adapted from Eamily Faalasli

The third part of the framework has two steps. In the first step, the qualitative intensities of preferences are aggregated into social intensities of preferences on each single criterion. In other words, instead of forcing people to reach a consensus, we propose to use a voting rule (Condorcet) as well as a mathematical approach to ensure that its results are more reliable than a consensus-reaching process. However, reaching a social value is not the final aim of our study and we should be able to provide an insight into the policy making process. In the second step, the aggregated values will be entered into a qualitative MCDA to provide a rank order of alternative plans that are proposed at the end of the group discussion (the last tow boxes in Figure 2.3). The MCDA is able to use stakeholders' preferences and their intensities to construct a rank order of alternative plans. This is an advantage to voting systems as they cannot take into account voters' intensities of preferences for pair of alternatives.

Figure 2.4 provides a graphical view of our framework. The figure shows that in the first stage stakeholders come together with different ideas in mind. Therefore, each stakeholder uses his/her own knowledge to understand the problem and to think about a remedy. This is shown in the first step in Figure 2.4. However, after being involved in the group discussion, there is a chance stakeholders come to share opinions. This process helps stakeholders to support a unique idea rather than different interests (second step in the figure).

As shown, the diversity of ideas is transformed into a unique opinion. Of course the time that one needs to spend in order to narrow down the stakeholders' opinions depends on the complexity of the subject and the diversity of the social groups.

In the elicitation phase, the researcher and each stakeholder will sit together face to face and they will discuss the stakeholder's preferences over pairs of environmental plans on each criterion. This can provide enough freedom for each stakeholder to express his/her idea without any pressure from any interests groups. At the final stage, the researcher uses computer software to run the the ordinal MCDA to aggregate the individual preferences into a social preference and a rank order of alternative plans.

2.6 Conclusion

The basic idea in this chapter is to show how one can develop a valuation framework in such a way that it enables the policy maker to consider the different dimensions of environmental criteria. Rationality is one of the important dimensions of a valuation framework. It is emphasized that people are able to act in accordance with individual (consumer) or social (citizen) rationality. Formulation of an articulating institution based on individual rationality, as Sagoff (1988) says, is a categorical mistake and result in protest responses.

To provide a remedy for these difficulties we propose a combination of a discursive and an ordinal MCDA approach. In this framework, a discursive forum provides a pluralistic environment for stakeholders to exchange their ideas. In this method, stakeholders do not need to reach a consensus on social payment or a ranking of different courses of action. In other words, the MCDA helps stakeholders to act individually and expresses their intensities of preferences towards impacts of a set of environmental plans on each single criterion. This procedure eliminates the group dynamic and fosters the stakeholders to be involved into the valuation steps. The ordinality of the method is an important feature, as stakeholders do not need to use a monetary scale to express their intensities of preferences. Regarding the combination of the two methodologies, we are able to incorporate stakeholders' intensities of preferences into the group (final) decision. This feature decreases the strength of opposition towards the group decision and will increase social support that is a key element in sustainable development.

To be able to test the applicability of the proposed framework, we applied the proposed methodology in a rangeland area in Iran. The next chapter gives more information about the case study.

Chapter 3

Case study and problem setting

Abstract

Rangelands have had a great impact on economic, ecological and social development of Iran. As Iran is located in the arid zone of earth, 85% of the country has semi-arid, arid and hyper arid climate that cause rangelands as a main source of natural resources. From 164 million hectare total land area some 90 million hectare (55%) are rangelands. Most of the rangelands are inhabited by pastoral communities that mostly use rangelands to graze their livestock. Animal and dairy productions are among the primary products of rangelands. Secondary products from rangelands include water filtration, erosion control, climate regulation, waste treatment, biodiversity, recreational sites, and other numerous services to sustain human life in the arid parts of earth. During the last decades, policy makers in Iran have been trying to attach monetary values to rangeland services to be able to support them and to be sure that they would not be used to the point of extinction. The divergence of rangeland services and plurality of values that stakeholders hold towards these services face environmental valuation practitioners with a lot of difficulties. Conflicting and lexicographic preferences towards rangelands' services made it impossible to use a monetary approach to elicit stakeholders' WTP. This difficulty eliminates policy makers to take stakeholders' preferences into account to adjust rangeland policies, which in turn result in degradation of rangeland services.

As an example, a rangeland area (Lar rangeland) in Iran is chosen. The Lar rangeland is a complex ecosystem that provides a diversity of services to different social groups whose preferences are highly diverse. This diversity and complexity of stakeholders' preferences hinder policy makers to establish a socially acceptable policy, which result in overexploitation of Lar services. We assume that by enabling policy makers to explore stakeholders' preferences towards environmental services in Lar, they can use these preferences towards the policy making process which in turn increase social support and environmental sustainability.

3.1 Introduction

Lar is a mountainous rangeland that is located at 75 kilometres North East of Tehran (capital of Iran). The area is surrounded by mountains that in the highest point (Damavan mount) reached to 5670 m 'the highest point in Iran'. The climate of the area is characterized by the cold winter and the moderate summer. Based on a long term records of rainfall the area receives on average around 728 mm precipitation (Environmental Protection Organization, 2006). Regarding the long and cold winter people cannot permanently live in Lar that makes Lar a perfect place for wildlife. The area is mostly covered by grasses and forbs, which during warm seasons they provide food for wild and domestic animals. The diversity of flora in the area attracted a large number of animals such as birds, mammals, insects, reptiles as well as different groups of ranchers who come to Lar to graze their animals. Based on geographical condition Lar has the ability to collect water and to feed Lar dam that is an important source of drinking water for Tehran's inhabitants. Moreover, different recreational and touristic attractions of the Lar rangeland, such as waterfalls, springs, Lar River, mountain, rocks, Damavand mount, biodiversity and the moderate climate of the area during summer bring a large number of people to spend their leisure times in the area. Additionally, based on the diversity of ecological services, governmental organizations, such as the Environmental Protection, Natural Resources Management departments have been trying to establish management plans to conserve the ecosystem services in Lar. During the last 40 years several times the Environmental Organization have tried to ban human activities in Lar and turn the current land use into a national wildlife park. However, as a consequence of receiving resistance from other social groups the plan has failed. Moreover, based on not paying enough attention to stakeholders' interests and wishes in Lar, rangeland management plans have also failed. In this regard, during the last 40 years the Lar rangeland has been the witness of an ongoing degradation of its ecosystem services.

Being able to establish an informed policy based on stakeholders' preferences towards Lar ecosystem services, a valuation study linked to a tractable decision making process seems to be necessary. Before going to explain about the Lar rangeland, we would fist

like to provide economic, ecological and social dimensions of rangeland in Iran and then in the Lar rangeland.

3.2 An overview of rangelands in Iran

From 164 million hectares total land area of Iran, rangelands cover around 55% (90 million hectares) and they have been providing a large number of services to society (directly and indirectly) that in turn have helped economic and social development of the country (Badripour et al., 2006). Based on the land reform in 1963 (nationalization of the natural resources) all of the natural resources, including rangelands, forests, water and wildlife that had owned by landlords around the country, became state property (Fazilati and Hosseini Eraghi, 1984). Prior to the enforcement of the nationalization law of the natural resources, the landlords used to have cadastral documents for the lands they possessed (CENESTA, 2003; Badripour et al., 2006). The rangelands were part of their asset so they always protect them against over grazing and degradation (Badripour et al., 2006). Landlords even used to lease rangeland to the livestock breeders for a given period with a certain number of livestock. The landowners knew quite well that if their rangeland became degraded, they would gain less revenue during the coming year. Therefore, they would never let any one degrade their rangelands through monitoring the rangelands periodically. However, the aforementioned law cut the authority of landowners over their lands and speed up the competitions between herders to use up resources and there was no strict control over the utilization of rangelands (Kardavani, 1995; CENESTA, 2003; Badripour et al., 2006). Then, a few years after the natural resources nationalization, the government started to recognize the entitled users and embarked to issue grazing licenses in order to control the exploitation of rangelands. Grazing license is a permit that is issued for the entitled livestock breeders by Forest, Rangeland and Watershed Organization (FRWO) within a project called Range Cadastral Survey (RCS) (Fazilati and Hosseini Eraghi, 1984). In this project the experts of provincial offices of FRWO visit rangelands in grazing season to delineate the boundaries of the rangeland and calculate the grazing capacity, based on a standard procedure. Then the livestock breeders would be entitled for a grazing license. The livestock breeder who is granted a grazing license has to consider the guidelines written on the license such as

number of livestock, time and period of grazing. After a decade managing rangelands through grazing licences, FRWO realized that the grazing licence is too abstract to conserve the rangeland condition and there is a need to provide extended programs. Therefore, they started formulating different range plans to protect the rangelands. The rangeland plans put some more restrictions and guidelines on ranchers' activities and provide a 30 years contract with possibility to extend to 99 years between the government and rancher or a group of ranchers to increase the stability of property right and in turn protection of rangeland. The rangeland plan not only provide a new figure for animals based on a new rangeland survey, but also it introduces some plans such as grazing rate, grazing systems and restoration plans including seedling, shrub transplanting, water harvesting and some others that ranchers must take into account. If a rancher for any reasons couldn't follow the mentioned guidelines, his contract with the government will be cancelled and a new contract will be signed with another rancher for the same period (Fazilati and Hosseini Eraghi, 1984; Badripour et al., 2006).

According to all different plans that FRWO have applied to support rangelands' services, these services are still facing with challenges of degradation due to heavy users' pressure, overgrazing, diversity of social and management groups who have different interests and aims (Kardavani, 1995; Badripour et al., 2006). Lack of knowledge about stakeholders' preferences towards rangelands' non-use services such as water purification, soil protection, air regulation, biodiversity and many other services poses a new challenge towards the sustainable rangeland management in Iran as well as in other parts of the world (Kardavani, 1995; Arntzen, 1998; Amirnejad et al., 2006; Badripour et al., 2006; Abule et al., 2007a). To provide a remedy for this problem we take the Lar rangeland as a complex ecosystem with multiple users as a good example of rangeland ecosystem in Iran. The Lar rangeland is a complex ecosystem that provides a large number of use and non-use services that have not correctly been taken into account in the decision making process. As a consequence of not paying enough attention to Lar's non-use values, the area is dealing with degradation of its services (Environmental Protection Organization, 2006). To be able to protect environmental services in the Lar rangeland, an urgent action is needed. This aim cannot be reached without understanding stakeholders' preferences

on environmental services in the Lar rangeland (Environmental Protection Organization, 2006).

3.3 Lar rangeland

Lar rangeland with a total area of 73000 hectares is located mostly in Tehran province and some 30% of the area is under territory of Mazandaran province (Figure 3.1). The geographical location of the area is between 36º 4´ and 35º 48´ N and 51º 32´ and 52º 4´ E. From the total area, around 58000 hectares (79%) are covered by forbs and grasses and the rest includes; rocks, rivers, roads and etc. The highest altitude within the area is around 5670 m in Damavand mount (the highest place in Iran) and the lowest around 2400 m (higher than sea level). Based on the altitude, the Lar rangeland is the highest summer rangeland in Iran. Figure 3.2 shows the Lar rangeland and Damavand mount. The climate of the area is characterized by the cold winter and the moderate summer. The mean temperature during summer in Lar is around 18 °C and during winter it is around -5 °C. Mean annual precipitation is around 728 mm that will be affected very seriously by drought phenomena.

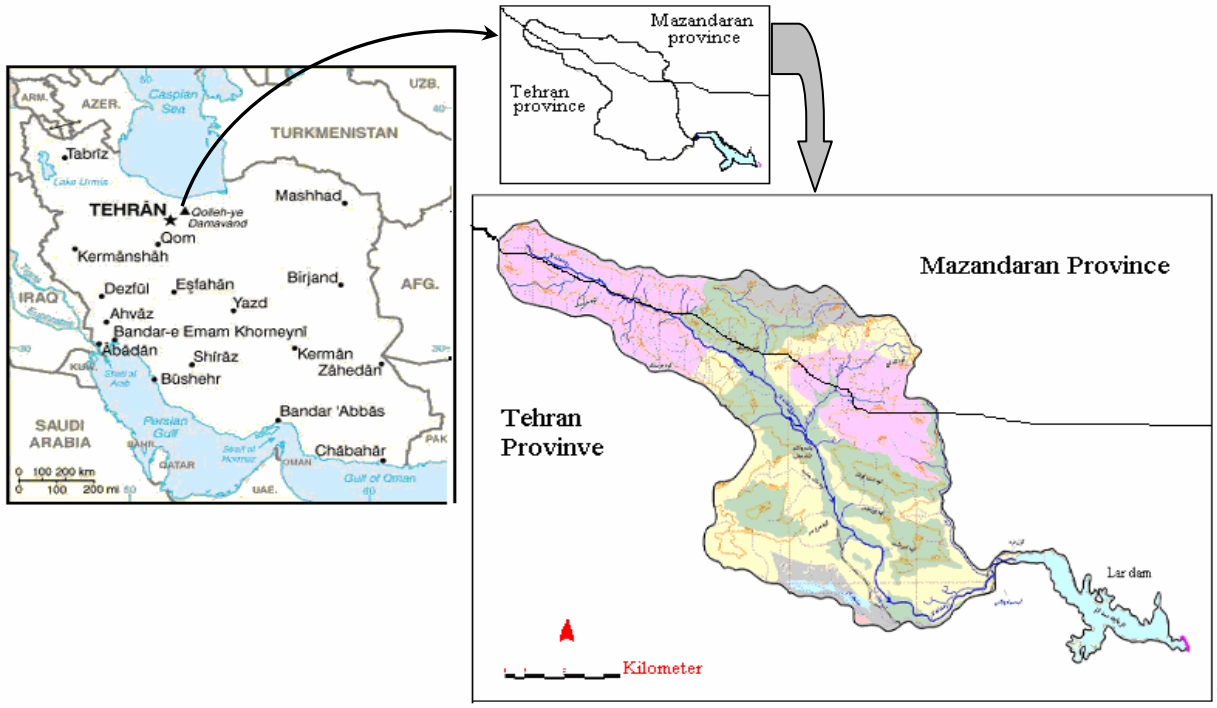

Figure 3.1. Sample area, Lar rangeland

Figure 3.2. Lar rangeland and Damavand mount

3.4 A short review of animal husbandry in the Lar range land

The Lar rangeland is being utilized by 250 households of nomads since 270 years ago (Technical Rangeland Office, 2000). Table 3.1 shows some statistics about the Lar rangelands and the number of ranchers and their animals based on two different years. The first time zone shows 1980 and the second shows the current condition (2005). As one can see in 1980, Lar rangeland was divided into 39 smaller fractions of rangeland (we are not going to give all details of each of this fraction but it is necessary to know that each fraction has a specific name with different number of ranchers, animals and different total areas).

Table 3.1. Number of areas, livestock, ranchers, and rangeland plans in the Lar rangeland in two time zones

year	Number of rangelands	Total area of rangelands	Allowed number of livestock	Number of existing livestock	Grazing period	Number of ranchers	Number of rangelands that have management plans	Number of rangelands that have no plans
1980	39	65096	72000	110025	90 days	350	4	35
2005	39	65096	82912	136256	100 days	577	14	25

These 39 groups of ranchers are using the total area of 65096 hectares that is constant during the period. In both years, 5 fractions out of the 39 fractions have only one user and the rest have more than one user. The maximum number of users that utilize a common fraction was 35 people in 1980 and 62 people in 2005. It should be explained that number of ranchers in a fraction depends on historical background, grazing tradition and number of ranchers that were using the area at the time of issuing grazing licence (the RCS started issuing grazing licence in Lar from 1965 to 1970). As shown in the table, the number of ranchers in the Lar area increased from 350 to 577 (almost 61% more). Normally number of ranchers in a rangeland area should not increase regarding the rules and restrictions after issuing the licence for a rangeland. However, a few years after the revolution in Iran (1979) and the establishment of a new government, FRWO was under huge pressure from some new governmental organizations to give right to those people who were working as shepherds in rangelands around the country as well as in Lar. This was a revolutionary idea that aimed to improve the equality among people (Technical Rangeland Office, 2000; Badripour et al., 2006). Therefore, if somebody could collect 10 signatures from a group of ranchers and prove that he has worked in a rangeland for some years, the local office of FRWO is forced to issue a grazing licence even for few livestock. As a consequence of this situation number of ranchers increased dramatically. Above this problem, real number of animals in rangelands is always more than rangelands' carrying capacities that are mentioned on grazing licences. For example in Lar, the number of animals is 33% (33343) more than the total number of allowed livestock based on the grazing licences (based on census in 2005, Table 3.1). This problem mainly relates back to those rangelands that have a large number of users, which

makes livestock control very difficult. Normally the regional government should control the number of animals based on grazing licences. However, it has not always been an easy task according to broadness of rangeland and number of ranchers. As it is also shown in the table, in the Lar rangeland, 36% (compare to 10% in 1980) of rangelands are managed based on range plans, the rest have no plan, and the government control them based on grazing licences.

3.5 Economic, ecological and social services of the Lar rangeland

Lar services are divided into three subgroups: 1- Economic services. 2- Ecological services and 3- Social services that will be explained.

3.5.1 Economic services of the Lar rangeland

Ranchers are one of social groups who are receiving direct benefits from the Lar rangelands. As in Section 3.4, ranchers graze 136256 livestock in Lar. This provides ranchers with a lot of economic advantages regarding the availability and quality of forage in the area. Moreover, Lar is very important area for ranchers due to its moderate temperature. In summer, temperature outside Lar raises to more than 35 °C. However, as we explained the average temperature in summer at Lar rangeland is around 18 °C, which provides a suitable place for ranchers and their livestock (Environmental Protection Organization, 2006). The statistics shows that during the 100 days using the Lar rangeland, ranchers' animals add between 5-10 kilogram weight depending on yearly rangeland conditions without any other complementary food (Technical Rangeland Office, 2000). In Lar, in some areas ranchers cultivate forage that is mostly used by lamb especially when the weather is not suitable to send out herds to graze. In total in different areas around 320 hectares of rangeland are cultivated by Medicago. Besides, no other agricultural activities is allowed in Lar based on limitations issued by the Environmental Organization. In the past local people and ranchers produce potatoes and vegetables in Lar, but these activities are now limited to just forage production as already explained.

Since the last 40 years, the area is renowned for tourism activities. The main tourism attractions in the area are camping, fishing, hiking, mountain climbing (especially during

the winter) and bird watching. On average around 33000 people visit the Lar rangeland during the warm seasons (Environmental Protection Organization, 2006). The Environmental Organization controls the two main entrances to the Lar rangeland by a group of officers in order to make sure the number of visitors stay at desired level. Therefore, any harm to environmental services and biodiversity can be prevented. Although the Environmental Organization does not ask any entrance fee from people, tourist agencies organize some short trips to Lar that it brings them some economic benefits. The Environmental Organization sells also fishing licences for three days a week in summer and the person who receive the licence is allowed to catch, up to 5 fish during the day that the licence issued. The tourist activities however have caused some problems such as water pollution, disturbing wildlife especially during the nesting period and cause conflicts with the rancher communities (Environmental Protection Organization, 2006). During summer, ranchers and local people gather yields from medicinal plants such as Galbanum from *Ferula gommosa* (Figure 3.3) and seeds of *Heracleom percicum* that they sell them in local markets. Purification of water through the Lar rangeland is also an economic benefit for government as well as for ranchers regarding the high quality of water that allows people to use water with almost no purification. In general, there is no economic study about Lar services.

Figure. 3.3. *Ferula gommosa*, one of the Lar medicinal plants

3.5.2 Ecological services of the Lar rangeland

Lar is one of the valuable rangelands in Tehran province due to its diversity of ecological services. Around 400 species includes; grasses, forbs, seven species of shrubs and one species of tree grow in Lar. Among these 400 species, 338 species are perennial that indicates stability of vegetations in Lar. Among the plants, 35 species are endemic and around 20 species are medicinal plans (Technical Rangeland Office, 2000; Environmental Protection Organization, 2006). The richness of the vegetations in Lar provides a suitable condition for the livings of 28 species of mammals, among them 3 species are under IUCN[2] category and 6 species under CITES[3]. In Lar, 105 species of birds, 23 species of reptiles and different species of insects are living some of which are endemic in the region. From 23 species of reptile, 2 species are under IUCN and 3 species under the national protection rule. The Lar rangeland is also the habitat of an endemic fish "Salmo trutta fario" that lives in Lar River and Lar Lake. Lar is further a place for a lot of pollinator insects that have an important impact on the agricultural and horticultural activities in the area. The Lar rangeland has an important effect on hazard reduction such as drought and flood in the area. Based on the good coverage of soil surface in Lar by vegetation, rainfall can easily penetrate into the soil that not only reduces soil erosion, flood risk and strength of drought in the area, but also it provides suitable water for people in Tehran. On average Lar River brings 453.9 cubic metres of water during a year to Lar dam. The minimum amount of water that is recorded in a year is 233.3 cubic metres in 2000-01. On average, the water in Lar supplies around 15% to 20% of drinking water of Tehran's residents.

No permanent inhabitants live in Lar according to the long and cold winter, which makes Lar a secure place for the wild plants and animals (Environmental Protection Organization, 2006). During spring and summer, around 80% of the area is covered by grasses and other species that this condition keeps soil erosion around 7 tons $he^{-1}y^{-1}$ in the area. (Watershed Management Department, 2002). It is worth knowing that the average soil erosion for rangeland ecosystem in Iran is around 20 tons $he^{-1}y^{-1}$ (Watershed

[2] IUCN: International Union for Conservation of Nature & Natural Resources
[3] Conservation on International Trade in Endangered Species of wild fauna & flora

Management Department, 2002). Based on a study that was undertaken before starting construction of Lar dam (1977), the amount of soil erosion on average in the area was only around 1.22 tone $he^{-1}y^{-1}$ that was due to more coverage of soil with vegetation and less human activities such as animal husbandry, tourism activities (Jamab, 1977). It should be mentioned that climate change also has a huge effect on severity of droughts and floods in the region that accelerate the soil erosion in the recent years. The quality of water in Lar varies year to year based on the amount of rainfall from 160 mg dissolved materials to 285 mg per litter, which indicates that the Lar water is very pure.

There is no study about the amount of CO_2 sedimentation and O_2 production in the Lar rangeland, but the proximity of Lar to Tehran having 15 million inhabitants, one can easily understand the importance of this area for quality of air in Tehran (Technical Rangeland Office, 2000).

3.5.3 Social services of the Lar rangeland

The Lar rangeland provides a diversity of social benefits. During summer Lar is one of the favourite destinations of people around Tehran who are searching for a silent environment. People come to Lar to see the biodiversity and sceneries. A lot of schools and universities bring students to Lar to teach them about plants, animals, biodiversity, wildlife, geology and nomadism (Environmental Protection Organization, 2006). From the sociologist point of view the Lar ranchers are an interesting case as their ancestors were originally from different parts of the country who were banished to the Lar rangeland to demolish their community power after protesting against the central government around 1760 (Hosseini, 2006). Now the ranchers still maintain their ancestors' traditions but some of the traditions have been changed based on the new environment and communications. This change has been interesting for sociologists who are trying to find out the environmental influences on existing traditions in Lar nomads and their origin (Hosseini, 2006).

Another important attraction for Lar is Damavand mount. As we explained, Damavand is the highest point in Iran, which makes Lar an interesting place for national and

international mountain climbers. It should be mentioned that Damavand also has a symbolic character in Iran's history, culture and literature. Damavand stands for stability and power and is mentioned in the national anthem to remind us about it. In this regard, an NGO namely "Koohestan" works together with governmental organizations and people to protect the area and to increase people's awareness about the Lar rangeland and importance of its services. Koohestan NGO held an international conference in 2004 in Tehran about protection and the importance of mountains around the world.

3.6 Conclusion

The diversity of services in Lar attracts a lot of social groups such as ranchers, local citizens, researchers, NGOs and policy makers from different branches such as, water management, nomad management, range management and environmental organization. All of these groups have different aims and policies that make conflicts among the groups. For example, the ranchers want to use Lar as a place to feed their animals. However, the Environmental Organization aims to bring a new land use policy to protect mainly ecological aspects of Lar. Nomad and Natural Resources departments aim to keep ranchers in the area with some new management plans. NGOs are working to improve governmental and stakeholders' knowledge towards importance of Lar services. All of these institutions are trying to conserve the area without any compromise on their plans. The Lar services are interrelated in a complicated manner and one cannot aim to improving one aspect without paying attention to other dimensions of the Lar rangeland.

First step before drawing any management plan is to elicit stakeholders' preferences towards the Lar services. Knowing stakeholders preferences will help the policy maker to incorporate stakeholders' preferences into the policy making process which would enhance the social support that is a necessary element to establish a sustainable decision. Furthermore, policy makers would be able to understand why stakeholders are in favour or opposition of a policy.

The next chapter describes our methodology to elicit stakeholders' preferences and enable policy makers to use these preferences into the policy making process.

Chapter 4

Methodology, discursive ordinal multi-criteria valuation method

Abstract

Taking into account the difficulties related to existing environmental valuation methodologies as explained in Chapter 1 and the conceptual framework as presented in Chapter 2, we will now introduce a discursive ordinal multi-criteria valuation method to elicit stakeholders' intensities of preferences on environmental criteria in the Lar rangeland. The shortcoming of the neo-classical economic value theory that forms the basis for Cost-Benefit Analysis (CBA) and the difficulties related to deliberative valuation methods such as Citizen Jury (CJ) and Deliberative Monetary Valuation (DMV) are at the basis to formulate a new combined valuation method. To be able to consider stakeholders' experiences and their cognitive limitations for providing cardinal value towards non-market environmental services, a discursive ordinal valuation methodology is introduced. The methodology is a combination of a discursive step to broad stakeholders' knowledge and an ordinal multi-criteria decision aid step to enable stakeholders to further simplify a complex environmental issue and to take environmental criteria incommensurable. The first part of the method aims to construct stakeholders' preferences over a set of environmental criteria. The second part elicits and aggregates these preferences and their intensities to construct social intensities of preferences on each single criterion. Finally, the aggregated values will be entered into an ordinal Multi-Criteria Decision Aid (MCDA).

Part of this chapter is under publication:

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4.1 Introduction

As explained in Chapter 1, the neo-classical economic value theory underlying Cost-Benefit Analysis (CBA) and the Contingent Valuation Method (CVM) has been the subject of a large number of criticisms (Sagoff, 1998; Vatn, 2004a). The essential assumption of this method is that individuals are able and willing to exchange one bundle or combination of goods for another and can do so without affecting their welfare level (Howarth and Wilson, 2006). However, numerous real-world studies have shown that people do not agree to make trade-offs between environmental services with market products (Kahneman et al., 1993; O'Neill, 1993; Sen, 1995b; O'Hara, 1996; Jacobs, 1997; Sagoff, 1998; Brouwer et al., 1999; O'Connor, 2000; Spash, 2000b; Perkins, 2001; Spash, 2002; Wilson and Howarth, 2002; Smith, 2003; Zhang and Li, 2005; Howarth and Wilson, 2006; Meyerhoff and Liebe, 2006).

Liljas and Lindgren (2001) argue that people use ordinal preferences for most analytical purposes. Thus, individuals are able to rank bundles of goods according to their desirability, but not to quantify to what extent they prefer one bundle to another. An individual's preference can then be represented by an ordinal utility function (Cook and Kress, 1985; Liljas and Lindgren, 2001). Based on this expression and taking into account the three properties of incommensurability and complexity of environmental criteria and plurality of environmental values, which are described in Chapter 2, a combined valuation method is proposed. The proposed methodology starts with a discursive part. In this step stakeholders have an opportunity to discuss on an environmental problem. The second part of the methodology aims to elicit stakeholders' preferences towards a set of environmental criteria related to the problem under the discussion. Finally, an ordinal Multi-Criteria Decision Aid (MCDA) will be used to enable stakeholders to deal with environmental complexity and the bounded rationality. In this regard, the methodology on one hand holds advantages of a deliberation method and on the other, usefulness of an MCDA in presences of conflicts among stakeholders.

Based on participatory structure of the methodology, we need to establish a group of participants. This will be done through a historical and stakeholder analysis in the Lar

rangeland (this part will be described in the following chapter). After establishment of the group of participants, the policy maker will bring them together several times to discuss about environmental problem, related environmental criteria and applicable alternative plans. Construction of a list of environmental criteria and alternative plans is the final aim of the discursive step. Then, a group of experts will formulate an Impact Matrix (IM) based on impact of the alternative plans on the criteria. Therefore, the IM provides us with impact of each plan on each single criterion. After making the IM, the stakeholders should first personally attach a qualitative weight to each single criterion. In this regard, five linguistic labels from not important to extremely important are introduced.

To elicit stakeholders' preferences towards environmental criteria, we use Alternative Impacts (AIs) rather than alternative plans. The assumption is that using alternative plans to elicit stakeholders' preferences will influence stakeholders' presence based on presence of conflict among stakeholders in Lar. We indeed assume that using AIs is neutral as their association with alternative plans is not presented during the preference elicitation step. In this regard, stakeholders should express their preferences for the AIs on each single criterion. In order to do so, the stakeholder needs to construct an ordinal rank order of the AIs on each single criterion (ordinal utility function). To be able to elicit stakeholders' intensities of preferences for each pair of AIs on the constructed rank order, five qualitative indicators are proposed. In this way, stakeholders are able to benefit from their daily life experience to present to what extent they prefer one AI to another on each single criterion based on their rank order.

To aggregate stakeholders' elicited intensities of preferences on each single criterion, one first needs to construct a social rank order based on ordinal utility functions. In order to do so, we propose to use the Condorcet criterion. The Condorcet criterion does not consider any assumption based on the position of alternative in the rank order (Arrow, 1963; Craven, 1992; Nurmi, 1999; Gaertner, 2006). This is the problem related to Borda rule, which is open to political manipulation (Nurmi, 1999). After establishing a social rank order on each single criterion, the second step is to construct the social intensities of preferences based on the social rank order. This can be done based on the median value among the intensities of preferences while taking the social rank order and stochastic

monotonocity into account. To be able to hold the stochastic monotonocity constraint a mathematical approach will be used (OSDL). The OSDL (Ordinal Stochastic Dominance Learner) will guarantee that the distributions of intensities of preferences w.r.t. each other on the social intensities of preferences are stochastically monotone. An aggregation weight for each criterion will be provided based on the median value. Finally, an outranking method, ARGUS (Achieving Respect for Grades by Using ordinal Scales only) will be used to provide a rank order of the alternative plans based on the social intensities of preferences and social weights of criterion. It is assumed that as the methodology is able to use stakeholders' intensities of preferences in a tractable way to construct the outcome, stakeholders are more likely to understand and support the final decision. This is in line with our goal, which is environmental sustainability.

4.2 Combining a discursive structure with an MCDA to build an environmental valuation method

MCDA approaches are useful tools when policy makers aim to analyse conflicts between multiple social groups (Gregory and Wellman, 2001; Proctor and Drechsler, 2003; Munda, 2004; Vatn, 2005; Damart et al., 2007; Doukas et al., 2007). The concept of conflict may imply that interests and values are multi-dimensional and one cannot easily trade them against each other. MCDA are constructed to handle values or criteria that are not easily transformed into one dimension such as a monetary measure (Gregory and Wellman, 2001; Proctor and Drechsler, 2003; Munda, 2004; Springael and De Keyser, 2004; Vatn, 2005). MCDA are also methods that put much emphasis on the process of decision making rather than the final decision (Munda, 2004; Vatn, 2005). The method fosters policy makers to decompose a multi-criteria problem and sheds light into decision making complexity. From this perspective, MCDA can be described as a structured process where the analyst supports the decision maker or the actual stakeholder groups in defining the problem, looking for alternatives, assessing their consequences, ranking the alternatives and so on (Martinez-Alier et al., 1998; Proctor and Drechsler, 2003; Tompkins, 2003; Munda, 2004; Vatn, 2005). In this regard, MCDA enable stakeholders to improve their cognitive capacity and eliminate the bounded rationality issue that

Simon (1972) describes. These are important elements for any MCDA approach that characterize in our methodology.

While MCDA is based on a mathematical logic, a discursive method is based on the communicative theory (Dryzek, 2002; Spash, 2007). It emphasises on the role of the argument and potential preference changes following from communication about what should be done for society. The fundamental idea is that through discussion and reasoning people can reach agreement on the basis of the better argument, mutual understanding and trust (Vatn, 2005, page 350). The same as MCDA, a discursive method is a response to the bounded rationality of individuals but in a different way (Vatn, 2005). The process of discussion not only makes the participants aware of the needs and perspectives of others, but it is also a core of communicative aspects.

Regarding the difficulties that are described for both valuation methodologies (individualistic and group-based valuation methods) in previous chapters, there is a growing literature on combining a discursive method (the third category in Table 1.1) (Vatn, 2005). As we explained, there are two directions. First, there is method where the MCDA is the main method and a discursive method is added to it. For example Munda (2004) applied a social MCDA approach to elicit stakeholder preferences towards water allocation policies in Sicily (Italy). There is another combination when the deliberative process is the core method and a MCDA is added to provide a structure to the deliberation. The focus in this method such as Deliberative Mapping (DM) is on social learning in a participatory MCDA.

In this chapter we introduce a valuation methodology that lies on the first group of combined valuation methods. The first category of solution acknowledges that several social groups or stakeholders are involved and a MCDA can be developed to include the communicative process into a social outcome. Based on the complexity and incommensurability of environmental criteria as well as diversity of social groups with different interests towards the criteria in our case study (Lar rangeland), we chose a discursive ordinal MCDA approach. This approach is applied to elicit stakeholders'

intensities of preferences towards a set of environmental criteria to be used into a tractable decision making process.

4.3 A discursive ordinal multi-criteria approach to environmental valuation

The methodology is presented in Figure 4.1. The method begins with problem identification and stakeholder analysis. These steps allow the researcher to find out different social groups who affect or are affected based on environmental decision in the Lar rangeland. Then group discussions will be applied among representatives of the social groups. In the beginning, each group of participants makes a discussion among themselves to improve their knowledge about the environmental problem and importance of environmental services in Lar.

After the single group discussions the groups come together in an inter-group discussion to discuss on construction of a list of environmental criteria and applicable environmental plans that can possibility support the criteria. It is assumed that an agreement on a list of environmental criteria and plans can be reached. Construction of a list of environmental criteria and alternative plans for a group of stakeholders are less influential on the decision making process compared to a consensus reaching approach especially when the groups have conflicting preferences. If a doubt appears on the importance of a criterion or a plan among the participants, the criterion or the plan will be added to the list of environmental criteria or plans respectively. It should be mentioned that a facilitator will help the stakeholders to have a fair discussion and provides them with a fair opportunity of exchanging their opinions during the group discussions.

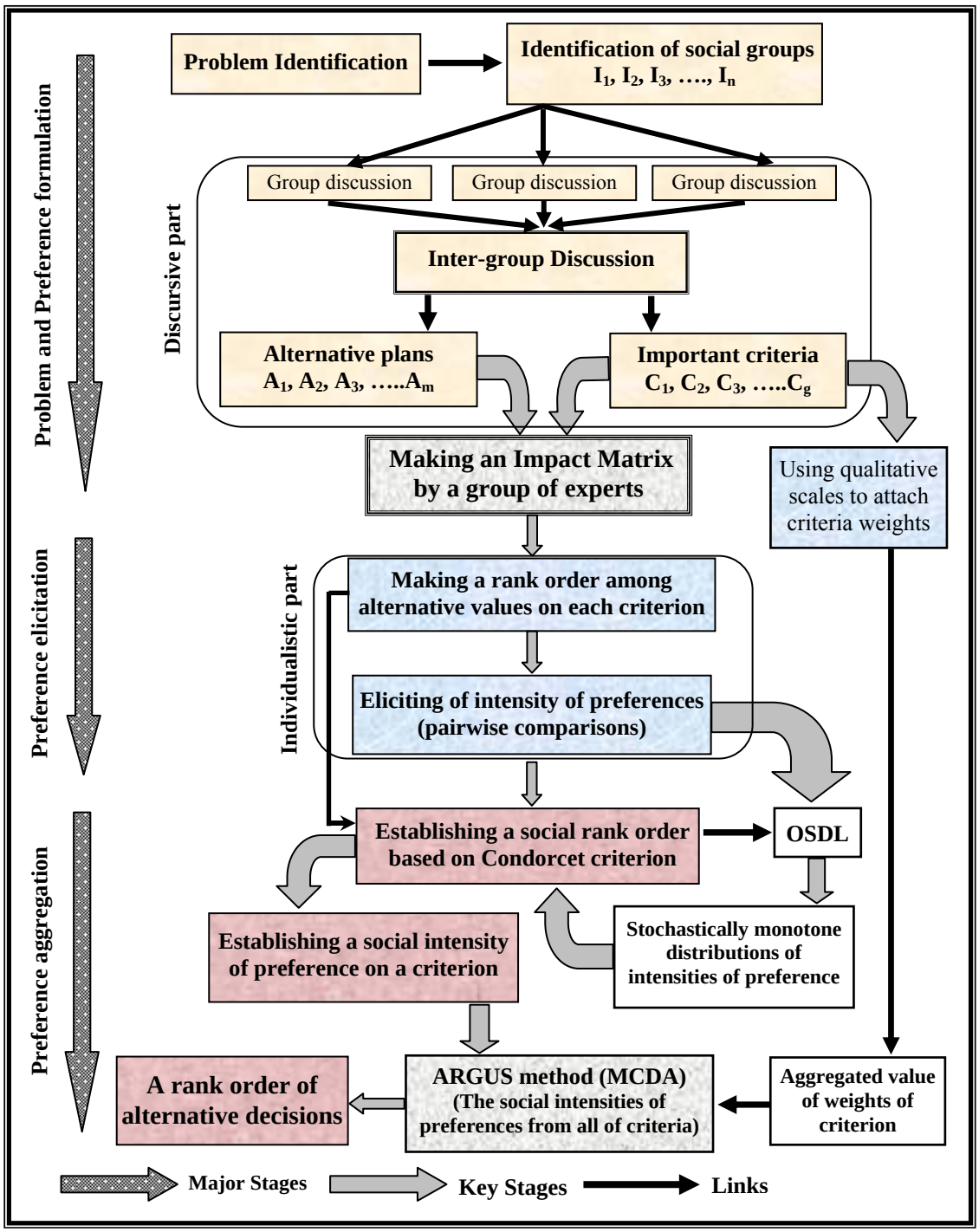

Figure 4.1. A discursive ordinal multi-criteria valuation method with combination of an ordinal MCDA

In general, the criteria should be complete and exhaustive in that they cover all possible aspects of the decision making problem and make the analysis complete. At the same time, the criteria should be mutually exclusive (non-redundant) to prevent 'double

counting' (De Groot et al., 2002; Proctor and Drechsler, 2003; Tompkins, 2003). The selection of criteria should be based on what is learned through the participatory process (Jacobs, 1997; Munda, 2004; Howarth and Wilson, 2006; Munda, 2006). In the next step, the list of environmental criteria and alternative plans will be given to a group of experts to construct an Impact Matrix (IM). The group of expert also provide additional information about environmental criteria such as current condition of the criteria and their trends, which will be used as an anchor by stakeholders when they want to express their preferences in the next step.

4.4 Attaching weight to each single criterion

The weight of a criterion in a multiple criteria method can indicate the importance that the participant attaches to that criterion and can be used as a scaling constant. In these methods, a weight of a criterion can be expressed by cardinal values or ordinal values, or by a ranking according to importance, or by a relative weighting of all criteria (Proctor and Drechsler, 2003). According to people's experience to use qualitative labels to attach weights to different objectives (Cook and Seiford, 1984; Liljas and Lindgren, 2001; Vatn, 2004a), we propose to use qualitative labels instead of quantitative to order environmental criteria. The qualitative labels are: *Unimportant (Uim) – Little important (Lim) – Moderately important (Mim) – Very important (Vim) – Extremely important (Eim)*. The stakeholders will use these labels to express how important each of environmental criteria is, according to their own view.

Once stakeholders attached weights to environmental criteria, they should express their preferences and their intensities among AIs for each single criterion.

4.5 Elicitation of respondents' intensities of preferences on each criterion

Given the criticisms of monetary valuation methods, an ordinal (qualitative) scale is proposed to elicit stakeholders' intensities of preferences. The rationale is that a representation of the intensities of preferences by numbers is not unique and does not add anything but only increases possible confusion with an interval or ratio scale (De Keyser and Peeters, 1994; De Keyser and Peeters, 1996; Godo and Torra, 2000; Springael and

De Keyser, 2004). An ordinal scale does not change in any way the character of the scale of the variable. The modelling of the intensity of preference by means of an ordinal variable can be illustrated by Figure 4.2. As one can see the intensities of preferences is not limited and researchers may add some extra qualitative values to the list based on the problem at hand and the usefulness of extra boundaries.

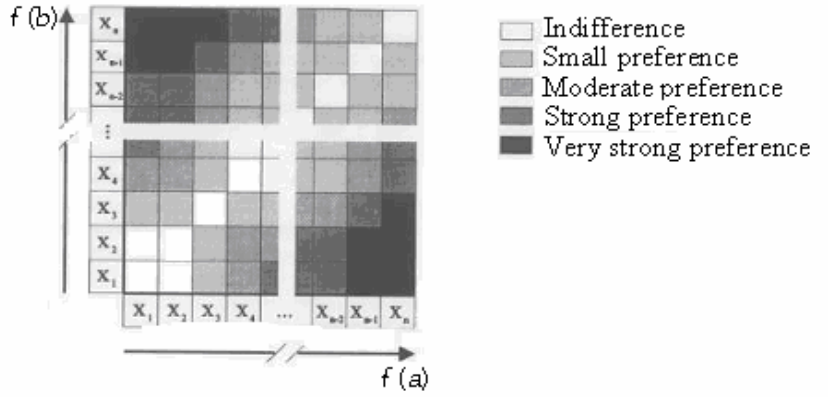

Figure 4.2. Intensity of preference for evaluations on an ordinal scale, (De Keyser and Peeters, 1994)

To be able to apply an ordinal MCDA approach to elicit stakeholders' intensities of preferences, one needs to follow two steps:

1- Stakeholders should construct a rank order of AIs. This will illustrate the individual's preferences on each single criterion (ordinal utility function) (the first box in individualistic part of Figure 4.1).

2- In the second step, stakeholders are asked to apply pairwise comparisons between pairs of AIs on the constructed rank order. To apply the pairwise comparisons, stakeholders will use a 5 point qualitative scale. We denote the qualitative scales as follows: *very small preference (vsm) - small preference (sm) - moderate preference (mo) - strong preference (st) - very strong preference (vst*). Although an intensity among a binary preference relation is a cardinal concept, in this study we call them ordinal intensity based on their qualitative structure.

4.5.1 Elicitation of stakeholders' preference

In this step, respondents are separately asked to provide a rank order of AIs on each single criterion. In the Choice Experiment (CE) researchers use Alternative Plans (APs) and their attributes to elicit respondents' preferences (Ruto and Garrod 2004), but in our methodology AIs instead of APs are used. Elicitation of stakeholders' preferences on the basis of the alternative plans can motivate stakeholders to act politically and present biased preferences. It is obvious that each decision has its supporters and oppositions, who need not necessarily consider a true opinion towards the consequences of the decision. To easily eliminate this problem, AIs are used and their association with the APs are removed during the preference elicitation step. A straightforward way of doing this is by replacing APs in the IM by some neutral indicators (Diemer and McKean, 1978).

In our methodology stakeholders will rank AIs on each single criterion. The experiences of ranking methods in practice have been good (Kangas et al., 2006). This procedure helps stakeholders to focus on one criterion without needing to consider all criteria. Moreover, the procedure is also in line with the limitation of people's cognitive capacity to take more than 7±2 elements at the same time into account when they want to make a decision (Miller, 1955; Saaty and Ozdemir, 2003). In this step we ask stakeholders to provide a complete rank order of AIs without any tie. However, stakeholders will be able to express a weak intensity among pair of AIs instead of using a weak rank order (De Keyser and Peeters, 1994). The next section gives more information about this idea.

4.5.2 Elicitation of stakeholders' intensities of preferences

Stakeholders are more familiar with using an qualitative values to express their intensities of preferences than using a numerical values (Liljas and Lindgren, 2001; Zendehdel et al., submitted). In this order, a qualitative procedure is proposed to elicit stakeholders' intensities of preferences. After establishment of a rank order of AIs (the first step), stakeholders will be asked to supplement the rank order with pairwise comparisons among pairs of AIs by using the qualitative labels, *vsm, sm, mo, st, vst*. To facilitate respondents to be consistent on their intensities of preferences during the pairwise

comparisons (regular monotonicity), a preferences matrix will be provided for each stakeholders. Table 4.1 shows an example of the preference matrix and its properties.

Table 4.1. Preference matrix for a criterion k and individual i

AIs from worst to best
(from each participant's point of view)

AIs from worst to best

Criterion k	d_{ik}	c_{ik}	b_{ik}	a_{ik}
d_{ik}	Indifferent			
c_{ik}	***mo***	Indifferent		
b_{ik}	***st***	***st***	Indifferent	
a_{ik}	***vst***	***vst***	***sm***	Indifferent

The table shows preference $a \succ b \succ c \succ d$ (*abcd*) (for simplicity we removed two indicators of *i* and *k*) as a rank order that the AIs are established from worst to best in the table (left to right, top to bottom in the table). The first pairwise comparison is among two AIs of *c* over *d* (top left corner). According to the rank order, the stakeholder prefers *c* over *d* and he expresses his intensity of preference among the two AIs by choosing "*mo"* (moderate preference). This value shows that the stakeholder prefers *c* over *d* with a moderate intensity. Stakeholders should follow a simple consistency rule to express their intensities of preferences (regular monotonicity): the intensities of preferences should neither decrease from top to bottom nor from right to left in the preference matrix (having a monotone distribution among intensities of preferences) (Table 4.1). This means that if the respondent has a strong intensity of preference for one of top left cells, such as the preference of *c* over *d*, then he cannot indicate a weak intensity of preference on one of the cells that lie immediately below such as *b* over *d* or *a* over *d*.

This procedure will be followed by all respondents for each criterion until the last criterion. With this methodology the necessity of making any trade-offs between different criteria are eliminated as pairwise comparisons take place among AIs for a single criterion. Table 4.1 also shows a filled in preference table that its intensities have a monotone structure. Based on this step, the policy maker will reach stakeholders' intensities of preferences among each pair of AIs on each single criterion separately. This

procedure has an advantage to the CVM as stakeholders do not need to make any kind of trade-offs between criteria. However, the final aim of the methodology is to enable the policy maker to use these intensities of preferences in a tractable way to formulate the final (social decision). Therefore, the policy maker needs to make trade-offs between criteria in the end of process. In this regard, the policy maker will use an appropriate MCDA to do the trade-offs and to reach the best decision based on stakeholders' preferences. The hope is that this procedure will help the policy maker to establish a sustainable decision that will meet social support. In this regard, the next section will provide us with the aggregation of stakeholders' intensities of preferences.

4.6 Construction of a social intensities of preferences on each single criterion

The differences between individual preferences are resolved by an aggregation method, associated to each profile of preferences, a collective –or social– preference relation interpreted as the ordinal as the ordinal collective welfare (Moulin, 2003; Gaertner, 2006). The aggregation role plays exactly the same role, in the ordinal context, as the collective utility function in the cardinal context. Collective welfare is identified with a preference relation R, guiding the collective choice over any subset B of feasible outcomes: welfare is identical to choice (Gaertner, 2006). This construction is anthropomorphic, in the sense that the collective body is treated exactly like an individual agent. The mechanical computation of the collective relation R from a profile is social engineering at its best, or its worst namely a controversial normative construction. Collective decisions merely result from the interaction of free citizens exercising their political rights. This decision process may indeed yield a pattern of choices that can in no way be deciphered as rational, as maximizing some underlying collective preference (Johansson, 1991). However, social choice theory takes the diametrically opposed view that the process to reach a democratic compromise should rest on sound axiomatic and allow positive prediction. For instance cycle of the majority relation are deemed undesirable because they lead to the chronic formation of unstable coalitions and arbitrariness of the final decision which, ultimately, threatens the political legitimacy of the institutions for collective decision. The model of preference aggregation is the most general and ambitious project of mechanism design in the microeconomic tradition. Its

limited success, underlined by Arrow's impossibility theorem, can just as easily be viewed as a vindication of the minimal state doctrine-the search for rationality of collective choice is hopeless-or as the first step in a larger project of social engineering poised to discover specific allocation problems for which rational collective choice is within our reach (Moulin, 2003).

In our study we use Condorcet criterion (the majority aggregation method) to aggregate the stakeholders' ordinal rank orders. The majority aggregation method meets the property of Independence of Irrelevant Alternatives (IIA) (Arrow, 1963) but does not always produce a rational collective preference (Condorcet paradox) (Moulin, 2003). In presence of Condorcet paradox (cycle), any method to break the cycle, for instance at its weakest link, leads to a violation of IIA. It should be mentioned that other aggregation methods such as Borda method, which produce a rational collective preference for any profile of preferences but fail to respect IIA property (Moulin, 2003). Arrow's impossibility theorem explores a sharp trade-off between the IIA property and the rationality of collective preferences, in the formal context of aggregation functions (Moulin, 2003). In abstract, the theory says that any aggregation function producing a rational collective preference and meeting IIA must be highly undesirable on account of its lack of efficiency or fairness (Moulin, 2003).

The core element in our methodology is however, the notion of intensity of preference as an important measure of support or opposition for stakeholders towards a course of action. In order to do so, instead of using stakeholders' intensities of preferences to provide individual rank orders of alternative decisions, it is mostly the case in MCDA approaches, we propose to use social intensities of preferences on each single criterion to determine the social attitudes on that criterion. The social intensities of preferences are constructed for each single criterion, on the basis of all stakeholders' intensities of preferences. This procedure enables policy makers to process the stakeholders' intensities of preferences without having to immediately transform them into rank orders of alternative decisions. To allow construction of social intensities of preferences on each single criterion, a Social Rank Order of Alternative Impacts (SROAI) on each single

criterion is first needed. The next two steps introduce how one can reach a social intensity of preference on each single criterion.

1- A social rank order will be constructed among all rank orders of respondents on each criterion according to the Condorcet criterion (social utility function).

2- To reach a SROAI stakeholders intensities of preferences are aggregated based on each binary relation of social preferences (the first step).

It is clear that not everybody has the same rank order as social rank order. Therefore, to be able to use every respondent's intensities of preferences, we need to mirror some intensities of preferences that are not in line with the SROAI (in the next chapter we will explain this process in details). In this regard, instead of using just those whose rank order is in line with the social rank order on each criterion, we use every respondent's intensities that will reduce the majority voice.

4.6.1 Construction of a SROAI for different rank orders on each single criterion

The aim of any valuation methodology is to provide a social value over individual values. This can be done in different ways. The CVM reaches a social Willingness To Pay (WTP) through a mean value based on all individuals' WTP. The second way is to provide an aggregated value through a consensus reaching process. This is the procedure that the DMV uses to make a social WTP. The third way in case of collecting ordinal intensities of preferences is to cardinalize ordinal values and then taking a simple mean and if it is necessary return to the ordinal environment (Godo and Torra, 2000). This is the method that the CE uses to provide an aggregated value with respect to individual's choices (Garrod and Kenneth 1999).

In our method we will collect purely ordinal preferences and an ordinal procedure will also be followed to make aggregation steps. Consequently, using approaches that require a cardinalisation is not an option. Two aggregation approaches that respect the ordinal rank order are the determination of the mode and the median. Using the mode does not guarantee monotonicity, even for distributions that are stochastically monotone with

respect to each other. The median does guarantee this property. Therefore, an ordinal aggregation method will propose.

The reason for following such a pure ordinal procedure is that stakeholders' preferences towards the environment have ordinal aspects (Liljas and Lindgren 2001; Vatn 2004). Moreover, based on limitation of people cognitive capacity and the concept of bounded rationality, using a numerical procedure is not considered. Our first aggregation task is to establish a social rank order among all individuals' rank orders. In absence of strategic considerations, one can identify the most preferred alternative among different pairwise comparisons based on the Condorcet criterion (Gaertner, 2006). The preferred alternative among a set of alternatives is the one that receives a majority of votes over the other alternatives (Condorcet winner) (Craven, 1992; Nurmi, 1999). If there is a Condorcet cycle, it will be resolved in a way that results in the minimal protest voices among stakeholders w.r.t. the social rank order. In this situation we propose utilizing either voter-based tiebreakers (Craven, 1992; Nurmi, 1999) or use the information of intensity of preference in order to resolve the paradox.

4.6.2 Construction of social intensities of preferences

After determining the Condorcet winner, the second step is to aggregate the intensities of preferences according to the social rank orders. However, we are not dealing with one single respondent and we have a multitude of rank orders and corresponding intensities of preferences. This necessitates the selection of a consensus among the intensities of preferences. One can draw a distribution graph among all intensities of preferences along each social rank order. The aggregated value among all individual intensities of preferences would be the median value of intensities of preferences on each pair of social rank order. As all stakeholders will not always reveal a similar rank order on all criteria, aggregations of these intensities on each binary relation on a social rank order result in a non-stochastically monotonocity (Lievens et al., in press). The distribution equivalent of the monotonicity constraint is called stochastic monotonicity (Lievens et al., in press). The stochastic monotonocity is a necessary element for a social distribution of intensities of preferences. To solve the problem we use a mathematical method (OSDL) (De Baets et

al., 2004; Lievens et al., in press; Lievens and De Baets, submitted). The application of OSDL guarantees a stochastically monotone distribution of intensities in the social context.

By using every stakeholder's intensities of preferences, minority groups will have the chance to have a voice into the SROAI. It should be mentioned that although minorities' views do not change the social rank order, its intensities among pairs of AIs will change and become weaker based on opposition of minorities with the SROAI. Social intensities of preferences will help policy makers to understand stakeholders' attitudes toward the alternative plans on each single criterion. To provide a social rank order of alternative decisions, one needs to combine these social intensities of preferences over all criteria. The next steps describe the process.

4.7 Construction of a social decision based on application of an MCDA

The final aim of the methodology is to reach a social decision according to stakeholders' intensities of preferences (the last phase in the aggregation step in Figure 4.1). To combine the social intensities of preferences and social weight of criterion, an outranking method (ARGUS) will be used. ARGUS stand for Achieving Respect for Grades by Using ordinal Scales. This method can handle ordinal and cardinal information in the same way to come up with a rank order of alternative plans. As ARGUS processes criteria without supposing a weak commensurability, it does not necessarily come up with a complete rank order. In other words, it is possible that some alternatives may become indifferent, while others remain incomparable (De Keyser and Peeters, 1996).

Therefore, ARGUS will combine the social intensities of preferences with social weights of different criteria to make a pre-rank order of the alternative plans. This will be done through a combined table, which facilitates consideration of both intensities and weights at the same time to come up with the rank order of alternative plans (De Keyser and Peeters 1994). It is assumed that construction of social intensities of preferences and social weights will shed light into the process of ARGUS and help stakeholders to understand the output. This process will improve tractability of the methodology and

increase social support. Details about application of ARGUS will be provided in Chapter 7.

Such obtained pre-rank order of alternative plans will yield useful information for policy makers in the environmental field as they can evaluate their policies according to stockholders' preferences and wishes. It is also possible to add some hypothetical plans, which might be used in future, to find out stockholders' preferences.

4.8 Conclusions

Ecological economics needs to be more psychologically and ecologically realistic than economically (Blamey, 1998). In order to so, valuation practitioners need to take the three economic, ecological and social dimensions of environmental criteria into account. However, consideration of the three environmental dimensions makes difficulties for valuation practitioners as well as stakeholders. First, presence of multiple dimensions makes it hard to use a common scale to value all environmental services. Second, assumption of commensurability between environmental dimensions results in stakeholders' protest responses that are a sign of lexicographic preferences (Spash, 2000b). Finally, aiming to take all three dimensions into account adds complexity to environmental valuation methodologies that hinders stakeholders to understand valuation questions and provides biased preferences (Diamond and Hausman, 1994; Vatn, 2004a). Researchers believe that the absence of direct market parallels and the complexity of environmental problems affect both the ability to judge and the possibility to calibrate a true and valid preference towards environmental goods and services (Diamond and Hausman, 1994; Diamond, 1996; Jacobs, 1997; Sagoff, 1998; Spash, 2000b; Vatn, 2004a).

In order to be in line with the structure of stakeholders' preferences and to be able to handle diversity of environmental criteria, plurality of social values and presence of multiple stakeholders with different interests, we propose a discursive ordinal MCDA valuation approach. Combining a discursive method with an outranking approach (ARGUS) enables researchers to benefit the advantages of both methodologies in

construction, elicitation and aggregation of stakeholders' intensities of preferences (Vatn, 2005, page 355). Moreover, both methods will help stakeholders with the bounded rationality that hinders them to understand a complex environmental issue. Using a qualitative method allows stakeholders to express their attitudes and beliefs in an easier way than using a numerical procedure (Miller 1955; De Keyser and Peeters 1994).

To be able to test the usefulness of the proposed methodology, we applied it in our case study (the Lar rangeland in Iran). In the next chapter we will provide the first step of the methodology. The first step is formulation of environmental problem and stakeholders' preferences towards environmental criteria.

Chapter 5

Stakeholder analysis, group discussion and formulation of an impact matrix

Abstract

Based on the proposed methodology in Chapter 4, the policy maker needs to follow different necessary steps. In this chapter, the first step of the methodology (problem and preference formulation) will be explained. Deliberative approaches have been used in different cases to help policy makers to bring stakeholders' insights into the decision making process. Policy makers have well understood that the communication and discussion between a group of stakeholders can increase quality of decision. To establish a group discussion or deliberation, care should be taken towards fairness and equity between group's members. In other words, the diversity of negotiation powers among a group of stakeholders can effectively influence the outcome and results in a biased decision. In our case study (the Lar rangeland), a lot of emphases is given towards recognition of social groups who should be involved into the study. In opposed to a consensus reaching process, such as deliberative approaches, that focus on reaching a consensus, we rather focus on the process of deliberation and emphasize on discussion and reasoning between stakeholders. In this regard, first a stakeholder analysis is applied in the case of Lar rangeland. As a result of the stakeholder analysis, six social groups and representatives for each group are identified. Then, to improve stakeholders' knowledge and to construct their preferences towards environmental services in Lar, group discussions are performed in two steps. As the first step, each single group will discuss the importance of environmental services and their usefulness in the region. During the second step, all groups are brought together to make an inter-group discussion to construct a list of environmental criteria and alternative plans. In case of the Lar rangeland, the inter-group discussion ended up with 12 environmental criteria and 4 alternative plans. Then, a group of experts will formulate an impact matrix based on the criteria and the alternative plans.

5.1 Introduction

Participatory approaches have increasingly been used in the environmental decision making (O'Hara, 1997; Pykäläinen et al., 1999; van den Hove, 2000; Spash, 2001; Kangas and Store, 2003; Renn, 2006). These methods are largely derived form the theory of deliberative democracy (Sen, 1970; Habermas, 1984; Habermas, 1987; Dryzek, 2002). Different participatory approaches such as Citizen Jury (CJ), Citizen Workshop (CW), Planning Cell (PC), Citizen Advisory Committees (CAC), Consensus Conference (CC) Participatory Planning (PP) and Focus Groups (FG) are used in the environmental decision making. For example, Pykäläinen et al., (1999) use a PP to incorporate stakeholders knowledge into the policy making process in a state owned forest in Finland. Reed and Dougill, (2002) use a participatory framework to identify, evaluate and select rangeland condition indicators. Participatory approach legitimises the decision making as they incorporate public values and preferences. This is one important reason why these approaches receive much attention from policy makers (Reed and Dougill, 2002; Renn, 2006).

To apply a participatory approach one first needs to select a group of participants. Selecting a group of participants not only depends on the problem at hand, but also it depends on the chosen approach. For example where a CJ randomly selects a group of about a dozen jurors to represent a microcosm of their society, in CC the participants are chosen based on socio-demographic criteria. After selection of stakeholders, it is also important to provide a preparatory step before inviting stakeholders into the group discussion (Keeney et al., 1990). In some cases, it is useful to have a series of separate meetings with stakeholders in order to define the problem and to introduce different criteria and alternative plans (Keeney et al., 1990; Gregory and Wellman, 2001).

To be able to identify relevant social groups in our case study, a Stakeholder Analysis (SA) is first applied. SA is a useful tool to establish a group of stakeholders to be involved into a group discussion (Kontogianni et al., 2001). In addition, SA is more than the identification of a group of stakeholders. SA is an approach for understanding a system by identifying the key actors or stakeholders in the system, and assessing their

respective interests in that system. Stakeholders include all those who affect, and/or are affected by, the policies, decisions, and actions of the system. Stakeholders can be individuals, communities, social groups or institutions of any size, aggregation or level in society (Grimble and Chan, 1995). Though, in complex issue and prior to applying a SA, application of a Historical Analysis (HA) is needed (Grimble and Wellard, 1997). The HA sheds light into the problem and helps policy makers to reveal networks and boundaries between different social groups in the area.

HA and SA are respectively applied in the Lar area and six groups of stakeholders are recognized. Before inviting representatives from each group to be part of a group discussion, we provided them with a workbook that gives general information. The information included: a short history about wildlife diversity, the amount of soil erosion during a period of time, diversity of vegetation, number of livestock, water production, water quality and number of tourists who have visited the area during previous years. This information helped the groups to formulate their arguments and is used as a starting point for group discussions. During the group discussions our emphasis was on the process rather than on the result. Therefore, the stakeholders did not concentrate on the final decision and they focus mostly on environmental criteria in Lar and tried to be involved in a mutual discussion to convince other stakeholders about their view. The group discussions are managed by a facilitator.

Eleven environmental criteria were established as the result of stakeholders' discussion. We added one extra criterion "Cost of Plan" as it is always important for policy makers to know to what extent the stakeholders are willing to spend public money to conserve environmental services (Gregory and Wellman, 2001). In addition, the stakeholders agreed on 4 alternative plans that might help policy makers to improve and conserve the chosen environmental criteria. The list of environmental criteria and alternative plans are given to a group of experts to formulate an Impact Matrix (IM). The impacts of the alternative plans on each criterion in the IM are used in further steps to elicit stakeholders' preferences and their intensities.

5.2 The requirements for participatory processes in the Lar area and its structure

Environmental policy makers in Iran like in other parts of the world are faced with a difficult dilemma: on the one hand, technical expertise is necessary but not a sufficient condition to establish practical environmental policies. Without consideration of public values and preferences, decisions cannot be legitimised. On the other hand, public understandings are at least partially based on biased and false assumptions about potential environmental impacts of human actions (van den Hove, 2000; Reed and Dougill, 2002; Renn, 2006; Kalibo and Medley, 2007). This is even more problematic in our case study as inter-group conflicts during the last decades hinder people to think rationally about the importance of environmental criteria. However, there is no other method than deliberative approaches that might help policy makers to legitimise policies that should be applied to support the environmental criteria. Therefore, the question is who can legitimately claim the right to select the values or preferences that should guide collective decision making in an area? One answer to this question can be drawn from the theory and practice of discursive forum (Renn, 2006). The German philosopher Jürgen Habermas denotes the term discourse as a special form of dialogue in which all affected parties have equal rights and duties to present claims and test their validity in a context free of social or political domination (Habermas, 1987). According to Habermas and others, a discourse is called rational if it meets the following specific requirements (van den Hove, 2000; Spash, 2001; Reed and Dougill, 2002; Smith, 2003; Renn, 2006; Spash, 2007). All participants are obliged to:

- seek a consensus on the procedure that they want to employ in order to derive the final decision or compromise (such as voting, sorting of positions, consensual decision making or the involvement of a mediator or arbitrator),

- articulate and criticise factual claims on the basis of the ‘‘state of the art’’ of scientific knowledge and other forms of problem-adequate knowledge (in the case of dissent all relevant camps have the right to be represented),

- interpret factual evidence in accordance with the laws of formal logic and analytical reasoning,

- disclose their relevant values and preferences, thus avoiding hidden agendas and strategic game playing,

- process data, arguments and evaluations in a structured format (for example a decision-analytic procedure) so that norms of procedural rationality are met and transparency can be created.

Regarding the criticisms that have been attached to the first requirement (reaching a consensus) (De Keyser and Peeters, 1994; Cookson, 2000; Tompkins, 2003; Vatn, 2004a) and being free from the difficulty of the third one (disclose stakeholders' relevant values and preferences), especially when the group's interests are highly diverse and inter-group conflicts are revealed, we decided to not ask participants to reach a consensus during the group decision. However, we asked the participants to reach an agreement on a list of environmental criteria and alternative plans that are broader than a consensus on a decision. We explained the groups that the proposed criteria and plans will be used as a tool to elicit their preferences and based on these preferences the final decision will be established. This procedure will mostly remove reasons for acting politically among stakeholders as there is no final decision, which is made based on the group discussion. To be able to apply group discussions, one first need to establish relevant stakeholder groups and their representatives. Following section provides more information about the application of SA in Lar.

5.3 Stakeholders analysis in the Lar rangeland

To establish a list of participants, there are two basic approaches, stakeholder approach and representative approach (Keeney et al., 1990). In the stakeholder approach, groups that have a strong interest in the policy problem and have clear values and preferences are identified for participation and discussion. The stakeholder approach is most useful, when the policy issue is highly controversial and when there is hope of achieving some kind of agreement (Keeney et al., 1990). In the representative approach, members of the public

are selected at random to participate in one or more group discussions. The representative approach is most useful, when there exists very little knowledge about reasonable public values, when the emphasis is on broad policy issue rather than one resolution of specific conflicts (Keeney et al., 1990).

In the case of Lar rangeland, the stakeholder approach is chosen due to controversy of Lar management issue. In this regard, SA is applied to reveal those stakeholders who should be involved into the decision making in Lar. The process of identifying relevant stakeholders and deciding which stakeholders should be included or excluded from the full analysis must be carefully considered at an early stage (Grimble et al, 1995). However, before starting the SA, application of a HA was necessary. The HA in Lar revealed that there have historically been three different groups who had direct interest in using the Lar rangeland during summer (Hosseini, 2006). The ranchers and their family are the first group who have been using the area. This group have used the Lar rangeland for more than 270 years to feed their animals. The second group are people who had close relations with Iran's former king. They owned large fractions of rangelands in Lar to graze their livestock. However, after the revolution in Iran and establishment of the new government in 1979, they left the country and their fractions of land were given to ranchers, and other organizations such as Bank (as a compensation to the bank which gave loan to them) and Ministry of Agriculture. Army also has a small fraction of the Lar rangeland to feed their horses. The third group is those stakeholders who come to Lar to enjoy from the beautiful environment and nice scenery mostly during the warm seasons and some other people who are indirectly used Lar services such as those who drink water in Tehran or clean air that is partly provides from Lar. By taking into account this information and the application of SA, six groups of stakeholders are recognized to be involved into the study.

Regarding different benefits that Lar provides to society (which are explained in Chapter 3) different management departments are involved into the policy making process in the Lar rangeland. The application of SA shows that four management departments strongly influence management policies in Lar: Natural Resources, Environmental Organization, Watershed Management and Nomad Management departments. To choose the

representatives from these groups, we invited those experts who have been involved into the Lar policy formulation during the last 10 years. The SA further shows that different NGOs are working together with the governmental departments and local people to conserve Lar services. Among the NGOs, one NGO (koohestan) was more active than the others and they have held some meetings with local people, ranchers, and tourists during the last years about Lar environmental services and their importance. Moreover, based on the NGO's willingness to participate into the study, we consider the group as representative of people who are living outside the area but are receiving benefit from Lar services. Among the chosen NGO, 3 persons who have been involved into preservation activities in Lar are invited for the group discussions.

Therefore the groups include four governmental departments, one NGO and the ranchers. Among ranchers, community leaders are taken as representatives of the group. Table 5.1 shows each group and the number of its representatives.

Table 5.1. Stakeholder groups and the number of representatives in each group

Ranchers	Nomad Department	Environmental Department	Natural Resources Department	Watershed Department	NGO	Total
7 persons	3 persons	5 persons	9 persons	4 persons	3 persons	31

As it can be derived from the table, the number of participants varies between the groups. The diversity of participants between the groups did not make any problem for the study as we did not use any voting system to reach the final decision. The total number of the stakeholders who were involved into the group discussion in this study was 31. After establishment of the list of participants, we asked each group separately to come together to discuss about environmental criteria in Lar. Based on the literature (Gregory and Wellman, 2001), a workbook is provided about Lar environmental services before the group discussion. Next section will give more information about the workbook.

5.4 Construction of a workbook about environmental services in Lar

During the application of SA in the area, we understood that each group of stakeholders has different information about criteria in Lar. For example, each group know that what is soil protection; however, their information about the amount of soil erosion was completely different. To be able to provide accuret and precise information for all groups, we decided to formulate a workbook. In this regard, we used the information that is provided in Chapter 3 to make the workbook. The workbook is designed in two sections, past and present condition of criteria in the Lar area. This structure introduced a correct perception about environmental criteria to the stakeholders. The workbook was distributed among the stakeholders two weeks before the group discussion. This provides an opportunity for the stakeholders to improve their knowledge about the Lar rangeland. We were questioned by the stakeholders several times on different parts of the workbook. This convinced us that the stakeholders are interested in the workbook and spent some time to read it.

5.4.1 First chapter, Lar condition in the past

In the first chapter of the workbook, we used all the information that was collected from the past. It was possible to consider all information that we had collected through discussion with the different groups as initial information for group discussion. However, we preferred to use information that was available in books, newspapers and articles to be sure that the provided information has minimum bias. We also used some pictures that the Environmental Department provided us during the primary discussion with their experts.

5.4.2 Second chapter, Lar condition in the present

In this chapter all available information related to the present condition of the Lar rangelands is provided. The information is characterized into three sections, economic, ecological and social. We classified related information that is provided in Chapter 3 based on the three above categories. The aim was to help stakeholders to be involved effectively into the group discussions. Differences between the past and the present

condition of Lar criteria made the groups quite interested and cooperative during group discussions.

5.5 Involvement of the stakeholders into single group discussion

Provision of the workbook for the stakeholders was the first step in group discussion. The single group discussion is held between members of each group. The single group discussion was an opportunity for the stakeholders in each group to review the general information that was provided about the Lar services. Moreover, the single group discussion was an exercise for those stakeholders that had not any experience to express their opinion among a group. A neutral moderator supervised the stakeholders in each group to have a fair discussion and prevent them being influenced by group dynamic. Each group of participants met each other twice to discuss about environmental criteria. The group discussions helped the stakeholders to construct their preferences towards environmental criteria. The discussion also helped the stakeholders to think in a pluralistic way about environmental criteria that is a sign of social rationality (Sagoff, 1998; Vatn, 2004a). During the single group discussion stakeholders had the opportunity to adjust their preferences and attitudes towards environmental services in Lar. For example, when the ranchers started to discuss about wild animals (mostly about deer, wild goats and sheep), the general idea was that presence of these animals in the area have no effect or even negative effect on their well-being. Most ranchers believed that these animals have a competition with their livestock to find food. In this regard, the ranchers were not in favour of supporting deer and the other wildlife in the area. Additionally, some of the ranchers explained about problems and limitations that the Environmental Protection Agency put on them due to protection of wildlife. However, opposing to the other ranchers, one particular rancher told a story about the usefulness of deer and wild goats in the area especially for his livestock. He explained that he not only has never shot any deer and the others in his rangeland, but also he has protected them by providing shelter and food. He explained that since the number of wild animals has increased in his rangeland, the number of times that wolves attack his livestock has decreased. This was due to availability of the wild animals to be caught by wolves. The second benefit that the rancher explained was that he did not need to hire more than two

shepherds to help him to manage his herd, as he was not worried about wolves' attacks. Therefore, wildlife protection brought him economic advantages as well. This example was very convincing for the group and most of the ranchers changed to some extent their opinion about the usefulness of wildlife in the area.

During the single group discussion the stakeholders exchanged their idea and this was an opportunity to think carefully about environmental services in Lar. At the end of each group discussion two questions were asked to the stakeholders. The questions were: what are the most important services that should be protected in Lar? Second, what is a useful plan that might support the indicated services? Table 5.2 and Table 5.3 give all services and alternative plans that are proposed by the groups.

Table 5.2. Proposed criteria based on single group discussion

Group name	**Proposed services**
Natural Resources	Forage production, water purification, water supply, rancher activities, security of area, animal production, plant diversity, soil conservation.
Watershed Management	Water supply, water quality, people access, vegetation diversity, soil coverage, water regulation, supporting social knowledge towards nature and tourism attractions.
Environmental Organization	Biodiversity, climate regulation, security for animals, tourism attraction, animal habitat, water purification, beautiful scenic, social education, gene conservation, CO_2 absorption, O_2 production and refugee services for wildlife.
Nomad Management	Dairy production, social education, cultural attributes, tourist attraction, beautiful scenic, security for ranchers, water supply, and vegetation diversity.
NGO (Koohestan)	Biodiversity, climate regulation, security for animals, tourism attraction, animal habitat, water purification, beautiful scenic, social education, gene conservation, refugee services for wildlife, symbolic character,
Ranchers	Job protection, water supply, dairy production, security of habitat, cultural attributes and security.

Table 5.3. Proposed alternative plans based on single group discussion

Plan	Group name	Proposed plan
1	Natural Resources	Livestock control, decreasing grazing rate, providing a new grazing system, cultivation of seeds of local grasses in the degraded areas, decreasing at least 40% of number of ranchers by promoting them to sell their rights, cutting 40% of livestock.
2	Watershed Management	Watershed management, including water harvesting through contour furrow, gabion and bio-mechanical treatment. Exclude those areas that are under rehabilitation from grazing programs. Animal control based on cutting 20% of livestock.
3	Environmental Organization	Changing the Lar land use to a National Park without any ranchers. Improvement of ecotourism in the area by providing facility and new investment.
4	Nomad Management	Rangeland rehabilitation, including hand planting, seedling and introducing a grazing system with establishing a system to control the grazing licences in the area. Providing rangeland management training for ranchers and trying to improve their skills.
5	NGO (Koohestan)	Protecting Lar services by removing ranchers and their animals to other places. Improvement of ecotourism in the area by providing facility based on private and governmental sectors.
6	Ranchers	Controlling ranchers and number of their livestock based on the grazing licences. Providing range management programs, such as seedling, water harvesting, soil conservation. Limiting the number of tourists in the area.

5.6 Inter-group discussion

After the single group discussions, the groups participated twice in an inter-group discussion. The inter-group discussion was a place for the stakeholders in Lar to join together and to discuss about what is the best for all stakeholders rather than for one. Before the first inter-group discussion, one sheet of information was prepared showing the conclusions from the single group discussions. The sheet includes a list of environmental criteria and alternative plans that the stakeholders proposed during the single group discussions (Tables 5.2 and 5.3). By adding together the proposed environmental services and alternative plans, we came up with 20 environmental criteria and 6 alternative plans. As one can understand, some of the proposed services have overlap with each other. For example, most of the groups indicated Water Quality and Soil Conservation as two different services. These two services could not be in the final list of the environmental criteria as they are mainly related to one criterion (Soil Protection).

The list of proposed services and alternative plans are distributed between the participants in the beginning of the first inter-group discussion and the stakeholders are asked to read it carefully. In this way, we provided the stakeholders enough time to read and think about the list of environmental and alternative plans. Each inter-group discussion took one day and a free meal is arranged for the participants.

The first inter-group discussion was very important for us and a lot of effort is put in encouraging the stakeholders to be involved in the discussion. The stakeholders spent around 6 hours to discuss about different environmental criteria and their importance for well-being of the groups. In the first inter-group discussion we did not discuss about any alternative plans. In the first inter-group discussion we aimed to reach an agreement on a list of environmental criteria. We asked the participants to focus on reducing overlaps and try to come up with a new list of environmental criteria. A moderator helped the groups to have a fair discussion. Table 5.4 shows the final list of criteria in Lar. The stakeholders selected 11 criteria to which that we added one more criterion (Cost of Plan) as an important factor to draw any policy. This additional criterion allows the policy maker to see to what extent the stakeholders are willing to assign public budget to conserve the Lar criteria.

Table 5.4. List of environmental criteria in Lar (proposed by the groups)

1- Climate Regulation 2- Soil Conservation 3- Plant Diversity 4- Wildlife Diversity 5- Security of Habitat 6- Social Education 7- Cultural Attributes 8- Recreation 9- Public Access 10- Part Time Job 11- Water Supply 12- Cost of Plan

The second inter-group discussion took place one week after the first inter-group discussion. It should be mentioned that we aimed to hold the two inert-group discussions continually, but based on time limitation of the stakeholders it seemed impossible. The main aim of the second inter-group discussion was to narrow down the diversity of attitudes on formulating a list of alternative plans to protect the Lar environmental

services. Although it is not possible to reach one hundred percent agreement on a list of alternative plans, we tried to minimize the number of alternative plans as far as possible. After several hours discussion finally, the stakeholders agreed on 4 alternative plans that were a combination of all six proposed plans (Table 5.5). Some of the plans had just one supporter, such as plan number 4, proposed by the Environmental Organization (Table 5.5) (although the NGO aimed to ban animal husbandry in the area, they did not support establishment of a national park) and other plans had more than one supporter. For example, the third and the first plans in Table 4.2 were partly supported by the Natural Resources, Watershed and Nomad Departments.

Reducing the number of criteria and alternative plans is an important aim, because by dealing with a long list of environmental criteria and alternative plans, stakeholders should spend a lot of time in the elicitation phase that will reduce their accuracy to express factual preferences.

Table5.5. Alternative plans based on an agreement between the stakeholders

First plan (1)	**Second plan (2)**
Livestock control and reducing 40% of animals during 5 years**.** Supporting an institution to facilitate transaction of grazing license among different parties	Rangeland rehabilitation, including hand planting, seedling and introducing a grazing system (no change in number of animals)
Third plan (3)	**Forth plan (4)**
Watershed management, including water harvesting through contour furrow, Gabion and bio-mechanical treatment**.** Reducing 20% of livestock during 5 years	Changing area to a national park without any ranchers. Introducing different plans for ecotourism and wildlife protection

5.7 Formulation of an impact matrix

Table 5.6 shows an Impact Matrix (IM) for the proposed criteria and the alternative plans. As shown each of the plan has a specific impact on each single criterion. The matrix includes both qualitative and quantitative impacts. The reason why some AIs are qualitative relates back to availability of information on that specific criterion. However, as the stakeholders in the next step will use the AIs based on each single criterion, the

diversity of scale does not make any problem for the methodology. In other words, as each stakeholder compare a pair of AIs on each criterion the diversity of scale of AIs will not make any important for the methodolgy. It should be mentioned that the stakeholders used the information from the workbook and the group discussion to understand the magnitude of AIs on each criterion. As an example, the stakeholders were able to understand the meaning of "4 tonnes per hectare per year " in the Soil Conservation criterion based on its current and past figures.

In our case study, we used a group of experts from different executive organizations and universities such as Forest, Rangeland and Watershed Organization (FRWO) and Tehran University to formulate the IM. In order to do so, we gave the list of environmental criteria and the four alternative plans to the experts. Besides the IM the experts received the workbook and detailed information about each plan. Formulation of the IM is a very important stage in our methodology as the preference elicitation steps are built based on AIs in the IM. In the IM, the name of plans are removed during the process of preference elicitation. This is done for eliminating any influence of plans on stakeholders' preferences.

5.8 Conclusion

Construction of preferences towards environmental services needs a discursive forum (Jacobs, 1997; Sagoff, 1998). In other words, people do not have well defined preferences over environmental services. As we explained, some stakeholders changed their opinion due to other people's argument and reasoning. An interesting example was the one we gave about wildlife diversity and its relation with the well-being of ranchers. It should be noticed that both group discussions were very important for us as the groups constructed their preferences towards the Lar services during this procedure. Most existing deliberative approaches bring stakeholders together to discuss about environmental criteria. these methods aim to reach a consensus on social payment or group decision. However, in our method the discursive forums are used to improve the stakeholders' knowledge towards the environmental criteria and helped them to construct their preferences. Altering the aim of the group discussion from reaching a consensus to a list

of environmental criteria and plans will reduce the inter-groups conflicts and help us to collect factual information.

Table 5.6. Impact Matrix of different alternative plans on environmental criteria in the Lar rangeland

	Ecological Criteria					Social Criteria				Economic Criteria		
Plan	**Climate Regulation**	**Soil Conservation**	**Plant Diversity**	**Wildlife Diversity**	**Security of Habitat**	**Cultural Attributes**	**Social Education**	**Recreation**	**Public Access**	**Part- Time Job**	**Water Supply**	**Cost of Plan**
	A	**b***	**c**	**d**	**e**	**f**	**g****	**h****	**i**	**j**	**k**	**l**
1	positive effect	5 tonnes per hectare per year	moderate increase in support	strong increase in support	strong increase in support	fully compatible	6	4	no effect	400 persons	10% increase	10000-20000 Euro
	a_1	b_2	c_3	d_1	e_1	f_1	g_2	h_3	i_3	j_1	k_3	l_1
2	no effect	7 tonnes per hectare per year	small increase in support	no support	no support	slightly compatible	3	5	small increase	600 persons	5% increase	30000-50000 Euro
	a_2	b_4	c_4	d_4	e_4	f_2	g_4	h_2	i_2	j_3	k_4	l_2
3	no effect	4 tonnes per hectare per year	strong increase in support	small increase in support	moderate increase in support	slightly compatible	5	3	small decrease	500 persons	20% increase	100000-200000 Euro
	a_2	b_1	c_2	d_3	e_2	f_2	g_3	h_4	i_4	j_2	k_1	l_3
4	positive effect	6 tonnes per hectare per year	very strong increase in support	moderate increase in support	small increase in support	incompatible	7	8	strong increase	1000 persons	15% increase	300000-500000 Euro
	a_1	b_3	c_1	d_2	e_3	f_3	g_1	h_1	i_1	j_4	k_2	l_4

* Soil conservation is expressed as the expected amount of soil lost due to erosion per hectare per year (tonnes per hectare per year), with the current situation being 7 tonnes lost per hectare per year

** The scores range from 0 to 10, where a score of 10 corresponds to availability of the service up to the maximal theoretically realisable capacity and a score of 0 corresponds to unavailability of the service

Chapter 6

Ordinal valuation of environmental criteria through a group consensus based on stochastic dominance

Abstract

This chapter introduces the second step of the proposed methodology to elicit stakeholders' intensities of preferences on complex environmental issues. Environmental valuation studies have shown that in any complex environment with a diversity of environmental services, stakeholders have difficulties following a monetary valuation to make trade-offs between different environmental services and reaching a consensus on their payment towards the environmental changes. Stated preference methods such as the Contingent Valuation Method (CVM) have been criticised for their individualistic format and assumptions of commensurability between environmental criteria and market products. To alleviate both of these criticisms, we propose an ordinal multi-criteria valuation method. In Chapter 5 we explained how the different social groups can come together and discuss on environmental problem and construct a list of environmental criteria and alternative plans that are used to make an Impact Matrix (IM). The first individualistic step consists of asking the stakeholders to rank Alternative Impacts (AIs) in the IM on each single criterion. The stakeholders are asked to express intensities of their preferences through pairwise comparisons between the AIs of the constructed rank order on each single criterion. These intensities are expressed on an ordinal scale. Subsequently, a social preference (social rank order) is established through the Condorcet criterion for each single criterion. The final step of the methodology is to establish social intensities of preference for each pair of AIs on the social rank order while taking the stochastic monotonicity constraint into account.

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6.1 Introduction

In Chapter 5 we explained how the stakeholders are bale to establish a list of environmental This chapter aims to explain how one can use stakeholders' intensities of preferences on a complex environmental issue to determine a group intensity of preference. Any complex environment with a diversity of ecological, social and economic values will be a centre of attraction for different social groups. To allow ecological economists to develop value indicators for decision making, they need to identify the services provided by the ecosystem and to determine the value that each of these services provides to the interested social groups. But in order to do so, they must understand and acknowledge the inherent complexities of ecological, social and economic systems. Because of these complexities, environmental valuation practitioners have introduced different valuation methodologies to elicit people's preferences. The most commonly applied valuation methodology, the Contingent Valuation Method (CVM), which is a stated preference method, simply considers a common scale (e.g. monetary) to make direct trade-offs between environmental criteria and market products to estimate stakeholders' Willingness to Pay (WTP). However, economic efficiency is only one of a diversity of indicators that can guide decision making. The procedure has therefore received considerable criticisms coming from economic (Hausman, 1993; Diamond and Hausman, 1994; Knetsch, 1994; Vatn, 2004a), political (Sagoff, 1998; Smith, 2003; Spash, 2007) and psychological fields (Kahneman et al., 1999; Spash and Vatn, 2006; Spash, 2007).

Recently, Choice Experiments (CE) and Deliberative Monetary Valuation (DMV) have been introduced to elicit stakeholders' preferences towards environmental criteria (Ruto and Garrod, 2004; Spash, 2007). Although these methods have some advantages over the CVM for the construction and elicitation of stakeholders' preferences, they still require people to make trade-offs between environmental criteria (Slovic, 1995; Vatn, 2004a). However, people are not capable to make trade-offs between environmental criteria and market products due to their cognitive limitation and bounded rationality (O'Neill, 1993; Liljas and Lindgren, 2001; Smith, 2003; Tompkins, 2003; Vatn, 2004a). When assessing alternative policy options, it is therefore necessary to create deliberative institutions that are able to consider a diversity of what may amount to be incommensurable and

incompatible values, goods or decision rules (Vatn, 2004a; Spash, 2007). Even though CE is a stated preference method that does not need a direct trade-off between environmental criteria, it does entail an indirect trade-off by asking stakeholders to choose between different levels of attributes (Ruto and Garrod, 2004; Vatn, 2004a).
In contrast to CE, DMV uses a deliberative structure and aims to reach a consensus among stakeholders on the social payment, though it still needs to perform trade-offs between environmental criteria. At the same time, however, the deliberative process increases stakeholders' awareness on the moral values of environmental criteria, which strongly reduces their willingness to make trade-offs between different environmental criteria (Diamond and Hausman, 1994; Smith, 2003; Vatn, 2004a; Howarth and Wilson, 2006). Moreover, the explicit focus on reaching a consensus on the social payment can pose a strong barrier to free dialogue (Smith, 2003).

An additional liability of monetary approaches, which assume peoples' preferences towards nature are cardinal, is that those preferences are in fact ordinal. It means that people do not use numerical indicators to express how much more desirable one bundle of goods is in comparison with another (i.e., differences in desirability) (Diemer and McKean, 1978; Cook and Kress, 1985; Liljas and Lindgren, 2001; Smith, 2003; Vatn, 2004a). More precisely, the problem with using numerical values is that they can misleadingly induce the respondents to assume the presence of interval or ratio scale properties.
Conventional monetary approaches usually expect stakeholders to consider simultaneously a multitude of alternatives during the elicitation of preferences. However, psychologists have shown that people have some natural limitations to take into account more than 7±2 items at the same time (Miller, 1955; Saaty and Ozdemir, 2003).

The criticisms we have mentioned above have resulted in protest responses to the conventional monetary approaches, which leads us to look for a methodology that is based on a differing set of assumptions. The methodology we propose is firmly rooted in respect for the three central properties of environmental decision making: environmental and social complexity, incommensurability between environmental criteria (no trade-offs

between different criteria in preference elicitation step) and plurality of environmental values.

The methodology partly consists of an exploratory discussion among stakeholders to broaden their view on the problem at hand. This can be achieved by letting each stakeholder formulate his personal interests in the area, which will lead to the identification of a multitude of environmental criteria under discussion. Next, each stakeholder group suggests one or more possible alternative plans that address each of the criteria identified in the previous discussion. Because the stakeholder groups have a diversity of interests, the alternative plans can address the criteria in a conflicting manner. The formulated alternative plans and environmental criteria allow a group of experts to construct an Impact Matrix (IM). On the basis of this IM, one can straightforwardly identify the impact of each alternative plan on each of the criteria. These impacts are called Alternative Impacts (AIs).

The AIs are used to elicit each respondent's preferences on each single criterion by asking them to provide an ordinal rank order of the AIs on each selected criterion. Pairwise comparisons of the AIs for each criterion allow the stakeholders to express the intensity of their preference on each pair. These intensities are expressed on a five point qualitative scale (from very small preference to very strong preference). Respondents are more comfortable with an qualitative values than a numerical format because it is closer to their daily life experience in expressing intensities of preferences between two alternatives.

In the following step, a social rank order is established based on the Condorcet criterion. We aim to incorporate as much as possible the input of each stakeholder when determining the social rank order. We will regard the social rank order as a group consensus on the rank order, without demanding unanimity on the intensities of preferences. This allows us to maximally respect individual intensities of preference when determining the social intensities of preference. However, we cannot ignore the simple fact that by equating the social rank order with a group consensus, we restrict the extent to which we can respect each stakeholder's opinion. Instead of the harsh constraint

of unanimity on the intensities of preference, we have to respect the looser constraint of stochastic monotonicity on the collection of individual intensities of preference. We illustrate the approach for the case study area.

6.2 A multi-criteria deliberative approach to elicit stakeholders' intensities of preferences on different environmental criteria

Figure 6.1 indicates the different steps in the methodology. In Chapter 5 we explained that a Stakeholder Analysis (SA) is applied to identify the different social groups who benefit from environmental services in the area. Subsequently, group deliberations conducted among representatives of the social groups and provided a list of environmental criteria and applicable alternative plans to support those criteria. The lists are given to a group of expert to formulate an IM (Table 6.1).
In the IM one can find the criteria but as we explained in Chapter 4, the alternative plans are replaced by numbers. We give a short description of the plans based their number in the table (Table 6.1).

Plan **1**: Livestock control: reduction of livestock by 40% in the area, and introduction of new legislation to facilitate grazing license transactions.

Plan **2**: Rangeland rehabilitation: introduction of hand planting, seedling and a grazing system (no change in number of animals)**.**

Plan **3**: Watershed management: water harvesting through contour furrow, gabion and bio-mechanical treatment**.** Reduction of livestock by 20% in the area.

Plan **4**: Environmental preservation: changing the area to a national park without any ranchers and implementation of diversity of plans for ecotourism and wildlife diversity.
Subsequently, a group of experts constructed an IM that describes the impact of each of the alternative plans on each of the environmental criteria.

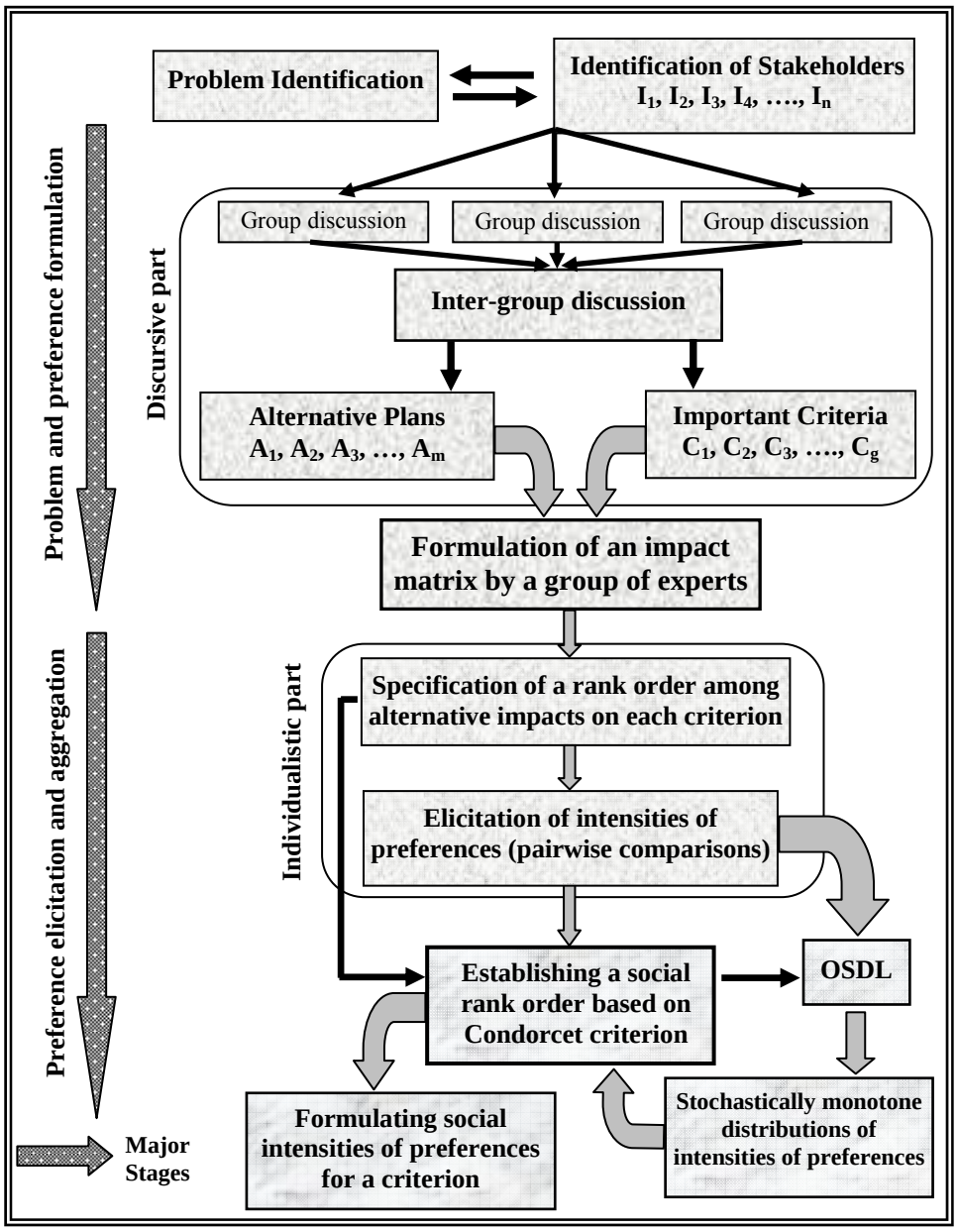


Figure 6.1. A conceptual framework to construct social intensities of preferences on a criterion

Once this matrix is obtained and Alternative Impacts (AIs) are determined, the problem is how stakeholders can use these AIs to express their preferences in a straightforward manner. As psychologists have indicated, human cognitive capacity is quite limited and people cannot take a large number of alternatives into account at the same time to come up with a right choice (Miller, 1955; De Keyser and Peeters, 1994; Cookson, 2000; Saaty and Ozdemir, 2003). Additionally, by considering environmental criteria one at a time,

we are sure to respect their incommensurability. In this regard, the stakeholders do not need to make trade-offs between environmental criteria. Therefore, stakeholders can compare the usefulness of alternative plans on each single criterion by providing a rank order of the plans without the need to take other criteria into account. However, presence of conflicts among the social groups in the Lar rangeland hinders us to use directly the four proposed plans. Therefore, stakeholders can act politically and express biased preferences if they know which plan corresponds to which social group. In this regard, we eliminated the name of each plan from the IM and just used AIs for each single criterion to elicit stakeholders' preferences and their intensities among pairs of AIs. The following section provides more information on the elicitation of stakeholders' intensities of preferences.

6.3 Elicitation of stakeholders' intensities of preferences

6.3.1 Provision of a preference matrix and abbreviation of the IM

The main difficulty faced by researchers in environmental valuation is eliciting respondents' intensities of preferences in a way that respects the three properties of incommensurability, complexity of environmental criteria and plurality of environmental values. An individual's preferences can be represented by an ordinal utility function (ordinal rank order) without necessitating the existence of a common scale and making trade-offs between environmental criteria (Cook and Kress, 1985; Liljas and Lindgren, 2001; Cook, 2006). But an ordinal utility function is weak as it does not give any information about the intensities of preferences of a respondent (Spash, 2007). This weakness can be circumvented by asking respondents to express their intensities among each pair of alternatives (De Keyser and Peeters, 1994). The scale of these intensities should be cardinal. However, it is possible to use qualitative indicators instead of using numbers. People use a qualitative format to express the intensity of their preferences between two alternatives in daily life. This helps stakeholders utilise their knowledge and experience to express their intensities of preferences (De Keyser and Peeters, 1994).

Table 6.1. Impact Matrix of different alternative plans on environmental criteria in the Lar rangeland

	Ecological Criteria					Social Criteria				Economic Criteria		
Plan	**Climate Regulation**	**Soil Conservation**	**Plant Diversity**	**Wildlife Diversity**	**Security of Habitat**	**Cultural Attributes**	**Social Education**	**Recreation**	**Public Access**	**Part-Time Job**	**Water Supply**	**Cost of Plan**
	a*	**b****	**C**	**d**	**e**	**f***	**g†**	**h†**	**i**	**j**	**k**	**l**
1	positive effect	5 tonnes per hectare per year	moderate increase in support	strong increase in support	strong increase in support	fully compatible	6	4	no effect	400 persons	10% increase	10000-20000 Euro
	a_1	b_2	c_3	d_1	e_1	f_1	g_2	h_3	i_3	j_1	k_3	l_1
2	no effect	7 tonnes per hectare per year	small increase in support	no increase in support	no increase in support	slightly compatible	3	5	small increase	600 persons	5% increase	30000-50000 Euro
	a_2	b_4	c_4	d_4	e_4	f_2	G_4	h_2	i_2	j_3	k_4	l_2
3	no effect	4 tonnes per hectare per year	strong increase in support	small increase in support	moderate increase in support	slightly compatible	5	3	small decrease	500 persons	20% increase	100000-200000 Euro
	a_2	b_1	c_2	d_3	e_2	f_2	G_3	h_4	i_4	j_2	k_1	l_3
4	positive effect	6 tonnes per hectare per year	very strong increase in support	moderate increase in support	small increase in support	incompatible	7	8	strong increase	1000 persons	15% increase	300000-500000 Euro
	a_1	b_3	c_1	d_2	e_3	f_3	G_1	h_1	i_1	j_4	k_2	l_4

* On this criterion, some plans have identical impacts

** Soil conservation is expressed as the expected amount of soil lost due to erosion per hectare per year, with the current situation being 7 tonnes lost per hectare per year

† The scores range from 0 to 10, where a score of 10 corresponds to availability of the service up to the maximal theoretically realisable capacity and a score of 0 corresponds to unavailability of the service

To simplify the data representation in our text, we denote the 12 criteria with **a** to **l** respectively, and denote the specific AIs for each criterion with subscripts 1, 2, … up to the number of distinct AIs proposed by the plans (see Table 6.1 for the specific values of the AIs and the corresponding plan or plans – for most criteria, each AI was proposed by a unique plan). We have opted to use a natural ordering to assigns subscripts to AIs, i.e., the AI denoted with subscript 1 is the ecologically most desirable impact proposed. For example, all other things remaining equal, taking measures to promote wildlife diversity is ecologically more desirable than doing the opposite. Hence, the AI of *strong support* for criterion **d** would be denoted d_1, as it is the largest increase in support proposed by one or more of the four plans, in this case by the first of the four plans. Obviously, it is not always the case that the first plan proposed the environmentally optimal choice, as can be easily verified in Table 6.1. Consequently, for the Wildlife Diversity criterion (**d**) the AIs d_1, d_2, d_3 and d_4 stand for *strong increase*, *moderate increase*, *small increase* and *no increase in support* respectively. For the Recreation criterion (**h**), the values of h_1, h_2, h_3 and h_4 stand for *score 8*, *5*, *4* to *3* respectively (denoting on a 0 to 10 scale to what extent the recreational facilities of the Lar rangeland will be exploited). Each stakeholder can rank the AIs for each criterion in a different way, they neither need to agree with each other nor with the environmentally optimal ordering.

To elicit stakeholders' intensities of preferences, two steps are needed: the stakeholders indicate their preferences by making a rank order of AIs, after which they express the intensities of their preferences using a qualitative scale (individualistic part of Figure 6.1).

6.3.2 First step, construction of a rank order of AIs

A voting system is used to elicit stakeholders' preferences towards environmental criteria in Lar. Voting is widely known in the democratic world and methods are fairly easy to explain to the decision makers or participants (Moulin, 2003; Gaertner, 2006). The comprehensibility makes the methods fair for all stakeholders, with or without prior knowledge of decision support methods. For instance, for those familiar with value

function or AHP, the results are easily manipulated by inflating the importance of some aspects (Kangas et al., 2006). The same applies, of course, also to market-based approaches, such as Cost-Benefit Analysis (CBA). Most voting techniques are also transparent and the results are easy for stakeholders and other participants to interpret. This can be seen as an asset, since it is easier to trust results when the rules used for receiving them are understood (Gregory, 2002).

In our study, to come up with an ordinal utility function, respondents are individually asked to provide a rank order of AIs on each single criterion. In CE, researchers use alternative plans and their attributes to elicit respondents' preferences (Garrod and Kenneth, 1999), but in our methodology the AIs (and not the alternative plans) are used to establish the stakeholders' ordinal utility function. The reason we take this approach is that eliciting respondents' preferences on the basis of the alternative plans can motivate them to act politically and present biased preferences on the environmental criteria, as each alternative plan has its supporters and opponents, who need not necessarily truly consider the environmental consequences of the plan. To easily eliminate this problem, we use AIs from the IM and remove their association with the alternative plans during the preference elicitation step in the IM: subscripts in the IM should not refer to the plan that proposed the AI, but are to be constructed on the basis of some other rationale. Respondents should first rank these AIs for each criterion according to their personal preference, without the possibility of easily doing so on the basis of political motivations. Tables 6.2 and 6.3 show the different rank orders of AIs elicited for the Wildlife Diversity and the Recreation criteria, as well as the frequency of each rank order. There is a clear difference in the diversity of stakeholders' opinions on the criteria, with the number of different elicited rank orders for the Wildlife Diversity being higher than for the Recreation criterion. Nevertheless, a 50% majority exists among the rank orders of AIs for the Wildlife Diversity criterion (18 stakeholders out of the 31 chose $d_1 > d_2 > d_3 > d_4$ as their rank order), while there is no such majority among the rank orders for the Recreation criterion.

Table 6.2. Rank orders of AIs for the Wildlife Diversity criterion (d)

Number of respondents	Rank order
18	$d_1 > d_2 > d_3 > d_4$
3	$d_3 > d_4 > d_2 > d_1$
3	$d_4 > d_3 > d_2 > d_1$
2	$d_2 > d_1 > d_3 > d_4$
1	$d_2 > d_3 > d_1 > d_4$
1	$d_2 > d_4 > d_3 > d_1$
1	$d_3 > d_2 > d_4 > d_1$
1	$d_4 > d_2 > d_3 > d_1$
1	$d_2 > d_3 > d_4 > d_1$

d_1: Strong increase d_3: Small increase
d_2: Moderate increase d_4: No increase

Table 6.3. Rank orders of AIs for the Recreation criterion (h)

Number of respondents	Rank order
11	$h_2 \succ h_3 \succ h_4 \succ h_1$
9	$h_1 \succ h_2 \succ h_3 \succ h_4$
8	$h_2 \succ h_3 \succ h_4 \succ h_1$
2	$h_2 \succ h_1 \succ h_3 \succ h_4$
1	$h_3 \succ h_4 \succ h_2 \succ h_1$

h_1: Score 8 h_3: Score 4
h_2: Score 5 h_4: Score 3

6.3.3 Second step, expression of intensities of preferences

To elicit stakeholders' intensities of preferences, two different approaches can be considered. The first is to use a quantitative approach to determine the respondents' intensities of preferences (Cook and Kress, 1985; Perkins, 2001; Proctor and Drechsler, 2003; Tompkins, 2003). For example, CVM uses a monetary system to facilitate calculation of trade-offs to determine social intensities of preferences. The method is almost the same for DVM as it aims to construct a social WTP through a consensus reaching process on an economic payment. The second approach is to use a qualitative scale to elicit stakeholders' intensities of preferences (De Keyser and Peeters, 1994), and this is the one we also propose. To prevent using quantitative valuations and to respect the qualitative nature of the respondents' intensities of preferences, we follow a purely ordinal approach. To do this, stakeholders are asked to make pairwise comparisons between AIs and express the intensity of their preference on a 5 point qualitative scale, we denote as $\mathcal{L}$: *very small preference (vsm) - small preference (sm) - moderate preference (mo) - strong preference (st) - very strong preference (vst)*. To facilitate a respondent to be consistent on the intensities of preferences during the pairwise comparisons, a preference matrix is constructed based on the rank order for the respondent. Table 6.4 shows such a preference matrix and its properties (De Keyser and Peeters, 1994).

Table 6.4. General structure of a preference matrix for the Recreation criterion (h)

Criterion **h**	h_1	h_4	h_3	h_2
h_1	Indifferent			
h_4		Indifferent		
h_3			Indifferent	
h_2				Indifferent

The table shows $h_2>h_3>h_4>h_1$ (abbreviated as $h_2h_3h_4h_1$) as an example of a rank order in which AIs for the Recreation criterion (**h**) have been established from worst to best (left to right and top to bottom). Each cell in the lower left triangle should be filled in by one of the values from the scale $\mathcal{L}$. The stakeholders should follow a simple consistency rule to express their intensities of preferences: the intensity of preference should neither decrease from top to bottom nor from right to left in the preference matrix (Table 6.4). This means that if the respondent expressed a strong intensity of preference for one of the top left cells, such as the preference of h_4 over h_1, (h_4h_1) then he cannot indicate a weaker intensity of preference in one of the cells that lie immediately below, such as for the preference of h_3 over h_1 (h_3h_1) or for that of h_2 over h_1 (h_2h_1) as the rank order is $h_2h_3h_4h_1$ (Table 6.4).

The pairwise comparisons are done for each single criterion and the respondents do not need to make trade-offs between different criteria. This is an important advantage to the CVM where people need to make trade-offs between private consumption and public good, which need a lot of information and strong sense of calculation. Based on human cognitive limitation and the bounded rationality, our approach is more efficient than the CVM and helps stakeholders to focus on just one criterion and express their intensities of preferences based on that specific criterion without having to take into account other criteria (De Keyser and Peeters, 1994).

An example of a completed preference matrix is provided in Table 6.5 for the Recreation criterion (**h)**. It shows the intensities of preferences of a respondent whose rank order is $h_2h_3h_4h_1$. The respondent filled in the lower triangle with the qualitative intensities (shown in bold). As one can see the expressed intensities have a consistent structure

(monoton) and follow the mentioned rule. The significance of the upper part of the triangle (containing negative values) will be explained in Section 6.4.2. Based on the elicited intensities of preferences for each criterion for all respondents, we want to calculate the social intensities of preferences. This will be done through the steps we discuss next.

Table 6.5. Completed preference matrix for the Recreation criterion (**h**)

Criterion **h**	h_1	h_4	h_3	h_2
h_1	Indifferent	$-mo$	$-st$	$-vst$
h_4	$+mo$	Indifferent	$-st$	$-st$
h_3	$+st$	$+st$	Indifferent	$-vst$
h_2	$+vst$	$+vst$	$+vst$	Indifferent

6.4 Construction of social intensities of preferences on each single criterion

6.4.1 Establishing a social rank order among individual rank orders

To determine social intensities of preferences, first a social rank order is needed among the stakeholders' rank orders of AIs on each single criterion. A social rank order can be reached according to different ranking rules. However, no voting method could be said to be the best to combine the individual preferences to determine social choice (Arrow, 1963; Sen, 1970; Johansson, 1991; Craven, 1992; Moulin, 2003; Gaertner, 2006; Kangas et al., 2006). Various methods have different strengths and weaknesses, and various voting systems might even produce different results. For instance, possibility to manipulate the system, and the selection of Condorcet winner can both be seen as important properties (Craven, 1992; Gaertner, 2006; Kangas et al., 2006). In absence of strategic considerations, one can identify the most preferred alternative among different pairwise comparisons based on the Condorcet criterion (Craven, 1992). As we explained, Condorcet criterion holds the condition of independent of irrelevant alternative. This is an important condition for our study as we should minimize the influence of other alternatives on each pair of AIs. In this regard, we could be sure that the collected preferences are at least independent from other alternatives. The preferred alternative among a set of alternatives is the one that receives a majority of votes over the other

alternatives (Condorcet winner) (Craven, 1992). For the Wildlife Diversity criterion (**d**), a 50% majority rank order ($d_1d_2d_3d_4$) was shown to exist among the rank orders. For the Recreation criterion (**h**), however, we have no such majority among the rank orders. In this case we determine the Condorcet winner as the social rank order $h_2h_3h_4h_1$. If there is a Condorcet cycle, we will resolve the paradox in a way that results in the minimal protest voices among stakeholders w.r.t. the social rank order. The traditional way to resolve the paradox is to utilize voter-based tiebreakers (Mas-Colell et al., 1995; Nurmi, 1999). We propose a different way that uses the intensity of preference information. (of course for the proposed method, we need interpersonal comparability). To be able to explain the procedure we consider three hypothetical alternative impacts *p*, *q* and *r* for an unspecified criterion. Suppose we have the Condorcet cycle *pq* (according to 20 respondents, and the median of all respondents' intensities of preference is "*small*"), *qr* (16 respondents, median is "*strong*") and *rp* (17 respondents, median is "*moderate*"). Instead of using the number of supporters, we can use the median intensity of preference as a guideline to decide where to break the cycle. To be precise, we propose to disregard the preference with the weakest intensity, instead of the preference supported by the smallest number of votes. For the discussed example, this means we will choose to ignore the majority vote of *pq* (20 respondents), as its median intensity of preference is the weakest. If we were only to look to the number of supporters, we would choose to disregard the *qr* preference, as this preference has the smallest number of supporters (16 respondents), even though it has the strongest median intensity of preference.
For our data set, however, no Condorcet cycles were present for any of the criteria.

6.4.2 Establishing social intensities of preferences based on the social rank order

After establishing a social rank order of AIs on each single criterion, the second step is to construct the social intensities of preferences based on the social rank order. This can be done based on the median value among the intensities of preferences while taking the social rank order and stochastic monotonocity into account. Even though the concept of stochastic monotonicity and the related concept of stochastic dominance play a very important role in many branches of economics and finance (Levy, 2000; Urcola and

Lowenberg-DeBoer, 2007), we will explain why the concept of stochastic monotonocity is applicable when determining a social rank order and intensities of preferences.

To facilitate the introduction of this concept, we return to the Recreation criterion (**h**) and the social rank order $h_2h_3h_4h_1$. In this situation a median value for the intensities of the preferences (h_2h_3, h_2h_4, h_2h_1 and so on) should be computed based on all respondents' intensities of preferences on each pair. But as we can see in Table 6.3, the rank order can differ from one individual to the next. For those whose rank order is different from the social rank order, we are unable to directly use the intensities of preferences to obtain a social value based on each pair of the social rank order. To be able to use every respondent's intensities of preferences, we opted to mirror the intensities of preferences for all individuals (Table 6.5, upper triangle), which necessitates the introduction of a new scale $\mathcal{L}^*$, which is a signed version of our original scale $\mathcal{L}$. This step enables us to have all possible pairwise comparisons (12 pairs based on 4 AIs). In this way, one can easily construct hierarchical diagrams such as the one in Figure 6.2. This figure depicts the hierarchical structure of preferences and intensities of preferences for a stakeholder who indicated $h_2h_3h_4h_1$ as his individual rank order: the strongest positive preference (h_2h_1) is at the top of the structure, the strongest negative one is at the bottom (h_1h_2). All others lie in between. The structure in Figure 6.2 is a representation of a partially ordered set (poset); (see (Davey and Priestley, 2002). Because the final rank order is $h_2h_3h_4h_1$, the h_2h_1 comparison, for example, implicitly contains the h_2h_4 and h_3h_1 comparisons. We will denote this relation as $h_2h_4 \preceq h_2h_1$. These relations are straightforwardly represented in Figure 6.2: h_2h_1 is above both h_2h_4 and h_3h_1.

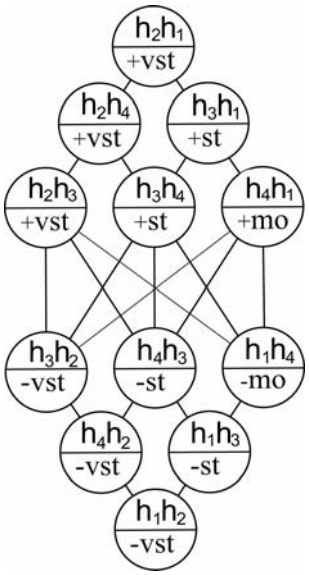


Figure 6.2. $h_2h_3h_4h_1$ rank order

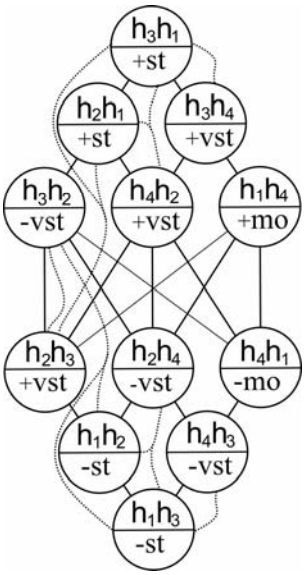


Figure 6.3. $h_3h_2h_4h_1$ rank order

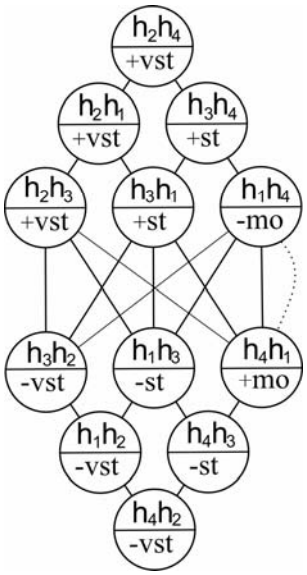


Figure 6.4. $h_2h_3h_1h_4$ rank order

Consequently, the restriction posed during the preference elicitation (non-decreasing intensities when moving down or to the left in the table) means that there will be no downward path for which the intensity of preference increases at any one point in the preference structure in Figure 6.2. Such a collection of intensities and associated preference ranking is called monotone or consistent. The example in Figure 6.2 is an example of such a consistent preference structure. As we can see, Figure 6.2 includes the positive and negative intensities of Table 6.5.

In the case of respondents indicating different preferences, not everyone will fully agree with the social rank order. Observe now what happens if we transform the preference structure in Figure 6.2 to fit these respondents' preferences to a new social rank order, $h_3h_2h_4h_1$. Figure 6.3 uses for the most part the same preferences and intensities of preferences as Figure 6.2, but in a different ordering, to reflect that the social rank order is $h_3h_2h_4h_1$ instead of $h_2h_3h_4h_1$. Consequently, the top element is h_3h_1 instead of h_2h_1 (Figure 6.3). Remark that the structure is now no longer monotone. When we confine ourselves to the top part of the structure, it is easily seen that the intensity of h_3h_1 is less strong than that of h_2h_1. Examining the entire structure reveals even more non-monotone relations, all of which have been denoted through dotted arcs in Figure 6.3.

Not every rank order differing from the one the respondent has chosen needs to be that highly non-monotone however. Figure 6.4 illustrates this for a hypothetical social rank order, $h_2h_3h_1h_4$. The only inconsistency is the negative intensity of h_1h_4, incompatible with the rank order of the AIs. This also results in a non-monotone relation between h_1h_4 and h_4h_1.

However, the problem is even more complex as we are not dealing with a single respondent but with a multitude of opinions and corresponding intensities of preferences. For such a multitude of opinions and a single social rank order, structures such as the ones in Figures. 6.2 to 6.4 contain distributions of intensities. The problem is thus to compute a monotone structure on the basis of a collection of such partially non-monotone structures. Instead of the regular monotonicity constraint, which is simply not applicable to distributions, the distributions of intensities for the preferences in the social rank order are bound by the stochastic monotonicity constraint. The concept of stochastic monotonicity is of great importance, as it is a required property if one aims to regard the social rank order as one that accurately reflects the group consensus. Stochastic monotonicity is defined on cumulative distributions. One distribution is said to dominate another one, if, seen as functions, it lies below this second one. Two distributions are stochastically monotone w.r.t. each other if the one that should contain the higher values, dominates the one that should contain the lower values. This is applicable in our application: intensities of preference for the top elements in structures such as the ones in Figures 6.2 to 6.4 should be greater than for the lower elements. If this is not the case, the distributions are not stochastically monotone w.r.t. each other. We provide a straightforward example on the basis of Figure 6.5.

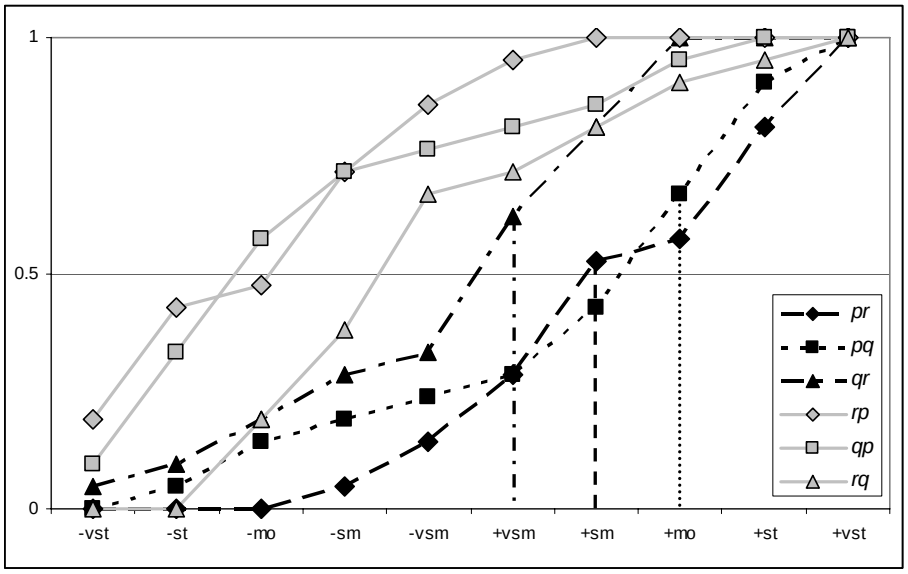


Figure 6.5. Stochastically non-monotone cumulative distributions

By including each respondent's intensities of preferences in the distributions, instead of only the ones belonging to those whom agreed with the social rank order, we are able to better incorporate the multiple (partially) conflicting opinions. This possibly leads to stochastically non-monotone distributions of preference intensities. Additionally, these distributions will now contain negative intensities of preferences as well. Figure 6.5 denotes the cumulative distributions for a subset of the preference matrix for a hypothetical criterion with a social rank order of *pqr*. In a discrete setting, the median is not always well defined, but can be an interval (Lievens et al., 2007). In such a situation, we consistently take the upper median. Paying close attention to the *pr* and *pq* distributions of intensities in Figure 6.6 shows that their distributions are not stochastically monotone w.r.t. each other. For reasons of clarity, we will first restrict our examination to these two distributions (extension to the remaining distributions is straightforward however).

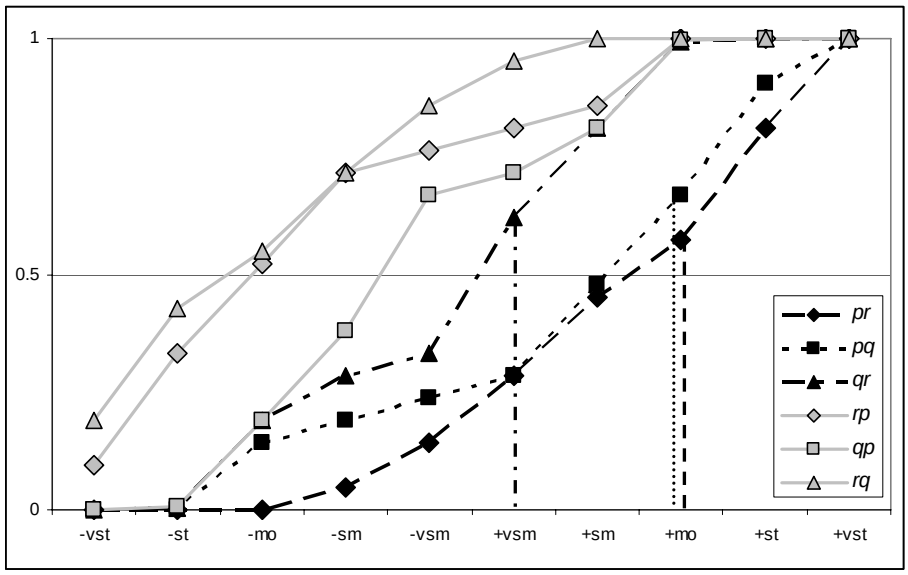


Figure 6.6. Stochastically monotone cumulative distributions (after applying OSDL)

The *pr* distribution at first lies below the *pq* distribution, as should be the case, because $pq \preceq pr$ for a rank order of *pqr*. Later on, close to where the distributions intersect the 50% line (Figure 6.5), we can see that the *pq* distribution lies above the *pr* distribution. Consequently, stochastic monotonicity is not fulfilled. Using the median of the respondents' elicited intensities of preferences would result in a social intensity of *"+mo"* (dotted line on Figure 6.5) for *pq* and a social intensity of *"+sm"* (dashed line) for *pr*. This would not be in line with the supposed *pqr* social rank order, since the social intensity of *pr* is reported to be smaller than that of *pq*. In this way, stochastically non-monotone distributions on the intensities of preference do not only signify that the group is not in consensus on the rank order of the AIs, but can even lead to inconsistent social intensities of preference. This problem can be solved by restoring the stochastic dominance relation. How to do this will be discussed in the next section.

6.5 The Ordinal Stochastic Dominance Framework

The ordinal stochastic dominance learning framework (Lievens et al., in press) consists of a main theorem that helps building monotone distribution-based classifiers. One of these classifiers is the Ordinal Stochastic Dominance Learner (OSDL), which is only one of several variants of an algorithm to solve the supervised ranking problem. As we are

dealing with distributions of intensities for each pairwise comparison of AIs, the explicit distribution-based approach makes this framework very well suited to our particular problem. We give here only a limited introduction to the framework, more information can be found in (Lievens et al., in press). We will use the OSDL algorithm (Cao-Van and De Baets, 2004; Lievens et al., 2007; Lievens et al., in press). The input to the algorithm will be the (possibly stochastically non-monotone) set of distributions, and the output will be a stochastically monotone set of distributions.

In order to describe the OSDL algorithm, we first briefly repeat the notions we have introduced throughout the text, and introduce notations and new concepts as needed. For each respondent *i* we have his intensities of preference $v_i(xy)$ as entered in the preference matrix. For each preference *xy*, we have the intensity of preference relative frequency distribution f_{xy} over all respondents, with cumulative relative frequency (CRF) distribution F_{xy}, i.e. $f_{xy}(\lambda) = \frac{\#\{v_i(xy) = \lambda \mid i = 1,...,N\}}{N}$ and $F_{xy}(\lambda) = \frac{\#\{v_i(xy) \le \lambda \mid i = 1,...,N\}}{N}$ (where *N* is equal to number of respondents). For each preference *xy* and each intensity of preference λ from our scale $\mathcal{L}^*$, we will additionally need the *minimal* and *maximal extensions* $F_{xy}^{\min}(\lambda)$ and $F_{xy}^{\max}(\lambda)$. These distributions are defined as follows: $F_{xy}^{\min}(\lambda) = \min\{F_{uv}(\lambda) \mid uv \preceq xy\}$ and $F_{xy}^{\max}(\lambda) = \max\{F_{uv}(\lambda) \mid uv \succeq xy\}$ (inequalities such as $uv \preceq xy$ simply signify xy itself and all implied preferences). We will often omit the intensity indicator (λ) when we do not specify an intensity or when discussing the entire distribution. Figure 6.5 will allow us to intuitively describe $F_{xy}^{\min}$ and $F_{xy}^{\max}$.

We will determine $F_{pr}^{\min}(+vsm)$ and $F_{pr}^{\max}(+vsm)$, as well as $F_{pr}^{\min}(+sm)$ and $F_{pr}^{\max}(+sm)$. $F_{pr}^{\min}(+vsm)$ is then simply the minimum of the *"+vsm"* frequency of all distributions (as all preferences are $\preceq pr$). This minimum is equal to the $F_{pr}(+vsm)$ itself, i.e. $F_{pr}^{\min}(+vsm) = F_{pr}(+vsm)$ (though it should be mentioned that $F_{pr}(+vsm)$ and

$F_{pq}(+vsm)$ happen to coincide). $F_{pr}^{\max}(+vsm)$ is even more straightforward to determine, as it is the maximum of the *"+vsm"* frequency of all preferences which are $\succeq pr$, which is simply $F_{pr}(+vsm)$ itself. It turns out therefore, that $F_{pr}^{\max}(+vsm)$ is equal to $F_{pr}^{\min}(+vsm)$. For our specific setting, the latter will always be the case for distributions that are stochastically monotone w.r.t. the other distributions. When we determine $F_{pr}^{\max}(+sm)$ and $F_{pr}^{\min}(+sm)$, we will see when this is not the case. $F_{pr}^{\max}(+sm)$ is again equal to $F_{pr}(+sm)$. $F_{pr}^{\min}(+sm)$, however, is equal to $F_{pq}(+sm)$, not $F_{pr}(+sm)$. The *pr* distribution does not dominate the *pq* distribution, as the latter dips below the former at the intensity *"+sm"*. Consequently, the lack of stochastic monotonicity causes $F_{pr}^{\min}(+sm) < F_{pr}^{\max}(+sm)$.

In this way, examining $F_{xy}^{\min}$ and $F_{xy}^{\max}$ allows to pinpoint the intensities of preference for which the distributions are not in line with the stochastic monotonicity requirement. In order to render the distributions monotone for *pq* and *pr*, we will therefore have to change the frequencies for the *"+sm"* intensity (as well as for the *pq*, *qr* and *rq* distributions for the *"-vst"* and *"-st"* frequencies, as these intersect as well). We will do this by interpolating between $F_{xy}^{\min}$ and $F_{xy}^{\max}$ for both *pr* and *pq* on the basis of some simple counting arguments, $N_{xy}^{\min}$ and $N_{xy}^{\max}$. $N_{xy}^{\min}(\lambda)$ (respectively $N_{xy}^{\max}(\lambda)$) is simply the number of times a respondent indicated an intensity of preference greater than (resp. at most) λ for any *pq* that is smaller than (resp. greater than) or equal to xy, i.e. $N_{xy}^{\min}(\lambda) = \#\{v_i(pq) > \lambda \mid pq \preceq xy\}$ and $N_{xy}^{\max}(\lambda) = \#\{v_i(pq) \leq \lambda \mid pq \succeq xy\}$. On the basis of these counting arguments, we compute a weighted sum $\widetilde{F}_{xy}$ that is guaranteed to yield stochastically monotone distributions. The $\widetilde{F}_{xy}$ will be computed as follows, guaranteeing a stochastically monotone output:

$$\widetilde{F}_{xy}(\lambda) = \frac{N_{xy}^{\min}(\lambda) \times F_{xy}^{\min}(\lambda) + N_{xy}^{\max}(\lambda) \times F_{xy}^{\max}(\lambda)}{N_{xy}^{\min}(\lambda) + N_{xy}^{\max}(\lambda)}.$$

Closer inspection of the expression for $\widetilde{F}_{xy}$ clearly shows that this is a weighted average of $F_{xy}^{\min}$ and $F_{xy}^{\max}$. Obviously then, if $F_{xy}^{\min}$ and $F_{xy}^{\max}$ are both equal to F_{xy} (as is the case for all intensities of preference of stochastically monotone distributions), $\widetilde{F}_{xy}$ is simply equal to F_{xy}. If not, $N_{xy}^{\min}$ and $N_{xy}^{\max}$ allow an interpolation between $F_{xy}^{\min}$ and $F_{xy}^{\max}$ for those intensities where $F_{xy}^{\min} > F_{xy}^{\max}$. Because of the properties of $N_{xy}^{\min}(\lambda)$ and $N_{xy}^{\max}(\lambda)$ ($N_{xy}^{\min}(\lambda)$ will be non-decreasing for increasing *xy* and decreasing λ, while $N_{xy}^{\max}(\lambda)$ will be non-decreasing for decreasing *xy* and increasing λ) this interpolation at first (for the greatest negative intensities of preference) lies close to $F_{xy}^{\min}$ and will later, for the greatest positive intensities of preference, lie close to $F_{xy}^{\max}$. The procedure we just described, is in fact the double balanced version of OSDL when applied to this specific problem (Lievens et al., in press). The computed distributions will be stochastically monotone w.r.t. each other, which guarantees that the median intensities of the stochastically dominated distributions cannot be greater than the median intensities of the dominating distributions (Lievens et al., in press). We propose to regard these monotone distributions as a necessary reflection of the group consensus on the relative order of the preferences (i.e. which preference is implied by the other one) or the social rank order. To provide an example, we return to the stochastically non-monotone distributions in Figure 6.5. In Figure 6.6 we show the stochastically monotone distributions that have been computed on the basis of the distributions in Figure 6.5. Observe that for the *pq* and *pr* distributions, the frequencies have changed only for the *"-vst*", *"-st"* and the *"+sm"* intensities. The distribution of *pr* now dominates that of *pq,* which should be the case according to the social rank order *pqr*. Because of this, we are now guaranteed that the use of the median as a social intensity of preference will respect the social rank order. For the OSDL output in this example, the social intensities of preferences for *pr* and *pq* have both become *"+mo"*, which is not in conflict with the social rank order.

6.6 Discussion of the OSDL output

To take a closer look at the effects of the inclusion of minority voices in the determination of the final intensities of preferences, we have examined the effect of inclusion or exclusion of the different minority groups on the final stochastically monotone distributions. For this purpose, we opt to give the median of the distribution for each pair of AIs, as single values can more easily be compared w.r.t. each other than distributions. It can easily be derived from Table 6.6 that the median values differ according to the inclusion or not of some of the minority respondents into the distribution (Table 6.6).

In the second column of Table 6.6 we can see the social intensities of preferences for the consensus rank order $h_2h_3h_4h_1$. The rank order shows that the stakeholders consider alternative h_4, corresponding to the biggest increase (that was taken into consideration during the group deliberation) in support for the recreational services rendered by Lar (see Table 6.2), to be the least preferable alternative. However, this does not mean they are adverse to the idea of any increase of recreational opportunity in Lar, as alternative h_2 turns out to be the social first choice. This gives a clear message to the policy makers in Lar that the stakeholders are willing to support recreational services in Lar only up to a certain extent, and not to the maximum extent formulated in the IM.

Table 6.6. Intensities of preferences for the different groups through OSDL

Recreation ($h_2h_3h_4h_1$)					
Preference	**Social intensity of preference**	**Only $h_2h_3h_4h_1$**	**All 31 except $h_4h_3h_2h_1$ (11)**	**All 31 except $h_1h_2h_3h_4$ (9)**	**All 31 except $h_2h_3h_4h_1$ (8)**
h_2h_1	Strong	Very strong	Strong	Strong	Moderate
h_2h_4	Moderate	Strong	Strong	Moderate	Small
h_3h_1	Strong	Strong	Small	Strong	Moderate
h_2h_3	Small	Moderate	Moderate	Small	Very small
h_3h_4	Small	Small	Small	Small	Very small
h_4h_1	Small	Small	Very small	Strong	Small

In some sense, these social intensities can also be used to determine a kind of "distance" between AIs, in order to refine the message given by the social rank order. Let us examine the social intensities for the Recreation criterion (**h**) according to all respondents. The intensities of h_2h_1 and h_3h_1 are both "*strong*", while the intensity of h_2h_4 is only "*moderate*". This further reinforces the message that the stakeholders are hesitant to fully support recreational facilities in Lar: the increase in satisfaction when going from *3* (h_4) to *5* (h_2), is less than the decrease in satisfaction when moving from *4* (h_3) to *8* (h_1). The most significant care must be taken then not when deciding whether to increase support or not, but rather when determining the extent of increased support. More dissatisfaction will occur when support is overly increased then when support is too little increased or even not at all.

Let us see what will happen if one does not take into account the minority groups' opinions, as CVM does, and just takes the intensities of preferences of the majority group. Column three of Table 6.6 shows the median intensity of preferences of solely those respondents who are in line with the social rank order ($h_2h_3h_4h_1$). As can be seen, the intensity of h_2h_1 has become stronger than before. Interestingly, the intensity of preference between alternatives h_2 and h_3 has also increased: the social intensity of h_2h_3 is now "*moderate*" instead of only "*small*". Therefore, in case of difficulties to reach h_2 and having to select h_3 as the best achievable policy, moderately strong opposition will come from those who subscribe to $h_2h_3h_4h_1$ as rank order (opposition will naturally also arise from everyone else who indicated h_2 as his most preferred AI). However, choosing h_3 instead of h_2 also lets the policy maker gain the support of those who indicated $h_3h_2h_4h_1$ as rank order (as well as everyone else who indicated h_3 as his most preferred alternative). This is why using the social intensity of preference according to all respondents, rather than only those who fully agreed with the social rank order, will give a clearer view on the overall gain or loss of support. A policy maker is therefore able to make more informed decisions on the basis of the social intensity according to all respondents: instead of only keeping protest responses in mind, and striving to minimise these, the policy maker is able to take the gain in support into consideration, allowing him to maximise the social support (as the net combination of support and protest).

For the Wildlife Diversity criterion (**d**) the social rank order $d_1d_2d_3d_4$ follows a natural order for maximum preservation of wildlife diversity to the current condition. Based on the social intensities of preferences in Table 6.7 one can see that decreasing the level of wildlife diversity from d_2 to d_3 in Lar will result in the maximum decrease (for any two alternatives that are next to each other in the social rank order) in social support: moving from d_1 to d_2 or from d_3 to d_4 will result in a small decrease in social support, while the move from d_2 to d_3 would result in a moderate decrease in social support. As such, one could theorise that the stakeholders want to increase the level of wildlife diversity to at least alternative d_2.

Table 6.7. Intensities of preferences for the different groups through OSDL

Wildlife Diversity ($d_1d_2d_3d_4$)			
Preference	**Social intensity of preference**	**Only $d_1d_2d_3d_4$**	**All 31 except $d_1d_2d_3d_4$ (18)**
d_1d_4	Strong	Very strong	Moderate
d_1d_3	Moderate	Strong	Small
d_2d_4	Moderate	Moderate	Small
d_1d_2	Small	Strong	Very small
d_2d_3	Moderate	Moderate	Small
d_3d_4	Small	Small	Small

Let us examine the loss of social support for a policy change from d_1 to d_3 or from d_2 to d_4, both of which imply the move from d_2 to d_3: both of these changes would result in a moderate decrease in social support. This again leads to the conclusion (keeping the intensities of d_1d_2, d_2d_3 and d_3d_4 in mind) that the most significant protests would occur for a wildlife diversity support of alternative d_3 or d_4. Therefore, most important to the stakeholders is whether or not a plan aims to guarantee an increase to at least d_2 as support for wildlife diversity, rather than whether or not it proposes d_1 (the most preferred social choice) or d_2. Table 6.7 additionally shows how taking into account only those who chose the $d_1d_2d_3d_4$ as a rank order, significantly changes the social intensities of preferences.

6.7 Conclusion

In this chapter we argued that people cannot realistically estimate the amount they are willing to pay to support environmental services because it is too far from their ability to construct a precise value towards environmental criteria (Kahneman and Knetsch, 1992; Kahneman et al., 1993; Diamond and Hausman, 1994; Diamond, 1996; Fischhoff et al., 1999; Kahneman et al., 1999; Liljas and Lindgren, 2001). Additionally the increased knowledge of people on environmental ethics has previously been reported to result in protest responses on the trade-offs among untraded environmental services and market products (Liljas, 2001; Smith, 2003; Tompkins, 2003; Vatn, 2004; O'Neill, 1993).

We demonstrated that using an ordinal format is not only useful to rank alternatives, but also that it allows for the elicitation of stakeholders' intensities of preferences in a way that is consistent with human experience (Diemer and McKean, 1978; Springael and De Keyser, 2004; Vatn, 2004a). Using a qualitative method allows stakeholders to express their attitudes and beliefs on AIs in a more natural and accurate way than using a monetary approach (Miller, 1955; De Keyser and Peeters, 1994, Brouwer et al., 1999; Chilton and Hutchinson, 1999). Moreover, we showed that even though it is possible to derive a social rank order, care must be taken to ensure that the distributions of intensities of preferences according to the entire group of respondents uphold the stochastic dominance relation. We used OSDL as it is able to calculate stochastically monotone distributions on the basis of possibly stochastically non-monotone distributions, and does not modify the distributions if they were already stochastically monotone. As illustrated, taking into account the minority opinions may change the intensities of preference of the social rank order. Furthermore, this allows policy makers to consider not just protest responses, but to easily take into account both protest and support voices in the decision making process. This will allow the final decision to not just attempt to minimise protests, but instead to attempt to maximise the combination of the support and the antagonistic protest voices. The rationale behind this approach is that the social voice will be the combination of both the support of those who agree, and the opposition of those who disagree.

We now have a method that allows determining social rank orders and social intensities of preferences for each criterion, the next challenge is to determine a rank order on the alternative plans. The next chapter will analyse how this can be done in a consistent way.

Chapter 7

Tractable group decisions based on social intensities of preferences

Abstract

Group decision aiding methodologies need to be tractable in order to be acceptable to the Decision Makers (DMs). As DMs can have differing opinions (expressed by intensities of preferences), any group decision aiding methodology will need to resolve conflicting preferences at some point. Additionally, it is difficult for policy makers to interpret a wide range of conflicting preferences. Conflict resolution can be performed in roughly three different ways: (1) on the input level, via a consensus reaching process, (2) implicitly during the decision making process, by outputting the best fitting group decision, and (3) on the output level, by outputting for each DM the best fitting decision, and resolving conflicts only then.

In this chapter, we argue that it will benefit the acceptability of the group decision and tractability of the methodology if conflict resolution is performed prior to the use of a decision aiding methodology, as it will allow for a more condensed presentation of the preferences. Furthermore, we will address a problem common to voting processes, where adhering to a majority voice often brings about the neglecting of minority voices. To this end, we propose a decision making method that computes the social intensities of preferences for each of the criteria to perform conflict resolution, and then supplies these social intensities of preferences to a conventional outranking method in order to construct a group decision. In this way, DMs are able to verify that their opinion is taken into account, even if it is contrary to the majority voice. Policy makers will benefit from an increased insight into the prevalent opinion on each of the criteria through the supplied social intensities of preferences, enabling a more easily communicated justification of the final decision, and an augmented tractability of the decision making process.

This chapter is submitted as:

Zendehdel, K., M. Rademaker, B. De Baets, and G. Van Huylenbroeck (submitted). Tractable group decisions based on social intensities of preferences. *Decision Support Systems*.

7.1 Introduction

Attempting to process a group of stakeholders' intensities of preferences on a set of environmental decisions, in order to determine a group decision, has always been a controversial subject (Sagoff, 1998; Proctor and Drechsler, 2003; Tompkins, 2003; Munda, 2004). Group decision aiding methodologies need to be consistent and tractable in order to be acceptable to the Decision Makers (DMs). As DMs can have differing opinions (expressed by intensities of preferences), any group decision aiding methodology will need to resolve conflicting preferences at some point. Additionally, it is difficult for policy makers to interpret a wide range of conflicting preferences. Conflict resolution can be performed in roughly three different ways: (1) on the input level, via a consensus reaching process, (2) implicitly during the decision making process, by outputting the best fitting group decision, and (3) on the output level, by outputting for each DM the best fitting decision, and resolving conflicts only then.

In presence of multiple Decision Makers (DMs), Group Decision Support Systems (GDSSs) are used to select a group (consensus) course of action from all possible decisions. Although GDSS methods are well accepted by policy makers, these methods might be too complicated to be used by DMs in full understanding (Proctor and Drechsler, 2003; Tompkins, 2003; Springael and De Keyser, 2004; Matsatsinis et al., 2005; Vatn, 2005). Furthermore, no attempt at conflict resolution is made, as the only result is the output that fits best to the opinions within the group. This lack of explicit conflict resolution can lead to DMs not accepting the decision however, as the decision making process is not tractable due to the simultaneous processing of multiple conflicting opinions. Consequently, a DM cannot see how his/her voice has been sufficiently taken into account. It will be also quite difficult for a DM to see how his/her voice might be contrary to the community voice, and thus is unable to be taken into account to the extent he/she would prefer. To avoid the difficulties inherent to GDSSs, valuation practitioners have proposed alternative approaches. In recent years, a combination of a Multi-Criteria Decision Aid (MCDA) and a voting system was proposed and applied in different fields (Lei and Youmin, 1996; Scott and Canter, 1997; Gregory and Wellman, 2001). The main idea is to use an MCDA for its ability to provide a rank order of alternative plans for each

single DM, and let a subsequent voting system provide a group (winner) decision and resolve conflicts. Often however, the voting systems are confronted with problem of manipulation and paradox (as it is explained in Chapter 6). Irrespective of the exact way in which these methods provide a group decision or resolve paradoxes, it is well understood that even though each DM can easily verify that his voice or vote is entered in the methodology, a voting process cannot provide a convincing output for all DMs. It is because following a majority's view is always authoritarian (Tompkins, 2003; Munda, 2004; Spash, 2007). Observe that the DMs' expressed intensities of preferences no longer play a role in establishment of the social view.

In order to construct the final decision on the basis of the stakeholders' intensities of preferences, as they also determine which specific rank order fits best, another type of valuation methods has to combine a deliberation session with an MCDA application. More precisely, these methods consist of two steps: in the first step, a deliberative forum helps policy makers to reach a consensus on the DMs' intensities of preferences on each single criterion; in the second step, the consensus decisions (one for each criterion) are processed by an MCDA to determine the group decision (Proctor and Drechsler, 2003; Munda, 2004). Even though the tractability will surely benefit from the use of consensus decisions, due to a reduced number of conflicting inputs, the need to reach a consensus through a deliberative session is rather problematic, as in the presence of multiple DMs with a diversity of interests, it can prove almost impossible to reach a reasonable consensus (Cookson, 2000; Tompkins, 2003). Moreover, the explicit focus on reaching a consensus can marginalize the group discussion and result in a biased consensus that is no longer representative of the DMs' attitudes (Cookson, 2000; Tompkins, 2003; Vatn, 2004a; Spash, 2007).

To alleviate the difficulties related to the described aggregation approaches, and provide a clear and acceptable conflict resolution, we propose a mathematical determination of the social intensities of preferences on each single criterion based on the notion of stochastic dominance (using the Ordinal Stochastic Dominance Learner, OSDL), and a subsequent processing of these social intensities of preferences by an outranking method (ARGUS), to select the group decision from a set of alternative decisions in a more tractable way. In

other words, the stakeholders' intensities of preferences on each single criterion are used to construct social intensities of preferences, processed by ARGUS (Achieving Respect for Grades by Using ordinal Scales only) (De Keyser and Peeters, 1994; Springael and De Keyser, 2004). In addition to intensities of preferences, stakeholders attach a weight to each of the different criteria. The median among these weights for each criterion is used as a social weight and also supplied to ARGUS. Due to the use of the social intensities of preferences and social weights, the number of intensities and weights that need to simultaneously processed, is reduced. Policy makers and DMs will then benefit from an increased tractability in the decision making process.

7.2 Aggregation operators and stakeholders' ordinal preferences

Stakeholders usually prefer to express their preferences using linguistic labels, and even more so when discussing daily life experiences (Cook and Kress, 1985; Liljas and Lindgren, 2001; Zendehdel et al., submitted). In contrast, aggregation operators have traditionally been defined in the numerical setting. Most of the numerical aggregation operations are based on the Weighted Mean (WM) or the Ordered Weighted Average (OWA) (Yager, 1988). However, in many applications, values to be aggregated are qualitative, or ordinal, rather than quantitative. It is common in such cases to map the qualitative values and weights into a numerical scale, and then perform the aggregation of those numerical values, possibly followed by an inverse transformation to return to the ordinal scale (Godo and Torra, 2000). Cardinalization of ordinal values is a controversial undertaking however, as it presupposes the validity of either a ratio or interval scale and the existence of an accurate way of quantifying distances between the ordinal values (De Keyser and Peeters, 1994; Godo and Torra, 2000; Vatn, 2004a). For these reasons, we will discuss only aggregation methods that can process ordinal information.

7.3 Decision making using ordinal intensities of preferences on environmental services

Natural ecosystems play an essential role in the regulation and maintenance of ecological processes and life support systems on earth (Daily, 1997). This fact increases social liability towards environmental conservation. The conservation of environmental services

needs a sustainable policy to ensure that these services will be available for the generations to come. Establishing sustainable policies requires social support, which needs to take into account the stakeholders' preferences. By incorporating stakeholders' preferences and their intensities into the environmental policy formulation, policy makers can ensure that their effort will more easily receive social support. In order to incorporate these intensities in an interpretable manner, a policy maker needs to narrow down the stakeholders' opinions into a social view (Jelassi et al., 1990; Gregory and Wellman, 2001; Proctor and Drechsler, 2003; Tompkins, 2003; Munda, 2004; Matsatsinis et al., 2005). In other words, the policy maker needs to utilize stakeholders' intensities of preferences and weights of criteria in order to determine a group decision. We now review some ways in which to do so, and propose a new methodology resolving some problematic aspects of the existing ones.

7.3.1 Applying GDSS to provide a group decision

Group Decision Support Systems (GDSSs) are among the most frequently used methods to process stakeholders' preferences on alternative decisions (Proctor and Drechsler, 2003; Tompkins, 2003; Springael and De Keyser, 2004; Matsatsinis et al., 2005; Vatn, 2005; Jelassi, 1990). GDSSs are built upon a mathematical framework and take into account stakeholders' intensities of preferences and weights of criteria jointly in order to provide a group decision or a rank order of alternative decisions, without needing to perform conflict resolution for the possibly diametrically opposed preferences of the DMs (Jelassi et al., 1990; Springael and De Keyser, 2004; Matsatsinis et al., 2005; Damart et al., 2007). This is shown in Figure 7.1.

Understanding and analyzing the GDSS process, and receiving social support for its outcome, is made more difficult by the complexity of the multifaceted environment, as well as the presence of multiple DMs, each of whom has his/her own perceptions of the way the problem should be handled and the decision be made (Jelassi et al., 1990; Matsatsinis et al., 2005).

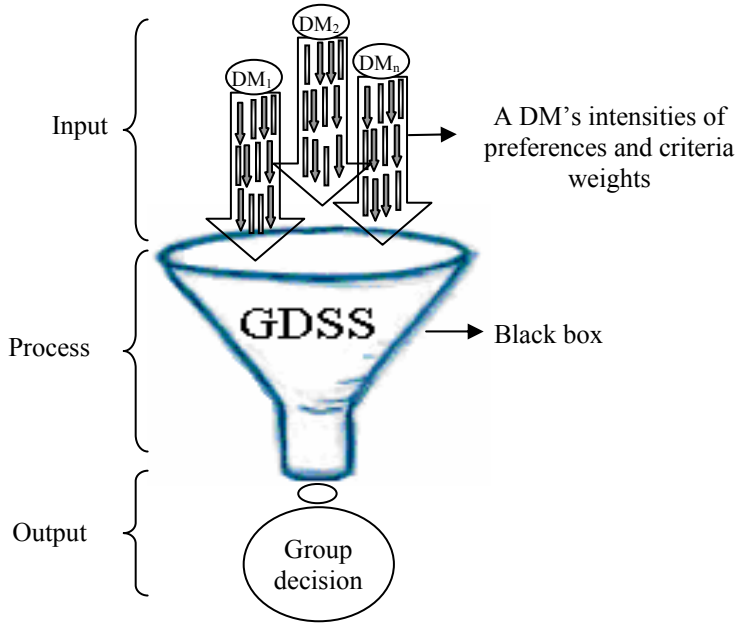


Figure 7.1. A GDSS procedure

Although applying a GDSS will certainly allow environmental valuation practitioners to come up with a group decision, the complexity of the procedure renders it intractable to the DMs: to understand the GDSS, DMs need a mathematical background; otherwise, the GDSS will amount to a black box system. Even if each DM fully understands the GDSS, the sheer number of simultaneously processed inputs still makes the process intractable: it is almost impossible for each DM to see how his voice is accurately incorporated by the GDSS without involving a conflict resolution scheme (Matsatsinis et al., 2005). This results in dissatisfaction of DMs and makes social support for the group decision less likely, which is problematic as it is a cornerstone of environmental sustainability.

7.3.2 Using a combination of MCDA and a voting system to provide a group decision

In view of the complexity of GDSSs, alternative approaches were proposed to construct the group decision. These new methods combine an MCDA with a voting system to provide a group (consensus) decision (Lei and Youmin, 1996; Gregory and Wellman, 2001). In these methods, each DM uses an MCDA (it is not always necessary for all DMs to use the same MCDA) to construct a rank order of alternative decisions. This procedure

is more comprehensible for DMs as each of them uses separately the MCDA (Figure 7.2). As it is seen in the figure, by applying the MCDA, DMs have the possibility to immediately see how their intensities of preferences and their weights of criteria translate into a rank order of alternatives, which in turn will be taken into account when determining the group decision.

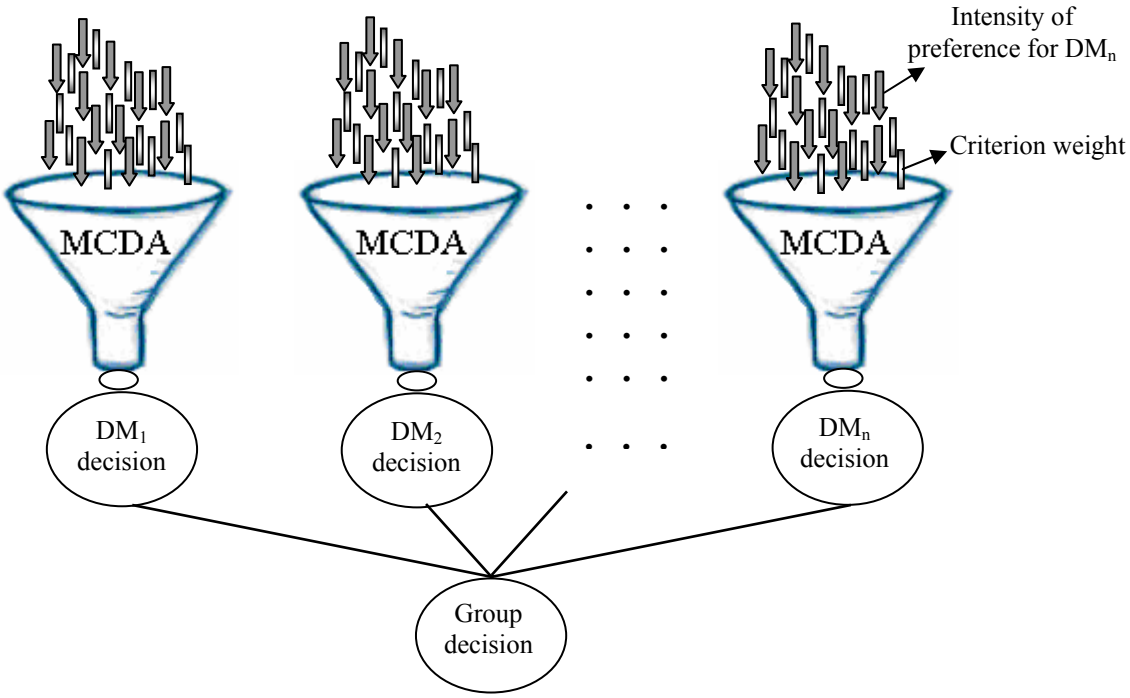


Figure 7.2. A combination of an MCDA and a voting system

These rank orders can be conflicting, and the final decision will be supplied through conflict resolution. Perhaps the most straightforward manner in which one can determine the group decision when supplied with a multitude of rank orders, is to use a majority rule to select a single rank order as the winner (Lei and Youmin, 1996; Nurmi, 1999; Laukkanen et al., 2002; Laukkanen et al., 2004; Eklund et al., 2007). As voting processes are well understood, the combination of an MCDA and a simple voting system can be considered tractable. However, when comparing several alternatives, voting processes are susceptible to paradoxical situations (Craven, 1992; Lei and Youmin, 1996; Nurmi, 1999; Kangas et al., 2006). A possible solution to this problem of finding a consensus ranking was already proposed by (Kendall and Smith, 1939) in an implicit manner through the use of the so-called Kendall's rank correlation coefficient. They propose to use the

median of Kendall's τ's (Kendall, 1938) as a measure for the (dis)agreement between the different decision makers. The agreement of each rank order (for each stakeholder) with the social rank order, as expressed by Kendall's τ, varies between +1 to -1, respectively representing full agreement and full disagreement. The social rank order proposed by this method is the one that has a maximum median value over all stakeholders' rank orders. Based on this procedure, it is assumed that at least 50% of DMs will have a sufficiently high level of agreement with the group rank order.

Nevertheless, there remains the problem that, irrespective of the voting method used, the group rank order is established based on the number of votes that are in favour of a plan, without taking the intensity of each vote into consideration. No voting procedure is able to consider stakeholders' intensities of preferences as a measure of agreement or disagreement (Tompkins, 2003; Munda, 2004; Vatn, 2004a). Related to this, Spash (2007) writes: "Voting is a means of aggregating individual preferences that are (by assumption) defined by ordinal rankings. Basically the most valued outcome is the highest ranked e.g. the option gaining the most votes in a first past the post system. How much more valuable the first outcome is relative to the second is not then judged."

The importance of this remark will be made clear by the following example: suppose that there are five DMs and two alternatives *a* and *b*. Three out of five DMs preferred *a* to *b* (written as *a*>*b* or, even more concise, *ab*) with a weak intensity, and two other DMs chose *ba* but indicated a very strong intensity of preference. In this case, looking to the number of rank orders will result in a consensus rank of *ab* (based on the voting assumption). But by looking to the intensities of the preferences one might theorize that making the three DMs slightly unhappy and the two DMs strongly happy is better than vice versa. Therefore, the consensus decision made by a policy maker might very well be *ba* rather than *ab*. However, what if we instead have only one DM very strongly preferring *ba*, and four weakly preferring the opposite? Or instead of the two DMs very strongly preferring *ba*, we have them preferring *ba* "merely" strongly? As we clearly cannot determine exactly when it becomes better to ignore the majority voice, it is not feasible to ignore it. The majority rule always has a lot of supporters (Craven, 1992; Nurmi, 1999; Moulin, 2003; Gaertner, 2006). This is why we propose to enrich the

majority vote with the intensity of preference supporting the majority: we indicate that the majority prefers *ab*, but only with a weak intensity of preference, thus providing more information and identifying potentially unsustainable decisions.

7.3.3 Combining a deliberative approach with an MCDA

The third approach we now describe is a combination of a deliberative approach and an MCDA: through a deliberative process, policy makers first reach a consensus on stakeholders' intensities of preferences and weights of criteria. Consequently, conflict resolution is the first step in this approach, and this will benefit the tractability due to a reduced number of conflicting preferences that are simultaneously taken into account. Then, these consensus values are used as input to the MCDA. Therefore, in this method the output of the MCDA is a group rank order rather than an individual rank order (Figure 7.3). The figure shows that the group deliberation provides DMs with an opportunity to discuss and deliberate on complex environmental issues. The aim of the deliberation is for the DMs to reach an agreement on the importance of each of the criteria that need to be considered, as well as on the preferred course of action for each of the criteria, and on the extent to which one course of action is preferred over another. Focusing on stakeholders' intensities of preferences (input) and weights of criteria as the reasons why the stakeholders agree or disagree with a course of action, helps the policy maker to communicate more effectively, and increases the social support for the output of the MCDA. In a complex issue, the deliberation will help stakeholders to understand the different aspects of the problem at hand and facilitate them with the consequences of the bounded rationality (Tompkins, 2003; Munda, 2004; Spash, 2007). Moreover, the possibility to refer to the social intensities of preferences as community voice will facilitate the acceptance of the entire process.

An example of this approach is given in Proctor and Drechsler (2003), for the problem of how to address and solve the complex issues of tourism management in the upper Goulburn Broken Catchment of Victoria, Australia. It is addressed using a deliberative process among a group of environmental experts aided by the PROMETHEE method (Brans et al., 1984; Brans and Vincke, 1985; van Huylenbroeck, 1995). A stakeholder

jury first helped the policy makers to establish the relevant criteria and alternative decisions. Then, they reached a consensus on the weight of each criterion and intensities of preferences through pairwise comparisons (Proctor and Drechsler, 2003).

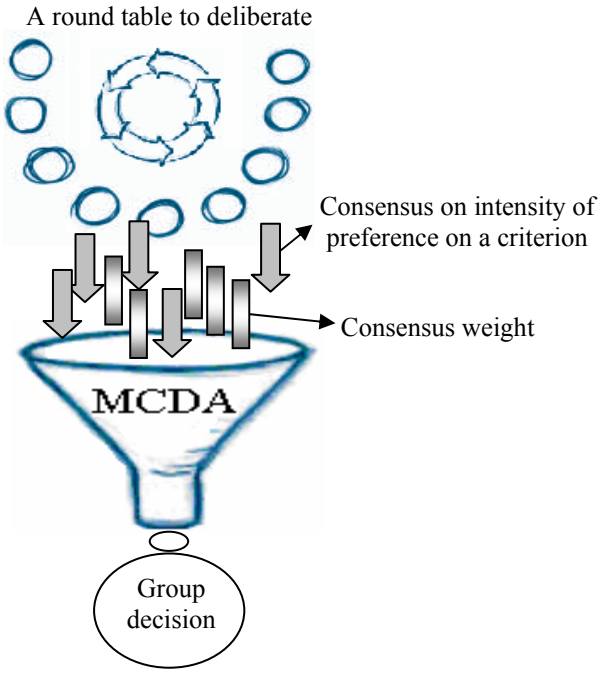


Figure7. 3. A Deliberative MCDA approach

Even though this methodology has the advantage of not using a voting system and resolves conflict almost immediately, there remains the problem that in environmental valuation studies, the policy maker is usually dealing with multiple DMs with very different perceptions and interests. Deliberative approaches are then often not able to narrow down the diversity of stakeholders' attitudes in a reasonable way, nor help them to resolve conflicts or reach a consensus on decisions (Proctor and Drechsler, 2003; Tompkins, 2003; Springael and De Keyser, 2004; Matsatsinis et al., 2005; Vatn, 2005). Furthermore, even if a consensus were reached through deliberation, it is not guaranteed to be representative of the group's opinions (Cookson, 2000; Springael and De Keyser, 2004). A deliberative procedure is additionally criticized because of the group dynamic that forces participants to act in a way that they do not like (De Keyser and Peeters, 1994; Cookson, 2000; Tompkins, 2003; Vatn, 2004a). As Cookson (2000) argues, a consensus

reaching process is too paternalistic and authoritarian, and fails to respect people's actual, unconsidered preferences. Therefore, group consensus on intensities of preferences reached through a deliberative approach, cannot always be assumed to be the most accurate input to an MCDA when the aim is to construct a social decision.

7.3.4 An integrated methodology - conceptual framework

Based on the pros and cons of the three previously explained methods, we strongly prefer the general idea of the third approach where conflicts are resolved as early as possible in order to benefit the tractability, but would like to formulate an alternative to the deliberative approach used to do so. We propose to mathematically compute social intensities of preferences and a weight for each single criterion, rather than using a deliberative approach, and to utilize the computed values as input to an outranking method such as ARGUS to determine the group decision.

This approach has two advantages over the existing aggregation methods. Firstly, although the mathematical determination of the social intensities of preferences increases the complexity of the methodology, the provision of social intensities of preferences on each single criterion will increase the acceptability and tractability. The social intensities will help DMs to understand the group opinion and prevalent voices on each single criterion, rather than letting them face a group decision over all criteria and stakeholders, which is difficult to interpret. Secondly, the method does not use a voting procedure 'that is open to criticisms' to construct a consensus rank order. Rather than merely following a majority vote, the method additionally utilizes stakeholders' intensities to determine the group decision. To illustrate the applicability of this approach we use the constructed social intensities of preferences in Chapter 6 to establish a group decision for the Lar rangeland. As we explained in Chapter 5, the existence of conflicting preferences among the groups for the different environmental services has resulted in failure of deliberative and negotiation-driven attempts to establish a sustainable management plan for the area. An important factor interfering with the deliberation is the presence of conflicts between groups, inciting stakeholders to act politically and express biased preferences. This is a strong obstacle for a consensus reaching process aiming to come up with a decision.

7.4 Weighting the environmental criteria in the Lar rangeland

In MCDA methods, a weight of a criterion can be expressed by cardinal values or ordinal values, or by a ranking according to importance, or by a relative weighting of all criteria (Proctor and Drechsler, 2003). Based on people's experience to use qualitative labels to attach weights to different objectives (Cook and Seiford, 1984; Liljas and Lindgren, 2001; Vatn, 2004a), we use qualitative labels to order environmental criteria. The qualitative labels are: *Unimportant (Uim) – Little important (Lim) – Moderately Important (Mim) – Very Important (Vim) – Extremely Important (Eim)*. The stakeholders used these labels to express how important each of the 12 environmental criteria is, according to their own view. These weights were elicited prior to the elicitation of the intensities of preferences. Figure 7.1 shows the distribution of the weights, with the criteria sorted according to decreasing median weight (from *Eim* on the left, to *Mim* on the right side of the figure). For example, the figure shows that for all three of the criteria Water Supply, Soil Conservation and Plant Diversity more than 50% of the stakeholders chose *Eim* as weight.

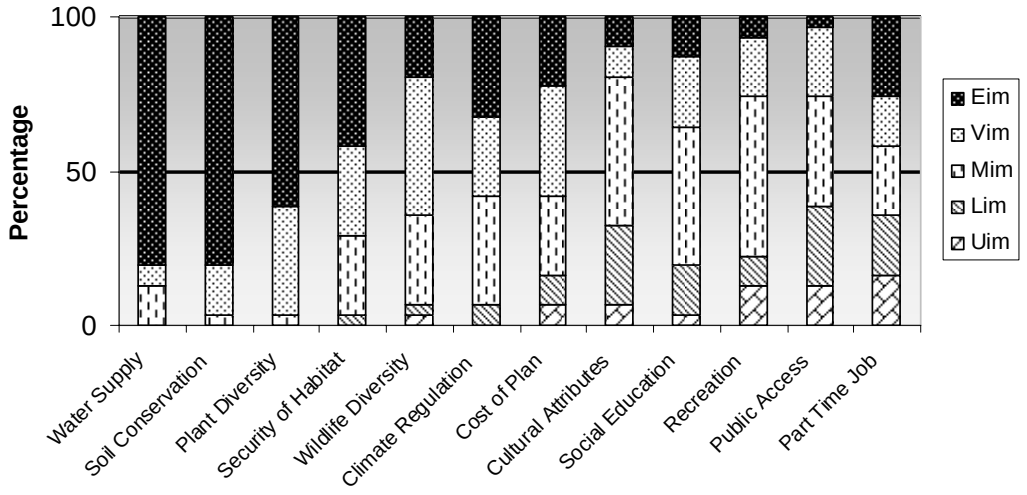


Figure.7.4 Distribution of the attcahed weights on ecah criterion

7.5 Aggregating stakeholders' intensities of preferences and weights of criteria

7.5.1 Social rank orders of alternative impacts

Before going to describe social intensities of preferences, once more we provide the impact matrix (Table 7.1). As one can see, based on the group discussions twelve environmental criteria are considered in the problem of the Lar rangeland, and four alternative plans, each represented as a different combination of impacts on these criteria, have been formulated as possible decision.

Plan **1**: Livestock control: reduction of livestock by 40% in the area, and introduction of new legislation to facilitate grazing license transactions.

Plan **2**: Rangeland rehabilitation: introduction of hand planting, seedling and a grazing system (no change in number of animals)**.**

Plan **3**: Watershed management: water harvesting through contour furrow, gabion and bio-mechanical treatment**.** Reduction of livestock by 20% in the area.

Plan **4**: Environmental preservation: changing the area to a national park without any ranchers and implementation of diversity of plans for ecotourism and wildlife diversity.

All criteria and alternative plans are presented in the Impact Matrix (IM) that has been formulated by a group of experts (Table 7.1). As before, we refer to values in IM as Alternative Impacts (AIs).
To attach a weight to each criterion and to elicit stakeholders' intensities of preferences during a pairwise comparison of two AIs for each single criterion, qualitative labels are used. We now describe both procedures in more detail.

Table 7.1. Impact Matrix of different alternative plans on environmental criteria in the Lar rangeland

	Ecological Criteria					Social Criteria				Economic Criteria		
Plan	**Climate Regulation**	**Soil Conservation**	**Plant Diversity**	**Wildlife Diversity**	**Security of Habitat**	**Cultural Attributes**	**Social Education**	**Recreation**	**Public Access**	**Part- Time Job**	**Water Supply**	**Cost of Plan**
	A	**b***	**c**	**d**	**e**	**f**	**g****	**h****	**i**	**j**	**k**	**l**
1	positive effect	5 tonnes per hectare per year	moderate increase in support	strong increase in support	strong increase in support	fully compatible	6	4	no effect	400 persons	10% increase	10000-20000 Euro
	a_1	b_2	c_3	d_1	e_1	f_1	g_2	h_3	i_3	j_1	k_3	l_1
2	No effect	7 tonnes per hectare per year	small increase in support	no support	no support	slightly compatible	3	5	small increase	600 persons	5% increase	30000-50000 Euro
	a_2	b_4	c_4	d_4	e_4	f_2	g_4	h_2	i_2	j_3	k_4	l_2
3	No effect	4 tonnes per hectare per year	strong increase in support	small increase in support	moderate increase in support	slightly compatible	5	3	small decrease	500 persons	20% increase	100000-200000 Euro
	a_2	b_1	c_2	d_3	e_2	f_2	g_3	h_4	i_4	j_2	k_1	l_3
4	positive effect	6 tonnes per hectare per year	very strong increase in support	moderate increase in support	small increase in support	incompatible	7	8	strong increase	1000 persons	15% increase	300000-500000 Euro
	a_1	b_3	c_1	d_2	e_3	f_3	g_1	h_1	i_1	j_4	k_2	l_4

* Soil conservation is expressed as the expected amount of soil lost due to erosion per hectare per year (tonnes per hectare per year), with the current situation being 7 tonnes lost per hectare per year

** The scores range from 0 to 10, where a score of 10 corresponds to availability of the service up to the maximal theoretically realisable capacity and a score of 0 corresponds to unavailability of the service

The core of the methodology is to use the notion of intensity of preference as an important measure of support or opposition for a DM towards the consensus decision. To this end, instead of using stakeholders' intensities of preferences to provide individual rank orders of alternative decisions (Section 7.3.2) and determining the social decision on the basis of these, we will use social (consensus) intensities of preferences to determine the social decision. The social intensities of preferences are constructed for each single criterion, on the basis of all stakeholders' intensities of preferences. This procedure enables policy makers to process the stakeholders' intensities of preferences without having to immediately transform them into rank orders of alternative decisions. To allow construction of social intensities of preferences on each single criterion, a Social Rank Order of Alternative Impacts (SROAI) on each criterion is first needed. Each SROAI is formulated based on the Condorcet criterion. In this regard, the SROAIs will be constructed based on a majority vote; otherwise one has to decide when exactly to disregard the majority opinion, an impossibility we also discussed in Section 7.3.2. By incorporating all stakeholders' intensities of preferences into the SROAIs, we significantly increase the information content of the majority rank order, by not ignoring the minority voices.

In the next step, we aim to extract a social intensity for each pair of AIs, on the basis of the collection (distribution) of intensities on each preference (Zendehdel et al., submitted). As there has been no consensus reaching step, we cannot expect stakeholders to have indicated the same rank orders, much less the same intensities of preferences. Consequently, these distributions can be quite wide, and we will need to do some pre-processing before extracting the social intensities of preferences. After all, just as each stakeholder needed to obey the monotonicity constraint when indicating his intensities of preferences, so do the distributions have to obey some constraints in order to be able to be compatible with the SROAI. More precisely, the distribution equivalent of the monotonicity constraint is called stochastic monotonicity (Lievens et al., in press). We will view the median of each distribution as the social intensity of preference. If distributions are not stochastically monotone w.r.t. each other, very well possible if the stakeholders expressed different rank orders, it is possible for the medians to be not

monotone w.r.t. each other as well, which would be in conflict with the supposed SROAI. To guarantee stochastically monotone distributions, the Ordinal Stochastic Dominance Learner (OSDL) algorithm is applied.

Table 7.2 shows the constructed SROAIs and their social intensities, which subscript 1 is the ecologically most desirable impact. For example, $b_1b_2b_3b_4$ indicates a SROAI for the second criterion (**b**, Soil Conservation), which the impacts are ranked from minimum amount of soil erosion (b_1) to its maximum (b_4). As some of the alternative plans were determined to have identical impacts on the first and sixth criterion (Table 7.1), they have just one and three social intensities of preferences in Table 7.2 respectively. The table only shows the positive preferences, with the negative ones being easily derived from them (the opposite preference holds a negative sign).

Table 7.2. The SROAIs, social intensities of preferences and social weights for the environmental criteria in the Lar rangeland

	Criteria	**Social rank order**													Median of weights based on all participants
1	Climate Regulation	a_1a_2	a_1b_1	*vst.*											*Vim*
2	Soil Conservation	$b_1b_2b_3b_4$	b_1b_4	*vst*	b_1b_3	*st*	b_2b_4	*st*	b_1b_2	*mo*	b_2b_3	*mo*	b_3b_4	*mo*	*Eim*
3	Plant Diversity	$c_1c_2c_3c_4$	c_1c_4	*vst*	c_1c_3	*st*	c_2c_4	*st*	c_1c_2	*mo*	c_2c_3	*mo*	c_3c_4	*mo*	*Eim*
4	Wildlife Diversity	$d_1d_2d_3d_4$	d_1d_4	*st*	d_1d_3	*mo*	d_2d_4	*mo*	d_1d_2	*sm*	d_2d_3	*mo*	d_3d_4	*sm*	*Vim*
5	Security of Habitat	$e_1e_2e_3e_4$	e_1e_4	*st*	e_1e_3	*st*	e_2e_4	*st*	e_1e_2	*mo*	e_2e_3	*mo*	e_3e_4	*mo*	*Vim*
6	Cultural Attributes	$f_1f_2f_3$	f_1f_3	*vst*	f_1f_2	*mo*	f_2f_3	*mo*							*Mim*
7	Social Education	$g_1g_2g_3g_4$	g_1g_4	*vst*	g_1g_3	*st*	g_2g_4	*st*	g_1g_2	*mo*	g_2g_3	*mo*	g_3g_4	*mo*	*Mim*
8	Recreation	$h_2h_3h_4h_1$	h_2h_1	*st*	h_2h_4	*mo*	h_3h_1	*st*	h_2h_3	*sm*	h_3h_4	*sm*	h_4h_1	*sm*	*Mim*
9	Public Access	$i_2i_3i_4i_1$	i_2i_1	*mo*	i_2i_4	*mo*	i_3i_1	*sm*	i_2i_3	*sm*	i_3i_4	*sm*	i_4i_1	*vsm*	*Mim*
10	Part Time Job	$j_2j_1j_3j_4$	j_2j_4	*mo*	j_2j_3	*sm*	j_1j_4	*mo*	j_2j_1	*vsm*	j_1j_3	*vsm*	j_3j_4	*sm*	*Mim*
11	Water Supply	$k_1k_2k_3k_4$	k_1k_4	*vst*	k_1k_3	*st*	k_2k_4	*st*	k_1k_2	*st*	k_2k_3	*mo*	k_3k_4	*mo*	*Eim*
12	Cost of Plan	$l_3l_2l_1l_4$	l_3l_4	*mo*	l_3l_1	*mo*	l_2l_4	*mo*	l_3l_2	*mo*	l_2l_1	*sm*	l_1l_4	*vsm*	*Vim*

7.5.2 Providing social weights of criteria

As the stakeholders used linguistic labels to attach a weight to a criterion, one can choose the median among the attached weights as a social weight for that criterion. The social weights are shown in the last column of Table 7.2 for all criteria. It is also possible to take the median from those whose rank order is identical to the SROAI on the given criterion. It might be reasonable to take into account only the weight of those stakeholders agreeing with the social rank order, as taking into account the weight of those stakeholders that do not agree with the social rank order, could result in protests: a decision they did not support, could receive a greater weight because of their input. On the other hand, it is very well possible that only few stakeholders or none of the stakeholders chose the SROAI, in which case the median of those agreeing with the rank order can hardly be considered to be representative for the entire group of stakeholders. For this reason we recommend using the first approach to establish social weights. Nevertheless, remarkably in our study, the social weights according to both everyone and to only the subset of those agreeing to the SROAI, were identical for all criteria.

7.6 Using ARGUS to determine the group decision based on social intensities of preferences and weights of criteria

The first voice views aggregation as an operator that transforms single-dimensional information on the alternatives (sets of relations or vectors of numbers) into a global preference (Bouyssou and Pirlot, 2005). It takes its inspiration from the tradition of social choice theory (Arrow, 1963). It characterises a number of mechanisms that can transform a certain type of input information related to the evaluation of the alternatives on several dimensions into a synthetic output, most of the time a relation (Bouyssou et al., 2005).

In our study, after providing social intensities of preferences and weights of criteria, one should choose a compatible MCDA with respect to the structure of data to be used to establish a group decision. Among different MCDA the outranking methods have some advantages to others (Kangas et al., 2001; Proctor and Drechsler, 2003; Cook, 2006; Munda, 2006). Outranking methods are able to deal with uncertain, qualitative and quantitative preferences of DMs (De Keyser and Peeters, 1994; Proctor and Drechsler, 2003). We opted to use ARGUS in this study, as it is an outranking method that can

handle ordinal and cardinal preferences without requiring the decision criteria to be commensurable (De Keyser and Peeters, 1994). The method uses concordance and discordance indices to determine a credibility matrix to establish a rank order relation on the alternatives. As ARGUS processes criteria without supposing commensurability, it does not necessarily output a complete rank order, i.e., some alternatives may become indifferent, while others remain incomparable (De Keyser and Peeters, 1994). A stakeholder needs only to enter, for each criterion, his/her weight and intensities of preferences. In our method, we will let ARGUS determine the group decision by entering the social weights and social intensities of preferences.

The ARGUS methodology combines intensities of preferences with the weight of the corresponding criterion to provide an indicator with a specific rank number and a positive or negative sign depending on the direction of preference. The indicators explain in an easy way certain aspects of ARGUS. The use of such a sign is not standard in the ARGUS (Table 7.3). The indicators constitute a totally ordered set, and indicators with lower rank numbers are the result of stronger intensities of preferences and/or higher weight than those with higher rank numbers. Each combination of intensities of preferences and weight corresponds to a specific indicator, though multiple combinations can yield the same one. For example, the indicator $+R_1$ is the result of an extremely important criterion with a "very strong" intensity of preference. The second indicator $+R_2$ is yielded by two different combinations of weight and intensity of preference: "Very strong" intensity of preference on a "very important" criterion and a "strong intensity" of preference on an "extremely important" criterion. The different combinations for the different positive indicators ($+R_1$, $+R_2$, …, $+R_n$) are the following:

$+R_1$. Very strong - Extremely important

$+R_2$. Very strong - Very important / Strong - Extremely important

$+R_3$. Very strong - Important / Strong - Very important / Moderate - Extremely important

$+R_4$. Very strong - Little important / Strong - Important / Moderate - Very important / Small - Extremely important

$+R_5$. Very strong - Unimportant / Strong - Little important /Moderate - Important / Small - Very important / Very small - Extremely important

$+R_6$. Strong - Unimportant / Moderate - Little important / Small - Moderately important / Very small - Very important

$+R_7$. Moderate - Unimportant / Small - Little important / Very small - Extremely important

$+R_8$. Small - Unimportant / Very small - Little important

$+R_9$. Very small - Unimportant

The decision maker can alter which combinations correspond to which indicators, if the default combinations do not match his/her personal view (De Keyser and Peeters, 1994). As we explained, combinations of an intensity of preference with a weight yield a set of indicators for each pair of alternative plans (Table 7.3). Combined positive intensities of preferences with weights are denoted with the positive symbols ($+R_1$, $+R_2$, …, $+R_n$), and the combined negative intensities of preferences (corresponding to the converse of the preferences which the DM indicated as his/her personal preferences, as discussed in Sections 6.4.2 in Chapter 6) with weights are denoted with the negative symbols ($-R_1$, $-R_2$, …, $-R_n$). Based on these negative and positive indicators for all criteria, one can establish a relation of outranking, indifference or incomparability between two alternative plans.

Table 7.3. Combining an intensity of preference with a weight

Intensity of preference	Unimportant	Little import	Moderately	Very important	Extremely
Positively very strong	$+R_5$	$+R_4$	$+R_3$	$+R_2$	$+R_1$
Positively strong	$+R_6$	$+R_5$	$+R_4$	$+R_3$	$+R_2$
Positively moderate	$+R_7$	$+R_6$	$+R_5$	$+R_4$	$+R_3$
Positively small	$+R_8$	$+R_7$	$+R_6$	$+R_5$	$+R_4$
Positively very small	$+R_9$	$+R_8$	$+R_7$	$+R_6$	$+R_5$
Indifferent	--	--	--	--	--
Negatively very small	$-R_9$	$-R_8$	$-R_7$	$-R_6$	$-R_5$
Negatively small	$-R_8$	$-R_7$	$-R_6$	$-R_5$	$-R_4$
Negatively moderate	$-R_7$	$-R_6$	$-R_5$	$-R_4$	$-R_3$
Negatively strong	$-R_6$	$-R_5$	$-R_4$	$-R_3$	$-R_2$
Negatively very strong	$-R_5$	$-R_4$	$-R_3$	$-R_2$	$-R_1$

We have outranking (indicated for two alternatives Plan **1 (**P_1**)** and Plan **2** (P_2) as P_1SP_2) between two alternative plans if, for each rank number, the number of positive indicators is greater than or equal to the number of negative indicators. In general, this outranking relation establishes a rank order relation on the alternative plans. We have indifference between P_1 and P_2 (denoted as P_1IP_2) if we have both P_1SP_2 and P_2SP_1 and, incomparability (denoted as P_1RP_2) if we have neither P_1SP_2 nor P_2SP_1.
The outcome of our case study, where we processed social intensities of preferences and weights of criteria to yield a group decision, was the following: P_1RP_3, P_1SP_4 and P_1SP_2, P_3SP_4 and P_3SP_2, P_4SP_2. As there is no indifference present, we have a partial order relation in our specific case. Based on this partial order relation, policy makers should choose between P_1 and P_3, and no longer need to take P_2 or P_4 into consideration.

7.7 Discussion on the output of ARGUS

The output of ARGUS is a rank order relation on the alternative plans, constructed on the social intensities of preferences and social weights. It enables the policy maker to select the plan that is the best fitting decision for the group, which he will have to communicate to the stakeholders. This will involve a justification of the decision, as not all stakeholders have to agree on the final decision. In order to render the decision acceptable to them, the policy maker should clearly describe how the collection of all stakeholders' inputs was correctly processed to yield the final decision. We will provide an example on the basis of our case study.

In our case study P_1 and P_3 are incomparable, both of them outrank plans P_2 and P_4, with P_4 outranking P_2 (Figure 7.5). The figure shows the graphical representation of the outranking relation in our case study. The direction of each arrow shows the outranking relation. Consequently, the policy maker still has to decide on either P_1 or P_3, taking care to justify the final decision, as there is no objective ground to presume one of the two decisions better reflects the social intensities and weights than the other. Furthermore, it is also important to explain the stakeholders why P_4 and P_2 are outranked by P_1 and P_3. To this end, policy makers can use the SROAIs and social intensities that have been computed based on all stakeholders' input, as presented in Table 7.2.

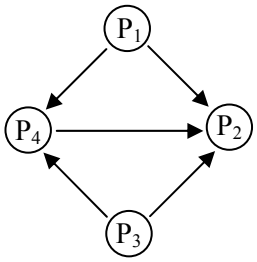


Figure 7.5. Graphical representation of our outranking relations

The SROAIs intuitively make it clear that P_2 and P_4 cannot be the best fitting group decision, as the least preferred plan according to each criterion separately, is in almost all cases one of these two. In fact, there are only two criteria (1 and 2) for which either P_1or P_3 is the least preferred plan (even though these criteria are respectively very important and extremely important). Consequently, the undesirability of P_2 and P_4 should be justifiable, and P_1 and P_3 will be the most desirable. Even though we do not expect the incomparability of P_1 and P_3 will be cause for much protests, we will explain it somewhat further, as it is a nice illustration of the role of intensities of preferences in a voting problem. Table 7.4 provides the stakeholders' social intensities for these two alternatives and the social weight of each criterion. Referring to Table 7.4, which contains the indicators for this pair of plans as computed by ARGUS for all criteria. On 7 out of the 12 criteria, P_1 is preferred to P_3, and on the remaining 5, the opposite holds. Simple voting would then suggest that P_1 should be preferred to P_3. However, we also have the social intensities of preferences, social weights and the resulting indicators. Examining these clearly shows that for most of the 7 criteria where P_1 is preferred to P_3, the combined intensities and weights are rather weak ($+R_4$ to $+R_6$), while for the remaining 5 we have several stronger intensities (including even a $+R_1$). In other words, somewhat informally regarding the criteria as voters, we have here a prime example of a voting problem where the minority has expressed stronger intensities than the majority. The policy maker should in such a case judge whether it makes sense to follow the majority or rather the strongest voice. The SROAIs and associated intensities will prove useful in that regard, as taking into account simultaneously the rank orders of AIs and intensities of all

stakeholders, is impossible for a policy maker. The SROAIs consequently greatly benefit the tractability of the process.

Table 7.4. Indicators for P_1P_3 for each criterion

P_1P_3			
Criterion	Social intensity of preference	Social importance	Indicator
Climate Regulation	*vst*	*Vim*	$+R_2$
Soil Conservation	*vst*	*Eim*	$-R_1$
Plant Diversity	*mo*	*Eim*	$-R_3$
Wild Life Diversity	*mo*	*Vim*	$+R_4$
Security of Habitat	*mo*	*Vim*	$+R_4$
Cultural Attributes	*mo*	*Im*	$+R_5$
Social Education	*mo*	*Im*	$+R_5$
Recreation	*sm*	*Im*	$+R_6$
Public Access	*sm*	*Im*	$+R_6$
Part Time Job	*vsm*	*Im*	$-R_7$
Water Supply	*st*	*Eim*	$-R_2$
Cost of Plan	*mo*	*Vim*	$-R_4$

7.8 Conclusion

Environmental sustainability requires sustainable policy making, which in turn requires the incorporation of the stakeholders' opinions into the decision making process, in order to render the final decision acceptable to them (Pearce, 1993; Pykäläinen et al., 1999; Proctor and Drechsler, 2003). Decision aiding methodologies need to be judged w.r.t. their consistency and transparency, key factors in meeting social support towards the group decision. In this regard, it is reasonable to pay special care to correctly process stakeholders' intensities of preferences, as they are related to the strength of their conviction to support or oppose a plan. In our methodology, these intensities are maintained in every step of the decision making process, so as to determine the group decision in a consistent way.

Because even the best understood methodology will no longer be tractable if the number of inputs is too large, we opted to input social intensities of preferences and social

weights into ARGUS, rather than each individual stakeholder's intensities of preferences and weights of criteria. Even though the calculation of the social intensities of preferences amounts to an increase in complexity of the application of the MCDA, we feel the methodology as a whole becomes more understandable and tractable as a result. The provision of social intensities of preferences and social weights helps both stakeholders and policy makers to see the diversity of opinions, as well as the overall social choice for each single criterion. Moreover, it is clear that the methodology does not take into account solely the majority's view, as more contested criteria will by construction receive lower social intensities of preferences in our conflict resolution using OSDL. We focus on the intensities of preferences as the reasons why one plan will meet with less opposition and more support than another one. This is in contrast with conventional group decision support systems, which mostly focus too much on the stakeholders' preferences and not enough on the corresponding intensities. Stakeholders will understand that decreased intensities of preference will lead to lower rank numbers in ARGUS, causing the corresponding criteria to play a smaller role in the determination of the final social decision. Minority groups will consequently be able to see and understand how their voices were taken into account in the social rank orders when performing the conflict resolution. All stakeholders will therefore more readily accept the group decision, which in turn improves the environmental sustainability. This is due in part to the fact that we opted to resolve conflicting preferences and corresponding intensities as soon as possible, rather than waiting until the very end, by resolving conflicting rank orders of alternatives. The SROAIs will also prove invaluable if ARGUS should output not a total rank order, but rather indicate some incomparability among plans. On the basis of the SROAIs and associated intensities, a policy maker can more easily understand how exactly the incomparability arises. More importantly, through the SROAIs, social intensities and social weights, the policy maker can determine the expected opposition or support to the choice of one incomparable plan over another.

The next chapter provides us with results of the study and general discussion based on previous chapters.

Chapter 8

Results and their interpretations

Abstract

Application of the methodology shows that there are four criteria out of the twelve on which the stakeholders have conflicts. Public Access, Recreation, Part Time Job and Cost of Plan are the criteria on which the Alternative Impacts (AIs) are very differently ranked by the stakeholders. It is exactly because we asked stakeholders to rank Alternative Impacts (AIs) rather than plans, we were able to avoid the most straightforward source of political voting, allowing us to see reveals that on most of the criteria, the stakeholders do not entirely support the impact of their own plan on the criteria. In other words, the stakeholders did not consider the impact of their plan on most of criteria as the best decision. This is a strong reason to advocate the use of AIs rather than plans to elicit stakeholders' preferences. Application of the methodology furthermore demonstrates that there is a correspondence between the distribution of the criteria weights and the intensities of preferences. Among all weight indicators only the distribution of *Uim* (Unimportant) shows an inconsistency compared to the other distributions. In other words, those stakeholders who indicated a weight *Uim,* expressed differently their intensities of preferences among pairs of AIs compared to the other stakeholders. Results also reveal that elimination of those stakeholders who used *Uim* as a weight or those who are not in line with the social rank order rarely changes a social rank order in our case study. It does change social intensities of preferences on most of criteria, however. In both cases, the social intensities of preferences become stronger due to less opposition. Based on our data set, changes in the social importances more strongly affect the output of ARGUS than changes in social intensities of preferences.

We are going to submit this chapter as an outcome of the proposed methodology to the Journal of Environmental Economics and Management (JEEM).

8.1 Introduction

Application of the methodology as described in previous Chapters 6 and 7 show that conflicting social groups are able to come to an agreement on a broader concept such as a list of environmental criteria and alternative plans even if they are unable to reach a consensus on social decision over several criteria (possibly from the very same list). When there are conflicts between Decision Makers (DMs) such as in our case study, it is hard to reach a consensus on social object. Subsequently, by involving stakeholders into the selection of decision criteria and alternatives, the policy maker more likely meets the social support. This will also increase acceptability and applicability of the decision. The core concept in our study is how a policy maker can reduce conflicts between multiple stakeholders. As a response to this question we introduced a discursive and multi-criteria method to provide a tractable process for both policy makers and DMs to reach a sustainable decision. We further used AIs to elicit the stakeholders' intensities of preferences on each single criterion to be sure that association of alternative plans with the social groups will not influence the stakeholders to act politically and express biased attitudes. It seems reasonable to expect stakeholders to support the usefulness of their proposal on each criterion, even if the link to the originating proposal is no longer explicit. However, in our case study the use of AIs reveals that on some criteria the stakeholders do not believe in their decision and do not support it. The rank orders of AIs on some criteria such as Part Time Job show that a large number of stakeholders did not consider their plan as the best decision. Moreover, the application of the methodology in Lar indicates that on most of the criteria the stakeholders have a strong agreement and only on some of the social and economic criteria they have conflicts. It should be mentioned that the stakeholders have almost no conflict on the ecological criteria. The presence of agreement among the stakeholders on the ecological criteria might be related to the group discussions or to the way that the method elicits the stakeholders' preferences. Consequently, this procedure will provide the policy maker with the ability to convince the stakeholders about the usefulness of the outcome even if it is not proposed by them.

One of the most important difficulties facing environmental valuation studies is stakeholders' protest responses (Kahneman and Knetsch, 1992; Diamond, 1996; Spash, 2001; Meyerhoff and Liebe, 2006; Marta-Pedroso et al., 2007). The protest responses and zero bids do always relate back to the complexity and the difficulty of valuation questions (Urama and Hodge, 2006) or stakeholders' lexicographic preferences (Spash, 2007). However, considering the simplicity and transparency of the preference elicitation steps in our methodology, the stakeholders easily understood the process and expressed their intensities of preferences on each criterion. In our methodology stakeholders do not need to consider environmental criteria commensurable and make trade-off between environmental criteria and market products to formulate their willingness to pay. Additionally, the ordinal character of the method was an important advantage for the stakeholders, as they were able to use their daily life experiences to proceed with the methodology. Because of this procedure, we did not face any protest responses or difficulties in the elicitation of stakeholders' preferences and their intensities.

The results show that there is a strong correspondence between the weight of a criterion and the intensities of preferences that a stakeholder expresses during the pairwise comparisons. To be more exact, in most cases when the stakeholders indicated a criterion extremely or very important, their intensities among the pairs of AIs are most often stronger than the intensities of preferences expressed by the stakeholders who indicated the criterion not very important. The exception to this tendency however, are those occasions where a stakeholder assigned *Uim* to a criterion: there is no tendency for the intensities of preferences for *Uim* criteria to be weaker than those for criteria with a higher weight. This will raise a question regarding the possibility of eliciting only one of these values instead of asking stakeholders to attach a weight to each criterion and express their intensities of preferences on the criterion.

It is important to know that the social intensities of preferences are sensitive to any change in the stakeholders' intensities of preferences. In other words, by excluding a minority group's intensities of preferences from the list of intensities on each criterion, social intensities of preferences are changed. This exclusion in turn will reduce the acceptability of the final decision as its hardship will be increased for the minority group.

However, this case study shows that if for any reason the social importance of criteria remains constant, changes in social intensities of preferences will mostly not change the output of ARGUS. In other words, as ARGUS calculates the final decision based on two elements, intensities of preferences and weights, changing one of these elements will not certainly affect the result.

8.2 The group discussion and its advantage and disadvantage

The group discussions were the only step during the application of our methodology where the stakeholders met and discussed with each other on the environmental criteria. Therefore, it was very important for us to apply this step in such a way that motivates the participants to be effectively involved into the study.

8.2.1 Number of stakeholders in each group and its effect on the final output

By accepting the necessity of a discursive method and deliberative democracy as an institution that enables stakeholders to construct their preferences towards environmental services, a participatory method was chosen. In order to do so, the stakeholder analysis provided us with six groups, represented by 31 stakeholders to be involved in the discussions. Each group of stakeholders has a unique number of participants and as we provided in Table 5.1 the numbers vary from three people to nine. A question comes up as the number of stakeholders neither is identical across the groups nor do the social groups have equal power in decision making. How can one be sure that the stakeholders and their corresponding groups have a fair opportunity to explain their idea? Clearly, each participatory method (such as citizen jury, mediation, advisory committee, citizen pool and referendum) has its own way to select the participants. Our methodology is much like mediation where participants are directly selected based on their involvement into the problem. Therefore, we did not have a random selection of stakeholders. This procedure guarantees that the participants are sufficiently motivated and informed to be involved in the discussion. This is a trade-off between having an equal number of stakeholders in each group based on a random sampling or selecting those who have more incentive to participate in the group discussion. It is difficult to have different

groups of stakeholders that are identical on their number, negotiation power and cognitive capacity. In our case study however, neglecting to reach a consensus through the group discussion and focusing on deliberation as a tool to eliminate the bounded rationality reduce the importance of the number of stakeholders in each group. In other words, based on the stakeholder analysis we understood that the group's political power is very important in decision making even when the number of stakeholders is limited. For example, the Environmental Organization mostly manages biodiversity in the area, however, they influence all other organizations and groups based on their institutions.

As explained in previous chapters, the stakeholders should discuss on importance of a criterion in Lar and try to convince other stakeholders to pay attention to the criterion. In this regard, we did not ask the group to vote or to reach a compromise on the usefulness of each plan. The only difficulty that could influence the group discussion based on the diversity of number of participants was larger groups have more negotiation power than smaller ones. In this case the former have a better chance to convince the latter. It should be mentioned that the concept of equality among a group of participants (even when the number of participants between the groups are equal) is a difficult concept. This problem can be reduced by a trained moderator or facilitator, which we used during our group discussion.

8.2.2 Limitation of the stakeholders to act politically to express biased preferences

One of the most important difficulties facing discursive methodologies is the problem of group polarization (Brouwer et al., 1999; Cookson, 2000; Tompkins, 2003; Springael and De Keyser, 2004). Group polarization happens when stakeholders are under influence of a participant or a group of participants who may misleadingly change the group's attitudes. In this condition, the outcome of the group discussion is not truly representative of the stakeholders' attitudes and in turn the outcome will not receive social support. It is also possible that a group of participants, due to some internal conflicts or hierarchical relationship, expresses biased preferences (Cookson, 2000). In our study, as explained, the group had already conflicts on the application of any common plan and we knew that talking about any plan from any group could motivate the participants to act politically

and express biased attitudes. In this regard, we removed the name of alternative plans from the impact matrix. To show the usefulness of the methodology in eliciting unbiased preferences and eliminate the stakeholders to act politically, we take two criteria from our list of criteria as examples. Tables 8.1 and 8.2 present the alternative plans, their impacts and social rank orders on Wildlife Diversity and Part Time Job criteria respectively. We used the same procedure as cited in Chapter 6 to establish a social rank order on each criterion based on all stakeholders (31 stakeholders). The Condorcet criterion is used to establish a group rank order for each group of the stakeholders based on their individual rank order on each criterion (Appendix 1). As one can see, on the Wildlife Diversity criterion, no group selected its own proposed plan and the selected Alternative Impact (AI). The selected AI for each group is presented in bold font style in Tables 8.1 and 8.2. For example, in Table 8.1 as seen the Nomad's proposed plan is (Plan **2**) (originated from Table 5.5 in Chapter 5). One expects that the Nomad group rank order (the group rank order is established based on the Condorcet criterion) should present the impact of its plan (d_4) as the best decision on the criterion. However, as one can see, the Nomad's group rank order on the Wildlife Diversity criterion is $d_2d_1d_3d_4$. In other words, the group rank order indicates the impact of its plan in the fourth place. Moreover, the group rank order also indicates that d_2 (proposed by the NGO and the environmental group) on this criterion turns out to be the best impact. On the Part Time Job criterion (Table 8.2), the Nomad group is the only group whose group rank order is consistent with its proposed plan. The rest of the groups show their proposed impact as second, third or even fourth in the order of desirability (Table 8.2). This can easily demonstrate that the methodology is able to elicit the factual preferences and eliminate the stakeholders to express biased preferences due to the procedure. However, it might be questioned that the groups did not rank their plans and they ranked the AIs on each criterion. Therefore, how can one conclude this result? It is rational that people judge about any policy based on its effects on decision criteria. Therefore, eliminating association of plan and its effects should not change the people's attitudes. However, if it does, it can be supposed that two plans with the same effect can be ranked differently. This however, does not seem rational. Therefore, we suppose that our conclusion might be right.

Table 8.1. The group rank order on the Wildlife Diversity criterion

Plan	Impact of each plan on the criterion	Name of group and its selected impact	Group's rank order	Social rank order of AIs
1	Strong increase in support (d_1)	Nomad (***d*****4**)	$d_2d_1d_3\boldsymbol{d_4}$	$d_1d_2d_3d_4$
2*	No increase in support (d_4)	Environment (***d*****2**)	$d_1\boldsymbol{d_2}d_3d_4$	
3	Small increase in support (d_3)	Natural Resources (***d*****1**)	$d_2d_3\boldsymbol{d_1}d_4$	
4*	Moderate increase in support (d_2)	NGO (***d*****2**)	$d_1\boldsymbol{d_2}d_3d_4$	
--	--	Ranchers (***d*****4**)	$d_2d_3\boldsymbol{d_4}d_1$	
--	--	Watershed (***d*****3**)	$d_1d_2\boldsymbol{d_3}d_4$	

***** Plan **2** and Plan **4** are proposed by two groups

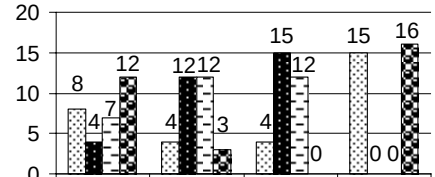
Table 8.2. The group's rank orders on the Part Time Job criterion

Plan	Impact of each plan on the criterion	Name of group and its selected impact	Group's rank order	Social rank order of AIs
1	400 persons (j_1)	Nomad (***j*****3**)	$\boldsymbol{j_3}j_4j_2j_1$	$j_2j_1j_3j_4$
2	600 persons (j_3)	Environment (***j*****4**)	$j_1j_2j_3\boldsymbol{j_4}$	
3	500 persons (j_2)	Natural Resources (***j*****1**)	$j_4j_3j_2\boldsymbol{j_1}$	
4	1000 persons (j_4)	NGO (***j*****4**)	$j_1j_2j_3\boldsymbol{j_4}$	
--	--	Ranchers (***j*****3**)	$j_4j_2\boldsymbol{j_3}j_1$	
--	--	Watershed (***j*****2**)	$j_1\boldsymbol{j_2}j_3j_4$	

8.3 Which criteria are a source of conflict between the stakeholders?

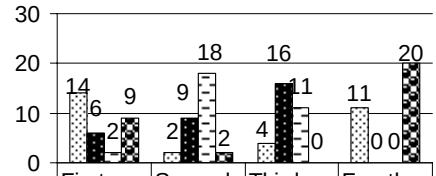
Evidence shows that during the last decades the social groups in Lar have never reached a consensus on the usefulness of a unique decision to manage the area. Presence of conflicting interests among the groups has hindered them to dig deeper into other group's values and interests to see what are the causes of the conflicts, which make them reluctant towards any compromise. In other words, the policy making process was always a black box for the stakeholders and due to lack of transparency, the final decision have met with

almost no social support. The result of our study however, does not reveal such opposition among the groups. The preference elicitation step shows that the stakeholders not only do not have that much conflicting interest as they believe in, but also that they nearly have strong agreement on most of the criteria. Regarding the stakeholders' rank orders of AIs, 5 out of the 12 environmental criteria (Climate Regulation, Soil Conservation, Plant Diversity, Cultural Attributes and Water Supply) show a 100% agreement between the six groups. The next three criteria, Social Education, Security of Habitat and Wildlife Diversity, show 87%, 80% and 58% agreement between the groups on the rank orders of AIs respectively. The stakeholders ranked only the AIs on Recreation, Public Access, Part Time Job and Cost of Plan criteria differently and no consensus appears among the stakeholders on these criteria. Figures 8.1 to 8.4 show the distribution of rank orders on these four criteria.



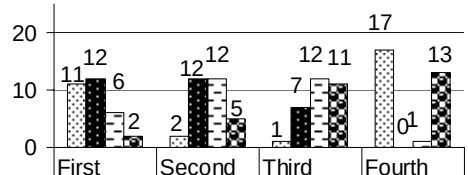
	First order	Second order	Third order	Fourth order
l1	8	4	4	15
l2	4	12	15	0
l3	7	12	12	0
l4	12	3	0	16

Figure 8.1. Stakeholders' rank orders of AIs for the Cost of Plan criterion



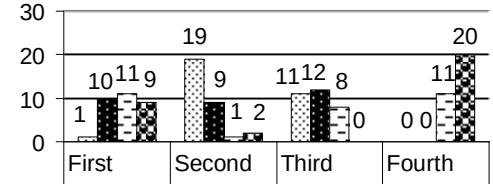
	First order	Second order	Third order	Fourth order
j1	14	2	4	11
j2	6	9	16	0
j3	2	18	11	0
j4	9	2	0	20

Figure 8.2. Stakeholders' rank orders of AIs for the Part Time Job criterion



	First order	Second order	Third order	Fourth order
i1	11	2	1	17
i2	12	12	7	0
i3	6	12	12	1
i4	2	5	11	13

Figure 8.3. Stakeholders' rank orders of AIs for the Public Access critrion



	First order	Second order	Third order	Fourth order
h1	1	19	11	0
h2	10	9	12	0
h3	11	1	8	11
h4	9	2	0	20

Figure 8.4. Stakeholders' rank orders of AIs for the Recreation criterion

As described, for all four criteria the stakeholders have different rank orders. For example in Figure 8.1 one can see that 8, 4, 7 and 12 stakeholders select l_1, l_2, l_3 and l_4 as most preferred alternative respectively. However, moving from the first order to the fourth order in all figures (from the left side of each figure to the right side) the agreement on AIs becomes stronger. In other words, the diversity of alternatives in the first order is larger than in the fourth order. There is a majority for the fourth order on all four criteria. As it is seen in the figures the majority of the stakeholders believe that Plan **4 (**P_4**)** (corresponding to h_4, i_4, j_4 and l_4) is the worst plan. The strongest majority exists for the Recreation and Part Time Job criteria where 65% of the stakeholders choose alternative P_4 on both criteria as their worst plan. Therefore, based on the stakeholders' rank orders the main conflicts are between alternatives P_1, P_2 and P_3 on these four criteria. However, it should be mentioned that the intensities of preferences will reduce or increase the strength of differences between the rank orders. As an example, suppose that a stakeholder indicates *abcd* as a rank order four alternatives and another person chooses *dcba* as his rank order. As it is seen, the orders are completely opposite. However, if both persons express weak intensities among the pairs of alternatives on each rank order, these two rank orders will be much closer than when they express strong intensities of preferences between the pairs. However, it should be mentioned that intensity of preference (weak or strong) cannot change in any way the existing order among pairs of alternatives.

8.4 Differences among the groups on the importance of the criteria

As explained in Chapter 7, the stakeholders use five qualitative labels to attach weights to the criteria. Figure 8.5 shows the median weight for each group of stakeholders on all criteria. The medians in the figure are arranged based on the diversity of weights. In other words, from left to right the diversity of weights is increased. As one can see, all stakeholders attached the same weight to the Soil Conservation and the Water Supply criteria, which is *Eim* (Extremely important). It is reasonable that the stakeholders considered Water Supply as an extremely important criterion. As we explained before, around 20% of Tehran residents' drinking water provides by the Lar watershed, which in turn makes this criterion very critical for all groups. Based on interdependency of soil

conservation and quality and quantity of water, soil erosion is also an extremely important criterion. However, the median weights on the other criteria are different. As shown, the last four criteria, Climate Regulation, Security of Habitat, Social Education and Part Time Job received a diversity of weights respectively.

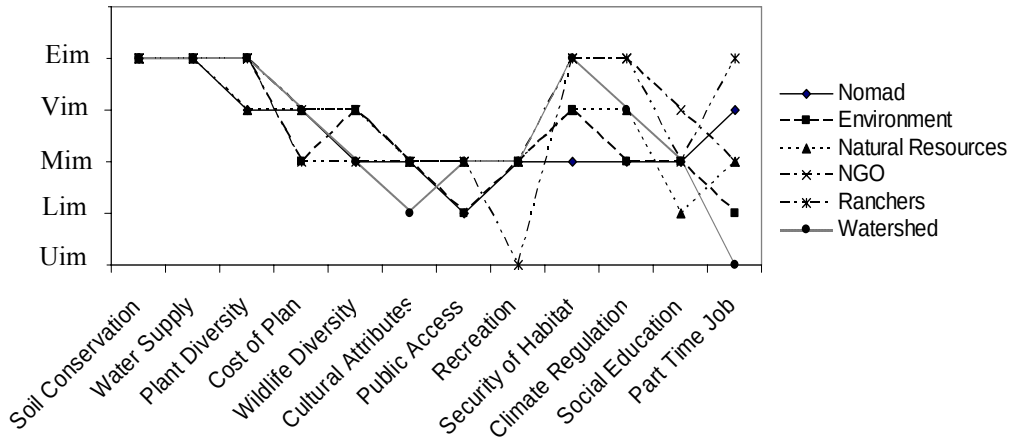


Figure 8.5. Arrangement of the median weights for each group from most to least important criteria in Lar

It should be mentioned that that there is a correspondence between the group weights and the group rank order of AIs on some criteria. For example, based on Figure 8.5, the median weights for the Part Time Job criterion are extremely diverse. The same holds for group rank orders on this criterion (Table 8.2). The table shows that the group rank orders are completely opposite w.r.t. each other on the Part Time Job criterion. The Natural Resources department and Ranchers chose an impact of 1000 persons (j_4) as their best decision on this criterion, which is the maximum number of job opportunities among the AIs. The three other group rank orders show that the Environmental, Watershed department and the NGO are in favour of 400 job opportunities as a best decision on this criterion. The group rank order for the Nomad indicates that 600 jobs opportunities is the best decision. Therefore, the group rank orders show diversity of views on this criterion.

The median weights show three different levels for the importance of the criteria in Lar (Figure 8.6). The first level shows three criteria, Soil Erosion, Water Supply and Plant Diversity (in the left side of the figure), of which their median are Extremely important

(*Eim*). The second level shows four criteria, Security of Habitat, Climate Regulation, Cost of Plan and Wildlife Diversity. The median weight for these criteria is Very important (*Vim*). The median weight of the third group of criteria including, Social Education, Part Time Job, Cultural Attributes, Public Access and Recreation is Moderately important (*Mim*). One can generally conclude that the median weights of ecological criteria are higher than the two other groups of criteria, economic and social. Additionally, the social crietria almost received the minimum weight compared to the other criteria.

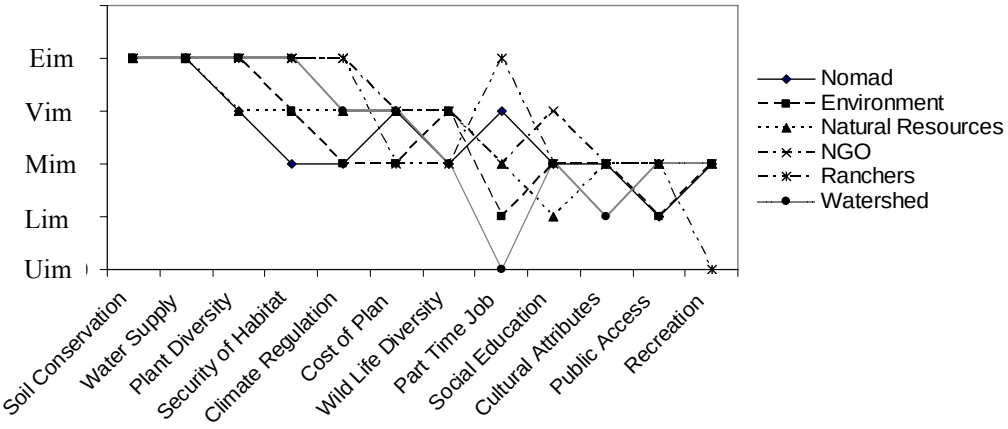


Figure 8.6. Arrangement of the median weights for each group from most to least important criteria in Lar

8.5 Differences between the social rank orders and stakeholders' rank orders on each criterion

In Chapter 6 it is explained that the social rank orders of AIs are constructed based on the Condorcet criterion. We further described why it is necessary to obey the majority voice to establish a social rank order. Figure 8.7 shows the percentage of stakeholders who are in line with the social rank order on each criterion. As seen the percentage of having a similar rank order with the social rank order decreases from left to right in the figure (from 100% to 6%). On the contrary, number of rank orders that are not the same as the social rank order on each criterion is increased from 0% in the left side of the figure to 94% in the right side of the figure for the Part Time Job criterion. As shown, on the 5 criteria of Climate Regulation, Soil Erosion, Plant Diversity, Cultural Attributes, Water

Supply, the stakeholders expressed identical rank orders. On Social Education, Security of Habitat and Wildlife Diversity criteria, the social rank orders are also identical with existing majorities of rank orders, but with less support. However, on the rest of the criteria the social rank order is only revealed by a small percentage of identical rank orders among existing rank orders. Of course based on the Condorcet criterion the social rank order (the winner) has the maximum support due to stakeholders' votes, but the number of people who choose exactly the same rank order as the social rank order on these criteria is low.

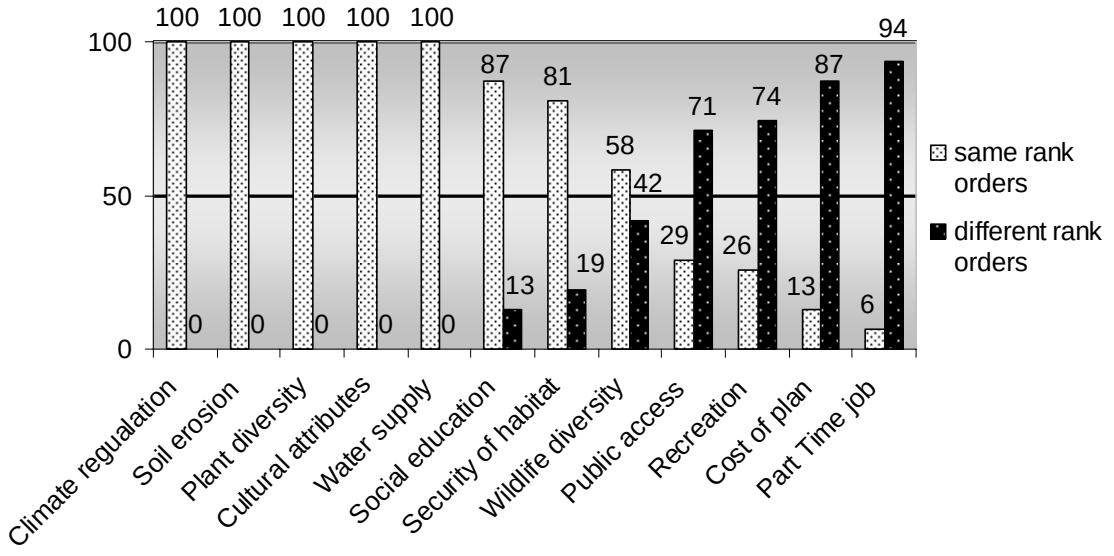


Figure 8.7. Percentage of the stakeholders who have the same rank order with the social rank order on each criterion

We should stress that the number of people who are in line with the social rank order on each criterion cannot be an indicator of support towards the social rank orders. For example, on the Part Time Job criterion two people have the same rank order as the social rank order. However, this does not mean that the social rank order has 29 opponents. It is clear that there is a diversity of rank orders on each criterion and in absence of a paradoxical condition, the social rank order has more support than the others. Moreover, as we explained in Chapter 7, the intensities of preferences can change the strength of support or opposition between the rank orders. To find out how close the stakeholders' rank orders are to the social rank order on the criteria, we propose to calculate the

Kendall's rank correlation coefficient between each rank order and the social rank order. In this regard, we take three criteria, Part Time Job, Cost of Plan and Public Access, of which the social rank orders have a few identical rank orders between all rank orders. Table 8.3 shows the correlation coefficients the on the Part Time Job criterion. As one can see the social rank order is $j_2j_1j_3j_4$ and only 6% (two people) ranked the alternatives the same as the social rank order (Appendix 1). The other stakeholders have different rank orders compared to the social rank order. As explained in Chapter 7, Kendall's rank correlation coefficient varies from −1 (100% disagreement) to +1 (100% agreement) between two rank orders. The table shows that none of stakeholders has an opposite rank order with the social rank order. In other words, Kendall's rank correlation coefficient for any of stakeholders is −1. The table shows that the Kndall's rank correlation coefficients of 11 stakeholders are negative and they are not in favour of the social rank order. Nine out of 31 stakeholders chose $j_4j_3j_2j_1$ as their rank order that its Kendall's rank correlation coefficient is −0.67. The Kendalls' rank correlation coefficient of two other people also is negative (−0.33). The table further shows that the number of people who support the social rank order is more than the other group. It is interesting that the Kendall's coefficients for two group of supporter and opposition are identical and just their sign is different. It shows that although social rank order receives the majority of votes, it is not that much strong and any small changes in votes or number of participants can change the social rank order. It should be mentioned that although 14 stakeholders choose $j_1j_2j_3j_4$ as their rank order, it is not considered as a social rank order on this criterion. In other words, this rank order has more opponents compared to its proponents between the stakeholders.

Table 8.3. Kendall's rank correlation coefficients between social rank order and the stakeholders' rank orders on Part Time Job criterion

Social rank order	Frequency	Existing rank orders	Kendall's rank correlation coefficient
$j_2j_1j_3j_4$	14	$j_1j_2j_3j_4$	+0.67
	9	$j_4j_3j_2j_1$	−0.67
	4	$j_3j_2j_1j_4$	+0.33
	2	$j_2j_1j_3j_4$	+1.00
	2	$j_3j_4j_2j_1$	−0.33

The Cost of Plan criterion is the other criterion that we chose to discuss. Figure 8.7 shows that on the Cost of Plan criterion 13% of the stakeholders (four people) have the same rank order as the social rank order. Table 8.4 indicates that the majority of people are indifferent to the social rank order. In other words, the rank orders of 20 people show zero correlation with the social rank order. Nevertheless, the social rank order has the support of 11 people whose rank orders show positive correlations.

Table 8.4. Kendall's rank correlation coefficients between the social rank order and the stakeholders' rank orders on the Cost of Plan criterion

Social rank order	Frequency	Existing rank orders	Kendall's rank correlation coefficient
$l_3l_2l_1l_4$	12	$l_4l_3l_2l_1$	0.0
	8	$l_1l_2l_3l_4$	0.0
	4	$l_2l_1l_3l_4$	+0.33
	4	$l_3l_2l_1l_4$	+1.00
	3	$l_3l_4l_2l_1$	+0.33

The social rank order on the Public Access criterion receives a greater support through the stakeholders' rank order than the two former criteria (Table 8.5). As one can see 26% (9 people out of the 31) have the same rank order as the social rank order (Figure 8.7). As shown in the table, most of the group support the social rank order and it has no opponent.

Table 8.5. Kendall's rank correlation coefficients between the social rank order and the stakeholders' rank orders on the Public Access criterion

Social rank order	Frequency	Existing rank orders	Kendall's rank correlation coefficient
$i_2i_3i_4i_1$	12	$i_1i_2i_3i_4$	0.00
	9	$i_2i_3i_4i_1$	+1.00
	5	$i_3i_4i_2i_1$	+0.33
	1	$i_3i_2i_4i_1$	+0.67
	1	$i_2i_3i_1i_4$	+0.67
	1	$i_4i_3i_2i_1$	0.00
	1	$i_2i_1i_3i_4$	+0.33
	1	$i_2i_1\ i_4i_3$	0.00

Therefore, we can conclude that the number of people who are in line with the social rank order is a poor indicator for understanding the level of convergence among groups. Moreover, a social rank order does not need to have some identical rank order(s) among all rank orders. As known, a social rank order is constructed based on a pairwise comparison among pairs of alternatives. This can simply lead to a new rank order among existing rank orders as a social rank order. In this regard, the aggregated weight on each criterion is not based on those who were in line with the social rank order. As one can see, this could lead to a problem where the social rank order has a few identical rank orders or it has no similar rank order among the rank orders. In this regard, we took a median among all stakeholders' to establish a social weight of criterion.

In our study the stakeholders are asked to provide a complete rank order of AIs on each single criterion. However, it is possible that two AIs turn out to be indifferent for a stakeholder. In this regard, we are dealing with a weak order relation that holds indifference between two alternatives. Therefore, a question comes up that why the stakeholders should make a complete rank order to express their preferences. The next section will provide a response to this question.

8.6 Why the stakeholders are asked to construct a strong rank order of AIs on each single criterion?

A criticism to our methodology is that each DM should rank AIs strictly for each single criterion. In other words, a DM cannot indicate ties among AIs on a criterion. Of course it is possible that different courses of action are regarded identical on a specific criterion. However, we already explained that presence of conflicts between the social groups in Lar has resulted in the lack of ability to establish an applicable decision to manage the Lar environmental services. In this regard, the first priority for us was to eliminate the groups to act politically and express biased preferences with the aim of changing the result for their own benefit. As we described, the name of plans are eliminated from the impact matrix as a first policy against political action. However, the stakeholders could still behave politically during the preference elicitation step. In other words, the stakeholders could prefer indifference relation among the AIs to create ambiguity for

policy makers in the establishment of the final decision. Moreover, by eliminating the name of the plans form the IM, stakeholders are motivated to use indifference as a preference among AIs because of lack of awareness about corresponding plans. It could also be due to the inhibition to support other groups who differ in opinion. Therefore, we decided to ask stakeholders to make a strong rank order rather than a weak one. It should be mentioned that this difficulty can be solved by using an indifference indicator as an intensity of preference. Suppose that one constructs *ab* as his preference. He can indicate indifference as an intensity of *ab*, which means that he has no preference among *a* and *b*. In other words, *a* and *b* are identical. However, this argument seems to be at odds with the first preference relation that was *ab*. It is rational when one indicates *a* over *b*, he should has an intensity among *a* and *b*. This difficulty is solved by providing an indicator "very small preference" (*vsm*) as a closest indicator to indifference to enable the stakeholders to show their wishes among pairs of AIs.

We discussed the diversity in the stakeholders' rank orders w.r.t. each criterion. We also discussed the weight that the stakeholders attached to each criterion. As we explained after the construction of the rank order of AIs, the stakeholders used qualitative labels to express their intensity among each pair of AIs for the constructed rank order. A question may come up regarding the relationship between the weight of criterion and the intensities of preferences among pairs of AIs on that criterion. In other words, is there any relation between a weight that is attached to a criterion and the intensities that a stakeholder expressed on that criterion? The next section provides a response to this question.

8.7 Relationship between the intensities of preferences and criteria weights

To investigate the relationship among the indicated weights and the intensities of preferences, four different criteria out of the twelve criteria are chosen. Figures 8.8 to 8.11 show the distribution of the weights based on the different intensities of preferences for all stakeholders. The four criteria show almost stochastically dominating distributions of the importances. In other words, the figures show that there is a correspondence between the indicated weight and the intensities of preferences. As seen in Figure 8.8

those stakeholders who regard the Social Education criterion to be *Eim (*Extremely important), also express strong intensities rather than weak ones between pairs of AIs in their rank orders for this criterion. The figure shows that the distribution of *Eim* lies below the other distributions, which specifies that those stakeholders who indicated this criterion to be extremely important, also expressed stronger intensities of preferences compared to others who indicated this criterion less important. As one can see in Figure 8.8 the median of the distribution of *Eim* is *st* (strong preference) where its distribution intersects the 50% line, which is stronger than the median of the other distributions. However, the distribution of *Uim* (Unimportant) is different from the other distributions. The distribution of *Uim* lies below the distribution of *Lim* (Little important) and these are not stochastically comparable. This relation can also be derived from Figures 8.10 and 8.12. It might be possible that those stakeholders who indicated *Uim* did not comprehend fully the purpose of the indicator *Uim* compare to the other indicators.

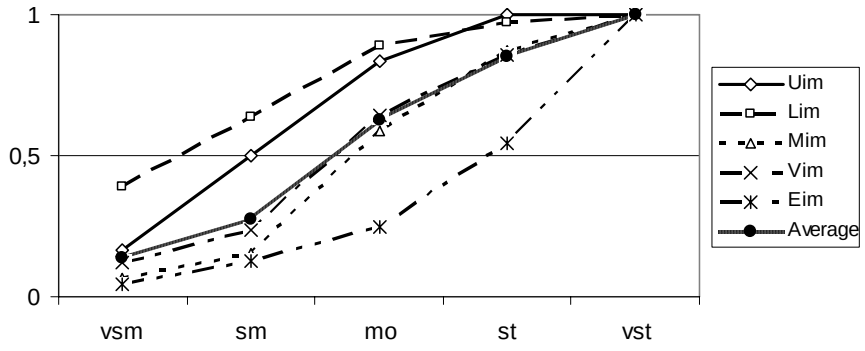


Figure 8.8. Cumulative graph among the weights and the intensities of preferences on the Social Education criterion

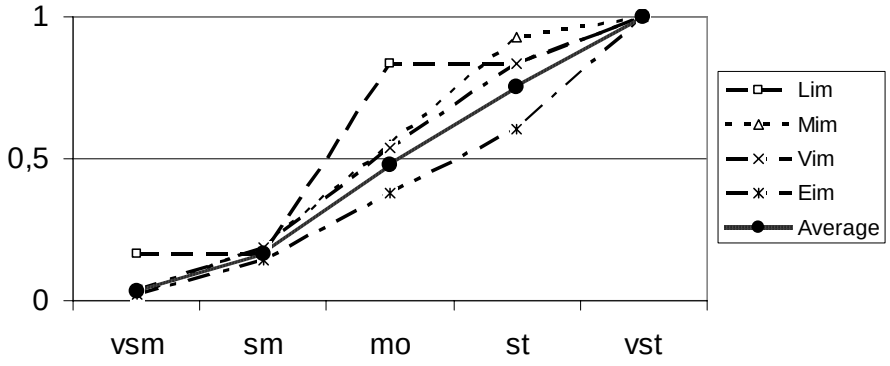


Figure 8.9. Cumulative graph among the criteria weights and the intensities of preferences on the Security of Habitat criterion

Figure 8.9 shows the distribution of different importance labels based on the intensities of preferences for the Security of Habitat criterion. As seen, on this criterion none of the stakeholders used *Uim* as weight of criterion. The figure however, shows that the distribution of *Lim* is not in line with the other distributions. As seen, the distribution of *Lim* is completely different compared to the other distributions. The distribution of *Eim* again lies below the other distributions indicate a consistency between the weight and the expressed intensities of preferences.

The distribution of importances in Figure 8.10 (the Part Time Job criterion) is almost the same as for the previous criterion with this difference that the distribution of *Vim* lies below the other distributions before intersecting the 50% line. However, after intersecting the 50% line, it crosses the *Eim* distribution. It means that for this criterion there is less consistency among the importances and intensities of preferences than for the Security of Habitat criterion.

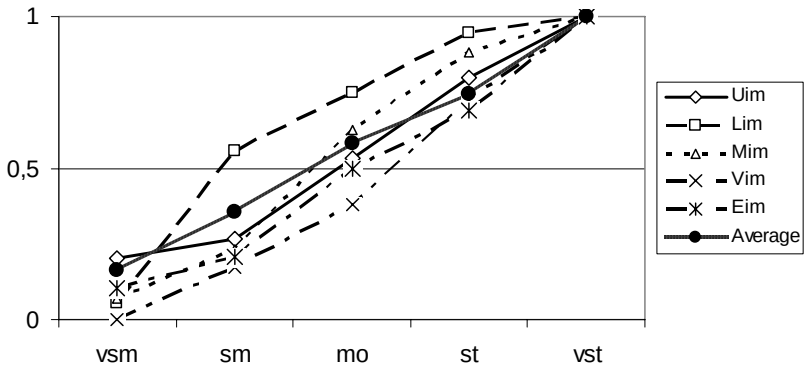


Figure 810. Cumulative graph among the criteria weights and the intensities of preferences on the Part Time Job criterion

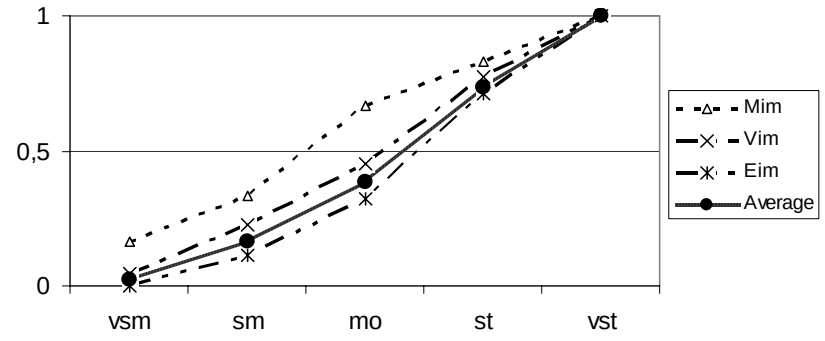


Figure 8.11. Cumulative graph among the criteria weights and the intensitie sof preferences on the Plant Diversity criterion

As mentioned before, those criteria that the stakeholders regarded as very important such as Plant Diversity (Figure 8.11) reveal a strong consistency between the distribution of importances and intensities of preferences. As can be derived from the figure, the distributions of *Mim*, *Vim* and *Eim* are stochastically monotone w.r.t. each other. In other words, there is a strong correspondence between criteria weights and expressed intensities of preferences for the Plant Diversity criterion.

In all these figures we added an extra line that is Average line. This line indicates the distribution of intensities of preferences based on different importance values. Therefore, when a lot of stakeholders expressed weak intensities rather than strong ones, the lines move to the right side of the figure and vice versa. For example, in Figure 8.10 the line lies to the left side and indicates that most of stakeholders expressed weak intensities of preferences. However, in Figure 8.11 the Average line lies in the right side and indicates that the stakeholders expressed stronger intensities of preferences based on different importance labels.

To conclude the discussion of the relationship of the indicated weights and intensities of preferences in our case study, Figure 8.12 gives the distributions of all importance indicators based on the expressed intensities of preferences for all criteria. As can be seen the distributions of the weights are almost stochastically monotone w.r.t. each other from weak intensity to strong. The figure shows that those who regarded a criterion more important, used in general stronger intensities of preferences during the pairwise comparisons. Consequently, the distribution of *Eim* lies below the other distributions. Figure 8.12 also shows that the distribution of *Uim* among indicated weights is not consistent with the other distributions. As one can see the distribution of intensities of those stakeholders who chose U*im* lies below the distribution of intensities of preferences of those who chose *Lim*, which theoretically should not be the case.

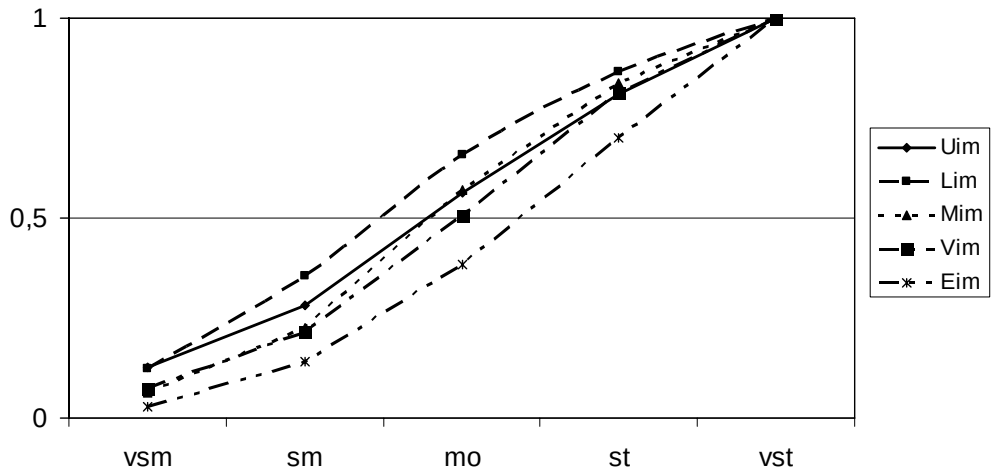


Figure 8.12. Cumulative graph of attached importances based on the intensities of preferences for all criteria

Although one can easily understand the presence of correspondence between the attached weights and the intensities of preferences, it is hard to say whether this will always be the case or not. It is reasonable that when one indicates a criterion very important, he/she is more willing to express strong intensity towards small changes in the criterion. However, the presence of the distribution of those stakeholders who indicated *Uim* as their weight of criterion acts in a different way and this seems to be at odds with the above assumption. The second reason for this problem might be that as the number of those who indicated *Uim* is quite limited, the distribution of *Uim* cannot follow the other distributions regarding the express intensities of preferences. It needs further research to demonstrate that stakeholders' intensities of preferences can completely present the importance of a criterion. Based on the above hypothesis it should be sufficient for policy makers to just use stakeholders' intensities of preferences as an input into a MCDA to establish the final decision without needing to elicit weight of criterion. In other words, assuming all criteria with the same importance, one can apply an MCDA as usual to provide the output.

In our methodology, the social intensities of preferences are constructed based on a mathematical approach (OSDL). Although OSDL will provide the presence of stochastic monotonicity between distributions of social intensities of preferences, it will also add

complexity to the methodology. The next section provides a short discussion on this concept.

8.8 Application of OSDL and its complexity for policy makers

As explained in Chapters 6 and 7, in both elicitation and aggregation of stakeholders' intensities of preferences the monotonicity constraint is an essential element. In other words, presence of monotonocity between intensities of stakeholders' preferences is a sign of rationality. The second consistency rule is the presence of stochastic monotonocity between distributions of intensities of preferences on the social rank order. We further described that by incorporating all stakeholders' intensities through different rank orders, the distribution of social intensities of preferences could be stochastically non-monotone. To eliminate this problem, OSDL is applied to construct stochastically monotone distributions of social intensities of preferences. Although presence of stochastically monotone distributions of intensities on social preferences is a necessary element, it also adds complexity to the process and makes the process of OSDL a black box for DMs and policy makers. This disadvantage might be reduced by providing a combination of OSDL with ARGUS in a consistent and easier way to motivate policy makers to apply the methodology.

In the case of not being able to simplify OSDL process, one can neglect using OSDL by eliminating those stakeholders who are not in line with the social rank order. In this regard, distributions of intensities of preferences w.r.t. each other are stochastically monotone and the policy maker does not need to apply OSDL.

8.9 Alternative ways to construct social intensities of preferences

Table 8.6 shows the social rank orders and their corresponding social intensities. This is the same table as the one determined in Chapter 7 (Table 7.2). This table is constructed based on all stakeholders' intensities of preferences and weights of criteria. For each criterion we have a social rank order (based on the Condorcet criterion), social intensities of preferences and a social weight (Zendehdel et al., submitted). To provide a response to the question, whether neglecting some stakeholders can make changes, we constructed

Table 8.7. This table contains just intensities of preferences of those stakeholders who have identical rank order with the social rank order on each criterion (one can find the percentage of those who are in line with the social rank order on each single criterion in Figure 8.7). As it can be derived from the table, 19 social intensities of preferences are changed compared to Table 8.6. The changes are indicated with the bold font style. Most changes of social intensities occurred between comparison of the best and the worst decision on each criterion (presented in the fourth column). The six social intensities of preferences are changed from *st* to *vst* and from *mo* to *st*. It is obvious that when one takes into account just the majority's opinions instead of all, the strength of intensities will increase. The most changes take place among the first presented pair of AIs on the table as these are the points that minority groups have the maximum disagreement and neglecting their opinion will make greatest impact on social intensity.

Table 8.6. The social intensities of preferences for the environmental criteria in the Lar rangeland based on all stakeholders

	Criteria	**Social rank order**	**Social intensities of preferences**													Median of weights
1	Climate Regulation	a_1a_2	a_1b_1	*vst.*												*Vim*
2	Soil Conservation	$b_1b_2b_3b_4$	b_1b_4	*vst*	b_1b_3	*st*	b_2b_4	*st*	b_1b_2	*mo*	b_2b_3	*mo*	b_3b_4	*mo*		*Eim*
3	Plant Diversity	$c_1c_2c_3c_4$	c_1c_4	*vst*	c_1c_3	*st*	c_2c_4	*st*	c_1c_2	*mo*	c_2c_3	*mo*	c_3c_4	*mo*		*Eim*
4	Wildlife Diversity	$d_1d_2d_3d_4$	d_1d_4	*st*	d_1d_3	*mo*	d_2d_4	*mo*	d_1d_2	*sm*	d_2d_3	*mo*	d_3d_4	*sm*		*Vim*
5	Security of Habitat	$d_1d_2d_3d_4$	e_1e_4	*st*	e_1e_3	*st*	e_2e_4	*st*	e_1e_2	*mo*	e_2e_3	*mo*	e_3e_4	*mo*		*Vim*
6	Cultural Attributes	$f_1f_2f_3$	f_1f_3	*vst*	f_1f_2	*mo*	f_2f_3	*mo*								*Mim*
7	Social Education	$g_1g_2g_3g_4$	g_1g_4	*vst*	g_1g_3	*st*	g_2g_4	*st*	g_1g_2	*mo*	g_2g_3	*mo*	g_3g_4	*mo*		*Mim*
8	Recreation	$h_2h_3h_4h_1$	h_2h_1	*st*	h_2h_4	*mo*	h_3h_1	*st*	h_2h_3	*sm*	h_3h_4	*sm*	h_4h_1	*sm*		*Mim*
9	Public Access	$i_2i_3i_4i_1$	i_2i_1	*mo*	i_2i_4	*mo*	i_3i_1	*sm*	i_2i_3	*sm*	i_3i_4	*sm*	i_4i_1	*vsm*		*Mim*
10	Part Time Job	$j_2j_1j_3j_4$	j_2j_4	*mo*	j_2j_3	*sm*	j_1j_4	*mo*	j_2j_1	*vsm*	j_1j_3	*vsm*	j_3j_4	*sm*		*Mim*
11	Water Supply	$k_1k_2k_3k_4$	k_1k_4	*vst*	k_1k_3	*st*	k_2k_4	*st*	k_1k_2	*st*	k_2k_3	*mo*	k_3k_4	*mo*		*Eim*
12	Cost of Plan	$l_3l_2l_1l_4$	l_3l_4	*mo*	l_3l_1	*mo*	l_2l_4	*mo*	l_3l_2	*mo*	l_2l_1	*sm*	l_1l_4	*vsm*		*Vim*

Table 8.7. The social intensities of preferences based on those stakeholders who have the same rank order as the social rank order on each criterion

	Criteria	Social rank order	Social intensities of preferences													Median of weights
1	Climate Regulation	a_1a_2	a_1b_1	*vst.*												*Vim*
2	Soil Conservation	$b_1b_2b_3b_4$	b_1b_4	*vst*	b_1b_3	*st*	b_2b_4	*st*	b_1b_2	*mo*	b_2b_3	*mo*	b_3b_4	*mo*		*Eim*
3	Plant Diversity	$c_1c_2c_3c_4$	c_1c_4	*vst*	c_1c_3	**st**	c_2c_4	*st*	c_1c_2	*mo*	c_2c_3	*mo*	c_3c_4	*mo*		*Eim*
4	Wildlife Diversity	$d_1d_2d_3d_4$	d_1d_4	**vst**	d_1d_3	**st**	d_2d_4	*mo*	d_1d_2	**mo**	d_2d_3	*mo*	d_3d_4	*sm*		*Vim*
5	Security of Habitat	$e_1e_2e_3e_4$	e_1e_4	**vst**	e_1e_3	*st*	e_2e_4	*st*	e_1e_2	*mo*	e_2e_3	*mo*	e_3e_4	*mo*		*Vim*
6	Cultural Attributes	$f_1f_2f_3$	f_1f_3	*vst*	f_1f_2	*mo*	f_2f_3	*mo*								*Mim*
7	Social Education	$g_1g_2g_3g_4$	g_1g_4	*vst*	g_1g_3	*st*	g_2g_4	*st*	g_1g_2	*mo*	g_2g_3	*mo*	g_3g_4	*mo*		*Mim*
8	Recreation	$h_2h_3h_4h_1$	h_2h_1	**vst**	h_2h_4	**st**	h_3h_1	*st*	h_2h_3	**mo**	h_3h_4	**mo**	h_4h_1	*sm*		*Mim*
9	Public Access	$i_2i_3i_4i_1$	i_2i_1	**st**	i_2i_4	*mo*	i_3i_1	**mo**	i_2i_3	*sm*	i_3i_4	*sm*	i_4i_1	**sm**		*Mim*
10	Part Time Job	$j_2j_1j_3j_4$	j_2j_4	**st**	j_2j_3	*sm*	j_1j_4	*mo*	j_2j_1	**sm**	j_1j_3	**sm**	j_3j_4	*sm*		*Mim*
11	Water Supply	$k_1k_2k_3k_4$	k_1k_4	*vst*	k_1k_3	*st*	k_2k_4	*st*	k_1k_2	*st*	k_2k_3	*mo*	k_3k_4	*mo*		*Eim*
12	Cost of Plan	$l_3l_2l_1l_4$	l_3l_4	***st***	l_3l_1	**st**	l_2l_4	**st**	l_3l_2	*mo*	l_2l_1	*sm*	l_1l_4	**sm**		*Vim*

As we explained in Chapter 7 the median weight of those who are in line with the social rank order are completely identical to the median of all stakeholders on each single criterion. Therefore, the last columns in both tables where the median weights are provided remain identical.

In Section 8.7 we discussed about the correspondence between the indicated weights and the intensities of preferences on each single criterion. We further concluded that those stakeholders who indicated a criterion *Uim,* their distribution of intensities of preferences is not consistent w.r.t. the distribution of intensities of preferences those stakeholders who indicated a criterion *Lim, Mim, Vim* and *Eim.* Therefore we examine what will happen if one aims to eliminate those stakeholders who indicated *Uim* as weigh to compute social intensities of preferences. Table 8.8 presents the social intensities of preferences based on the new list of stakeholders. As a result, social rank orders on the Public Access and the Part Time Job criteria and their corresponding intensities are changed. Moreover, a few intensities of preferences on other criteria are changed as well (indicated with bold font

style). On the Public Access criterion the social rank order is changed from $i_2i_3i_4i_1$ to $i_2i_3i_1i_4$. In other words, where the former social rank order shows that strong increase in public access to Lar (i_1) as the worst case, the new social rank order shows that decreasing people access to the Lar rangeland (i_4) is the worst policy. It is not simple to judge which social rank order is the best and should be taken into account. However, one important conclusion is that exclusion of even a small group (four people out of the 31) on this criterion can influence the social rank order and by doing this on all criteria the output of the applied MCDA might change based on using wrong input.

Table 8.8. The social intensities of preferences based on all stakeholders except for those who indicated *Uim* as a weight for a criterion

	Criteria	**Social rank order**	**Social intensities of preferences**													Median of weights
1	Climate Regulation	a_1a_2	a_1a_2	*vst.*												*Vim*
2	Soil Conservation	$b_1b_2b_3b_4$	b_1b_4	*vst*	b_1b_3	*st*	b_2b_4	*st*	b_1b_2	*mo*	b_2b_3	*mo*	b_3b_4	*mo*		*Eim*
3	Plant Diversity	$c_1c_2c_3c_4$	c_1c_4	*vst*	c_1c_3	*st*	c_2c_4	*st*	c_1c_2	*mo*	c_2c_3	*mo*	c_3c_4	*mo*		*Eim*
4	Wildlife Diversity	$d_1d_2d_3d_4$	d_1d_4	*st*	d_1d_3	*mo*	d_2d_4	*mo*	d_1d_2	*sm*	d_2d_3	*mo*	d_3d_4	*sm*		*Vim*
5	Security of Habitat	$d_1d_2d_3d_4$	e_1e_4	*st*	e_1e_3	*st*	e_2e_4	*st*	e_1e_2	*mo*	e_2e_3	*mo*	e_3e_4	*mo*		*Vim*
6	Cultural Attributes	$f_1f_2f_3$	f_1f_3	*vst*	f_1f_2	**st**	f_2f_3	*mo*								*Mim*
7	Social Education	$g_1g_2g_3g_4$	g_1g_4	*vst*	g_1g_3	*st*	g_2g_4	*st*	g_1g_2	*mo*	g_2g_3	*mo*	g_3g_4	*mo*		*Mim*
8	Recreation	$h_2h_3h_4h_1$	h_2h_1	*st*	h_2h_4	*mo*	h_3h_1	**mo**	h_2h_3	*sm*	h_3h_4	*sm*	h_4h_1	***vsm***		*Mim*
9	Public Access	$\mathbf{i_2i_3i_1i_4}$	i_2i_4	*st*	i_2i_1	*mo*	i_3i_4	*sm*	i_2i_3	*sm*	i_3i_1	*sm*	$\mathbf{i_1i_4}$	*vsm*		*Mim*
10	Part Time Job	$\mathbf{j_3j_2j_1j_4}$	j_3j_4	*st*	j_3j_1	*mo*	j_2j_4	*mo*	j_3j_2	*sm*	j_2j_1	*sm*	j_1j_4	*vsm*		***Vim***
11	Water Supply	$k_1k_2k_3k_4$	k_1k_4	*vst*	k_1k_3	*st*	k_2k_4	*st*	k_1k_2	*st*	k_2k_3	*mo*	k_3k_4	*mo*		*Eim*
12	Cost of Plan	$l_3l_2l_1l_4$	l_3l_4	*mo*	l_3l_1	*mo*	l_2l_4	*mo*	l_3l_2	**sm**	l_2l_1	*sm*	l_1l_4	***sm***		*Vim*

For the Part Time Job criterion the social rank order is changed from $j_2j_1j_3j_4$ to $j_3j_2j_1j_4$. As seen, the influence of removing those stakeholders who indicated *Uim* on the Part Time Job criterion is more significant than on the Public Access criterion. In other words, j_3 (600 persons) that was ranked the third on the initial social rank order, turns out to be the best alternative. This change in the social rank order seems reasonable and can be explained by looking to Table 8.3. By referring to the table one can easily understand that

the social rank order on this criterion is not very strong based on the distribution of stakeholders' rank orders. In this regard, elimination of some stakeholders from the list of groups can easily change the social rank order. As showed in Table 8.3, although $j_2j_1j_3j_4$ is the Condorcet winner on the Part Time Job criterion and obviously it has the maximum support among the rank orders, it has not a very strong support compared to other rank orders. In other words, based on all Kendall's correlation coefficients, there should be other rank orders such as $j_3j_2j_1j_4$ that are close to $j_2j_1j_3j_4$. In this regard, by eliminating small number of people (five stakeholders), the preference relation on this criterion is changed and a new social rank order ($j_3j_2j_1j_4$) is appeared. Table 8.9 shows the Kendall's rank correlation coefficients between the new social rank order and the other rank orders. As shown, the new social rank order still does not very strong support between the stakeholders compare to the other ranks. As can be also derived from Table 8.8, the social weight only on the Part Time Job criterion is change after removing those stakeholders who indicated *Uim.* The social weight now became *Vim* (Very important) instead of *Mim* (Moderately important).

Table 8.9. Kendall's rank correlation coefficients between the new social rank order and the stakeholders' rank orders on Part Time Job criterion (without those who indicated *Uim*)

Social rank order	Frequency	Existing rank orders	Kendall's rank correlation coefficient
$j_3j_2j_1j_4$	14	$j_1j_2j_3j_4$	0.00
	9	$j_4j_3j_2j_1$	0.00
	4	$j_3j_2j_1j_4$	+1.00
	2	$j_2j_1j_3j_4$	+0.33
	2	$j_3j_4j_2j_1$	+0.33

The last step in the methodology was to enter the social inputs into the ARGUS to establish the social decision. As we now have three tables with different social rank orders and different social intensities of preferences, a new question comes up whether using the new information rather than the information in Table 8.6 would change the output of ARGUS? The next section will provide the new outputs of ARGUS.

8.10 Influence on the final decision when using different social inputs

Table 8.10 shows the application of ARGUS based on the four different social intensities of preferences and social weights of criteria. The second column shows the output of ARGUS based on Table 8.6. In other words, we entered all social intensities of preferences and social weights on different criteria into ARGUS. The output is $P_1||P_3>P_4>P_2$. Therefore, P_1 and P_3 are incomparable and the two other plans, P_4 and P_2 ranked in the second and third place respectively. When however, we consider all criteria with equal weight, given our discussion about correspondence between weights and intensities of preferences, the outcome is $P_1>P_3||P_4>P_2$. Therefore, now P_1 turns out to be the best plan, P_3 and P_4 are incomparable and P_2 is still the worst plan.

Table 8.10. Output of ARGUS based on different inputs

Order	All 31 stakeholders	Considering equal weights for all criteria	Those who are in line with the social rank orders	All stakeholders except those who indicated *Uim*
First	P_1* & P_3	P_1	P_1 & P_3	P_1 & P_3
Second	P_4	P_3 & P_4	P_4	P_4
Third	P_2	P_2	P_2	P_2
Fourth	--	--	--	--

* P_1, P_2, P_3 and P_4 are Plan **1** to **4** respectively

The third output (column four) comes from application of ARGUS based on social intensities of preferences of those stakeholders whose rank order is in line with the social rank order on each single criterion. In this case, the social weight is based on the median of all stakeholders on each criterion. We already mentioned that the median weight of those who are in line with the social rank order on each criterion is identical to the median weight based on all stakeholders. As can be derived from the output of ARGUS the same holds for the social intensities of preferences. The result did not even change when we removed the inputs related to those stakeholders who indicated *Uim* as a weight on a criterion.

One reason for not having many differences on the outputs of ARGUS is that the social weights w.r.t the different list of stakeholders on the criteria almost remained constant. Another reason is that the diversity of stakeholders' inputs did not change the social rank orders except on the Public Access and the Part Time Job criteria and this change is not enough to make differences on the output of ARGUS. However, when we consider the weights of criteria to be equal (in other words, weight does not play any role in the application of ARGUS) the output is changed. As we explained in Chapter 7, Table 7.4, the differences between P_1 and P_3 relate back to the importance of those criteria for which P_3 dominates P_1. In other words, P_1 is 7 times preferred to P_3, but the application of ARGUS showed the plans are incomparable. If one looks back to the table, it is seen that for those criteria on which P_3 dominates P_1, the weights are mostly *Eim* and in the opposite condition the weights are weaker than *Eim*. This situation eliminates P_1 to be the best plan based on the output of ARGUS. However, when the differences on weights of criteria is relaxed, P_1 turns out to be the best plan.

It should be mentioned that the application of the methodology without using OSDL by directly entering each stakeholders' intensities of preferences and criteria weight as an input into ARGUS results in $P_3 > P_1 || P_4 > P_2$. As we explained, with this procedure the construction of social rank order among individual rank orders of alternative plans will be done based on Kenall's rank correlation coefficient. In other words, the social rank order is the one that has the highest rank correlation with other rank orders. For this social rank order, the Kendall's coefficient is equal to +0.8. Based on the criticisms that we discussed in Chapter 7, this process is not considered in our methodology.

Chapter 9

General conclusions and recommendations

9.1 Sustainability and environmental valuation

Sustainability is a matter of the distribution of assets across generations. The principle of environmental sustainable development is that future generations should be able to enjoy at least as much as the current generation are enjoying from using the natural endowments (Howarth and Norgaard, 1992; Ekins, 2003). It is understood that societies overexploit natural resources as markets are imperfect for environmental services (Howarth and Norgaard, 1992; Pearce, 1993; Pearce and Moran, 1994). In this regard, environmental economists have tried to improve market failure by providing valuation approaches (Gowdy and Mayumi, 2001; Fischhoff, 2005). Although attaching monetary tags to environmental non-market services can be a useful proposal to allocate efficiently these services, it can also accelerate overexploitation of the services based on underestimation of their real values. Moreover, there is a growing tendency supporting the idea that environmental services cannot be measured by a monetary scale (Perkins, 2001; Vatn, 2004a; Spash, 2007). The valuation literature has demonstrated that monetary valuation approaches are not always appropriate methods to elicit stakeholders' intensities of preferences towards environmental services (Kahneman et al., 1993; Diamond and Hausman, 1994; Diamond, 1996; Brouwer et al., 1999; Perkins, 2001; Smith, 2003; Stagl, 2005; Brouwer, 2006). This is a strong criticism towards monetary approaches such as contingent valuation method that just take into account economic efficiency as the only criterion to attach value to environmental services. O'Nieill (1993) writes:

"The strength and weaknesses of the intensity of a preference as measured by a person's willingness to pay at the margin for their satisfaction(s) do count in a decision; the strength and weakness of the reasons for a preference do not. Preferences are treated as expressions of mere taste to be priced and weighed one with the other".

Additionally, presence of lexicographic preferences is a strong obstacle against a monetary valuation approach. In this regard, stakeholders are not able to make trade-offs between environmental criteria and their private consumptions. In other words, there is no indifference curve between public and private goods consumption to enable the policy maker to calculate stakeholders' willingness to pay (De Groot et al., 2002). Nevertheless, the policy maker should be informed about stakeholders' preferences and their willingness to trade–offs between public and private goods to be bale to formulate social policies. Therefore, we are dealing with a dilemma. On the one hand, lexicographic preferences and limitation of stakeholders' cognitive capacity both eliminate people to make trade-offs, on the other hand, without having any information on people preferences one cannot make a decision. In out study we aim to introduce a new approach in which stakeholders do not need to make trade-offs between environmental criteria and their market consumptions. In other words, the proposed methodology enables the policy maker to collect stakeholders' preferences and to make trade-offs based on the preferences. We assume that the policy maker with respect to the collected preferences is sufficiently capable to make trade-offs and to formulate environmental policies in a reasonable way.

9.2 Institutional failure in environmental valuation

There are different ways to make decisions for protecting natural resources and their functions. Among different approaches, we choose valuation of environmental services as a tool to help policy makers to be able to take a large number of non-market environmental services into account in the process of policy formulation. During the last decades different valuation approaches have been applied to attach prices to environmental services. The most world-wide used valuation approach is the Contingent Valuation Method (CVM). The CVM uses a hypothetical market to enable people to offer their bids towards environmental non-market services. CVM is developed based on neo-classical economic value theory. The core of the methodology is the assumption of commensurability between environmental services and market products (Jacobs, 1997; Sagoff, 1998; Spash, 2000a; Vatn, 2000; Vatn, 2005; Spash, 2007). There are some

fundamental problems related to using monetary valuation in the field of environmental services. The first problem relates to availability and complexity of information regarding the services under discussion. In other words, the environmental services are complex and unfamiliar to people. In this regard, constructing a monetary value for environmental goods is a difficult task. The second problem is the assumption of commensurability. Environmental goods and services are mostly a source for ethical motives and religious sources. Therefore, the issue of commensurability is unacceptable and is a source of protest responses among respondents (Vatn, 2005; Spash, 2007). Finally, interconnection of environmental services makes it hard to have a clear image from a good or service without having the problem of embedding effect.

Based on the CVM difficulties, deliberative approaches turn to be an appropriate value articulating institution to help policy makers to conserve environmental services. It is a strong belief that stakeholders need a deliberative forum to construct their preferences towards environmental services. Concerning the ethical motives, differences between just being a consumer of environmental services or a citizen with feeling liability towards the environment and society and finally plurality of people's preferences motivate policy makers to support the deliberative institution. The core concept in deliberative approaches is the role of the argument to construct stakeholders' preferences (Dryzek, 1997; Dryzek, 2002; Wilson and Howarth, 2002; Vatn, 2005). Deliberative valuation is a response to the bounded rationality of individuals. The process of deliberation not only provides an opportunity for stakeholders to be involved into the policy making process, but also gives awareness to the stakeholders about the perspectives of others. When the environmental services under the discussion are public, the best institution for consideration is a deliberative approach. Habermas (1984), one of those who develop the concept of communicative rationality, believes that a deliberation is a form of common reasoning where consensus is provided by mutual reasoning, understanding and changed preferences. Nevertheless, a deliberative forum as a political process that enables society to be a part of decision making is not free of problems. Based on Habermas idea, communication is thought to be free of strategic action and manipulation. Here a question comes up as diversity of power among different social groups might eliminate them to

have a fair discussion. Moreover, the concept of consensus is under scrutiny regarding its effect on marginalization of dialogue and forcing participants to come to a closer idea rather than focusing on reasons (Cookson, 2000). Although we strongly accept that dialogue will civilize people's behaviour (Dryzek, 2002; Smith, 2003; Vatn, 2005), it can also be authoritarian to force people to follow social view, which is to be at odds with the concept of individual freedom (Cookson, 2000; Tompkins, 2003; Springael and De Keyser, 2004). Moreover, group discussion will not enable those participants who hold lexicographic preferences to come up with a monetary payment towards the valuation question. Additionally, the group discussion might increase the conflict between stakeholders on the concept of environmental valuation.

Based on these reasons and criticisms to both approaches we neither entirely use the neo-classical economic value theory as a value articulating institution to elicit stakeholders' preferences, nor we take into account the whole concept of deliberative democracy. Our aim is to use the advantage of having a deliberative forum without needing to ask stakeholders to reach a consensus on a complex environmental issue. We further assist stakeholders with not asking them to make trade-offs between their private consumption and environmental services.

9.3 A discursive ordinal multi-criteria approach as a response to the institutional failure

There are two crucial aspects to the choice of proper value articulating institutions. First, one has to ask which issues are at stake. Are they individual? Is calculation and exchange the proper solution implying that the goods at stake can be interpreted as commodities? Or are more societal issues involved moving us to consider a forum type value articulating institution? Given that the latter is chosen, the issue of which type of forum to choose involves yet another evaluation of the type of problem at hand. It does, however, also involve a second issue, that of evaluating the more overall cultural and institutional setting in which the specific problem appears. In this regard, there is a growing literature on environmental valuation studies to combine deliberative approaches with MCDA (Stagl, 2003; Vatn, 2005). Social Multi-Criteria Evaluation (SMCE) (Munda, 2004),

Multi-Criteria Mapping (MCM) (Stirling, 1997; Stirling and Mayer, 2004) and Deliberative Mapping (DM) (Stagl, 2005) are methods that are recently used in valuation studies. Growing attention to these valuation approaches is related to difficulties that hinder stakeholders to construct a monetary payment. These approaches ask stakeholders to focus on each criterion once at the time to make trade-off and then in the end policy maker will make the final trade-offs between all criteria. Although this is an advantage to the CVM, stakeholders still need to do the trade-off. This can be supposed as a drawback for these approaches.

Therefore, to solve this multi dimensional problem our first aim was to relieve stakeholders from the difficulty of making trade-offs. In this regard, the policy maker will make the trade-offs instead of stakeholders. However, based on this decision (using an MCDA) we could not apply an individualistic procedure to elicit stakeholder' preferences as the application of MCDA might seem a black box for the stakeholders. Additionally, the diversity of stakeholders' preferences and presence of long term conflict motivates us to use a deliberative forum. Therefore, our aim from the deliberative part was to define the problem and to broad stakeholders perception. In order to do so, we propose a valuation method that is based on the social rationality to construct preferences rather than to establish a decision. In other words, by combining the discursive procedure with an ordinal outranking method through a mathematical process we are not only able to apply a constructive deliberation among stakeholders, but also we improve the merit of the deliberation by excluding the consensus reaching step. This is an important feature that enables policy makers to bring conflicting social groups without fearing to have difficulty to reach a consensus. Furthermore, this procedure can eliminate the difficulties related to a deliberative approach as participants are not concerned about the result and they should try to provide reasons to explain their opinions. O'Neill (1997) writes "to engage in reasoned dialogue is to aim not at compromise but at convergence in judgements". Moreover, by ignoring the consensus in a group discussion the stakeholders have less motivation to act politically to influence other participants.

As explained in Chapters 4 and 6, there is not any single methodology to satisfy all four Arrow's impossibility theorem (Harsanyi, 1953; Johansson, 1991; Heal and Karl-Goran

Maler and Jeffrey, 2005). In other words, with any aggregation rule at least one of Arrow's conditions will be violated. In our methodology we used the Condorcet criterion to establish the majority rank order and then the intensities of preferences are incorporated to the social rank order. As one knows the majority rule is not Pareto efficient. In other words, the outcome of our approach will violate weak Pareto condition. However, Pareto criterion is useless as a criterion for social choice in many, perhaps even most, real-world situation (Johansson, 1991). In general, one would expect a policy change to produce gainers as well as losers, and Pareto criterion cannot handle such mixed outcomes (Johansson, 1991; Gaertner, 2006). However, our result should be able to satisfy Kaldor-Hicks principle. As we described our cornerstone is the majority rule. In this regard, one expects that by incorporating stakeholders' intensities of preferences to the majority rank order the outcome produces more gainers compare to losers. It should be mentioned that in case of dealing with voting paradox, it is very hard to verify that the outcome satisfies the Kalodor-Hicks principle or not. This problem is very complicated when the data is qualitative.

9.4 An overview of the results for our case study

The application of the methodology in Lar showed that, it is possible to bring multiple social groups with conflictial interests together to discuss about environmental services and alternative plans. Although, the social groups had long term conflicts on application of any management plan, the simplicity of the methodology and transparency of its steps influenced the stakeholders to come together and to discuss about different future plans. Moreover, using alternative impacts instead of alternative plans effectively eliminates the stakeholders to act politically and express biased preferences. This is an important feature as presence of conflicts between different social groups always hinders the policy maker to dig deeper into the stakeholders' interests.

The methodology has a qualitative structure. This feature enabled us to be completely consistent with stakeholders' structure of preferences and appreciates the plurality of values that they hold towards environmental service. In this regard, we did not need to use a monetary value to elicit stakeholders' preferences. Another important feature of the

proposed methodology is that, it is a complete process from construction, elicitation, aggregation of stakeholders' preferences and finally formulation of a socially desirable decision. In this regard, the policy maker will be sure that the stakeholders are more likely to support the outcome due to transparency and its ability to take all stakeholders into account. Therefore, the policy maker will benefit from receiving social support, which is a necessary element to reach a sustainable management. In our methodology the policy maker has the opportunity to use social intensities of preferences and social weights to convince stakeholders towards the final decision. In other words, although these steps might increase complexity of the methodology, they also help the policy maker to be able to describe social values on each single criterion in a tractable way.

The acceptability of a method relates to its ability to consider minority groups' opinions. As a consequence of not being able to take minorities into account a lot of methodologies have not met social support. On the contrary, our methodology is capable to take all stakeholders' views into account, which makes it a useful tool for the policy maker. We demonstrated in Chapetr 8 that removing minorities from the list of group in our case study has made the social intensities of preferences stronger. This is mostly not in favour of minority groups. Moreover by using all intensities of preferences the hardship of social intensities of preference has reduced and made it easier for the stakeholders to understand and accept the final outcome.

In the final stage of the method we showed that small changes in ARGUS inputs will not make a lot of changes in the output. In other words, based on the ordinality of the methodology and the way that stakeholders' social intensities of preferences and social weights are incorporated into ARGUS, the methodology is not sensitive to small changes. In this regard, we further assume that this methodology strongly supports policy makers to use stakeholders' knowledge even in presence of conflicts to come up with an acceptable outcome. This can be a move towards the goal of sustainability that is an essential element for environmental policy makers.

9.5 Some conclusion remarks and recommendations for future research

The deliberative step is an important part of our method, which is supported by a mathematical and an MCDA approaches. An ambiguity still remains here that to what extent our method is succeeded to eliminate the stakeholders to act politically. Of course one needs to apply the outcome of our study to see how the social groups act and support the results. This needs further investigating for future studies. This is also questionable that how one can provide more information about environmental services without losing neutrality among different social groups. Further attention should be given to the list of stakeholders who should be representative of their society. It might be possible to consider some weights between groups as a sign of group's power in the policy making process. As we know one of the main criticisms to a deliberative approach is the influence of researcher based on the way that he/she presents the information. In this regard, different format of workbook should be designed and see what is the difference in the outcome of the discussion.

We also discussed about the relationship between weights and distribution of intensities of preference. There is a need to demonstrate this relation and provide a clear message for policy makers either to use both values or to use just intensities of preferences to construct the final decision. To be able to use the MCDA, we apply a mathematical approach (OSDL). We rather explained that this process will add complexity to the methodology that makes difficulty for policy makers to easily apply the approach. Here we believe that the mathematical part should be incorporated into ARGUS in a more consistent way to provide a simple package for the policy makers to be able to easily follow the steps.

Summary

Sustainability is a matter of the distribution of resources across generations besides other aspects. In other words, future generations should be able to enjoy from endowment of natural resources at least as much as the current generation. Societies do overexploit natural resources because of imperfect markets in the context of environmental services. To overcome this problem, environmental economists are working on different methods for valuing resources. Environmental valuation is a key tool to provide policy makers with values of environmental services. This information can assist policy makers in the environmental decision making that are based on stakeholders' preferences and wishes. Valuation approaches have been introduced to provide an opportunity for stakeholders to make trade-offs between public goods and private consumptions to express their Willingness To Pay (WTP) or Willingness To Accept (WTA) compensation towards gain or loss of environmental services respectively. However, measuring stakeholders' preferences is not always very straightforward. It might be that respondents are not sure about their preferences, unable to state them exactly, or even are unaware of them. Furthermore, the respondents may hold lexicographic preferences that hinder them to make trade-offs between environmental services and market products. The Contingent Valuation Method (CVM) as a widely applied valuation method, uses a monetary approach to elicit stakeholders' WTP towards environmental services. However, the CVM is subject to many criticisms because of its underlying assumptions.

To reduce the valuation difficulties and in order to take into account multiple stakeholders' interests and lexicographic preferences, this study proposes a new valuation approach that is consistently linked to a decision support system to help policy makers to use stakeholders' preferences to formulate a reasonable decision. Our methodology is a discursive ordinal multi-criteria valuation method that is a combination of three following steps. Firstly a discursive step allows stakeholders to come together to discuss on a specific environmental problem, related criteria and finally some applicable plans. This step provides an opportunity for stakeholders to construct their preferences towards environmental criteria. Secondly, to elicit the constructed preferences, stakeholders

should follow an ordinal procedure. This ordinal process helps stakeholders to express their preferences and their intensities in an easy way. To aggregate the stakeholders' preferences on each criterion, a mathematical method is used. Finally, a purely qualitative Multi-Criteria Decision Aid (MCDA) is applied to incorporate the aggregated preferences over all criteria to formulate a rank order of the environmental plans proposed in the first step.

The methodology is tested in a rangeland area (Lar rangeland) with a long term conflict among the stakeholders on utilization of rangeland services and their management plans. By applying the methodology in Lar we demonstrated that using a qualitative structure is not only useful to rank alternatives, but also that it allows eliciting stakeholders' intensities of preferences in a way that is consistent with human experience. By using a qualitative method stakeholders were able to express their attitudes and beliefs for each criterion in a more natural and accurate way than a monetary approach. In this dissertation we focus on stakeholders' and group's intensities of preferences as a reason why one plan will have less opposition and more support than another one. This is in contrast with conventional group decision support systems, which focus too much on the stakeholders' preferences and not enough on the corresponding intensities of preferences. Moreover, we show through the application of the procedure, how policy makers may use the elicited and aggregated qualitative intensities of preferences to convince the stakeholders about the outcome of the method.

Samenvatting

Duurzaamheid is ondermeer een kwestie van verdeling van goederen over verschillende generaties heen. In andere woorden, toekomstige generaties zouden minstens evenveel gebruik moeten kunnen maken van natuurlijke grondstoffen als de huidige generatie. Het is algemeen bekend dat samenlevingen de natuurlijke grondstoffen overexploiteren omdat het marktsysteem imperfect werkt voor ecologische diensten. Om dit probleem te omzeilen werken milieu-economen aan ecologische waarderingsmethoden. Ecologische waardering is een middel om de waarden verbonden aan ecologische diensten te meten en in rekening te brengen bij beleidsbeslissingen. De opgeleverde informatie geeft beleidsmakers de mogelijkheid om beslissingen te formuleren die gebaseerd zijn op de voorkeuren en wensen van belanghebbenden. Waarderingsmethoden zijn geïntroduceerd om belanghebbenden de mogelijkheid te verschaffen om de bestaande trade-offs tussen gemeenschapsgoederen en persoonlijke consumptie uit te drukken in een zogenaamde Willingness To Pay (WTP) of Willingness To Accept (WTA) waarde die ze hebben tegenover een toename van, respectievelijk afname in, de beschikbaarheid van ecologische diensten.Het meten van die voorkeuren is echter niet eenvoudig. Zo is het mogelijk dat de respondenten niet zeker zijn omtrent hun voorkeur, ze niet precies kunnen uitdrukken, of ze zelfs niet weten. Daarenboven is het mogelijk dat de respondenten lexicografische voorkeuren hebben die hen verhinderen om trade-offs te maken tussen ecologische diensten en persoonlijke consumptie.

The meest wijdverspreide ecologischevalueringsmethode, de Contingent Valuation Methode (CVM), gebruikt een monetaire eenheid om de voorkeur belanghebbenden voor ecologische diensten te meten. Omwille van een aantal veronderstellingen, is deze CVM echter onderhevig aan kritiek.

Om aan deze kritiek tegemoet te kunnen komen en rekening te kunnen houden met de diverse intresten en lexicografische voorkeuren van verschillende belanghebbenden, stelt dit onderzoek een nieuwe waarderingsmethode voor die op een consistente wijze verbonden is aan een beslissingsondersteunende techniek, die beleidsmakers toelaat die

voorkeuren in rekening te brengen bij het formuleren van een aanvaardbaar beleid. Onze methodologie is een discursieve, ordinale multicriteria methode welke bestaat uit een combinatie van drie stappen. Vooreerst is er de discursieve stap, welke belanghebbenden toelaat om te overleggen over een specific ecologisch probleem, de criteria welke van belang zijn aan te geven en, tot slot, verschillende mogelijke beleidsplannen te formuleren. Deze stap van informatieuitwisseling maakt dat belanghebbenden beter in staat zullen zijn om hun eigen voorkeuren tegenover de ecologische criteria te formuleren. Vervolgens, om deze voorkeuren tot uitdrukking te brengen, dienen de belanghebbenden een ordinale procedure te volgen, dit wil zeggen de verschillende plannen te rangschikken per criterium. Deze ordinale procedure is van die aard dat iedereenzijn preferenties op een natuurlijke wijze kan uit drukken zonder omrekening te maken naar monetaire waarden. Om vervolgens de preferenties van de verschillende belanghebbenden voor elk criterium te aggregeren, wordt een wiskundige techniek gebruikt. Tot slot wordt een kwalitatieve Multi-Criteria Decision Aid (MCDA) toegepast om de geaggregeerde voorkeuren voor elk criterion in rekening te brengen teneinde een rank orde van de in de eerste stap geformuleerde beleidsplannen te verschaffen.

De methodologie is uitgetest voor de rangeland area (Lar rangeland) in Iran. Dit is een gebied waar de verschillende belanghebbenden reeds lang in conflict zijn omtrent de exploitatie en het onderhoud van de het gebied. Door de methodologie in Lar toe te passen, tonen we aan dat de ordinale procedure geschikt is om niet enkel alternatieven te rangschikken, maar dat ze tevens toelaat om de preferenties van de belanghebbenden te onttrekken op een wijze die nauw aansluit bij de dagdagelijkse menselijke ervaring. De toepassing toont aan dat het gebruik van een kwalitatieve in de plaats van een kwantitatieve (monetaire) aanpak de betrokkenen hun instelling tegenover en mening betreffende de voorgelegde keuzes makkelijker kunnen uitdrukken. In dit proefschrift wordt verder aangetoond hoe via het meten van de de intensiteiten van voorkeuren van betrokken belanghebbenden een verklaring kan geven waarom het ene plan op meer steun en minder protest zal stuiten dan een ander. Dit staat in contrast met traditionele ‘group decision support’ systemen, welke zich veelal overmatig toespitsen op het meten van de preferenties van belanghebbenden, en niet voldoende op de bijhorende

intensiteiten. Bovendien is in de toepassing aangetoond hoe het beleid de methode kan hanteren om de belanghebbenden bij het proces te betrekken en de bekomen resultaten kunnen gebruiken om de sociale aanvaardbaarheid van een keuze of beslissing te vergroten.

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Appendix: Stakeholder preferences and criteria weight for all stakeholders based on different groups

Stakeholders' rank order of alternative impacts on the Climate Regulation criterion

Name of Group	Name of respondents	First order	Second order	Third order	Forth order	Importance
Nomad	Ghaffari	a_1	b_1			Little important
	Momaeezi	a_1	b_1			Important
	Montazer Lotf	a_1	b_1			Important
Environment	Hosseni Jabali	a_1	b_1			Very important
	Kargar	a_1	b_1			Important
	Mashadi Ahmadi	a_1	b_1			Important
	Sadooghi	a_1	b_1			Important
	Shekar Abi	a_1	b_1			Important
Natural resources	Mossaebi	a_1	b_1			Very important
	Ansari	a_1	b_1			Ex. important
	Badi Nia	a_1	b_1			Important
	Behzad	a_1	b_1			Very important
	Fallahi	a_1	b_1			Little important
	Mahdavi	a_1	b_1			Important
	Zanjani	a_1	b_1			Ex. important
	Nik Nejad	a_1	b_1			Very important
	Rahmani	a_1	b_1			Important
N.G.O	Ashtari	a_1	b_1			Important
	Shabani	a_1	b_1			Ex. important
	Nia Sari	a_1	b_1			Ex. important
	Badripour	a_1	b_1			Very important
Ranchers	Arab Halvai	a_1	b_1			Ex. important
	Asivan	a_1	b_1			Ex. important
	Feredooni	a_1	b_1			Ex. important
	Gholam Hosseni	a_1	b_1			Very important
	Haji Noroozi	a_1	b_1			Important
	Noroozi	a_1	b_1			Ex. important
	Mash Golberar	a_1	b_1			Ex. important
Watershed	Fallah Rad	a_1	b_1			Ex. important
	Haji Sabili	a_1	b_1			Very important
	Haddadi	a_1	b_1			Very important

Stakeholders' rank order of alternative impacts on the Soil Conservation criterion

Name of Group	Name of respondents	First order	Second order	Third order	Forth order	Importance
Nomad	Ghaffari	b_1	b_2	b_3	b_4	Very important
	Momaeezi	b_1	b_2	b_3	b_4	Ex. important
	Montazer Lotf	b_1	$b2$	b_3	b_4	Ex. important
Environment	Hosseni Jabali	b_1	b	b_3	b_4	Ex. important
	Kargar	b_1	b_2	b_3	b_4	Ex. important
	Mashadi Ahmadi	b_1	b_2	b_3	b_4	Ex. important
	Sadooghi	b_1	b_2	b_3	b_4	Ex. important
	Shekar Abi	b_1	b_2	b_3	b_4	Ex. important
Natural resources	Mossaebi	b_1	b_2	b_3	b_4	Ex. important
	Ansari	b_1	b_2	b_3	b_4	Ex. important
	Badi Nia	b_1	b_2	b_3	b_4	Important
	Behzad	b_1	b_2	b_3	b_4	Ex. important
	Fallahi	b_1	b_2	b_3	b_4	Ex. important
	Mahdavi	b_1	b_2	b_3	b_4	Ex. important
	Zanjani	b_1	b_2	b_3	b_4	Ex. important
	Nik Nejad	b_1	b_2	b_3	b_4	Ex. important
	Rahmani	b_1	b_2	b_3	b_4	Very important
N.G.O	Ashtari	b_1	b_2	b_3	b_4	Ex. important
	Shabani	b_1	b_2	b_3	b_4	Very important
	Nia Sari	b_1	b_2	b_3	b_4	Very important
	Badripour	b_1	b_2	b_3	b_4	Ex. important
Ranchers	Arab Halvai	b_1	b_2	b_3	b_4	Very important
	Asivan	b_1	b_2	b_3	b_4	Ex. important
	Feredooni	b_1	b_2	b_3	b_4	Ex. important
	Gholam Hosseni	b_1	b_2	b_3	b_4	Ex. important
	Haji Noroozi	b_1	b_2	b_3	b_4	Ex. important
	Noroozi	b_1	b_2	b_3	b_4	Ex. important
	Mash Golberar	b_1	b_2	b_3	b_4	Ex. important
watershed	Fallah Rad	b_1	b_2	b_3	b_4	Ex. important
	Haji Sabili	b_1	b_2	b_3	b_4	Ex. important
	Haddadi	b_1	b_2	b_3	b_4	Ex. important

Stakeholders' rank order of alternative impacts on the Plant Diversity criterion

Name of Group	Name of respondents	First order	Second order	Third order	Forth order	Importance
Nomad	Ghaffari	c_1	c_2	c_3	c_4	Important
	Momaeezi	c_1	c_2	c_3	c_4	Very important
	Montazer Lotf	c_1	c_2	c_3	c_4	Very important
Environment	Hosseni Jabali	c_1	c_2	c_3	c_4	Very important
	Kargar	c_1	c_2	c_3	c_4	Very important
	Mashadi Ahmadi	c_1	c_2	c_3	c_4	Ex. important
	Sadooghi	c_1	c_2	c_3	c_4	Ex. important
	Shekar Abi	c_1	c_2	c_3	c_4	Ex. important
Natural resources	Mossaebi	c_1	c_2	c_3	c_4	Very important
	Ansari	c_1	c_2	c_3	c_4	Very important
	Badi Nia	c_1	c_2	c_3	c_4	Ex. important
	Behzad	c_1	c_2	c_3	c_4	Ex. important
	Fallahi	c_1	c_2	c_3	c_4	Ex. important
	Mahdavi	c_1	c_2	c_3	c_4	Very important
	Zanjani	c_1	c_2	c_3	c_4	Very important
	Nik Nejad	c_1	c_2	c_3	c_4	Very important
	Rahmani	c_1	c_2	c_3	c_4	Very important
N.G.O	Ashtari	c_1	c_2	c_3	c_4	Very important
	Shabani	c_1	c_2	c_3	c_4	Ex. important
	Nia Sari	c_1	c_2	c_3	c_4	Ex. important
	Badripour	c_1	c_2	c_3	c_4	Ex. important
Ranchers	Arab Halvai	c_1	c_2	c_3	c_4	Ex. important
	Asivan	c_1	c_2	c_3	c_4	Ex. important
	Feredooni	c_1	c_2	c_3	c_4	Ex. important
	Gholam Hosseni	c_1	c_2	c_3	c_4	Ex. important
	Haji Noroozi	c_1	c_2	c_3	c_4	Ex. important
	Noroozi	c_1	c_2	c_3	c_4	Ex. important
	Mash Golberar	c_1	c_2	c_3	c_4	Ex. important
watershed	Fallah Rad	c_1	c_2	c_3	c_4	Ex. important
	Haji Sabili	c_1	c_2	c_3	c_4	Ex. important
	Haddadi	c_1	c_2	a_3	c_4	Ex. important

Stakeholders' rank order of alternative impacts on the Wildlife Diversity criterion

Name of Group	Name of respondents	First order	Second order	Third order	Forth order	Importance
Nomad	Ghaffari	d_4	d_2	d_3	d_1	Little important
	Momaeezi	d_2	d_1	d_3	d_4	Very important
	Montazer Lotf	d_2	d_1	d_3	d_4	Important
Environment	Hosseni Jabali	d_3	d_4	d_2	d_1	Important
	Kargar	d_1	d_2	d_3	d_4	Very important
	Mashadi Ahmadi	d_1	d_2	d_3	d_4	Ex. important
	Sadooghi	d_1	d_2	d_3	d_4	Ex. important
	Shekar Abi	d_1	d_2	d_3	d_4	Very important
Natural resources	Mossaebi	d_3	d_4	d_2	d_1	Important
	Ansari	d_1	d_2	d_3	d_4	Very important
	Badi Nia	d_4	d_3	d_2	d_1	Ex. important
	Behzad	d_2	d_3	d_1	d_4	Ex. important
	Fallahi	d_2	d_4	d_3	d_1	Ex. important
	Mahdavi	d_1	d_2	d_3	d_4	Very important
	Zanjani	d_1	d_2	d_3	d_4	Very important
	Nik Nejad	d_3	d_2	d_4	d_1	Important
	Rahmani	d_1	d_2	d_3	d_4	Very important
N.G.O	Ashtari	d_1	d_2	d_3	d_4	Very important
	Shabani	d_1	d_2	d_3	d_4	Ex. important
	Nia Sari	d_1	d_2	d_3	d_4	Very important
	Badripour	d_1	d_2	d_3	d_4	Very important
Ranchers	Arab Halvai	d_1	d_2	d_3	d_4	Very important
	Asivan	d_3	d_4	d_2	d_1	Very important
	Feredooni	d_4	d_3	d_2	d_1	Important
	Gholam Hosseni	d_1	d_2	d_3	d_4	Very important
	Haji Noroozi	d_1	d_2	d_3	d_4	Important
	Noroozi	d_4	d_3	d_2	d_1	Unimportant
	Mash Golberar	d_2	d_3	d_4	d_1	Important
Watershed	Fallah Rad	d_1	d_2	d_3	d_4	Important
	Haji Sabili	d_1	d_2	d_3	d_4	Very important
	Haddadi	d_1	d_2	d_3	d_4	Important

Stakeholders' rank order of alternative impacts on the Security of Habitat criterion

Name of Group	Name of respondents	First order	Second order	Third order	Forth order	Importance
Nomad	Ghaffari	e_1	e_2	e_3	e_4	Important
	Momaeezi	e_2	e_1	e_3	e_4	Important
	Montazer Lotf	e_3	e_2	e_4	e_1	Important
Environment	Hosseni Jabali	e_3	e_4	e_2	e_1	Important
	Kargar	e_1	e_2	e_3	e_4	Ex. important
	Mashadi Ahmadi	e_1	e_2	e_3	e_4	Ex. important
	Sadooghi	e_1	e_2	e_3	e_4	Very important
	Shekar Abi	e_1	e_2	e_3	e_4	Very important
Natural resources	Mossaebi	e_1	e_2	e_3	e_4	Ex. important
	Ansari	e_1	e_2	e_3	e_4	Important
	Badi Nia	e_2	e_3	e_4	e_1	Little important
	Behzad	e_2	e_3	e_1	e_4	Important
	Fallahi	e_4	e_3	e_2	e_1	Ex. important
	Mahdavi	e_1	e_2	e_3	e_4	Very important
	Zanjani	e_1	e_2	e_3	e_4	Very important
	Nik Nejad	e_1	e_2	e_3	e_4	Important
	Rahmani	e_1	e_2	e_3	e_4	Very important
N.G.O	Ashtari	e_1	e_2	e_3	e_4	Very important
	Shabani	e_1	e_2	e_3	e_4	Ex. important
	Nia Sari	e_1	e_2	e_3	e_4	Very important
	Badripour	e_1	e_2	e_3	e_4	Ex. important
Ranchers	Arab Halvai	e_1	e_2	e_3	e_4	Important
	Asivan	e_1	e_2	e_3	e_4	Ex. important
	Feredooni	e_1	e_2	e_3	e_4	Ex. important
	Gholam Hosseni	e_1	e_2	e_3	e_4	Ex. important
	Haji Noroozi	e_1	e_2	e_3	e_4	Very important
	Noroozi	e_1	e_2	e_3	e_4	Ex. important
	Mash Golberar	e_1	e_2	e_3	e_4	Ex. important
Watershed	Fallah Rad	e_1	e_2	e_3	e_4	Ex. important
	Haji Sabili	e_1	e_2	e_3	e_4	Ex. important
	Haddadi	e_1	e_2	e_3	e_4	Very important

Stakeholders' rank order of alternative impacts on the Cultural Attributes criterion

Name of Group	Name of respondents	First order	Second order	Third order	Forth order	Importance
Nomad	Ghaffari	f_1	f_2	f_3		Little important
	Momaeezi	f_1	f_2	f_3		Important
	Montazer Lotf	f_1	f_2	f_3		Important
Environment	Hosseni Jabali	f_1	f_2	f_3		Ex. important
	Kargar	f_1	f_2	f_3		Important
	Mashadi Ahmadi	f_1	f_2	f_3		Little important
	Sadooghi	f_1	f_2	f_3		Important
	Shekar Abi	f_1	f_2	f_3		Important
Natural resources	Mossaebi	f_1	f_2	f_3		Little important
	Ansari	f_1	f_2	f_3		Very important
	Badi Nia	f_1	f_2	f_3		Little important
	Behzad	f_1	f_2	f_3		Little important
	Fallahi	f_1	f_2	f_3		Important
	Mahdavi	f_1	f_2	f_3		Unimportant
	Zanjani	f_1	f_2	f_3		Very important
	Nik Nejad	f_1	f_2	f_3		Important
	Rahmani	f_1	f_2	f_3		Important
N.G.O	Ashtari	f_1	f_2	f_3		Little important
	Shabani	f_1	f_2	f_3		Important
	Nia Sari	f_1	f_2	f_3		Important
	Badripour	f_1	f_2	f_3		Important
Ranchers	Arab Halvai	f_1	f_2	f_3		Unimportant
	Asivan	f_1	f_2	f_3		Important
	Feredooni	f_1	f_2	f_3		Very important
	Gholam Hosseni	f_1	f_2	f_3		Important
	Haji Noroozi	f_1	f_2	f_3		Important
	Noroozi	f_1	f_2	f_3		Ex. important
	Mash Golberar	f_1	f_2	f_3		Ex. important
Watershed	Fallah Rad	f_1	f_2	f_3		Little important
	Haji Sabili	f_1	f_2	f_3		Important
	Haddadi	f_1	f_2	f_3		Little important

Stakeholders' rank order of alternative impacts on the Social Education criterion

Name of Group	Name of respondents	First order	Second order	Third order	Forth order	Importance
Nomad	Ghaffari	g_1	g_2	g_3	g_4	Important
	Momaeezi	g_1	g_2	g_3	g_4	Important
	Montazer Lotf	g_1	g_2	g_3	g_4	Important
Environment	Hosseni Jabali	g_1	g_2	g_3	g_4	Important
	Kargar	g_1	g_2	g_3	g_4	Important
	Mashadi Ahmadi	g_1	g_2	g_3	g_4	Very important
	Saddoghi	g_1	g_2	g_3	g_4	Important
	Shekar Abi	g_3	g_2	g_1	g_4	Important
Natural resources	Mossaebi	g_3	g_4	g_2	g_1	Unimportant
	Ansari	g_1	g_2	g_3	g_4	Little important
	Badi Nia	g_1	g_2	g_3	g_4	Ex. important
	Behzad	g_3	g_1	g_2	g_4	Little important
	Fallahi	g_1	g_2	g_3	g_4	Ex. important
	Mahdavi	g_1	g_2	g_3	g_4	Little important
	Zanjani	g_1	g_2	g_3	g_4	Very important
	Nik Nejad	g_1	g_2	g_3	g_4	Little important
	Rahmani	g_1	g_2	g_3	g_4	Ex. important
N.G.O	Ashtari	g_1	g_2	g_3	g_4	Very important
	Shabani	g_1	g_2	g_3	g_4	Important
	Nia Sari	g_1	g_2	g_3	g_4	Important
	Badripour	g_1	g_2	g_3	g_4	Very important
Ranchers	Arab Halvai	g_1	g_2	g_3	g_4	Little important
	Asivan	g_1	g_2	g_3	g_4	Important
	Feredooni	g_1	g_2	g_3	g_4	Very important
	Gholam Hosseni	g_3	g_4	g_2	g_1	Important
	Haji Noroozi	g_1	g_2	g_3	g_4	Important
	Noroozi	g_1	g_2	g_3	g_4	Ex. important
	Mash Golberar	g_1	g_2	g_3	g_4	Very important
Watershed	Fallah Rad	g_1	g_2	g_3	g_4	Very important
	Haji Sabili	g_1	g_2	g_3	g_4	Important
	Haddadi	g_1	g_2	g_3	g_4	Important

Stakeholders' rank order of alternative impacts on the Recreation criterion

Name of Group	Name of respondents	First order	Second order	Third order	Forth order	Importance
Nomad	Ghaffari	h_3	h_4	h_2	h_1	Important
	Momaeezi	h_4	h_3	h_2	h_1	Little important
	Montazer Lotf	h_1	h_2	h_3	h_4	Very important
Environment	Hosseni Jabali	h_2	h_3	h_4	h_1	Ex. important
	Kargar	h_4	h_3	h_2	h_1	Important
	Mashadi Ahmadi	h_1	h_2	h_3	h_4	Very important
	Saddoghi	h_1	h_2	h_3	h_4	Important
	Shekar Abi	h_2	h_1	h_3	h_4	Important
Natural resources	Mossaebi	h_1	h_2	h_3	h_4	Very important
	Ansari	h_1	h_2	h_3	h_4	Important
	Badi Nia	h_1	h_2	h_3	h_4	Ex. important
	Behzad	h_2	h_1	h_3	h_4	Important
	Fallahi	h_4	h_3	h_2	h_1	Little important
	Mahdavi	h_2	h_3	h_4	h_1	Important
	Zanjani	h_1	h_2	h_3	h_4	Very important
	Nik Nejad	h_1	h_2	h_3	h_4	Important
	Rahmani	h_2	h_3	h_4	h_1	Very important
N.G.O	Ashtari	h_4	h_3	h_2	h_1	Important
	Shabani	h_4	h_3	h_2	h_1	Important
	Nia Sari	h_1	h_2	h_3	h_4	Important
	Badripour	h_2	h_3	h_4	h_1	Important
Ranchers	Arab Halvai	h_4	h_3	h_2	h_1	Unimportant
	Asivan	h_2	h_3	h_4	h_1	Important
	Feredooni	h_4	h_3	h_2	h_1	Unimportant
	Gholam Hosseni	h_4	h_3	h_2	h_1	Important
	Haji Noroozi	h_4	h_3	h_2	h_1	Little important
	Noroozi	h_4	h_3	h_2	h_1	Unimportant
	Mash Golberar	h_4	h_3	h_2	h_1	Unimportant
Watershed	Fallah Rad	h_2	h_3	h_4	h_1	Very important
	Haji Sabili	h_2	h_3	h_4	h_1	Important
	Haddadi	h_2	a_3	h_4	h_1	Important

Stakeholders' rank order of alternative impacts on the Public Access criterion

Name of Group	Name of respondents	First order	Second order	Third order	Forth order	Importance
Nomad	Ghaffari	i_1	i_2	i_3	i_4	Very important
	Momaeezi	i_1	i_2	i_3	i_4	Unimportant
	Montazer Lotf	i_1	i_2	i_3	i_4	Little important
Environment	Hosseni Jabali	i_2	i_3	i_4	i_1	Little important
	Kargar	i_2	i_3	i_4	i_1	Little important
	Mashadi Ahmadi	i_1	i_2	i_3	i_4	Little important
	Sadooghi	i_2	i_3	i_4	i_1	Important
	Shekar Abi	i_3	i_4	i_2	i_1	Little important
Natural resources	Mossaebi	i_2	i_1	i_4	i_3	Important
	Ansari	i_1	i_2	i_3	i_4	Ex. important
	Badi Nia	i_1	i_2	i_3	i_4	Very important
	Behzad	i_3	i_4	i_2	i_1	Unimportant
	Fallahi	i_2	i_3	i_4	i_1	Unimportant
	Mahdavi	i_1	i_2	i_3	i_4	Important
	Zanjani	i_1	i_2	i_3	i_4	Important
	Nik Nejad	i_2	i_3	i_1	i_4	Important
	Rahmani	i_1	i_2	i_3	i_4	Very important
N.G.O	Ashtari	i_3	i_4	i_2	i_1	Little important
	Shabani	i_1	i_2	i_3	i_4	Important
	Nia Sari	i_2	i_3	i_4	i_1	Important
	Badripour	i_2	i_3	i_4	i_1	Very important
Ranchers	Arab Halvai	i_3	i_4	i_2	i_1	Little important
	Asivan	i_2	i_3	i_4	i_1	Important
	Feredooni	i_2	i_3	i_4	i_1	Very important
	Gholam Hosseni	i_3	i_4	i_2	i_1	Important
	Haji Noroozi	i_1	i_2	i_3	i_4	Little important
	Noroozi	i_4	i_3	i_2	i_1	Unimportant
	Mash Golberar	i_3	i_2	i_4	i_1	Very important
Watershed	Fallah Rad	i_1	i_2	i_3	i_4	Very important
	Haji Sabili	i_2	i_3	i_4	i_1	Important
	Haddadi	i_2	i_1	i_3	i_4	Important

Stakeholders' rank order of alternative impacts on the Part Time Job criterion

Name of Group	Name of respondents	First order	Second order	Third order	Forth order	Importance
Nomad	Ghaffari	j_3	j_4	j_2	j_1	Important
	Momaeezi	j_1	j_2	j_3	j_4	Very important
	Montazer Lotf	j_4	j_3	j_2	j_1	Very important
Environment	Hosseni Jabali	j_1	j_2	j_3	j_4	Unimportant
	Kargar	j_1	j_2	j_3	j_4	Ex. important
	Mashadi Ahmadi	j_4	j_3	j_2	j_1	Little important
	Sadooghi	j_3	j_2	j_1	j_4	Little important
	Shekar Abi	j_1	j_2	j_3	j_4	Little important
Natural resources	Mossaebi	j_3	j_4	j_2	j_1	Important
	Ansari	j_4	j_3	j_2	j_1	Ex. important
	Badi Nia	j_4	j_3	j_2	j_1	Ex. important
	Behzad	j_1	j_2	j_3	j_4	Unimportant
	Fallahi	j_1	j_2	j_3	j_4	Little important
	Mahdavi	j_4	j_3	j_2	j_1	Very important
	Zanjani	j_4	j_3	j_2	j_1	Important
	Nik Nejad	j_4	j_3	j_2	j_1	Important
	Rahmani	j_4	j_3	j_2	j_1	Very important
N.G.O	Ashtari	j_1	j_2	j_3	j_4	Unimportant
	Shabani	j_2	j_1	j_3	j_4	Important
	Nia Sari	j_1	j_2	j_3	j_4	Important
	Badripour	j_1	j_2	j_3	j_4	Little important
Ranchers	Arab Halvai	j_3	j_2	j_1	j_4	Ex. important
	Asivan	j_1	j_2	j_3	j_4	Little important
	Feredooni	j_2	j_1	j_3	j_4	Ex. important
	Gholam Hosseni	j_4	j_3	j_2	j_1	Very important
	Haji Noroozi	j_3	j_2	j_1	j_4	Ex. important
	Noroozi	j_1	j_2	j_3	j_4	Ex. important
	Mash Golberar	j_1	j_2	j_3	j_4	Ex. important
Watershed	Fallah Rad	j_1	j_2	j_3	j_4	Unimportant
	Haji Sabili	j_3	j_2	j_1	j_4	Unimportant
	Haddadi	j_1	j_2	j_3	j_4	Important

Stakeholders' rank order of alternative impacts on the Water Supply criterion

Name of Group	Name of respondents	First order	Second order	Third order	Forth order	Importance
Nomad	Ghaffari	k_1	k_2	k_3	k_4	Ex. important
	Momaeezi	k_1	k_2	k_3	k_4	Ex. important
	Montazer Lotf	k_1	k_2	k_3	k_4	Ex. important
Environment	Hosseni Jabali	k_1	k_2	k_3	k_4	Ex. important
	Kargar	k_1	k_2	k_3	k_4	Ex. important
	Mashadi Ahmadi	k_1	k_2	k_3	k_4	Important
	Sadooghi	k_1	k_2	k_3	k_4	Ex. important
	Shekar Abi	k_1	k_2	k_3	k_4	Ex. important
Natural resources	Mossaebi	k_1	k_2	k_3	k_4	Ex. important
	Ansari	k_1	k_2	k_3	k_4	Ex. important
	Badi Nia	k_1	k_2	k_3	k_4	Important
	Behzad	k_1	k_2	k_3	k_4	Ex. important
	Fallahi	k_1	k_2	k_3	k_4	Ex. important
	Mahdavi	k_1	k_2	k_3	k_4	Very important
	Zanjani	k_1	k_2	k_3	k_4	Ex. important
	Nik Nejad	k_1	k_2	k_3	k_4	Ex. important
	Rahmani	k_1	k_2	k_3	k_4	Ex. important
N.G.O	Ashtari	k_1	k_2	k_3	k_4	Ex. important
	Shabani	k_1	k_2	k_3	k_4	Ex. important
	Nia Sari	k_1	k_2	k_3	k_4	Important
	Badripour	k_1	k_2	k_3	k_4	Ex. important
Ranchers	Arab Halvai	k_1	k_2	k_3	k_4	Important
	Asivan	k_1	k_2	k_3	k_4	Ex. important
	Feredooni	k_1	k_2	k_3	k_4	Very important
	Gholam Hosseni	k_1	k_2	k_3	k_4	Ex. important
	Haji Noroozi	k_1	k_2	k_3	k_4	Ex. important
	Noroozi	k_1	k_2	k_3	k_4	Ex. important
	Mash Golberar	k_1	k_2	k_3	k_4	Ex. important
watershed	Fallah Rad	k_1	k_2	k_3	k_4	Ex. important
	Haji Sabili	k_1	k_2	k_3	k_4	Ex. important
	Haddadi	k_1	k_2	k_3	k_4	Ex. important

Stakeholders' rank order of alternative impacts on the Cost of Plan criterion

Name of Group	Name of respondents	First order	Second order	Third order	Forth order	Importance
Nomad	Ghaffari	l_4	l_3	l_2	l_1	Very important
	Momaeezi	l_4	l_3	l_2	l_1	Very important
	Montazer Lotf	l_1	l_2	l_3	l_4	Very important
Environment	Hosseni Jabali	l_2	l_1	l_3	l_4	Little important
	Kargar	l_2	l_1	l_3	l_4	Ex. important
	Mashadi Ahmadi	l_4	l_3	l_2	l_1	Unimportant
	Sadooghi	l_3	l_4	l_2	l_1	Important
	Shekar Abi	l_4	l_3	l_2	l_1	Ex. important
Natural resources	Mossaebi	l_4	l_3	l_2	l_1	Very important
	Ansari	l_1	l_2	l_3	l_4	Important
	Badi Nia	l_1	l_2	l_3	l_4	Very important
	Behzad	l_4	l_3	l_2	l_1	Ex. important
	Fallahi	l_4	l_3	l_2	l_1	Important
	Mahdavi	l_3	l_2	l_1	l_4	Important
	Zanjani	l_1	l_2	l_3	l_4	Important
	Nik Nejad	l_4	l_3	l_2	l_1	Very important
	Rahmani	l_2	l_1	l_3	l_4	Very important
N.G.O	Ashtari	l_4	l_3	l_2	l_1	Important
	Shabani	l_3	l_2	l_1	l_4	Very important
	Nia Sari	l_1	l_2	l_3	l_4	Important
	Badripour	l_3	l_4	l_2	l_1	Very important
Ranchers	Arab Halvai	l_4	l_3	l_2	l_1	Unimportant
	Asivan	l_3	l_4	l_2	l_1	Little important
	Feredooni	l_1	l_2	l_3	l_4	Ex. important
	Gholam Hosseni	l_4	l_3	l_2	l_1	Important
	Haji Noroozi	l_4	l_3	l_2	l_1	Little important
	Noroozi	l_1	l_2	l_3	l_4	Ex. important
	Mash Golberar	l_3	l_2	l_1	l_4	Ex. important
Watershed	Fallah Rad	l_1	l_2	l_3	l_4	Ex. important
	Haji Sabili	l_3	l_2	l_1	l_4	Very important
	Haddadi	l_2	l_1	l_3	l_4	Very important

Curriculum Vitae

Kamran Zendehdel was born in Langerood, Iran on February 3th, 1971. He completed secondary school at the Imam Khomani High school in Langerood in 1989. He obtained his B.Sc. in Rangeland and Watershed Management from Mazandaran University (Iran) in 1995. He continued his academic education at the Tehran University, Faculty of Natural Resources, where he obtained his M.Sc. in Rangeland Management in 1998.
In August 2003, he started his PhD at Ghent University (Belgium), Faculty of Agricultural Economics on environmental valuation and policy making. At the same year he started a Doctoral Tranning program at Ghent University and he successfully obtained this diploma in March 2008.

He has participated in different national, international conferences, seminars and workshops where he presented oral and poster presentations.

Publications in peer-reviewed journal and book chapter:

Zendehdel, K., M., Rademaker, B., De Baets, G., Van Huylenbroeck, (2008), Tractable group decision based on social intensities of preferences. Submitted to the Journal of Decision Support Systems.

Zendehdel, K., M., Rademaker, B., De Baets, G., Van Huylenbroeck, (2007), Ordinal valuation of environmental criteria through a group consensus based on stochastic dominance. Accepted, Journal of Ecological Economics.

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Conferences and presentations:

2007, A multi-criteria approach in environmental valuation method, oral presentation. First International Conference on Environmental Management, Engineering, Planning and Economics (CEMEPE) Skiathos Island, Greece – June 24th to 28th.

2007, Introducing a deliberative multi-criteria decision approach to elicit respondents' preferences on environmental services. The 10th ABER-BVLE workshop at Leuven University, Belgium, April 25th.

2006, A Qualitative Approach in Environmental Valuation Method, oral presentation. Ninth Biennial Conference on "Ecological Sustainability and Human Well-being". December 15th-18th, India, New Delhi.

2006, A Novel Approach in Environmental Valuation Method, Poster Presentation. 12th PhD Symposium on Applied Biological Science, 21st September. Gent University, Belgium.

2006, A new approach in Environmental Valuation, Poster presentation. World Conference on Natural Resources Modelling, 25th-28th June, Bergen, Norway.

2005, A framework for participatory valuation method, Oral presentation. Symposium on applied Biological Science, Ghent University.

2001, Rangelands and Drought. National Conference of Environmental Impact, Oral presentation. Science & Research, Azad University of Tehran...

Work Experience

1998 - 2003, Expert of Technical Department of Range Management in Forest, Rangeland and Watershed Organization, Headquarters, Tehran, Iran.

2000 - 2003, Expert and member of "Special Committee for Rangeland Rehabilitation and Drought Control" Interior Ministry, Tehran, Iran.

1996 - 2003 Supervisor of range management plans in eight different provinces in Iran. Forest, Rangeland and Watershed Organization, Headquarters, Tehran.

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