

The influence of decision and information support tools on organisational interaction within desertification governance

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Desertification has been a priority in the environmental policy agenda over the last four decades. A number of tools have been proposed to support policy making and management of desertification, amongst which decision and information support tools (DISTs) constitute the object of study of this paper.

DISTs are defined as computer-based systems designed to support policy making and management. DIST literature has been so far mainly focussed on (i) analysing the potential application of DISTs within the environmental field (e.g. simulation of environmental processes, land use mapping or visualization of land use changes); (ii) identifying recommendations for a better design of DISTs; and, (c) studying the impacts of DIST use in the effectiveness and efficiency of organisations. However, there are no studies in the literature which investigate the role of DISTs in shaping interactions between organisations within environmental governance systems. In this context, the aim of this paper is to describe how DISTs play a role in modifying inter-organisational interactions within desertification governance networks.

The analysis presented is based on data gathered through a set of questionnaires and interviews with organisations involved in desertification policy and management at a number of scales from global down to sub-national. The data was analysed using a mixture of descriptive statistics and thematic analysis. Results suggest that DISTs have the potential to shape desertification governance interactions by making organisations more information-independent, by changing their mandate, by improving communication flows and discussion between organisations, and by making more stakeholders aware of information. DISTs are perceived as devices that objectively show the consequences of policy and management decisions as well as offering an opportunity for discussion amongst stakeholders, thereby enhancing the legitimacy of policy and management decisions.

The paper commences with a brief description of desertification governance. Following the presentation of research methods, the paper then describes the role(s) that DISTs play in desertification policy and management organisations. Results are then presented and discussed.

Keywords: *DISTs; desertification governance; interactions; legitimacy; structural changes*

1. INTRODUCTION

The formulation and implementation of policy and management action concerned with desertification has been described as a difficult task because of (i) a lack of robust assessment methods for identifying action priorities (Geist, 2005), and; (ii) poor integration and participation of local communities in policy or management action planning (Wilson and Juntti, 2005). To help remedy these issues a significant volume of research has been undertaken over the last few decades to develop computer-based tools to support environmental policy and management organisations based on various analytical techniques developed for option appraisal in the environmental sciences e.g. multi-criteria analysis, cost-benefit analysis, impact assessment, system dynamics simulation and life-cycle assessment.

DISTs are defined as computer-based tools conceived to provide accurate, reliable and objective information from which to base decisions. DISTs offer functionalities to capture, manage and store data; to better assess the extent of an environmental problem; to show scenarios of different policy alternatives; to represent data trends; or to engage stakeholders in policy making (Barr and Sharda, 1997; Carberry et al., 2002; McCown, 2002; Cockerill et al., 2004; McIntosh et al., 2005). Examples of DISTs include remote sensing, Geographical Information Systems (GIS), Decision Support Systems (DSS), computer simulation models and computer statistical models.

DISTs have become an important area of research since the 1990s. To cite just a few examples, DISTs have been developed to analyse the bio-physical and socioeconomic impacts of environmental policies, monitor changes in soil fertility or vegetation cover or water availability, select best available measures and policies, or determine driving forces (Diouf and Lambin, 2001; Holecz et al., 2003; Ochola and Kerkides, 2004; He et al., 2005). The impacts of DIST use on organisational performance – effectiveness and efficiency – and the identification of recommendations to improve the design of DISTs have received less attention. The influence of DISTs on organisational interactions – i.e. actions that occur as two or more organisations have an effect upon one another – has received even less attention in the literature, with no published analyses available.

Taking desertification as an example, this paper aims to explore the role of DISTs on intra- and inter-organisational interactions. At a preliminary stage, an analysis of desertification governance has been carried out with a view to determining how the current policy and management framework prevents organisations from more effectively combating desertification. Long Martello (2004) in her study of the past and present of desertification policy concludes that current desertification governance is characterized by a number of deficiencies that reduce the effectiveness of international action to combat desertification. The results of this paper indicate how DISTs are perceived as playing a role in overcoming those deficiencies and thereby altering current desertification governance towards a more effective policy and management structure.

Section 2 of the paper briefly describes desertification governance. Section 3 presents the research methods. Results are then presented and discussed, making reference to how DISTs might alter the desertification governance presented in Section 2. The last section of the paper highlights main research findings.

2. DESERTIFICATION AND DESERTIFICATION GOVERNANCE

Desertification is defined as the loss of soil fertility in the arid and semi-arid regions of the world. It is a global-scale problem that has caused serious impacts on soil quality, biodiversity of habitats and the socioeconomic structure of affected populations. Desertification is thought to be one of the most widespread environmental threats to human kind (Darkoh, 1997), having already reduced the productivity of more than 37.6 million Km² of land all over the world (Kosmas et al., 2003). Desertification is a local-contingent problem as driving forces are specific to each affected area (Long Martello, 2004). Common driving forces of desertification include land abandonment, aquifer overexploitation, urban sprawl, and agricultural overexploitation of land.

Unlike other environmental problems (e.g. climate change, biodiversity loss), desertification has traditionally suffered from political marginalization. It was not until 1994 that the Convention to Combat Desertification (UNCCD) was set up as the cornerstone of desertification policy and management. The analysis of the reports of the UNCCD also suggests that desertification has not been

a priority for action of many countries until very recently. The international effort of the last few years however indicates that desertification is on the spotlight of the international environmental policy agenda.

By the term ‘desertification governance’ we refer here to the set of organisations, as well as the relationships between those organisations, aimed at formulating and implementing policies to address environmental policy demands. Desertification governance is mainly characterised by the following elements:

Decentralisation. Policy making is not unified within a single body. Rather, a number of organisations from the international down to the sub-national level play a role in desertification policy making by either directly taking decisions (e.g. national ministries), establishing policy recommendations (e.g. international conventions), supporting the adoption of measures (e.g. United Nations agencies), or lobbying and representing local communities (NGOs) (Long Martello, 2004). Furthermore, the UNCCD has two groups of experts responsible for the provision of technical advice – the Group of Experts (GoE) and the Science and Technology Group (S&T). The UNCCD calls for a “bottom-up” approach based on involving traditional and local knowledge and practices in policy decisions (Long Martello, 2004). The “bottom-up” approach is considered highly valuable to set up suitable actions to combat desertification locally. Decentralisation offers an opportunity to all actors to participate in decision making. However, it has been acknowledged that further participation of local communities is still required (Long Martello, 2004).

Communication. Communication is one of the mainstays of desertification policy and management and, beyond the international scale is poorly done (Long Martello, 2004). Internationally, the Conference of Parties (COPs), held every two years, is a meeting point where organisations can discuss the evolution of, and the need for, policies and strategies to combat desertification. Other meetings that offer an opportunity for communication are the United Nations Convention on the Review of the Implementation to Combat Desertification (CRIC) and meetings of the GoE and the S&T.

Information dependency relationships. Information availability is one of the limiting factors of organisational action, and is particularly limiting for organisations with limited financial resources or technical expertise to collect, manage and analyse data. In this context, desertification policy and management organisations tend to establish relationships with others for the exchange and diffusion of information in order to guarantee the availability of information. A dependent organisation would be one that bases its decisions on the information provided by others. Information independency has been identified in the literature as one of the factors that limit the ‘power’ of organisations, where ‘power’ is understood as the ability of an organisation to act effectively without the resources of other organisations (Schneberger and Wade, 2007).

The existence of dependency relationships is common within the United Nations system where funding-oriented organisations rely upon the information provided by third parties.

The establishment of the UNCCD has had two main roles (i) it has strengthened policy interest in desertification issues and (ii) it has contributed to enhancing public awareness. More than 170 countries have already ratified the UNCCD, being in this regard even more successful than the Convention to Combat Climate Change (UNFCCC). Nevertheless, based upon the work of Long Martello (2004), current desertification governance presents a number of deficiencies that have to be overcome in order to make further progress in combating desertification namely:

- Insufficient participation of local entities in decision making
- Scarce knowledge of desertification, especially at the local level
- Absence of consensus. The existence of different policy preferences as well as the lack of objective and technical expertise that guides organisations in the selection of best available policies results in dissension about best available actions to combat desertification. This dissension of opinions may lead to the postponement, or even complete suspension, of the decision-making process. Examples of policy deferral are found both at the international and more local levels of action (e.g. replenishment of the GM – Global Mechanism – of the UNCCD or delays in the approval of the Spanish Action Plan).
- Dearth of mechanisms for effectively communicating and exchanging information between stakeholders

Treating these deficiencies as potential areas for improvement, it is considered that more effective desertification governance could be achieved if (i) the participation of local groups was fostered; (ii) more technical information about desertification was made available; and, (iii) mechanisms for better communication and exchange of information were identified.

3. RESEARCH METHODS

The results presented in this paper are based on the information compiled from fieldwork activities – questionnaires and interviews. Questionnaires and interviews were designed, under the framework of the EC FP6 DeSurvey Project to gather information on the types of DISTs used by end-user organisations, as well as the drivers for DIST implementation and impacts of DIST use with the ultimate aim of assessing the usefulness of DISTs in desertification policy and management (results reported in Diez 2009). However the information provided by questionnaire and interview respondents also offers an understanding of the relationship between DISTs and organisational interaction. The selection of questionnaires and interviews over other research methods (e.g. literature, observation) was based on the fact that (i) questionnaires are easy and cheap to distribute, and they allow the compilation of information from a large number of respondents; and, (ii) interviews provide detailed information on the issue of interest without requiring the continuous interference of the researcher, unlike observation.

In parallel with the preparation of questionnaires, a database with desertification policy and management organisations was built. More than 400 organisations between United Nations agencies, national ministries of agriculture, environment and foreign affairs, NGOs, sub-national departments of environment and agriculture, research centres, universities, and trade unions were contacted. Only organisations that answered the invitation letter were later invited to fill out the questionnaires. At a second phase of the research, interviews were designed. A stakeholder analysis (Mitchell *et al.* 1997) was carried out too in order to determine most relevant organisations for the purpose of our research based upon their involvement in desertification policy and management action, and their use of DISTs. In total 94 individuals were contacted for interview.

With the purpose of ensuring the quality of questionnaires and interviews a number of quality assurance measures were taken. Both questionnaires and interviews were piloted to determine the existence of ambiguous and difficult-to-understand questions. In order to prevent low response rates derived from language barriers, questionnaires were translated into four languages and interviews were conducted in English, French and Spanish.

84 responses to the questionnaire were received, a response rate of around 21%. 30 individuals were interviewed. Questionnaire responses were analysed and descriptive statistics determined for each question. A thematic analysis was carried out to analyse interviews.

4. PRESENTATION OF RESEARCH FINDINGS

75% of questionnaire respondents use DISTs to support their work and 85% of these respondents use more than one type of DIST (as illustrated in **Figure 1**). Similar results were obtained at the interview stage as 75% of the organisations use DISTs.

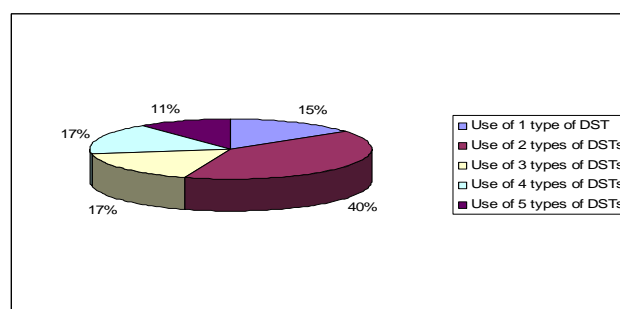


Figure 1. Number of types of DISTs used by respondents (or their departments) to support their work.

Questionnaire and interview results suggest that DISTs are perceived as being useful tools for overcoming the three deficiencies of desertification governance mentioned above (i.e. limited participation of local groups, shortage of technical knowledge about desertification, and absence of mechanisms to better communicate and exchange information). Furthermore, interview results indicate that DISTs are also perceived as being able to contribute to making organisations information independent of others, enhancing the ‘power’ of those organisations to act effectively.

Information dependency between organisations was perceived as a cause of two of the main problems to desertification policy and management organisations. On the one hand, it delays the decision-making process of information-dependent organisations as information is not typically delivered by the others at the time required. On the other hand, data providers are perceived as not always being aware of the information needs of end-user organisations (i.e. information-dependent organisations), and as a result information is often irrelevant. In this context, information independency might contribute to solving both problems and thereby enhance the effectiveness and efficiency of desertification policy and management organisations. Despite the volume of expenses (e.g. training, facilities, personnel) which organisations need to incur, the implementation and use of DISTs is justified by the information independency gained by end-user organisations.

Information independency was not only identified in the interviews as an impact of DIST use in organisations but also as a factor that could modify the structure of the desertification policy and management system as organisations could carry out activities that are not at present included in their mandate. The use of DISTs was linked to the emergence of new organisational mandates (i.e. responsibilities allocated to an organisation) and to changes in intra-organisational interactions such as the creation of new departments or units, or the development of new work protocols.

DISTs are also been perceived as instruments that facilitate communication between organisations and between organisations and stakeholders in general. Based upon interviewees’ responses, DISTs are perceived as improving communication because they enhance both the quality and the quantity of information provided to stakeholders. As for information quality, DISTs allow stakeholders to have a clearer understanding of the extent and severity of desertification by (i) developing and presenting data in the form of maps, which can be easily interpreted by stakeholders; (ii) carrying out scenario analyses of how policy decisions may alter the status of land; and, (iii) capturing data and monitoring changes of relevant desertification indicators. Regarding quantity issues, DISTs can facilitate the diffusion of information and make stakeholders aware of more information. A better and more objective understanding of desertification, coupled with the availability of more information, in turn is expected to help stakeholders reach consensus on best available measures to combat desertification.

Finally, respondents stressed the role of DISTs in enhancing participation and ‘decentralization’ in decision making. In fact, higher participation had the highest frequency of response at the interview stage, having been mentioned by 9 out of the 30 individuals interviewed (30%). DISTs have therefore been perceived as facilitators of participatory or ‘bottom-up’ approaches in desertification policy and management.

A summary of research findings is given in **Figure 2**. The list of features of organisational action has been taken from the analysis of questionnaires and interviews. **Figure 2** also represents the relationships that, according to our understanding, exist between those features.

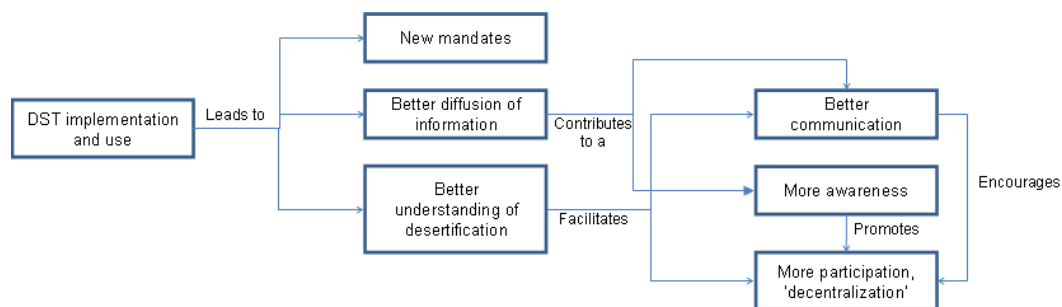


Figure 2. Components of organisational interaction affected by the implementation and use of DISTs.

5. DISCUSSION OF RESEARCH FINDINGS

Research findings indicate that the implementation and use of DISTs brings about a number of impacts on end-user organisations such as higher financial investment in the acquisition of facilities, employment of personnel or the provision of training. Research findings show that, in addition to changes at the organisational level, a number of impacts at the level of inter-organisational interaction occur namely – potential changes in the mandate of organisations, better diffusion of information amongst organisations, better communication, more awareness of desertification issues, and higher participation in decision making. Potential changes in the mandate could result from organisational motivations for information independency.

If we consider the current deficiencies of desertification governance (as described in **Section 2**), it can be observed that DISTs may act as organisational enablers and in doing so facilitate positive change in desertification governance.

DISTs are perceived as enabling organisations to both broaden the range of activities they are involved in as well as carrying out more activities in a productivity sense. Such an enabling effect may lead in some instances to changes in organisational mandates, causing the emergence of new responsibilities along with changes in the structure of organisations. At the intra-organisational level, changes in mandate can entail substantial financial investment in the acquisition of new facilities or the creation of new departments/ units. At the inter-organisational level, the potential of organisations to broaden the range of activities they are involved in leads to a number of benefits such as:

- A more equitable sharing of desertification-related tasks between organisations, therefore reducing excessive work loads of some organisations
- Capacity of organisations to develop new methodologies or adopt new approaches to combat desertification
- Capacity of organisations to become independent of the information provided by third parties, allowing organisations to take action at the time required and to avoid policy deferral

Policy deferral may also be avoided by improving communication flows between organisations. DISTs have a role to play here through facilitating the diffusion of information and by helping to ensure the production of high quality information in terms of reliability, accuracy, trustworthiness, relevance and objectivity. Better communication would not only be useful to enhance the efficiency of decision making but also support the legitimacy and credibility of decisions.

In addition to contributing to a better efficiency, the diffusion of information could facilitate higher rates of participation in desertification policy and management. As DISTs are used at the international down to the local level, there is some evidence to conclude that DISTs can be facilitators of local participation in desertification policy and management.

6. CONCLUSIONS

Desertification has become a top priority in the environmental policy agenda. United Nations agencies, regional organisations (e.g. European Commission), and national and sub-national ministries have worked over the last few years with the common aim of combating desertification. Nevertheless, the literature indicates that desertification policy and management governance needs to improve in the future in order to combat desertification more effectively and efficiently. Some of the deficiencies of current desertification governance include the limited participation of local groups in decision making, the shortage of technical knowledge from which to base decisions, and the lack of more tools to better communicate and exchange information. The study presented in this paper suggests that computer-based Decision Support Tools (DISTs) can contribute to overcoming these deficiencies by:

- Enabling organisations to carry out more and different activities, which may lead to changes in organisational mandate
- Enhancing public awareness of desertification issues and supporting the participation of different groups of stakeholders in the decision-making process
- Facilitating consensus as DISTs are perceived to offer better and more objective information from which to base decisions. Consensus in turn avoids policy deferral.

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- Providing an understanding of desertification through the provision of information and information analysis capabilities

These results are based on the data collected through questionnaires and interviews, which were originally developed to understand what drives the implementation and continuous use of DISTs in desertification policy and management organisations.

7. REFERENCES

Barr, S.H., Sharda, R. 1997. Effectiveness of decision support systems: Development or reliance effect? *Decision Support Systems* 21 (2) 133-146.

Carberry, P.S., Hochman, Z., McCown, R.L., Dalgliesh, N.P., Foale, M.A., Poulton, P.L., Hargreaves, J.N.G., Hargreaves, D.M.G., Cawthray, S., Hillcoat, N., Robertson, M.J. 2002. The FARMSCAPE approach to decision support: farmers', advisers', researchers' monitoring, simulation, communication and performance evaluation. *Agricultural systems* 74 (1) 141-177.

Cockerill, K., Tidwell, V., Passel, H. 2004. Assessing public perceptions of computer-based models. *Environmental Management* 34 (5) 609-619.

Darkoh, M.B.K. 1997. The nature, causes and consequences of desertification in the drylands in Africa. *Land Degradation and Development* 9 (1) 1-20.

Diez, E. 2009. *An assessment of the use and usefulness of decision support tools in desertification policy and management*, PhD Thesis, Cranfield University, UK.

Diouf, A., Lambin, E.F. 2001. Monitoring land-cover changes in semi-arid regions: Remote sensing data and field observations in the Ferlo, Senegal. *Journal of Arid Environments* 48 (2) 129-148.

Geist, H. 2005. *The causes and progression of desertification*. Ashgate studies in environmental policy and practice, Oxon.

He, C., Zhang, Q., Li, Y., Li, X., Shi, P. 2005. Zoning grassland protection area using remote sensing and cellular automata modelling – a case study in Xilingol steppe grassland in northern China. *Journal of arid environments* 63 814-826.

Holecz, F., Heimo, C., Moreno, J., Goussard, J.J., Fernandez, D., Rubio, J.L., Erxue, C., Magsar, E., Lo, M., Chemini, A., Stoessel, F., Rosenqvist, A. 2003. Desertification- a land degradation support service. *Proceedings at International Geoscience and Remote Sensing Symposium (IGARSS)*, 21-25 September 2003. Toulouse, France.

Kosmas, C., Kirkby, M., Geeson, N. 2003. *The MEDALUS Project. Mediterranean desertification and land use: Manual on key indicators of desertification and mapping environmentally sensitive areas to desertification*. Office for official publications of the European Communities, Luxembourg.

Long Martello, M. 2004. Expert advice and desertification policy: past experience and current challenges. *Global environmental politics* 4 (3) 85-106.

McCown, R.L. 2002. Locating agricultural decision support systems in the troubled past and socio-technical complexity of models for management. *Agricultural systems* (1) 11-25.

McIntosh, B.S., Jeffrey, P., Lemon, M., Winder, N. 2005. On the design of computer-based models for integrated environmental science. *Journal of Environmental Management* 35 (6) 741-752.

Mitchell, R. K., Agle, B. R., Wood, D.J. 1997. Toward a Theory of Stakeholder Identification and Saliency: Defining the Principle of Who and What really Counts. *Academy of Management Review* 22(4): 853 - 888.

Ochola, W.O., Kerkides, P. 2004. An integrated indicator-based spatial decision support system for

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land quality assessment in Kenya. Computers and electronics in agriculture 45 (1-3) 3-26.

Schneberger, S., Wade, S. Theories used in IS research. URL: www.istheory.yorku.ca.

Wilson, G.A., Juntti, M. 2005. Unraveling desertification: Policies and actor networks in Southern Europe. Wageningen Academic Publishers: Wageningen