



## Similarities in stakeholder identification of restoration targets in a semiarid area



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### ARTICLE INFO

#### Article history:

Received 24 February 2015

Received in revised form

18 November 2015

Accepted 4 December 2015

Available online 21 January 2016

#### Keywords:

Participatory management

Morocco

Ecosystem services

Consistency

### ABSTRACT

Ecological restoration is a suitable tool to revert the decline in the provision of ecosystem services in semiarid areas. Stakeholder opinion has been increasingly incorporated in ecological restoration strategies. However, the debate still exists whether the opinion of scientists and managers should be integrated together with that of local stakeholders in the decision making process. We assessed the restoration priorities in a semiarid area in North Morocco according to the opinion of 67 stakeholders, including scientists and managers, direct users and collaborators. The questions consisted in (i) ranking five categories of services in addition to economic benefits, and in (ii) comparing pairs of services within each category. We checked for both cardinal and ordinal inconsistency. The results showed an overall consensus about regulating and supporting services as the most valuable categories. More specifically, the most important services were erosion and flood control, soil fertility, water supply and species richness. The accuracy of the responses of the three groups was similar as the consistency for their judgments was not significantly different. Our results bring additional proof that the opinion of scientists, managers and local stakeholders should be considered of similar interest and accuracy when defining the most suitable restoration objectives.

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## 1. Introduction

Ecosystem services represent the benefits that humans obtain from ecosystems (Millennium Ecosystem Assessment (MEA), 2005). Their global provision is declining due to the strong pressure exerted by human societies on ecosystems (Butchart et al., 2010; Reyers et al., 2009). Ecological restoration has the power to revert such decline, particularly for supporting and regulating services (Society for Ecological Restoration and International Science and Policy Working Group, 2004). Restoration actions often involve a broad range of stakeholders with diverse and often conflicting interests. Incorporating stakeholder choices and preferences has therefore become a necessity in ecological restoration strategies and actions (Bullock et al., 2011; De Groot et al., 2010).

Although local stakeholders are increasingly involved in projects dealing with the restoration of ecosystem services, few efforts have been made to address their preferences on ecosystem services

from the perspective of their values, attitudes and beliefs (Martín-López et al., 2012). Furthermore, their opinion is rarely considered in the early phases of the projects, such as the definition of objectives and priorities of restoration actions (Khater et al., 2012). In most cases, scientists and managers seem more concerned about the acceptance of their own visions, rather than open to the perspectives and needs of other stakeholders (Menzel and Teng, 2009). A key factor behind this situation is that scientists and managers may differently understand and value ecosystem services in comparison to local stakeholders. In general, for scientists and managers, comprehension of ecosystem service notions pass through their scientific and technological experience, whereas for local stakeholders, it passes through their societal and cultural interactions with the immediate environment and their deep empirical knowledge, acquired over the years (McNeely, 2003; Reed, 2008). The two groups may also differ by their level of dependence on natural resources, their proximity to the considered area and their personal interests, among others. The main question here is whether these differences between the two groups may influence their choice of a suitable set of ecological restoration

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priorities. This topic has been widely discussed in the USA, Europe and South Africa, when assessing environmental and land management strategies (Chalmers and Fabricus, 2007; Goma et al., 2001; Lamarque et al., 2011; Payton et al., 2003; Strager and Rosenberger, 2006). The debate still exists whether the opinion of the two groups should be simultaneously integrated in environmental decision-making (Gadgil et al., 2003; Mauro and Hardison, 2000; Nadasny, 1999).

In environmental decision making processes, the estimation of the weight (importance) of the elements under assessment, mostly alternatives and criteria, is a fundamental step. Pairwise comparison has been frequently selected as the weighting procedure (Malczewski, 1999; Romero, 1996). This method allows comparing elements one by one, and assigning a judgment value along the 1–9 scale to each comparison, as recommended by Saaty (1980). The weight of each element is then mathematically computed. Pairwise comparisons offer the possibility to check the harmony and goodness of the preferences by computing the consistency of the emitted judgments. The consistency value is a useful statistical measure to ensure that the emitted judgments are closer to being logically made than randomly performed, and consequently that the corresponding weights are acceptably derived (Bozóki and Rapsák, 2008; Siraj, 2011). The consistency of the preferences expressed by scientists and managers in comparison to local stakeholders has been analyzed in many studies focused on environmental issues such as forest management planning (Kangas, 1994), energetic policies' implications (Noble, 2004), and selection of sites for waste disposal (De Feo and De Gisi, 2010). In ecological restoration, such comparative analysis is still rare.

In Morocco, new planning strategies consider local populations as a key factor in socioeconomic development. For example, in the forest sector, the National Forest Program adopted in 1998 stresses the importance of the adhesion of local populations to sustainable management programs (Moroccan Forest Ministry, 1999). Under these considerations, the Moroccan Administration has recently developed several agricultural and forest projects to restore degraded semiarid lands (Benbrahim et al., 2004). There are many experiences of the active involvement of stakeholders in development projects, including the GEF-Rif project (Melhaoui, 2002) which focused on the participative management of forest ecosystems in the Rif region, North Morocco, and the Demonstration Project on Strategies to Combat Desertification in Arid Lands with Direct Involvement of Local Agro-pastoral Communities in Tansift, south Morocco (Mulas et al., 2012). However, this is not a general trend, and the local community is still barely involved in agricultural and forest projects, especially in early stages of project formulation. Usually, local beneficiaries are asked to accept or refuse a specific package of actions, with no possibility to discuss their pertinence, level of priority or execution mode (International Bank for Reconstruction and Development, 2006). This may partly explain why many ecological restoration actions, such as reforestation programs, are often subject to massive objection by local populations who rarely recognize the positive impacts of these actions (Boujrouf, 1996; Moufaddal, 2007). There is an urgent need to develop more integrative restoration programs which consider opinions from different components of the community. Additionally, the need still exists for easy and flexible methods that elicit stakeholder preferences on ecosystem services in a manner that considers the various factors related to Moroccan semiarid rural areas such as poverty, analphabetism and high dependence on natural resources.

The main objectives of this study are: (i) to evaluate the environmental and socioeconomic priorities in a Moroccan semiarid area, expressed in terms of ecosystem services by a representative sample of stakeholders, (ii) to compare the priorities of scientists

and managers and those of local stakeholders, and assess the consistency of the judgments of both groups, and (iii) to propose a framework for an integrative definition of ecological restoration targets.

## 2. Material and methods

### 2.1. Study area

Our study was conducted at Béni Boufrah valley (34°58'–35°10'N; 4°14'–4°25'W) located in the Central Rif, 55 km W of Al Hoceima, and covering 163 km<sup>2</sup> (N Morocco, Fig. 1). Climate is semiarid Mediterranean with cold and mild winters. Rainfall is irregular and often stormy. Topography is abrupt and the valley is longitudinally crossed by a river, also called Béni Boufrah, which has a broad riverbed covered with gravels. Béni Boufrah is one of the Moroccan neediest areas (poverty rate of 18%) and it is characterized by high population size (10,298 inhabitants), high demographic density (65 inhabitants per Km<sup>2</sup>), large household size (6.6 inhabitant per household), high rates of illiteracy (57% for people over 10 years) and a serious problem of rural exodus (Moroccan General Census, 2004; Regional Forest Administration of NE Morocco, 2012). The proportion of active population is high, as 57% of the people are between 15 and 59 year-old. The gender structure is equilibrated, with 52% of men and 48% of women.

The productive system is polyvalent and it is mainly based on agriculture, animal husbandry and sea fishing (Al Karkouri et al., 2002). Subsistence farming delivers low yields as a consequence of land fragmentation, rough terrain, high soil stoniness, and lack of irrigation and mechanization. The dominant crops are rainfed cereals, mainly barley and wheat, and fruit trees, mostly almond and olive. Béni Boufrah is known by a cactus cultivar (*Opuntia ficus-indica* (L.) Mill. var. *Dellahia*), which has gained an increasing cultural and commercial value at regional and national scales. Animal husbandry (mostly extensive) is based on sheep and goats. Grazing pressure has been recently reduced as a result of successive droughts, rural exodus and abandonment of traditional agro-pastoral systems. Sea fishing has always constituted the main economic activity in coastal villages, but due to its artisanal nature, the contribution of this activity to monetary incomes and employment is limited. The area hosts other economic activities of lower importance such as harvesting of aromatic and medicinal plants, beekeeping, eco-tourism, among others.

Béni Boufrah forests are dominated by Barbary Red Cedar (*Tetraclinis articulata* Vahl Masters). In addition to its ecological and socioeconomic importance, *Tetraclinis* forest plays a relevant role in local customs and cultural identity. However, in the beginning of the 20th century, *Tetraclinis* forests have been intensely decimated as a consequence of illicit cutting and expansion of agricultural land (Pascon and Wusten, 1983). Forest decline has been accompanied by other forms of natural resource degradation, as soil erosion, loss of soil fertility and increased risk of flooding. Since the 1960s, the Moroccan Administration undertook several projects aimed at restoring the landscape in this region, including the DERRO project (Economic and Rural Development of the Western Rif, 1961–1972). Implemented measures encompassed the plantation of *Pinus halepensis* on terraces and almond trees on agricultural fields (Fig. 2), and a wide variety of actions to control erosion (Al Karkouri et al., 2002; Pascon and Wusten, 1983). Despite these initiatives, the provision of ecosystem services has steadily decreased as human pressure and degradation increased (Al Karkouri, 2003).

### 2.2. Establishment of a multi-stakeholder platform

In our study, we use the term “stakeholder” to refer to “those

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