



# How to improve strategic decision-making in complex systems when only qualitative information is available



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## ABSTRACT

This paper continues a line of research on improving strategic decisions (SD). The nature of governance issues (complex and uncertain world, lack of information, consideration of qualitative and quantitative information, participation of different actors in the decision making processes, etc.) implies that there is no unique solution or strategy in a complex system. On the contrary, there are a range of alternative strategies, which could lead to different futures (scenarios). Working with the qualitative methodology proposed allows decision makers and social actors to be more aware of the directions their decisions could lead the system; and what the key variables are for the implementation of public policies to achieve the desired (or agreed) scenario. An integrated methodology is discussed, and the process of desertification in the Canary Islands is used to illustrate it.

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## 1. Introduction

This article carries on the research of authors on the development of methodologies to improve Strategic Decisions (Legna Verna et al., 2005a,b; Legna Verna and González González, 2006, 2005; Legna Verna, 2010, 2007, 2000; Corral Quintana et al., 2002; Guimarães Pereira and Corral Quintana, 2002a,b). It is based on the results of a research project funded by the government of the Canary Islands to assess the process of desertification, which has been increasing over the last few decades, and to propose policies to reduce it. The research team was composed of the authors and other researchers from various departments of the University of La Laguna.

In recent years, the so called decision tools –in which decision support systems (DSS) are included– have been enhanced not only because of technology but also because of greater skills and acceptance to actually use such tools for consultation purposes. In a sense, we have been witnessing a change in the use of *decision tools* within *decision-making* processes. More accountable and inclusive governance styles have also been emerging, which highlight the fact there is not a single decision maker (there was never only one, but

now DSS developers are no longer pretending there is) but debates involving many actors that take place over policy issues. Accountability and inclusive processes have been progressively promoted in the last two decades through new legislation. Moreover, there has also been a progressive recognition that it is not at the level of *decision* that appropriate consultation, dialogue and deliberation take place among those concerned<sup>1</sup> with a certain *problematique*.

Environmental issues entail multiple dimensions of analysis that cannot be *amalgamated* into a single measurement scale because they belong to different aspects and actors of the processes. Actors *talk* different *languages*, express uncertainty in different ways – hence, new developments in information tools have to take into account this diversity. In the past, many *decision* systems, corresponding to institutional requests, were aimed at delivering expert knowledge to *legitimate* decisions taken. However, emerging governance styles require interfaces for the extended involvement of relevant actors (De Marchi et al., 2001). There is an opportunity here for developing these tools as platforms to involve different

<sup>1</sup> These are frequently called social actors or stakeholders (North American School) and in Dutch and German literature, the *betroffenen* (those concerned). Although throughout this paper, the word actors is used, while waiting for a better term. By *actors* it is meant here, those that may affect or be affected by a “problematique”, and this includes not only those that have a stake or interest or those that play a role but also anyone who is concerned or affected by a situation.

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flows of *knowledge and wisdom*. Such tools are no longer viewed as the means to legitimate decisions but rather to initiate and inform debates and decision-making processes.

As mentioned earlier, tools to inform such processes have been changing over time not only with the adoption of different technologies and design concepts, but also in the conceptual framework used. In the last few decades, DSS for environmental issues have evolved toward the integration of social research methods and institutional analysis (Guimarães Pereira, and Corral Quintana, 2002a; Paneque Salgado et al., 2009). Other authors such as Low and Astle, (2009) and Ostrom (1990, 2005) have also pointed out the importance of the social context and institutions in governance processes. In fact, several studies dealing with participation techniques and processes have been carried out with regard to natural resources management (De Marchi et al., 2000; Gamboa and Munda, 2007; Paneque Salgado et al., 2009; Khadka et al., 2013; Kangas et al., 2010).

In general, participatory methods for resource management are becoming increasingly important as a requirement for a high level of participation that has been prescribed in the environmental directives of the EU and elsewhere. Thus, several participatory approaches and methods have been proposed to facilitate an effective involvement of stakeholders in these issues. In this article, participatory modeling, and more specifically, system dynamics modeling methodology is integrated within a broader exploratory framework to facilitate the identification of the fundamental structure underlying the processing of information flows. It follows the work carried out by Videira, et al. (2003, 2009) in which, the role of collaborative environmental decision-making and the involvement of stakeholders in the development and experimentation of alternative policy scenarios is critically evaluated. Previously, d'Aquino et al. (2002) discussed the relevance of participatory modeling to deal with land-use management issues. These might be considered complex issues due to the uncertainty and the inherent variety of legitimate perspectives involved. Moreover, these approaches are particularly relevant when dealing with socio-environmental problems characterized by data scarcity, as Ritzema et al. (2010) suggested when dealing with environmental planning for the restoration of the Kolleru–Upputeru wetland ecosystem on the east coast of Andhra Pradesh in South India.

Essentially, tools to inform dialogues, debates and deliberations (TIDDD) are tools that deploy new information & communication technology (namely internet, multi-media and 3D virtual reality interfaces) in order to organize the information that feeds into a dialogue process about a governance issue. TIDDD are designed to support participatory processes. These types of tools originate from integrated assessment activities (Sors et al., 1997; De Marchi et al., 1998). TIDDD are designed for each context and audience in which they are to be used and feature *progressive disclosure of information*. They are a contribution to the implementation of the science and governance initiatives. (Corral Quintana et al., 2002; Guimarães Pereira and Corral Quintana, 2002b).

The role of information tools is not only to provide the *knowledge* to inform a debate but also to be the common ground platform through which the debate is organized, as well as to integrate other sources of knowledge that may emerge during the process. Involvement of actors is viewed as a mark of quality assurance in the decision-making processes and corresponds to the principles of extended peer review (Funtowicz and Ravetz, 1990), i.e. involving those that affect or are affected by a *problematique* to ensure higher quality of decision processes and identify different alternative courses of action (Commission-of-the-European-Communities 2001).

The first section deals with the elaboration of qualitative models; the second with the application of system dynamics based mainly on the results of the qualitative analysis; the third one the

definition of logical path of scenarios; and in the last section the authors explain how to combine these tools to select strategies.

## 2. The desertification process on small islands: a complex issue

Desertification is the result of the action of a set of processes that cause a decline in the biological potential of a territory and its productivity. It is basically based on the negative impact of human activities on geographical areas under arid conditions. Thus, the United Nations Convention to Combat Desertification (UNCCD) defined, in Article 1, this process as being “land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities.

It is a complex phenomenon in which multiple factors of various kinds are involved. It is an environmental problem, but also a social and economic one. Desertification is not solely due to aspects such as soil erosion, loss of vegetation cover, soil salinization, loss of welfare of the population, social marginalization, etc., but also, and mainly to the interaction among all of these.

The term desertification has been incorporated into common language in recent times, although in some cases its meaning has been misinterpreted. Desertification is neither just a kind of environmental degradation nor is limited to erosion or drought processes, it is the strong existing relationship between all of them. As said before, it is not a purely environmental problem; it also has important social and economic connotations. The UNCCD in its preamble declares: “...that desertification is caused by complex interactions among physical, biological, political, social, cultural and economic”. However, it is usually not associated with the abandonment of traditional farming systems, agricultural intensification, or concentration of economic activity in coastal zones, among others.

Besides taking into account the effect of this process on human welfare in the broadest sense, it may also affect education, food and health among other societal pillars and hence the quality of life (Adeel et al., 2005).

Decision-making actions are not only complex due to these systemic interactions but also due to the involvement of different stakeholders –private and public– with specific perspectives and values and pursuing different interests. These come from fields such as environment, agriculture, hydrology, land use, education and economics, among others; and whose powers usually reside in different institutional bodies and not always even in the same administration fields. Combating desertification requires a major effort of integration, coordination and also consensus among those involved.

The Canary Islands due to its geographical location and insular character is a territory where ecosystems and agricultural systems are generally very fragile, which makes it very sensitive to these processes. In fact, there are, nowadays, areas already showing the effects of desertification, while others are clearly at high risk of suffering it.

Among the main triggers of desertification in the Canary Islands, there are both natural causes (i.e. climate, topography, soil, etc.) and those related to human activities (grazing, intensive agriculture and loss of traditional culture styles, quality and management of irrigation water, changes in the characteristics of the soil cover and its sealing, population growth,...) involved.

An analysis of the situation shows that about 82% of the archipelago is included within the definition of aridity and therefore at risk from desertification. The islands of Lanzarote (LZ) and Fuerteventura (FV) have 100% of their area within the arid or semi-arid regime, while on the island of La Palma (LP) only 31% of the territory might be considered as dry lands. Table 1 shows the per-

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