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NEW OPTIONS FOR PUBLIC ENGAGEMENT WITH CLIMATE CHANGE ADAPTATION USING INFORMATION AND COMMUNICATION TECHNOLOGIES

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Tesi di Dottorato di Dragana Bojović, matricola 955711

Coordinatore del Dottorato
Prof. Carlo Barbante

Tutore del Dottorando
Prof. Carlo Giupponi

Department of Economics, Ca'Foscari University of Venice, Italy

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New Options for Public Engagement with Climate Change Adaptation Using Information and Communication Technologies

Dragana Bojović

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It always seems impossible until it's done

Nelson Mandela

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Dragana Bojović
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SUMMARY

This doctoral dissertation was inspired by the new possibilities offered by Information and Communication Technologies (ICT) for strengthening citizen agency to meet the widely recognized need for active public inclusion in decision-making on adaptation to climate change. To ensure the success of adaptation polices it is essential that policy-makers both involve public knowledge and experience and gain public acceptance for the measures they propose to cope with climate change. Traditional forms of public participation are often intensive, time-consuming and limited to small-scale participatory activities. However, recent years have seen a significant increase in the visibility of different citizens' perspectives in the online world. The two guiding questions behind the research for this thesis were thus as follows: 1) What is the role of ICT in current participatory processes?; and 2) Can ICT ensure efficient and meaningful public participation in climate change adaptation? To answer these questions, this dissertation analyses the use of online participation – eParticipation – in reaching out to the public. The paper draws on knowledge from different disciplines, including information and communication studies as well as classic works of social and political scientists, to understand the relation between social capital and adaptive capacity in the online world. The dissertation develops a theoretical framework for supporting online public participation in climate change adaptation. It further presents findings from tests undertaken as to the suitability of various online tools and social marketing approaches for applying different parts of this framework. The framework was implemented in a case study and the results obtained proved that eParticipation is efficient in terms of the time and money needed for participation. The results indicated the decreasing significance of the digital divide as an obstacle for using online spaces for public participation. For while a pre-existing online network of users is a prerequisite for conducting successful eParticipation involving high numbers of participants and obtaining meaningful results, we can reasonably expect different engagement approaches to become feasible with further Internet proliferation. Finally, eParticipation is not presented as a panacea but rather as an approach that can be combined with well-established participatory practices. For example, interviews were used in this study to ensure the acceptability and meaningfulness of the obtained results. The paper recommends assigning an important role to scientists, who are encouraged to reach out to the general public and act as "brokers" of information between different groups that would not otherwise be in contact.

From a research point of view, this dissertation contributes to a still-emerging research agenda aimed at identifying and understanding the options and limitations of using ICT for engaging citizens. From an action point of view, the results of this research signal how ICT can scale up public participation in climate change decision-making and thus add to a more equal and democratic climate change governance.

SOMMARIO

Questa tesi di dottorato trae ispirazione dalla necessità di una partecipazione attiva del pubblico nel processo di adattamento ai cambiamenti climatici e dalle possibilità offerte dalle tecnologie dell'informazione e della comunicazione (TIC). La politica riuscirà a garantire il successo nell'implementazione delle politiche di adattamento solo coinvolgendo la conoscenza locale e raggiungendo un livello soddisfacente di consenso pubblico. Le forme tradizionali di partecipazione pubblica sono spesso impegnative, richiedono molto tempo e hanno un potenziale di partecipazione piuttosto limitato, mentre la partecipazione *on-line* dà più visibilità ai cittadini e gli permette di esprimere la loro opinione in modo più conveniente ed efficiente. Questo studio è basato su due domande di ricerca principali: 1) Qual è il ruolo delle *TIC* negli attuali processi di partecipazione, e 2) Possono le TIC garantire una partecipazione efficiente della comunità nei processi di adattamento ai cambiamenti climatici? Per rispondere a queste domande la tesi analizza l'utilità della partecipazione on-line – *eParticipation*, nel raggiungere il pubblico. Questo lavoro integra diverse discipline, tra cui la scienza dell'informazione e della comunicazione, così come le scienze sociali e politiche per capire la relazione tra capitale sociale e capacità adattiva nel mondo online. Questa tesi sviluppa un quadro teorico per sostenere la partecipazione on-line nel processo di adattamento ai cambiamenti climatici. Inoltre, si analizzano i livelli di compatibilità dei vari strumenti online e strategie di marketing sociale nell'assemblaggio di diversi elementi del quadro proposto. L'implementazione del modello è avvenuta attraverso un *caso di studio* e i risultati ottenuti confermano l'efficacia dell' eParticipation in termini di tempo e di risorse monetarie necessarie per la partecipazione. I risultati indicano una progressiva riduzione del divario digitale nell'utilizzo di Internet. Una rete di utenti esistente è considerata come una condizione importante per un efficiente svolgimento dell' eParticipation, ovvero permette di coinvolgere un più alto numero dei partecipanti e di ottenere risultati significativi. E' ragionevole aspettarsi che i suddetti approcci di coinvolgimento digitale diventeranno sempre più fattibili con un ulteriore espansione dell'Internet. Tuttavia l' eParticipation non dovrebbe rappresentare una *panacea*, ma piuttosto un approccio capace di combinare le pratiche di partecipazione già consolidate, come ad esempio le interviste che sono state fatte per verificare l'accettabilità e la significatività dei risultati ottenuti. Un ruolo fondamentale in questo processo è riservato agli scienziati che dovrebbero agire da intermediari tra diversi gruppi sociali.

Il valore scientifico di questa dissertazione riguarda le possibilità e le limitazioni delle TIC. Da un punto di vista pratico, i risultati di questa ricerca indicano come le TIC possono migliorare la partecipazione della comunità nel supporto decisionale relativo ai cambiamenti climatici e come gestire il cambiamento climatico in un modo più egualitario e democratico.

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LIST OF ABBREVIATIONS

AM	Analysis Matrix
ARPAV	Environmental Protection Agency of the Veneto Region
CCA	Climate change adaptation
CO_2	Carbon dioxide
CSO	Civil Society Organisation
DSS	Decision support system
EC	European Commission
ELECTRE	Elimination and choice expressing reality (French: *Elimination et choix traduisant realité)*
EU	European Union
FPIC	Free, prior and informed consent
GDM	Group decision-making
GIS	Geographic Information System
ICT	Information and Communication Technologies
ICARUS	IWRM for Climate Change Adaptation in Rural Social Ecosystems in Southern Europe
IPCC	The Intergovernmental Panel on Climate Change
ISTAT	Italian National Institute of Statistics
IWRM	Integrated Water Resources Management
IWS	Internet World Stat
KIP	Knowledge Inventory Portal
MCA	Multi-Criteria Analysis
NUT	Nomenclature of Territorial Unites for Statistics
RV	Veneto Region (Italian: *Regione Veneto*)
SAW	Simple Additive Weighting
SNS	Social networking sites
SM	Social Media
SWOT	Strengths, Weaknesses, Opportunities, and Threats
tParticipation	Traditional participation
UAA	Utilised Agricultural Area
UGC	User Generated Content
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
Web	World Wide Web

CHAPTER I: INTRODUCTION

1.1. MOTIVATION

Since the widespread recognition of climate change as a serious threat to ecosystems and human development in the 1980s, research and policy development have been making progress towards finding a solution to this threat. Policy development in the field of climate change has evolved since the early 1990s and the adoption of the United Nations Framework Convention on Climate Change. Various solutions to climate change have been proposed and these are usually classified into two main groups of actions: mitigation and adaptation (Schellnhuber et al., 2006). Since the adoption of the Kyoto Protocol to UNFCC in 1997, considerable attention has been paid to the mitigation agenda, i.e., to actions that either reduce greenhouse gas emissions or enhance carbon sinks (IPCC, 2007; Adger et al., 2003, Burch, 2010). A number of different issues, however, including scientific uncertainties, the long time frame of the proposed measures, and unwillingness to take historical responsibilities, have all served to slow down progress in climate change mitigation (Tompkins and Adger, 2005). These obstacles to mitigation demand that more attention be paid to adaptation measures, i.e., to measures which address the effects of climate change rather than only the causes (Huntjens et al., 2012).

Adaptation refers to "adjustments in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderate harm or exploit beneficial opportunities" (IPCC, 2007). Adaptation to climate change is becoming a priority among environmental issues in Europe, as witnessed by recent initiatives and documents of the European Environmental Agency (e.g., the climate-adapt platform[1] and the EU Strategy on Climate Change Adaptation (EC, 2013)). National adaptation strategies are recommended as key analytical instruments to inform and prioritise adaptation measures (ibid.). Fifteen EU member states have already adopted adaptation strategies and other countries are currently working on their development.

The recently published *EU Strategy on Adaptation to Climate Change* (2013) suggests a flexible and participatory approach to climate change adaptation. Achieving meaningful participation is a laudable goal for climate change adaptation, since adaptation assumes both building adaptive

[1] climate-adapt.eea.europa.eu (accessed 15/08/2013)

capacity, through increasing ability to adapt to changes, and implementing decisions on adaptation, by transforming that capacity into action (Tompkins et al., 2010). This goal will be difficult to realize only through face-to-face contact since, though often considered the most effective participatory approach, it can be an intensive and time-consuming procedure, typically involving only a limited audience (Cornwall, 2000; Involve, 2005; Hooghe et al., 2010; Luyet, 2012).

In response to policy initiatives in the field of climate change adaptation in Europe, credit should be given to alternative methodologies and procedures that can encourage public participation, including the use of Information and Communication Technologies (ICT). A new form of social organization based on digital communication and networking – the network society (Castells and Cardos, 2005) – presents an opportunity to step out of established participatory practice and to use online spaces for public participation. In recent years, moreover, the Internet has emerged as an effective tool for strengthening citizen action (Kelly, 2012; Bond et al., 2012).

Amongst online approaches, eParticipation has rapidly been gaining recognition as an important tool for broadening participation (Sabo et al., 2008). eParticipation is primarily understood as a link between governmental institutions and citizens, and is thus expected to be enacted by governments (Sabo et al., 2008). Our understanding of eParticipation goes beyond this proposition and develops an eParticipation framework to be used by diverse stakeholders, including scientists and NGOs, as a link to the general public.

There is limited empirical evidence on the effectiveness of different online participatory approaches (Hooghe, 2010). Scepticism about the usefulness of the Internet as a tool for mobilisation may partly be grounded in knowledge about traditional media. Namely, drawing on experience with traditional media such as TV, newspapers, and even emails, one can assume that they offer limited support to social interactions (Sabo et al., 2009). However, the main characteristics of the new media, epitomised in Web 2.0, are precisely those of interactivity and the facilitation of collaborative efforts (Kaplan and Haenlein, 2008).

Another concern regarding eParticipation is that of representativeness (Reips, 2002), traditionally considered as an important determinant of the success of participation. For this reason, governmental agencies sometimes pay individuals to participate in order to achieve

representativeness. However, we prefer to consider participation as a purely voluntary process in which participants should have motives other than financial, such as a desire to exercise their right to take part in decision-making and to share useful knowledge with others. Thus we have opted out of considering monetary incentives and rather investigated what Web 2.0 offers for improving public mobilisation and participatory practice. In this investigation we have focused on the use of online social networks for reaching out to participants, since such networks often have many members and sustain a great deal of interaction. Traditional social networks are considered drivers in producing social capital (Putnam, 2000), which in turn can be closely related to adaptive capacity (Pelling and High, 2005). This should not exclude online social networks, which enhance knowledge-sharing and enable collective action through the Internet. In the same vein, some authors even mention Internet social capital (Williams, 2006). However, we draw from the classic work of social and political scientists, using the concepts of social capital (Putnam, 2000) and network society (Castells, 1996) to understand the relation between social capital and adaptive capacity in the online world.

Against this background, this doctoral dissertation aims to contribute to the challenge of actively including the general public into the climate change adaptation policy process. The thesis concentrates upon two main questions:

1. What is the role of Information and Communication Technologies (ICT) in today's participatory processes?

2. Can ICT ensure efficient public participation with a meaningful engagement in climate change adaptation?

This work was conducted by i) analysing both scientific literature and grey online resources keeping pace thereby with this rapidly evolving field and drawing knowledge from different disciplines, including political sciences, where the use of online participation is most advanced, and online social marketing to investigate new possibilities for reaching out participants; ii) extending the state-of-the-art methodologies so as to provide new online tools for public engagement in the specific field of climate change adaptation; as well as by iii) promoting and discussing the developed approach with local decision-makers in order to understand its perspective in the future development of climate change adaptation policy.

1.2. OBJECTIVES AND OUTLINE OF THE STUDY

This doctoral dissertation seeks to answer the abovementioned research questions by investigating the following research objectives:

1. To explore the use of ICT in climate change participation, and in particular its potential in the field of adaptation;
2. To analyse the role of online social networks in enhancing adaptive capacity;
3. To develop an eParticipation framework for meaningful public engagement and collaboration in climate change adaptation policy process;
4. To develop an online tool for the collaborative analysis of problems and solutions of adaptation;
5. To explore the use of the eParticipation framework and analyse the efficiency of the proposed tool in achieving meaningful public engagement with climate change adaptation.

The core of the dissertation is composed of two parts: the theoretical development of an eParticipation framework and, secondly, the implementation of the developed framework. The structure of the thesis is organised as follows:

Chapter II develops a theoretical framework to be used for eParticipation in the climate change adaptation policy process. This chapter thus tackles the first three dissertation objectives. The presented framework is a convergence of multiple aspects of ICT and climate change adaptation. Accordingly, a background is first presented of these two different discourses. It starts with a discourse about ICT and participation, illustrating the major features and concepts. The state of the art is presented through a literature review on ICT and participation, focusing on the issue of climate change. This is followed by concrete examples of public engagement with climate change through ICT that have been initiated by non-governmental organisations. The chapter goes on to present a second discourse on climate change adaptation, discussing connections between the concepts of social capital and adaptive capacity in the online world. The theoretical framework is built around three levels of public participation: engagement, involvement and empowerment. The framework shows how these participation levels can be achieved using online tools.

Parts of this chapter were presented at the following two conferences:

- The European Climate Change Adaptation Conference – Integrating Climate into Action: *Changing patter: eParticipation and online social networks in climate change adaptation decision-support,* Hamburg, Germany, 2013

- The GSGP Conference – The digital researcher session: *Merging eParticipation and Social Media: a new approach to decision support*, Cambridge, UK, 2013

Chapter III summarises our initial experiences with the online tools which helped us learn about eParticipation and the most suitable ways of using it in the field of climate change adaptation. After developing a theoretical eParticipation framework based on findings from the literature, we tested it through a set of 'experiments' with the aim of understanding how it can best be used in the practice. This experimental research was conducted within the framework of research projects and local initiatives. First we investigated the use of different online approaches for involving the public in the selection of preferable adaptation solutions, focusing on GoogleAdwords and Facebook advertising. This experiment also analysed the extent to which language can be a barrier to participation. In the subsequent experiment we compared the results obtained using mailing lists, Facebook groups and advertising for mobilising the public to complete an online survey on an issue of public concern. The next experiment applied multilingual online surveys distributed through professional mailing lists in the Alpine region that extends across the borders of seven countries. The final experiment showed how eParticipation allows for a bottom-up approach to decision-making, again experimenting with different online approaches.

Parts of this chapter were published as:

- Bojovic, D. and Mrkajic, V. (2011*) The Role of Social Networks in Environmental eParticipation.* ESEE 2011 Conference – Advancing Ecological Economics: Theory and Practice, Istanbul, Turkey

- Bojovic, D. and Sazdovski, I. (2012) *Energy efficiency in households – online survey result*. Project report, the UNDP office in Macedonia

- Bojovic, D., Dietachmair, J., Pfefferkorn, W., and Thamm U. (2013) *Survey on climate change adaptation – How to inform local, national and regional administration successfully,* Deliverable of WP5 in the C3-Alps project

Chapter IV offers a comparison between eParticipation and traditional participatory practice in environmental decision-making. After presenting a theoretical background of eParticipation, suggesting a new framework, and experimenting with the different online tools in order to understand how to implement the framework in an efficient and effective manner, we compared this new approach with traditional participatory practice. This chapter investigates these two types of public participation that currently take place in parallel in environmental decision-making processes from global to local scale. The two participation processes are compared against a set of different criteria using empirical examples from scientific and grey literature. The chapter suggests what each process can learn from the other and how they complement one another.

Part of this chapter was presented at:

- The ESEE 2013 Conference: Ecological Economics and Institutional Dynamics – 10th International conference of the European Society for Ecological Economics: Spiric, J. and Bojovic, D. *One Globe: From Talking with Local Indigenous Peoples to Having Global Community Voice Heard via Internet – What Participatory Processes Offer Today?*

Chapter V presents the online tool that applies the eParticipation framework developed in Chapter II and the experience presented in Chapter III. This Chapter shows the results of the implementation of the framework in the ICARUS project (IWRM[2] for Climate Change Adaptation in Rural Social-Ecosystems in Southern Europe), tackling the fourth and fifth objectives of this dissertation. This chapter details the development of a scientifically robust tool for the analysis of alternative adaptation measures, with a simple user-friendly interface – mDSSweb. It shows the efficiency and effectiveness of the eParticipation framework implemented in the ICARUS project.

[2]Integrated water resource managmenet

Part of this chapter was published as:

- Bojovic D., Bonzanigo L., Giupponi, C. (2012) Drivers of Change in Southern European Agriculture: Online Participatory Approaches for the Analysis of Planned and Autonomous Adaptation Strategies *in* R. Seppelt, A.A. Voinov, S. Lange, D. Bankamp (Eds.) (2012): International Environmental Modelling and Software Society (iEMSs) 2012 International Congress on Environmental Modelling and Software: Managing Resources of a Limited Planet: Pathways and Visions under Uncertainty, Sixth Biennial Meeting, Leipzig, Germany.

Chapter VI summarises the ongoing research. This ongoing research expands upon the results of the fourth chapter. Specifically, this latest research integrates spatial and visual elements into an online platform, widening its applicability and improving communication with participants. The chapter depicts the research background and the methodology used, showing how it builds upon the tool described in Chapter V. The implementation of this tool is still underway.

Chapter VII draws general conclusions, suggests further research and outlines the main policy implications of this research.

The dissertation is accompanied by various documents produced during the research process, including a scientific article produced in collaborative efforts, presented in Appendices I-III.

CHAPTER II: A FRAMEWORK FOR SUPPORTING CLIMATE CHANGE ADAPTATION IN AN ONLINE WORLD[3]

Bojovic, D. Giupponi, C.

This chapter presents the baseline theoretical research of multiple aspects of ICT and climate change adaptation. It outlines major features and concepts of eParticipation and literature review on state of the art of the ICT and participation, fulfilled with concrete examples from the field of climate change, answering the question: What is the role of ICT in today's participatory processes. It further discusses connections between the concepts of social capital and adaptive capacity in the online world. The chapter develops a theoretical framework for eParticipation in climate change adaption. The framework is built around three levels of public participation: engagement, involvement and empowerment. It suggests that online information sharing and knowledge-exchange can add to education and activate latent social capital, while collective action and group decision-making may result in changing power structures and institutional modifications. This can be a desirable direction for the development of climate change governance. Practical aspects of this framework and its applicability are tested in the following chapter that will then enable its implementation and provide empirical results, as presented in Chapter V.

2.1. INTRODUCTION

The need for active public inclusion in climate change policy and practice has been receiving increased attention in both political and academic circles. Traditional forms of public participation and citizen expression are rather fragile, since they are time-consuming and costly and require skilled professionals who are not always available (Hooghe et al., 2010; Sánchez-Nielsen and Lee, 2013). Thus these traditional forms are usually limited to small-scale participatory activities and may suffer from various flaws, such as a non-transparent selection of participants (Cornwall, 2000; Hooghe et al., 2010). In recent years, however, we have seen an increase in the visibility of different citizens' perspectives in the online world, which strengthens the possibility of greater citizen agency. New information and communication technologies, epitomised by the Internet, have emerged as an option for engaging citizens and scaling up

[3] This research was presented in the poster session of the ECCA 2013 (European Climate Change Adaptation Conference), under the title: Bojovic, D. and Giupponi, C. (2013) *Changing patter: eParticipation and online social networks in climate change adaptation decision-support*.

participation (Kelly, 2012; Galbraith et al., 2013). The authors are aware, nonetheless, of a limited existing literature on how public engagement and participation in climate change can be achieved through Web 2.0 and online tools.

The concept of climate change governance emphasises a shift in thinking and realization that government, as synonymous with hierarchical state authority, is not sufficient for tackling the complex challenges of climate change. Governance involves different actors, mechanisms and measures that help social systems to prevent, mitigate, or adapt to climate change (Jagers and Stripple, 2003). Climate change governance should allow participation that is not limited to enrolment in a set of top-down, institutionally predefined agenda (Ayers, 2011). Quite the contrary, the participation process should leave enough space for the self-development of the agenda, should facilitate autonomous actions on the part of social actors, and should allow their full contribution in a democratic manner.

Adaptation to climate change – an increasingly important aspect of climate change governance – assumes both building adaptive capacity, through increasing ability to adapt to changes, and implementing adaptation decisions through transforming that capacity into action (Tompkins et al., 2010). Thus the success of adaptation measures relies on the one hand on local knowledge and activities, and on the other hand on the acceptance of these measures by the public in order to ensure their effectiveness (Lopez-Marrero, 2010). Then again, the capacity of an individual to adapt is subject to their access to resources (Adger, 2003), and this may also refer to access to information (Phillips, 2003). Therefore, public engagement in climate change through information-sharing and knowledge-exchange could improve adaptive capacity. Finally, the public should be empowered to take part in decision-making (Corner and Randall, 2011; Whitmarsh et al., 2011), since the ability of society to adapt depends on the ability to take action collectively (Adger, 2003).

Communication with the public and the involvement of the public in participatory activities should correspond to actual societal trends. Castells and Cardoso (2005) propose that a new societal trend is associated with the emergence of ICT and is based on networking. Such a network society challenges power relations that are institutionalized (Castells, 2007). Similarly, Corfee-Morlot and colleagues (2011) find that the strengthening of the network society is happening at the same time as the weakening of the authority of state actors on issues of public

concern. This new societal trend, opening additional spaces for communication and public engagement, collaboration and participation, may affect and expand democratic participation (Gaventa and Tandon, 2010), which may ultimately result in institutional changes. Moreover, the new form of the Internet (Web 2.0), which supports online interactions between users and the simultaneous creation of content by many users, serves to facilitate mass communication and collective action initiated online. This concept of networking is closely related to that of social capital (Putnam, 2000) and, as we argue, can play a role in fostering adaptive capacity.

This chapter analyses how the Internet can provide information and involve people with climate change, allowing knowledge-exchange and collaboration on problem-analysis that can support decision-making. We propose merging eParticipation with social media and developing online tools for collective analyses of alternative adaptation solutions. This chapter develops a framework that links a growing societal trend – online networking, promising new online form of participation – eParticipation, and a pressing global problem of climate change adaptation. The proposed framework is expected to allow for the stepping outside of institutionalized power relations in decision-making processes, opening new spaces for public action and collaboration on climate change issues.

The framework presented in this paper is a convergence of multiple aspects of ICT and climate change adaptation. Thus the backgrounds of the two different discourses are presented first. Section Two presents a discourse about ICT and participation, outlining the major features and concepts. The state of the art is presented through a review of the literature on ICT and participation, focusing on the issue of climate change. This is followed by concrete examples of public engagement with climate change through ICT initiated by non-governmental organisations. Section Three presents a second discourse on climate change adaptation, discussing connections between the concepts of social capital and adaptive capacity in the online world. Section Four presents a framework that considers three levels of public involvement in the process of climate change adaptation policy using online tools. The final section presents the main conclusions about the online framework for public engagement in climate change adaptation and recommendations for future research.

2.2. ICT AND PUBLIC ENGAGEMENT

2.2.1. What ICT offers for public engagement and participation: main features and concepts

The manner and speed of obtaining information changed dramatically with access to the Internet and the World Wide Web (Web) becoming commonplace. The way in which we communicate has been particularly affected by Web 2.0, which allows immediate input from all users in a collaborative manner (Kaplan and Haenlein, 2010). This new media, known as social media, constitutes a shift from one-to-many communication (e.g., TV and newspapers) to many-to-many communication (O'Neill and Boykoff, 2010). Social media could be characterised as "a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of User Generated Content" (UGC) (Kaplan and Haenlein, 2010, p. 61). Table 2.1 shows some of the most commonly used social media.

Table 2.1. Social Media Classification (adapted from RIN, 2011)

Main purpose	Type	Definition	Tools/Examples
Communication	Blogging	Personal webpages composed of longer texts. Often interactive, allowing visitors to leave comments and/or messages for each other via widgets. May be maintained by an individual or a group.	Planet Under Pressure
	Microblogging	Supports the broadcast of short entries (typically up to 140 characters) as texts, pictures or short video clips.	Twitter, Google Buzz
	Social Networking	Building online communities, often accomplished both through 'groups' and 'friends lists' that allow greater interaction on websites.	Facebook, LinkedIn, Academia.edu
	Forum	Communication and discussion site where people can hold conversations in the form of posted massages.	Climate-Debate
Collaboration	Conferencing	For conducting live meetings, training and presentations via the Internet.	Skype, GoToMeeting
	Wikis	Collaborative websites that can be directly edited by anyone with appropriate permission.	Wikia
	Social documents	Shared documents hosted on sites, allowing multiple authors to contribute to and edit a document.	Google docs, Dropbox
	Photographs	Sharing photographs online.	Flickr, Picasa, Instagram
	Video	Sharing videos online.	Youtube
Multimedia	Live streaming	Multimedia content that is viewed while being delivered by a streaming provider.	Livestream
	Presentation sharing	Sharing presentations and other documents.	SlideShare

Online social networks

Social networking sites (SNS) such as Twitter or Facebook, as a type of social media, have become an important form of citizens' political expression (Sabo et al., 2009; Howard, 2010). The recent unrest in Turkey, in Taksim Square's Gezi Park, was followed from abroad through

social networks. Citizen journalism expressed through tweets (posts on Twitter), Facebook posts, and Instagram pictures enabled the instant provision of information, avoiding the time-lag common to traditional media.

In the same vein, crowdsourcing – a new form of citizen science presented through online data gathering – allows a broad range of participation, as well as a broad range of inputs from a divers group of participants. McCormic and colleagues (2012) suggest that crowdsourcing has potential particularly in disaster situations with a lack of time and infrastructure for experts to gather data. The authors propose crowdsourcing for risk assessment processes and facilitation of disaster recovery. Capturing great amount of data coming from divers sources before was limited by technical capacity. Today online approach facilitates inclusion of a broad range of participants, while results can be compared with official, government sources, increasing legitimacy of the monitoring process, and affecting power relations.

Researchers have been analysing the content of SNS, e.g., Twitter messages, to understand, measure, and even predict real-world phenomena (Mislove et al., 2007, 2011). New tools are developed for the analysis of big data and tracking and mapping agents' interactions. Similar to data mining, graph mining presents techniques that process and extract knowledge from the big datasets, including popular SNS, and apply it to graphs (Haralabopoulos and Anagnostopoulos, 2013). However, online social networks have some distinguishing features comparing to networks in general. This includes high clustering, explained by links created as a consequence of mutual introductions between people (Mislove et al, 2007). These networks also have more symmetrical links, and are presented as a large number of small, tightly clustered local user communities, connected with high-degree nodes (that present members of multiple groups) (ibid.).

Some of the popular graph mining tools are igraph – capable of real time random sampling of SNS and large graph sampling (Csardi and Nepusz, 2006), or Gephi. These are open source softwares for graph and network analysis and presentation. Gephi has a 3D render engine to display large networks in real-time, producing easy-to-read visual results, while allowing for personalization of the graph design, including design of nodes, edges and labels (Bastian et al., 2009). These tools are used both by scientists and for commercial purposes, such as informing the social marketing strategies.

Social marketing

Social marketing involves the use of marketing principles to sell ideas, attitudes and behaviours to the public (Weinreich, 2011). Together with online social media, social marketing has also been used by governments to involve citizens in different issues of public concern, primarily in politics. A well known example is the use of social media in US President Barack Obama's 2008 election campaign, resulting in an increase in the percentage of voters from minorities and from the 18–24 age group (U.S. Census Bureau, 2010). The climate change community could gain from the lessons learnt when social media meets politics.

Bond et al. (2012) have conducted the largest empirical study so far on the effectiveness of SNS mobilisation. Their 61-million person experiment looking into the political mobilization potential of messages sent online via Facebook shows that online political mobilisation has a positive effect on the off-line world. Contrary to some assertions made in the literature (see Boulianne, 2009 and Hooghe et al., 2010), this study shows the direct influence of the Internet on civic engagement. This was demonstrated by an increase in voter turnout of 340,000 additional votes (0.14% of the voting age population) at the 2010 US congressional elections after US Facebook users received a social message encouraging them to vote. The message had both a direct effect and an indirect effect through social contagion. According to the results of this experiment, the message also influenced political self-expression on the SNS and information-seeking.

eGovernment and eParticipation

Another form of digital interaction between governments and citizens, businesses and different agencies is *eGovernment*, which aims at providing better and more efficient public services (EC-Information Society, 2011; Bertot et al., 2010). According to the *Malmo Ministerial Declaration* on eGovernment, this initiative should be based on a common culture of collaboration. A derivative term, *eParticipation*, presents a set of technology-facilitated participatory processes that enable two-way communication between governments and citizens (Sabo et al., 2008; Paganelli and Pecchi, 2013). The European Commission defines eParticipation as a means of reconnecting "ordinary people with politics and policy-making, making the decision-making processes easier to understand and follow through the use of new ICT" (EC-Information society, 2011). eParticipation assumes both direct inclusion in decision-making and spontaneous citizen

participation in policy processes (Sabo et al, 2008). Calenda and Meijer (2009) find that citizens are willing to discuss issues of public interest, but prefer to do so in digital places with which they are familiar and comfortable (e.g., blogs and forums) rather than on government websites. This shows the advantages of eParticipation over eGovernment.

2.2.2. From climate change engagement to decision support in an online world: literature findings

Analysing the role of new (social) media in engaging the public with climate change, O'Neill and Boykoff (2010) consider three major aspects: information, interactivity and inclusivity.

The new media provide plenty of *information* on a variety of topics; but amongst the plethora of available information, the usefulness and quality of some of this information is questionable. Addressing this issue, Meijer et al. (2009) found that the Internet can contribute to the quality of the content of discussion, since people have the time and opportunity to look up relevant information and reconsider their responses. Nevertheless, this position is criticized on the grounds that information on the Web can be obtained in a short time and this may decrease the quality of knowledge (CIBER, 2008). This critique could be addressed by influencing smart search, and this is where scientists may play a role in the open system of new media. Scientists could try to reach out to the general public and spread knowledge as well as participate in public discussions and be more energetic in delivering their messages to citizens (Boykoff, 2012; *Nature*, 2012).

Interactivity is a key characteristic of the new media. However, O'Neill and Boykoff (2010) find that a frequent problem with new communication spaces such as blogs is the difficulty of sustaining them. This can result in the public losing interest in the topic. Another issue is the lack of follow-up or lack of commitment to behavioural actions. According to the authors, this lack of follow-up casts doubt on the success of targeted behaviour change through the provision of information in this way.

Regarding the *inclusivity* of new media, there is a concern that only a small part of the population uses new media to engage with climate change (Gavin, 2009). Nevertheless, in 2012

more than 34% of the world's population had access to the Internet, and this percentage is well above 50% in the 'global north' (IWS, 2012). Thus the Internet is enabling an increasing number of different actors and agents to contribute to the way in which the climate change debate is being framed (O'Neill and Boykoff, 2010). In the case of this global issue, an online approach may prove to be more appropriate than a face-to-face approach (Dietz and Stern, 2008), since it is not constrained by time and space. Still, online global discussions are usually conducted in dominant languages, like English in the Western world, presenting a possible barrier to wider global engagement. Likewise, O'Neill and Boykoff (2010) argue that blogging on climate change is mainly an Anglo–Saxon dominated activity.

Corner and Randall (2011) have presented one of the first systematic analyses of social marketing as a strategy for engaging the public on climate change. The specific characteristic of social marketing is that it tailors messages to people's different needs, maximizing the success of behavioural programmes. The authors see a potential role for social marketing in upgrading the information-sharing approach into a tool for changing behaviour with the aim of improving social welfare. The authors are concerned, however, as to whether this approach can be successful in tackling climate change, which demands major behavioural and policy change. Accordingly, the authors argue that it is the decision-making process that should be targeted, beyond merely engaging individuals in behaviour change. Similarly, Whitmarsh and colleagues (2011), studying public engagement with carbon and climate change, concluded that it is not enough solely to provide the public with information. Namely, the so-called 'information deficit' model, which suggests that the public will opt for rational action if provided with sufficient information, is criticized as inappropriate and ineffective. Besides being informed, the public also need to participate actively in decision-making in order to properly engage with climate change (Whitmarsh et al., 2011).

2.2.3. Early adopters of social media and eParticipation in climate change engagement: civil society examples

Although some authors argue that there is no concrete evidence of how social marketing helps spread pro-environmental – including climate-friendly – behaviour (see e.g. Boulianne, 2009; Cornel and Randal, 2011), examples from the use of online social media and eParticipation in the civil society sector prove the readiness of the general public to participate.

An increasing number of grass-roots movements are being initiated and coordinated through the Internet, building networks, and presenting online activism. An example is the Avaaz initiative, which is active in the field of climate change among other global social contemporary issues. Avaaz is an online global civil society organisation (CSO) created in 2006 with the aim of challenging well-established policy-making practices, mobilizing people from different countries, age groups and ideologies. This organisation works exclusively through the Internet and has created a vast social network reaching over 25 million members in 2013.[4] Avaaz aims at achieving transparency and accountability to participants through making all decisions immediately visible around the world by publishing them on their website (Meijer et al., 2009; Vernis, 2010). The campaigns typically consist of gathering members' positions regarding issues or actions perceived to have a strong influence on global society. A petition signed online by a large number of people is then delivered to decision-makers. Ahead of the Copenhagen UN Climate Change Conference in 2009, for example, Avaaz initiated a petition on climate change calling for the 'real deal' from heads of states. This petition collected 14 million signatures (Hill, 2010), and was delivered to presidents and prime ministers participating in the Copenhagen negotiations. Avaaz members take part in selecting the focus of campaigns. Hence in the 'People Power in 2010' survey, 48,000 members ranked different topics in order of priority, with climate change and the environment coming first place (ibid). Avaaz also uses existing popular online social networks such as Facebook for promoting its campaigns and reaching new members. In this way Avaaz joins eParticipation as a form of online petitioning, with SNS creating a new online network of its activists.

[4] http://www.avaaz.org/en/

Another example of a massive grassroots organisation supporting transnational activism in the area of climate change is the *350.org*. This global civil society organisation was initiated with the aim of influencing global climate negotiations, building from an International Day of Climate Action on 24 October 2009. On this day people gathered in over 5,200 events in 181 countries, united in calling for strong action on climate mitigation. Unlike Avaaz, this online initiative uses the web to mobilize people around the globe for campaigns in the off-line world. The name of the organization comes from its lobbying for a CO_2 level of 350 ppm[5] in the atmosphere as the necessary level of stabilization to avoid the worst impacts of climate change. Their website provides scientific debates, awareness-raising campaigns and petitions for stricter climate governance.

The examples presented in this section show how SNS has emerged as an interesting option for public engagement. The idea of social participation and social networks is related to Putnam's concept of social capital in the sense that a society with more active members will have higher social capital. Social capital, in turn, is an important feature of adaptive capacity. This brings us to the second discourse of this chapter: the connection between social capital and adaptive capacity and the role of SNS in their development.

[5] Parts per million

2.3. THE DEVELOPMENT OF SOCIAL CAPITAL AND ADAPTIVE CAPACITY IN AN ONLINE WORLD

"Social capital refers to connections among individuals – social networks and the norms of reciprocity and trustworthiness that arise from them." (Putnam, 2000, p. 19) Thus, according to Putnam (2000), social networks are drivers in producing social capital. This may also include online social networks, which enhance information-sharing and may enable social learning and collective action. Then again, adaptive capacity not only assumes all the different resources available for adaptation but also the system's capacity to use these resources effectively (Brooks and Adger, 2004). The social aspects of adaptive capacity include social and human capital, such as learning, knowledge, information, the recognised need to adapt and trust in polices, and may determine motivation to take action (Hobson and Nirmeyer, 2011).

In his work on social capital, *Bowling alone: The collapse and revival of American community* (2000), Putnam expressed concern that civic engagement – including voting, political participation, newspaper readership, and participation in local associations – is in steep decline. Then again, new forms of activism and social engagement, and potentially the development of social capital, have emerged online. As the two examples of online CSOs show, the Internet may provide new structures of communication and association. Putnam himself agrees that technology may play a role in connecting individual interests and collective interactions; he remains cautious, however, as to whether the Internet facilitates meaningful social interaction (Putnam, 2010).[6]

A modest positive relationship has been shown between the use of online social networks (e.g. Facebook) and social capital (Valenzuela et al., 2009), and this relationship is stronger for SNS users who have difficulties in forming and maintaining large and heterogeneous networks of contacts in the off-line world (Steinfield et al., 2008). Still, further empirical studies are needed to understand this relationship, particularly regarding how fast SNS evolve and diffuse into society (Valenzuela et al., 2009). In 2012, for example, over 12% of the world population were Facebook users (IWS, 2013).

[6] http://www.abhinemani.com/2010/12/24/bowling-alone-and-living-with-others/ (Accessed 15/06/2012)

The concepts of *bridging* and *bonding* offer dimensions by which we can compare different forms of social capital (Putnam, 2000). *Bonding* refers to connections and support among people already strongly tied, such as family, friends and neighbours, while *bridging* happens when social networks enable connections between people in different situations, with different backgrounds, forming heterogeneous groups of people.

Investigating social capital in the Internet context, Williams (2007) finds that online social interactions occur in parallel and in conjunction with real-life counterpart interactions. Thus the author proposes that the Internet may both displace off-line social capital and help create new forms of social capital in the virtual world. Furthermore, it is suggested that online social capital is a result of relatively low entry and exit costs when compared to real-life networks, so that more bridging relations can be expected online than offline (Galston, 2000; Williams, 2007). This idea of low entry and exit costs in online networks coincides with Putnam's idea that the success of churches in gaining new members and developing social capital is attributable to low entry barriers (Putnam, 2010).[7]

Some authors (Elison et al., 2007; Skoric, 2009) suggest that online social networks contribute to both bonding and bridging social capital, and that the latter is enabled as these platforms easily allow an individual to join different groups at the same time. Networking on the Internet widens knowledge of public issues through bridging ties, and social capital could emerge from participation in forums and blogs on issues related to public affairs (Skoric, 2009). However, an empirical study by Bond et al. (2012) shows that online mobilization depends on strong-tie networks, and this could mean that the engagement potential of SNS predominantly depends on bonding social capital.

Pelling and High (2005) analyse the contribution of social capital to behavioural aspects of adaptive capacity. The authors argue that understanding adaptive capacity means understanding the capacities in general that exist in a society and that can facilitate self-protection and collective action to prevent and cope with stressors. They graphically present adaptive capacity to climate change as seen through social capital, identifying four realms of social action (Fig. 2.1). The graphic is broken down along two continuous axes: the vertical axis shows purposeful (direct) interventions and incidental ones (i.e., interventions not directed specifically to climate

[7] http://bigthink.com/ideas/26655 (Accessed 10/04/2012)

change but with a potential effect on vulnerability to climate change), while the horizontal axis shows material interventions (i.e., social capital as a resource with which to mitigate risk) and institutional modifications (i.e., changing the power-related balance of decision-making). The authors find that research on adaptive capacity through the perspective of social capital is mainly focused on the first realm of social action, i.e., mobilising existing social capital to produce material interventions that can reduce vulnerability to climate change. According to Pelling and High (2005), the institutional modification aspects of adaptive capacity, including activating latent social capital – e.g., through changing social rules and incentives in society, and collective action (voting) – are still unexplored. Nevertheless, the authors propose that complex social ties of everyday interaction may constitute a resource in maintaining a capacity to change collective direction. They further propose that adaptive capacity for climate change arises out of social learning embedded in social relationships. Thus, as the authors suggest, flexible informal systems built on norms of trust and reciprocity can contribute to the capacity to adapt. This thesis proposes including online social networks in these informal networked relationships.

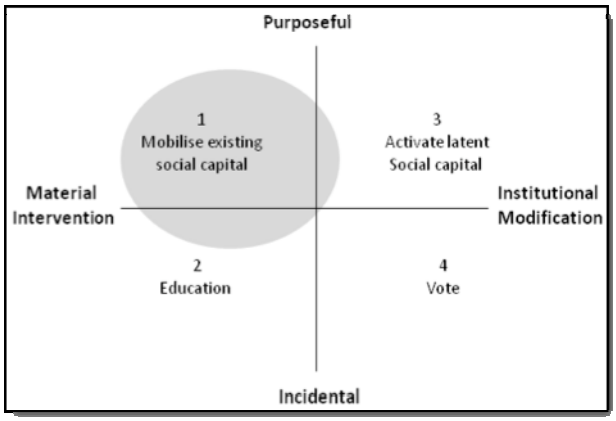

Fig. 2.1 Adaptive capacity to climate change, as seen through social capital
(from Pelling and High, 2005)

2.4. FROM ENGAGEMENT TO COLLABORATION IN DEVELOPMENT OF CLIMATE CHANGE ADAPTATION POLICY: A new framework for online participation

In order to address the abovementioned needs and flows of the participatory processes, we propose a framework for eParticipation in climate change adaptation. This framework tackles the issue of lack of participation and low motivation, while connecting simple information-sharing with more profound participation performed through decision support.

Lack of motivation to participate and a resulting low number of participants is recognised as one of the major drawbacks of participation, and eParticipation is not exempt from this (Sabo et al., 2008; Sanchez et al., 2013). In the case of eParticipation, however, participants can be approached using popular online networks or social marketing. In this way participation is brought to the public through commonly used online spaces, thus corresponding to the networking trend that dominates current society. This active approach could be used for better information-sharing but also for involving the broader public in meaningful participation.

Analysing the place of social networking services in the eParticipation context, Sabo and colleagues (2009) found that one of the features of SNS that can facilitate eParticipation is the viral dissemination of ideas, which may force media attention and play a role in political agenda-setting. Participation is an inherent characteristic of SNS, and social networks may have many users with a great deal of interactions and content-generation (ibid.). Combining eParticipation with online social networks, the framework developed in this paper aims at achieving participation that involves more participants in an efficient way.

This framework will go one step further from the simple provision of information or the gathering of public inputs about an issue of concern to suggesting the involvement of the general public in collaborative work on problem analysis and decision support. This is framed within the proposed three levels of eParticipation.

2.4.1. Levels of eParticipation

Since Sherry Arnstein's seminal work on participation, *A Ladder of Citizen Participation* (1969), levels of participation have been discussed and characterised in different research fields, including the environmental sciences (see, for example, Pretty, 1995; Richards et al., 2004). Similarly, there are different classifications of the levels of eParticipation (see, for example, OECD, 2001; Macintosh, 2004; Tambouris, 2007; Meijer et al., 2009; Sanchez, 2013). Drawing on propositions for eParticipation models provided by the OECD (2001), Macintosh (2004) Tambouris (2007), and Keskinen (2004), we propose the following eParticipation classification:

1. *Information and Engagement*, providing citizens with information on issues of public concern (e.g., climate change adaptation) and policies or projects meant to deal with those issues (e.g., national adaptation strategies). This eParticipation level includes active measures to disseminate information to the public. It is complemented by the provision of online spaces (forums, blogs) where the issue at hand can be discussed and more information obtained.

2. *Consultation and Involvement*, allowing deeper public contributions to agenda-setting by defining concrete aspects of previously defined issues. This level assumes citizen feedback on the issue in a more structured way. Namely, while citizen feedback in the previous eParticipation level can be grasped analysing online forums or blogs, this level envisages surveying the public on the issue of concern. The aim of such surveying is to understand public knowledge and perceptions (of climate change), responses to perceived changes (existing autonomous adaptation) and citizens' needs (e.g., for information and services, including the preferable form of such information). By allowing for the collection and analysis of information provided by citizens, this level adds to a better common understanding of the problem.

3. *Collaboration and Empowerment*, allowing people to participate actively in the development of alternative and the identification of preferred solutions (e.g., about the most suitable adaptation measures for their region). This collaborative approach informs decision-makers on public preferences and needs, while the public is empowered to take part in and monitor decision-making process, contributing to the accountability and transparency of the process.

4. *Self-mobilisation*, allowing people to take initiatives and decisions, and setting the political agenda independently of external actors. An example of such self-mobilization is eActivism, which is described in section 2.2.3.

The eParticipation framework presented in this paper is developed around the first three levels of eParticipation.

2.4.2. Online participation framework

Figure 2 graphically presents the proposed framework. Three eParticipation levels of this framework are discussed in more detail in the text below.

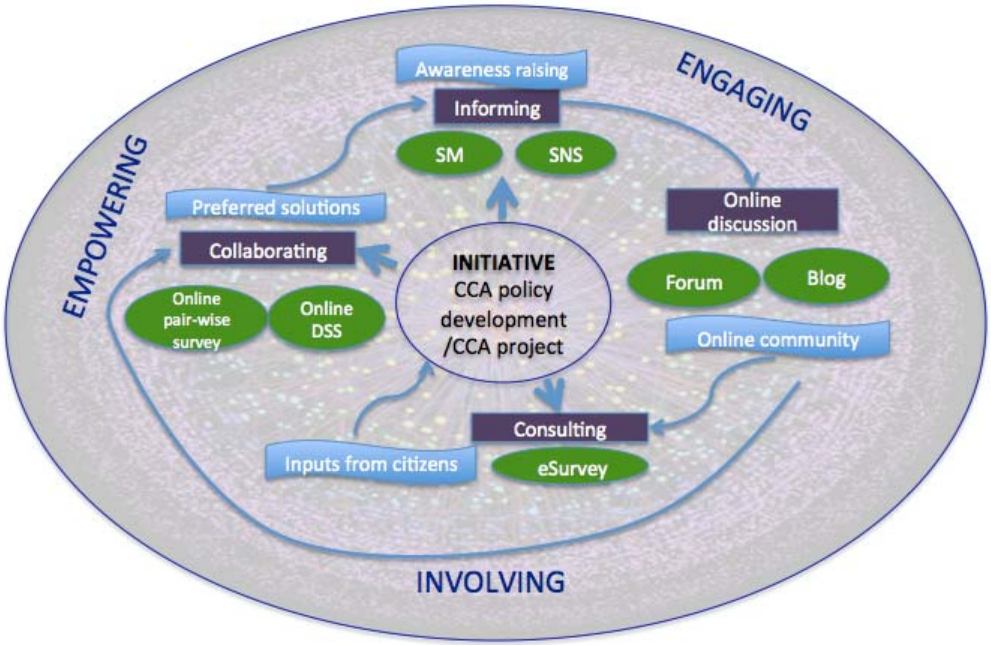

Fig. 2.2. Framework for online participation in climate change adaptation policy development. It starts with Informing through Social Media (SM) and Social Networking Sites (SNS), resulting in awareness-raising and initiating online discussion through Forums and Blogs, forming an Online community engaged in the topic at hand. Consulting is performed using online questionnaires (eSurvey), engaging the same Online community and providing inputs for the Initiative (policy development). Collaboration in problem analysis is performed using online decision support systems (DSS) or online pair-wise surveys, eliciting a preferred solution.

1. Informing and Engaging

Information regarding climate change, in particular concerning adaptation, should be disseminated using a social marketing approach. Engagement is achieved by initiating discussions through existing popular online social networks, offering the provision of new online information in the form of online bulletins or blogs, or using social marketing. Setting up an online forum, where scientists can be engaged in providing answers to the public, could add to Pelling and High's third realm (activate latent social capacity, see Fig. 2.1) by enabling communication and knowledge-sharing through this medium. Knowledge-sharing can also change a person's perception of their ability to adapt which, if underestimated, can be an important obstacle to adaptation (Grothmann and Patt, 2005). Although the Internet enables easy access to information, not all information can be considered reliable, especially in complex fields such as adaptation to climate change (Schmidt, 2012). This is where scientists can contribute by providing reliable and clear information in these forums.

This level should add to awareness-raising. It should also identify an online community that can easily be engaged in more profound participation.

2. Consulting and Involving

eParticipation can reach this level of consultation and involvement through the use of online questionnaires. By involving an already existing online group (e.g., Facebook users, or online forums or bulletins), or the one developed in the previous step, this level can benefit from the networks' high number of users and any available demographic information.

The public is consulted in order to gain an understanding of how it perceives issues related to climate change, the state of affairs regarding current adaptations, and major obstacles to adaptation. The systematic collection of citizens' opinions is important for gaining a picture of the public's understanding of less explored issues, and to facilitate the preparation of new policies to deal with those issues (Phang and Kankanhalli, 2008). In addition, the surveying of a large number of participants facilitates the identification of existing gaps in knowledge. Information about individual and collective behavioural responses to climate change and existing autonomous adaptations is typically insufficient. Investigating perceptions and autonomous responses to climate change is thus aimed at shaping future actions (Hobson and Niriers, 2011),

since understanding complex human behaviour with bounded rationality is crucial for formulating effective policies with complicated and long-lasting consequences (Gowdy, 2008; Gsottbauer and van den Bergh, 2010).

Besides disseminating invitations for participation through social networks, the use of social media in the form of online advertising can also have positive results. Bojovic and Mrkajic (2011) suggest that this non-aggressive sampling procedure would be suitable for targeting audiences specifically interested in the topic of concern. Still, the authors find that participants are more motivated to complete surveys when contacted in a more personal way through mailing lists or Facebook groups.

Being conducted online, this phase allows for the collection of results in real time, thus accelerating the analysis and communication of the results. The identified gaps in knowledge are then addressed through the first eParticipation level. The survey results are primary inputs toward finding solutions and suggesting adaptation measures.

3. Collaborating and Empowering

The network of participants established in the previous steps represents a community that is actively involved in problem analysis, exploring possible and identifying preferred solutions to the problem. Building on the information-sharing and knowledge-exchange accomplished in the previous participatory levels, this level of collaborating and empowering involves participants in more demanding and thorough participation.

Collaboration can be performed through the ranking of alternative solutions or, for example, by means of online pair-wise structured surveys (Phang and Kankanhalli, 2008). This survey can be supplemented with visualization tools to facilitate understanding of the offered solutions (for illustration, see Section 3.1). We suggest using multi-criteria analysis, involving evaluation techniques that evaluate all options against their contributions to solving the problem at hand and that can be performed using decision-support systems (DSS). The DSS family of tools uses socio-economic and environmental modelling techniques with the aim of providing informed and robust decision-making (Giupponi, 2007). This participatory activity is normally performed in workshops where mediators guide stakeholders through rather complex procedures. Due to technical limitations in group management and in some cases to limited resources (time, space

and money), these workshops are usually attended by a small number of stakeholders or by group representatives (such as representatives of farmers or local decision-makers). Bojovic et al. (2012) suggest using simplified online DSS in order to open this process to a broader public. Developing the online DSS platform in various languages can help to overcome the problem of the language barrier previously discussed. Additionally, the DSS platform can allow an option for posting questions and answers which demands the effective engagement of scientists. The results of such collaboration among scientists, policy-makers and the general public can guide further policy development and inform it on commonly agreed preferred solutions.

In this eParticipation level, people are empowered to collaborate in decision-making, thus contributing to adaptive capacity by enabling collective decision-making and inciting institutional modification (the Pelling & High's fourth realm, see Fig. 2.1).

2.4.3. Reshaping the effect of social capital on adaptive capacity in the online sphere

The framework proposed in this chapter expands upon the discussion initiated by Pelling and High (2005) on research connecting adaptive capacity and social capital. This framework assumes spreading this research to the right-hand side of the graph presented in Fig. 2.1, contributing to institutional modification in the third and fourth realm (Fig. 2.3).

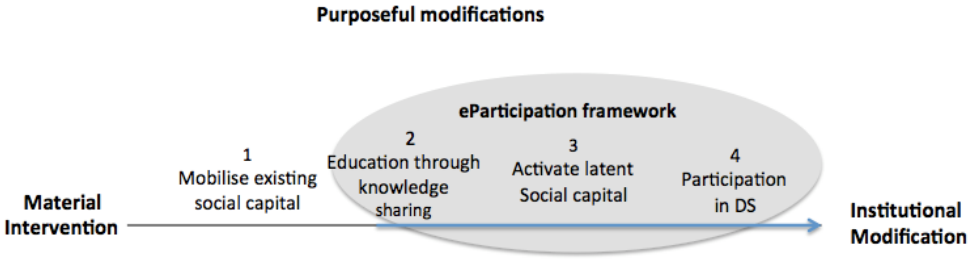

Fig. 2.3 Effect of social capital on adaptive capacity in the proposed eParticipation framework (adapted from Pelling and High, 2005)

This chapter proposes a twofold connection between online social networks and eParticipation, on the one hand, and adaptive capacity on the other. First we suggest surveying the cognitive aspects of adaptive capacity on a larger scale through eParticipation conducted via online social networks. These cognitive aspects have usually been neglected compared to the economic, material and institutional aspects of adaptive activities (Grothmann and Patt, 2005; Hobson and Nirmeyer, 2011). However, understanding cognitive aspects may help to better inform policy makers. The second connection, drawing on the literature findings, is that through supporting social capital, online social networks also support adaptive capacity. The framework is focused on purposeful modifications aimed at improving adaptive capacity. Information-sharing and knowledge-exchange through online discussions and online surveying, coming under the first two levels of the eParticipation framework, can add to education and activate latent social capital in weakly connected existing social networks, such as SNS. The third level of the eParticipation framework results in collective action and group decision-making. These participatory activities may result in changing power structures and institutional modifications. This can be a desirable direction for the development of climate change governance.

2.5. CONCLUSIONS

In this chapter we have proposed the use of eParticipation and social media as a new framework for public engagement and participation in climate change. eParticipation has been advocated by EU institutions as an approach that can improve public inclusion in politics, but here we show the use of this approach in the field of climate change adaptation.

Climate change presents an increasing threat and tackling this threat demands a complex process of multilevel and multidimensional change. The social aspects of climate change are gaining importance, as is the role of the public both in producing policies and in accepting them. Although participation has been seen as an important aspect of climate governance, it often suffers from insufficient engagement and a low number of participants, either as a result of insufficient resources for participation or lack of interest. Combining eParticipation and widely used online social networks, the proposed framework addresses this flow of a common participatory practice. Moreover, although face-to-face communication has been considered the most powerful engaging approach, the societal trend towards online networking may show communication via social media to be more in line with current public needs and habits.

This research aims to shift thinking about participation, suggesting that eParticipation and the use of social media may develop cross-cutting networks, linking civil society, citizens, scientists and policy-makers, and potentially achieving a policy change driven by public opinion. These new links can facilitate communication and enhance the exchange of information and knowledge in the multifaceted field of climate change. In particular, an important role in this framework is assigned to scientists, who are encouraged to reach out to the general public and spread knowledge about climate change. After engaging the public through information-sharing and online discussion, the public is further involved in the knowledge exchanged through online surveying. Finally, the public is empowered to take part in collaborative problem analysis and the selection of preferred options. Improved knowledge-sharing and new spaces for collective action may affect social capital and foster adaptive capacity, modifying power relations and resulting in institutional change.

This framework is expected to make the participatory process more efficient by reducing money and time demand, while the process is visible online and the results easily accessible, improving

the transparency of decision-making. Moreover, participatory decision-making increases the legitimacy of adaptation-related decisions. Like other participatory practices, however, it cannot guarantee representative participation. eParticipation can only engage Internet users; but with future internet penetration this concern about the digital divide could become negligible. Still, it is difficult to evaluate the effectiveness of the proposed framework until there are more case studies and empirical examples. Further research is needed in order to ground theory in this emerging field and to establish practice.

CHAPTER III: INITIAL EXPERIENCE WITH ePARTICIPATION

This chapter describes the initial experiences we have had with eParticipation 'experiments' within the frame of two research projects, one activity launched by an online CSO, and one local UN initiative. The common aim was to explore the functioning of eParticipation and how it can be combined with various online tools. After developing a theoretical eParticipation framework in the previous chapter, we present here results of its testing in order to understand how it can best be used in the practice. Besides testing various online approaches for applying different parts of the eParticipation framework, we also examined other factors, such as the extent to which language can be a barrier to participation, sampling dynamics, or applicability of the social marketing approach compared to a more direct and personal approach. The rest of this section summarises the four experiments and outlines the main conclusions we drew from this work. This experimental work gave us first hand experience that enabled more profound comparison of eParticipation with the traditional participatory practice, as presented in the next chapter, as well as assisted implementation of the framework, presented in the chapter V.

3.1. ONLINE RANKING OF WINTER TOURISM ADAPTATION STRATEGIES

3.1.1. eParticipation activity

This experiment was conducted within the ClimAlpTour Project (Climate change and its impact on tourism in the Alpine Space), and more specifically its case study in Auronzo di Cadore in the Italian Dolomites, focused on proposing innovative strategies for the development of winter tourism and climate change adaptation. Alternative strategies were developed in a workshop with local actors interested in the promotion of winter tourism. Three alternative strategies and 11 key criteria for choosing an alpine destination in winter were defined and ranked by stakeholders.

An Internet survey was developed to obtain the opinion of potential tourists to Auronzo and also of those who opted not to visit this ski resort. The survey consisted of a brief explanation of the project, two mandatory questions to characterize participants, and the ranking procedure. Alternative strategies were visually presented and accompanied with a short explanation. Respondents were offered to rank their preferences. The ranking took into consideration what the majority favoured as well as what they preferred least in order to omit the plurality rule paradox (Munda, 2008) (Fig. 3.1).

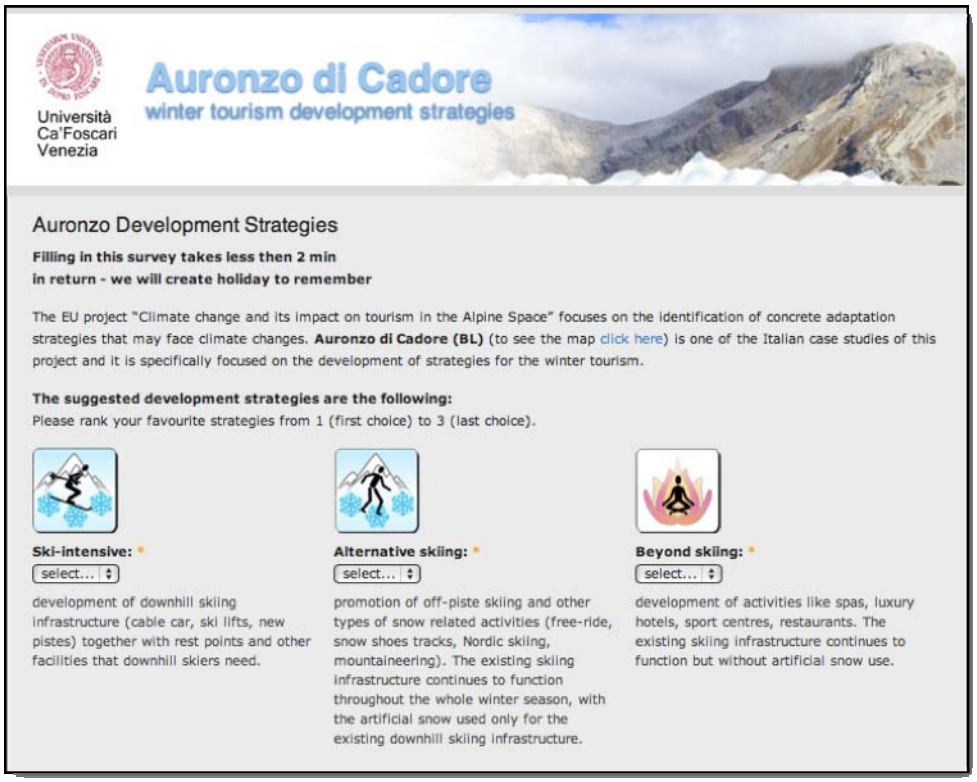

Fig. 3.1 Online interface for ranking alternative strategies

Participants had the further option of creating their own new strategy by selecting from 11 key elements previously found to be the most significant for an alpine destination in winter. The key elements were presented using icons and short descriptions developed within the ClimAlpTour project (Fig. 3.2).

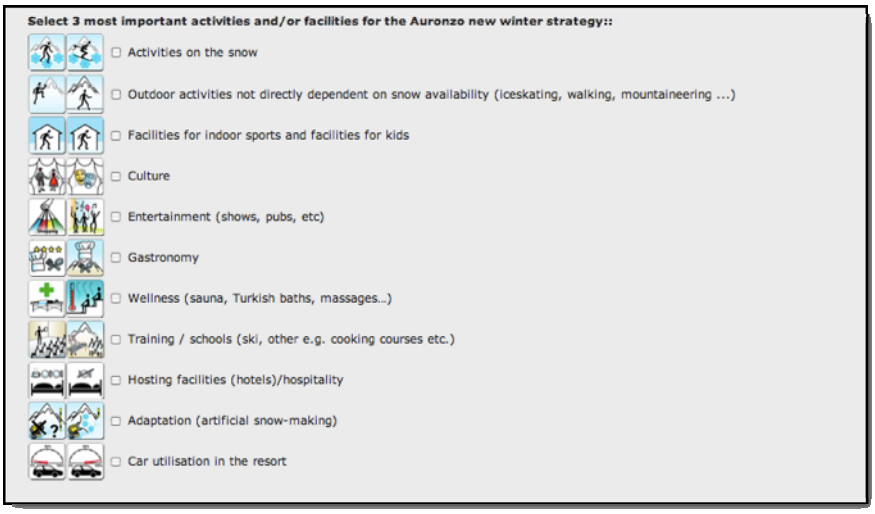

Fig. 3.2. Selection of the most important elements for developing a strategy (images developed by the ClimAlpTour project)

The invitation to participate in the survey was advertised using different approaches. In the first step we used the GoolgeAdwords tool to attract potential participants, with the idea of reaching people who used Google to search for Auronzo di Cadore. We also selected other keywords that should trigger the ad and the maximum amount we wanted to pay per click. Clicking on the ad led users to the online survey. The survey was bilingual, with the English version used throughout Europe while the Italian version was used only in Italy. We used Google Analytics, a service that generates detailed statistics on website visitors, to learn about how much time users spent on the website (survey), the number of new entries, and the geographical origin of the users. The results indicated that Google advertising was not a suitable tool for targeting a large population (i.e., Google users in Europe) when we needed responses on such a narrowly specific topic as the ski resort in Italy. Google determines the quality score of an advertisement according to a statistical click-through rate, the relevance of the key words and the advertiser's account history (using a precise formula secret to Google), which altogether was not in favour of our experiment. In particular, Google rewards advertisers for ads that are strongly related to what users are searching for, and in this way ensures that the most relevant and thus the most profitable ads appear most frequently. However, this does not exclude the possibility that this tool might prove suitable for topics related to climate change or environmental issues in general, which could be considered popular, if related to a specific region (meaning that Google targets only users from that region).

The next step in our exploratory experiment was to advertise the survey on social networks, Facebook in this case. The advertisement was prepared using an ad-creation platform through which people were invited to complete the survey (Fig. 3.3). The frequency of the appearance of an advertisement depends on the allowed budget and the maximum bid for a click. The height of the suggested bid and the average click-through rate are country-specific, as they depend on the popularity of the network and its social marketing activity. In our experience, adverting on Facebook Italy was rather expensive compared to advertising in certain other countries, such as Slovenia for example.

Fig. 3.3 Facebook advertisement for evaluation of winter tourism adaptation strategies

Two different approaches were used to advertise the survey on the Facebook social network. First we specified the target audience according to their interests, including different terms related to skiing, nature, the Alps, the Dolomites, and various ski resorts in this area. This approach was developed for the members of the Facebook network in Italy and Slovenia (Slovenia was chosen as the country with the highest number of non-Italian tourists in Auronzo di Cadore). A second audience was approached by making the advertisement available for all Facebook users in Italy and Slovenia without setting specific locations or interests.

The first Facebook advertising approach proved most successful, with 25 completed surveys in five days. The second approach of targeting the whole Facebook population in Italy, with above 35 million Facebook users and competitive Facebook marketing, collected only a few responses. The response-rate was also low in Slovenia, but as the survey was available only in English and Italian, language may have been the main barrier for Slovenian participants.

3.1.2. Main outcomes

The results of this experiment indicated that eParticipation activities should be disseminated using structured online groups, i.e., groups gathered around a particular issue of interest. The general characteristics of an online social network such as Facebook should not be overlooked. In this specific case, the Italian Facebook network had a large number of users and well developed social media advertising and may not be suitable for low-budget scientific experiments since a significant budget would be necessary to have the advertisement shown more frequently. Potential language barriers also need to be considered and multilingual platforms should be available in the case of cross-border research. Finally, Google advertising did not prove suitable for this type of experiment due to the large number of users with different interests and the very competitive online advertising market.

This first experiment focused on the third eParticipation level – collaboration on finding a preferred solution for a problem of climate change effects on tourism in the Italian Alps. Although the experiment was preceded with the traditional participatory practice, more precisely workshops with stakeholders, without conducting previous eParticipation levels, we did not have a pre-established online network of participants, which can explain low response rate in this experiment.

3.2. A BOTTOM-UP APPROACH TO PUBLIC INVOLVEMENT IN THE DEVELOPMENT OF URBAN CYCLING POLICY[8]

An online-created CSO initiated public participation in a new cycling policy in the Serbian city of Novi Sad. Public participation was accomplished using a survey that was distributed through mailing lists, social networks, and Facebook advertising. The main purpose was to consult the local community and cyclists in formulating the best location for new bicycle parking spaces.

The preliminary survey conducted among university students and employees showed that the main obstacle to the use of bicycles for commuting in this city with favourable cycling conditions was the lack of safe bicycle parking. In response, the University of Novi Sad initiated the construction of the first safe space for bicycle parking in the University campus. By achieving extensive use of the new parking space and attracting media attention, this project incited the city authority to devote some of its budget to the construction of a limited number of safe bicycle parking lots throughout the city. The online CSO conducted an online survey to consult cyclists about their needs and requirements.

3.2.1 eParticipation activity

Public was involved through two phases. In the first phase, the survey was distributed to various Facebook pages and groups mainly related to cycling, and also to the university mailing list and the regional voluntary centre mailing list.

In the second phase, the survey was directed towards the general public through a Facebook advertisement (Fig. 3.4). The target audience was specified according to the location, i.e., the city of Novi Sad, which included over 80,000 users.

In the first surveying phase, 680 responses were collected from approximately 10,000 members of these groups. This means that 6.5% of those who may have seen the invitation to complete the

[8] This study is published as Bojovic, D. and Mrkajic, V. (2011) *The Role of Social Networks in Environmental eParticipation*. ESEE 2011 Conference - Advancing Ecological Economics: Theory and Practice, Istanbul, Turkey.

questionnaire actually followed the link and entered the survey. Nevertheless, it was difficult to affirm the number of active users in these groups.

The survey based on the Facebook advertising campaign was run for 7 days. The cost of advertising on the Facebook social network in Serbia at the moment of conducting this survey was below the global average, probably due to the still relatively low number of advertisers using this approach. This phase collected 120 responses out of 1,000 users who clicked on the advertisement.

The two different dissemination approaches showed similar sampling dynamics: the majority of results were collected in the first 2–3 days after the invitation was launched. Responses were similar in the two samples except for the higher percentage of cyclists in the group that was approached via Facebook. This group was also less determined in completing the whole survey, 64% compared to 72% in the first sample. This suggests that online advertising as a nonaggressive sampling procedure is suitable for targeting audiences with a specific interest. Then again, when contacted more directly through invitations in inboxes or Facebook walls (for Facebook groups), even people not closely involved in the issue (non-cyclists) were motivated to complete the questionnaire.

The results of the survey were delivered to the public utility company in charge of providing bicycle facilities in order to guide the selection of new bicycle parking spaces.

Fig. 3.4 Facebook advertisement for survey on safe bicycle parking location (from Serbian: *With bicycle through Novi Sad: You are cycling and you need a safe parking? Tell us where. Click here*)

3.2.2. Main outcomes

Second eParticipation level was performed in this research using different online groups, as well as online advertising, for reaching the general public. The use of networks with members gathered around a specific issue/profession/activity, such as mailing lists, Facebook groups and pages, proved to be more suitable in reaching a higher number of participants. However, as there was no preceding online campaign on this matter (first level of eParticipation), it is not surprising that the participants from the first group (i.e., students, volunteers and activists, who are more likely to be familiar with the surveying method, and maybe even with the traffic congestion issue) proved more proactive in completing the survey. This group also gave more reliable answers in terms of the completeness of the questionnaire, but reached less diverse public in terms of educational background. Although the Facebook marketing method enabled participation of a broader public in terms of the participants' education and age, it predominantly reached the public more involved with the topic, i.e., there was a higher percentage of cyclists – 87%, compared to 72% in the first group. Finally, the fact that in both samples almost all the participants who did not complete the entire questionnaire gave up after the first page suggests that surveying conducted through eParticipation should be limited in length (e.g., up to one page) wherever feasible.

3.3. PUBLIC AWARENESS OF ENERGY-EFFICIENCY OPTIONS IN THE REPUBLIC OF MACEDONIA[9]

3.3.1. eParticipation activity

An online survey was conducted in collaboration with the UNDP[10] office in Skopje to assess the level of awareness among Macedonian citizens of the concept of energy efficiency and to identify the ways in which Macedonians gain information about energy-efficiency measures, which energy-saving measures they have already adopted, what the major barriers are to applying such measures, and how energy efficiency can be enhanced.

The questionnaires were launched via mailing lists (of UNDP employees) related to the environment and energy efficiency, as well as via Facebook groups related to the same topics. The group approached in this way were considered 'Experts'. The second group was engaged via different mailing lists, municipal webpages, and Facebook profiles and groups. The third group was engaged through a Facebook advertisement (Fig.3.5). The latter was open to a wider Facebook audience in order to attract people with different interests to participate actively in the survey.

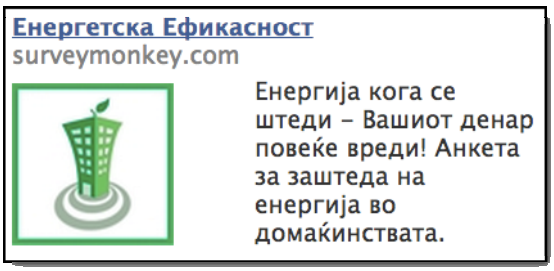

Fig. 3.5 Facebook advertisement for the energy-efficiency survey (from Macedonian: Energy efficiency: When you save energy your money has higher value! Energy-saving in households survey.)

[9] The results of the survey are presented in: Bojovic, D. and Sazdovski, I. (2012) *Energy efficiency in households – online survey results*, Project report, UNDP office in Macedonia.
[10] UNDP United Nations Development Programme

First participation level – informing – in a form of a media campaign on energy saving and energy efficiency was conducted prior to the survey. As a consequence, the majority of participants proved to be familiar with the concept of energy efficiency and claimed to have already received information about this topic.

The results of the second eParticipation level – consulting – demonstrated that the Internet was the major source of information for the expert group, while television was the main source of information for the general public (i.e., the second and third groups). The results further showed that, apart from installing energy-efficient lighting and solar panels, the participants had barely implemented any other energy-saving measure. Indeed, the majority of participants had never heard of some of the energy-efficiency measures, such as installing condensing boilers, despite the fact that the Government envisaged subsidies for all these alternative measures. A major barrier to implementing energy-efficiency measures proved to be a lack of financial resources, even though bank loans were on offer for this particular purpose.

The results of the survey were used as direct input for a new engagement activity – media campaign, broadcast both on the Internet and on TV, to promote less well known energy-efficiency measures, government initiatives to support energy-efficiency implementation, and bank loan plans.

3.3.2. Main outcomes

It is difficult to follow the response rate in the case of disseminating questionnaires through diversely populated online networks. Nevertheless, more than 500 answers were collected in this experiment: 165, 195 and 152 answers respectively for the three groups. The only cost of dissemination was the price of the Facebook advertisement, which had a much lower charge compared to the Facebook advertisement in Italy.

This experiment showed that conducting an online survey on an issue of interest (second eParticipation level – Consulting and Involving) can provide information to feed the first eParticipation level – Informing and Engaging.

3.4. INFORMATION NEEDS AND COMMUNICATION PROFILES OF CORE TARGET GROUPS OF THE C3-ALPS PROJECT: Results of an alpine-wide survey[11]

3.4.1. eParticipation activity

An online survey was conducted to consult the two target groups of the C3-Alps Project (Capitalising climate change knowledge for adaptation in the Alpine space) on their information needs and communication habits. The two groups were local political decision-makers and personnel from local administration and regional/national level administration.

The questionnaire was distributed through the project partners' mailing lists (in particular the lists of those partners working in public administration). A total of 358 responses were collected in less than two months.

The results revealed, among other things, that dialogue groups are generally interested in climate change adaptation, with the highest interest being demonstrated in future climate change scenarios, climate change impacts and vulnerabilities, and examples of good adaptation practice. Although both groups are familiar with the topic, the first group of mayors and local administration personnel is less familiar with the issue and deals less frequently with climate change adaptation than the second group of regional and national administration personnel. Participants demonstrated interest in different levels of information and information products, but particularly in visualised and geospatial information (maps and graphs) and how-to-do manuals. The Internet is a major source of information for both groups, while TV is not a popular source of information on climate change adaptation for either group.

Findings from this eParticipation activity provide a clear picture as to what form of information should be delivered to target stakeholders and through which media source. For instance, the results revealed that when participants look for information related to climate change adaptation they first do a Google search, which means that having a high-ranking for the project products and the project website in the Google search engine is an important determinant for the

[11] Bojovic, D. Dietachmair, J., Pfefferkorn, W., and Thamm U. (2013) *Survey on climate change adaptation – How to inform local, national and regional administration successfully,* Deliverable of WP5 in the C3-Alps project

successful dissemination of results. The strong interest shown in visualised and geospatial information also guided the way in which participants were involved in the next eParticipation level, i.e., collaboration on the assessment of adaptation measures (see chapter VI).

3.4.2. Main outcomes

This research confirmed the suitability of mailing lists for the purpose of involving and consulting stakeholders – second eParticipation level – on the issue of climate change adaptation. Inputs from stakeholders were useful for shaping project outputs to be shared with them, but also for producing tools for collaboration on the project – achieving third eParticipation level.

CHAPTER IV: COMPARING TRADITIONAL PARTICIPATORY PRACTICE AND ePARTICIPATION IN ENVIRONMENTAL DECISION-MAKING[12]

Bojovic, D. and Spiric, J.

This chapter compares two types of community participation that currently, in parallel, take place in environmental decision-making processes from global to local scale: a) traditional participation, a various types of face-to-face contacts between a community and policy makers, and b) eParticipation, a set of technology-facilitated participatory processes that enables the two-way communication between the civil society and decision makers. Previous chapters presented the eParticipation framework and results of experimenting with the different online tools in order to understand how to implement the framework in an efficient and effective manner. This provided knowledge and experience to compare online approach with traditional participatory practice. Two participation processes are compared against a set of different criteria. We conclude with suggestions on what one process could learn from the other and how they complement each other. This combined approach would benefit from increased efficiency – overcoming traditional participation's resource demanding nature, and from better reliability of results – enhancing usability of eParticipation in decision- making processes.

4.1. INTRODUCTION

Community participation is "the active, voluntary, and informed engagement of a group of individuals to change problematic conditions and to influence policies and programs that affect the quality of their lives or the lives of others" (Gamble and Weil, 1995: 483). The need for the active participation of a community – a group of individuals representing the general public from the local to the global scale, including urban and rural populations, has been recognised as important for improving the success of environmental policy-making processes (Reed, 2008; Berry and Higgs, 2012). Improved public participation has treble meaning: it is expected to

[12] An earlier version of this paper was presented at the ESEE 2013 Conference: Ecological Economics and Institutional Dynamics – 10th International conference of the European Society for Ecological Economics, under Spiric, J. and Bojovic, D., *One Globe: From Talking with Local Indigenous Peoples to Having Global Community Voice Heard via Internet – What Participatory Processes Offer Today?*

support basic human rights concerning democracy, to add to the legitimacy of decision-making, and to result in greater support for policies (Rowe and Frewer, 2000; Kelly, 2012). A decision-making process is considered legitimate if it rests on the approval and consent of all actors, who have been granted recognition and given the same chance to present their concerns with equal decision-making power (Paavola, 2003; Adger et al., 2003; Backstrand, 2006; Angelsen et al., 2009; Thomson et al., 2011).

Although the involvement of a range of stakeholders has often been demanded in official decision-making (e.g., The Aarhus Convention, 1998; the EU Strategy on Climate Change Adaptation, 2013), resulting in a variety of participatory procedures, many environmental policy processes still suffer from insufficient or inadequate participation (Cornwall, 2000). Some reasons for this include the lack of legal obligations or interest on the part of decision-makers, insufficient concern or capacity on the part of the community, or the time-consuming and financially costly nature of participation (Hooghe et al., 2010; Sánchez-Nielsen and Lee, 2013). These shortcomings could be addressed by raising public awareness about the issue at hand, by a better understanding of social, economic and cultural community contexts, and by developing new cost-effective participatory procedures (Owens and Driffill, 2008).

Participation should not be seen as a panacea (Reyes-Garcia, 2011), however, but should rather follow communities' needs and timescales. Moreover, greater participation includes divergent perspectives and viewpoints on a particular environmental issue that needs to be addressed (Kelly, 2012). This may result in long and resource-consuming processes and ultimately compromise policy design (Angleson et al., 2009). According to Paavola (2009), any participation which does not influence outcomes is meaningless. Meaningful participation, in turn, includes recognizing all actors, actively and effectively involving them, and granting them equal opportunity and power to influence the decision-making process (Thompson et al., 2011).

We identify two types of community participation that are presently taking place in parallel on various scales and under different circumstances and conditions: a) traditional participation (tParticipation), which refers to various types of face-to-face contacts between a community and policy-makers, including interviews, workshops, meetings and roundtables, and other participatory appraisal methods; and b) online participation (eParticipation), which is a set of technology-facilitated participatory processes that enable interaction between civil society and

the formal sphere of politics and administration (Sæbø et al., 2008), including online awareness-raising campaigns, online consultation, surveying, voting, and decision-support.

This chapter develops a framework with which to compare tParticipation and eParticipation processes against a set of criteria using empirical examples from available scientific and grey literature. The following section presents a list of the criteria. Section 3 presents the results of the comparison, while conclusions and recommendations are given in the final section.

4.2. ANALYTICAL FRAMEWORK

This section details the criteria selected to compare tParticipation and eParticipation: i) initiator, motivation and incentives; ii) recognition and representativeness; iii) levels of participation; iv) transparency; v) accountability; and vi) efficiency.

"Participation does not just happen, it is initiated." (Rahman, 2005: 4). Different societal groups can be initiators of participation, depending on the objective and aim of the decision-making process. Initiators hold the authority and manage the process by deciding how much or how little control is allocated to participants, therefore impacting on the legitimacy of the process (Thomson et al., 2011).

The success of participation depends on people's response to the invitation to take part (Bruce et al., 2002), which in turn depends on people's needs and motivations (Ghai and Vivian, 1992). Community participation in decision-making on environmental issues will be discouraged if it is given priority over other issues perceived as more important by a community, such as violence, health or poverty (Mathbor, 2008). People's motivation to participate in environmental decision-making can range from achieving purely personal goals to reaching common objectives. In order to motivate people to participate it is necessary to organise a proper system of incentives which suits the actors' social characteristics, including class, economic status, ethnicity, age and gender (Guthiga, 2008; Triguero-Mas, et al., 2010). Such incentives can be divided into two general categories: financial (e.g. substantial financial benefits, employment) and non-financial (e.g., permissions to use resources, property rights) (Ghai and Vivian, 1992).

The recognition of actors includes acknowledgement of their needs and the distribution of decision-making power, and is thus the first step towards ensuring the legitimacy of environmental decision-making (Paavola, 2004). When participation is fair everyone takes part on an equal footing. This refers to equal opportunities to determine the agenda, speak and determine the rules for discourse, as well as to have equal access to knowledge and interpretations (Webler, 1995). Then again, communicative competence is achieved if all participants performer the ability to use language, to create understanding and agreement (Habermas, 1970). Giving equal rights to express their views to participants of differing levels of positional power may enable the poorest groups to utilize sometimes the only resource they control – local knowledge, adding to their empowerment (McCall, 2003).

Lack of recognition may be closely linked to political and institutional hierarchies and social characteristics (Fraser, 2003). In order to fulfil a criterion of representativeness, the selected participants should, besides being recognised, perfectly mirror the social characteristics of the larger population to which they belong (Yount, 2006).

Several levels of participation can be differentiated according to the type of information flow and the amount of power given to the participants (see Arnstein, 1971; Biggs, 1989; Richards et al., 2004). For our analysis, we limit participation to four levels, drawing on the classification developed by Pretty (1995), from passive participation to self-mobilisation. In *passive participation*, people are only informed about the decision-making procedure on a certain environmental issue. *Participation by consultation* is when people are consulted on predefined problems while the initiators hold the right to decide whether or not to take these views into account. In *interactive participation*, people take control over local decisions through building action plans, forming new local groups or strengthening old ones, while the ultimate participation level of *self-mobilisation* occurs when people take initiatives and decisions independently of external actors. First three levels coincide with the three eParticipation levels, proposed within the eParticipation framework in Chapter II: information and engagement, consultation and involvement, and collaboration and empowerment.

The transparency of the process should ensure open communication among all the actors, with decisions and the reasoning behind those decisions being well documented, easily accessible in a timely manner, and understandable by all stakeholders (Jarvis and Sovacool, 2011). Participation

is genuinely about two-way communication (Visser, 2011) and the extent to which we can rely on the data provided by a community, i.e., the reliability of information is an important determinant of the transparency of a process (Pierce, 2008). Ideally, information should be triangulated among other community representatives or in repeated contact with the same participants when their identity is known.

Accountability involves a clear assignment of authority and responsibility to all actors in the process for their decisions and actions (Jarvis and Sovacool, 2011). Keeping the actors accountable ensures that no stakeholder group dominates the process and thus decreases the possibility of dispute (Beisheim and Dingwerth, 2008). The level of trust in a decision-making process depends directly on its transparency and accountability (Reed, 2008; Vatn and Vedeld, 2011). Moreover, transparent and accountable processes should ensure better understanding of others' views, resulting in social learning and greater acceptability and support of decisions by actors (Beisheim and Dingwerth, 2008; Cadman and Maraseni, 2011).

The efficiency of participation is determined by the amount of time and monetary and human resources allocated, i.e., achieving effective participation at minimum cost (Angelsen, 2008).

4.3. COMPARING TRADITIONAL PARTICIPATION AND ePARTICIPATION

This section compares the processes of traditional participation and eParticipation against the set of criteria defined in the analytical framework. The results are summarised in Table 4.1.

4.3.1 Initiators

tParticipation is mostly initiated by CSOs and, less frequently, by private organisations or governments. The interest of initiators in including people in the process of tParticipation ranges from CSO initiatives to legitimize and promote people's rights and building citizenship, to government activities to fulfil the requirements of international or national law (Rahman, 2005; van Bodegom, 2011). There are cases of self-initiated processes where the community itself is the promoter of participation, e.g., Community Forest Enterprises (CFE). Self-initiated community participation is need-based, usually entirely community-driven, and sometimes entirely self-funded (Deb, 2004).

In the case of eParticipation, initiating actors may include governments (eGovernment), scientists, CSOs (online activism – eActivism) and community members. The objectives of eParticipation can include: informing a community, generating support among its members, utilizing a community's input in decision-making, and probing for public needs (Phang and Kankanhalli, 2008, Bertot et al., 2010). eGovernment has been promoted by the European Commission for achieving "…increased access to public information, strengthened transparency and effective means for involvement of stakeholders in the policy process" (The Malmo Declaration, 2009: 2). Then again, CSOs appear as early adopters of social media and eParticipation in community engagement on pressing public issues, including climate change. An example is 350.org, a grassroots organisation supporting transnational eActivism in the area of climate change by using the Web to mobilize people around the globe for campaigns in the traditional off-line manner.

Participation is a voluntary process and people should be free to decide whether to grant or withhold their consent to proposed activities. The principle of free, prior and informed consent (FPIC) should ensure recognition of the inherent and prior rights of indigenous and local communities to lands and resources and the obtaining of informed consent when third parties are

to enter into a relationship with them (UN, 2007). The provision of right incentives to people is crucial to ensure participation. tParticipation combines financial and non-financial incentives. There is a general trend towards favouring financial incentives through market-based conservation mechanisms such as payment for ecosystem services, although many local communities would make better use of non-financial benefits as they might not be accustomed to managing cash incentives. Besides, monetary incentives could provoke conflicts within the community and result in the accumulation of benefits within a dominate group of individuals, i.e., elite capture (Madeira et al., 2012).

eParticipation mostly uses non-financial incentives, such as the provision of human rights, including the right to a healthy environment. External motivation is often unnecessary in online activities since collaboration and self-motivated online interactions among participants are inherent characteristics of Web 2.0 (Kaplan and Haenlein, 2008; Meijer et al., 2009).

4.3.2 Recognition and representativeness

Prior to participation, all relevant actors should be recognised. In the case of forest governance, the trends of decentralization have included the design of forest policies sensitive to local contexts, which enables the recognition of local actors (Mayers et al., 2002). However, there are still examples of lack of recognition, such as the case of landless people in carbon forestry projects (Corbera, 2005), or the persistent issue of women's marginalisation (Agrawal, 2009). tParticipation is considered representative if a sufficient number of actors participate in workshops and meetings as a proportion of the total community population and if representatives from each social group in the community are present. However, the success of participation should not be measured only by the number of people attending meetings but rather should be based on people's understanding of and contribution to the process (Maharjan, 2005).

By contrast, the Internet supports online interactions between all users and the simultaneous creation of content by many. eParticipation does not suffer from time and space barriers, i.e., participants can take part whenever and in whatever way is most convenient for them. However, uncertainty as to the identity of participants may undermine the claims of representativeness of some eParticipation processes. Furthermore, lack of Internet access resulting in a digital divide is perceived as one of the major constraints of eParticipation (Bekkers, 2004; European

Commission, 2009). A language barrier has also been recognised in online spaces, e.g., blogging on climate change mainly takes place in English (O'Neill and Boykoff, 2010), with some exceptions, such as multilingual online platforms for public engagement in decision-support (Bojovic et al., 2012; Sánchez-Nielsen and Lee, 2013).

4.3.3 Levels of participation

In the past, tParticipation has often been limited to passive participation (Ribot et al. 2006; Agrawal et al., 2008). Due to the general trend of promoting community-based projects and giving back decision-making power to local people, participation by consultation and interactive participation have become the most commonly identified levels (Cronkleton et al., 2008). There are also cases of self-mobilisation in tParticipation, such as the world's foremost international farmers' movement, Via Campesina, and the more recent example of REDDeldia, a civil society movement consisting of 100 community organizations united against the design and implementation of REDD+ in Mexico.

In the online sphere, participation by giving information takes the form of awareness-raising campaigns or information-sharing through social media, while community opinion is not necessarily taken into account in decision-making. eParticipation by consultation may take the form of online questionnaires, for example, which are suitable for obtaining public opinion on less explored policy issues, providing an initial understanding of public views and the collection of citizens' opinions on a large scale, which facilitates the preparation of new policies (Phang and Kankanhalli, 2008), such as climate change adaptation. Interactive participation, or collaboration as defined in the eParticipation framework, is easily achieved in online spaces that enable different actors to contribute openly to the framing of the problem (O'Neill and Boykoff, 2010) and to collective action. Finally, self-mobilisation is common for online participation, mainly through eActivism. An example is Avaaz, an online global CSO with over 25 million members, which empowers the global public by collecting their voices and positions on globally important social issues such as climate change (Avaaz, 2013). Besides these global initiatives, this group also empowers local communities to campaign on issues of concern to them by using online petitioning tools.

4.3.4 Transparency

In tParticipation, besides ensuring the inclusion of all relevant information, the transparency of the process implies communicating that information in a culturally appropriate way (i.e., in the local language and adapted to local knowledge) and in a timely manner (i.e., giving sufficient time to read and discuss the information) (Jarvis and Sovacool, 2011). Misunderstanding and mistrust between project authorities and local communities based on a lack of transparency are commonly found in traditional spaces (UNEP, 1996). Regarding reliability of information, the fact that the identities of actors in tParticipation are usually known makes it easier to triangulate information with the same people or in focus groups.

In the online sphere, transparency is reflected in the visibility of activities, i.e., citizens can see how others participate and how government responds, namely 'naming and shaming' offenders could go on instantaneously through the Web (Meijer et al., 2009). An example is citizens' provision of real time assessments of health-related exposures after the 2010 Deepwater Horizon oil spill in the Gulf of Mexico, using an online, open source mapping system. Comparing these results with those of government sources showed that residents noticed potential risks that were not detected by expert risk assessors, presented in federal assessments (McCormich, 2012).

Regarding the availability of information, the Internet can contribute to the quality of the content of discussion since people have time to look up relevant information and reconsider their responses (ibid.). This position is contrary to some assertions made in the literature (e.g. CIBER, 2008) that the little time needed for evaluating information on the Web may decrease the quality of knowledge.

An important barrier to transparency and data reliability in online participation is the fact that the identity of participants sometimes remains unknown. There are contrasting views on *the real name policy* – obliging users to register with their real names when participating online. A study by Ruesch and Marker (2012) shows that low rates of participation, reluctance to discuss openly, and the issue of privacy rights outweigh the positive aspects of real name policy in eParticipation. In the case study of farmers suggesting and evaluating climate change adaptation measures via an online decision-support platform, an option to leave email contacts proved useful for the identification of participants, since many participants decided to provide these

contact. In this case, the results were efficiently triangulated among the same group of people (Bojovic et al., 2012).

4.3.5 Accountability

In traditional spaces, accountability should be ensured by respect for formal international and national legal documents on the rights of local people, such as the abovementioned UN declaration and other national laws and informal customary laws. When participation is legally demanded, the law and regulations constitute the primary vehicles for clarifying the respective duties and obligations of the state and the citizens (van Bodegom, 2011). However, in the absence of relevant laws or in the case of their poor enforcement, citizens could use other formal mechanisms (e.g., roundtables with government, public hearings, and court cases), and informal mechanisms (e.g., protests, re-settlement in natural reserve areas, sabotage, armed conflict) to exercise their rights (Newell and Wheeler, 2006).

The Internet, on the other hand, is subject to relatively little regulation. It is difficult to agree on jurisdiction that would bring regulatory policies to this global online communication space. Furthermore, the Internet governing bodies are accountable if their activities are visible and subject to evaluation using established and globally accepted standards (Weber, 2009). Consultation with civil society can help the establishment and implementation of these policies and standards (ibid.), for which there are plenty of available online spaces and tools. The lack of widely accepted models and standards also applies to the design of eParticipation processes (Paganelli and Pecchi, 2013), although initiatives for establishing an eParticipation framework have been emerging in different fields (see Bojovic et al., 2012; Galbraith et al., 2013; Paganelli and Pecchi, 2013).

4.3.6 Efficiency

Recent studies on local forestry projects have documented a reduction in the period of consultations and a centralization of decision-making in order to cut the costs of participation and so improve the efficiency of the process (Lovbrand et al., 2009), which might hinder the effectiveness of community participation.

eParticipation can be described as an efficient process, since it is not resources demanding and it overcomes the physical constraints of time and space, allowing people to participate anytime and anywhere (Phang and Kankanhalli, 2008). For example, a campaign organised jointly by Avaaz and 350.org collected more than 1 million signatures in 15 days though the Internet (350.org, 2013). The aim of the campaign was to demand from the world leaders gathered at Rio + 20 summit an end to fossil-fuel subsidies.

Table 4.1 Comparative performance of the two participatory approaches

Criterion		tParticipation	eParticipation
Initiating participation	Initiator	/	/
	Motivation	Medium	High
	Incentives	Low	High
Recognition		/	/
Representativeness		Medium	Low
Levels of participation	Passive participation	High	High
	Participation by consultation	High	High
	Interactive participation	Low	High
	Self-mobilisation	Low	High
Transparency	Information availability	Low	High
	Participants identity	High	Low
Accountability		Medium	Low
Efficiency		Low	High

4.4. CONCLUSION AND RECOMMENDATIONS

Participation should not be bounded by enrolment in a set of top-down, institutionally predefined agenda (Ayers, 2011), but should leave room for the self-development of the agenda and allow full contributions from social actors in an open and equal manner. All available participatory approaches should thus be encouraged. We suggest merging tParticipation and eParticipation in communities with Internet access to improve the efficiency and effectiveness of the process. Combining these two approaches could help improve the reliability and tractability of the results of eParticipation and help shift this process from a passive and consultative one to a more meaningful process reflected in decision-support. Conversely, in this matched approach, the efficiency of tParticipation could be improved by reaching high numbers of participants in a short time. This would ensure the transparency of the process and enable equal rights for all the groups involved while adding to knowledge-sharing through interactive communication. An example, though still in its infancy, is the REDD+ Mexico online platform, which is open to everyone and dedicated to REDD+ related information-exchange among stakeholders, serving as an online counterpart to decision-making processes organised in traditional ways. While tParticipation will always have the advantage of personal contact and face-to-face communication, a recent large-scale empirical study confirmed that online mobilisation has a positive effect on the off-line world (Bond et al., 2012). This justifies the growing use of eParticipation and supports the further development of this new research field, while combining it with the experience and large body of knowledge related to tParticipation.

CHAPTER V: ONLINE PARTICIPATION IN CLIMATE CHANGE ADAPTATION: A case study of adapting agriculture in Northern Italy[13]

Bojovic, D., Bonzanigo, L., Giupponi, C., Maziotis, A. Online participation in climate change adaptation: a case study of adapting agriculture in Northern Italy (in preparation for the Journal of Environmental Management)

This chapter applies the eParticipation framework developed in Chapter II and the experience presented in Chapter III. The framework is implemented in a case study of adapting agriculture in Northern Italy, within the ICARUS project. This chapter addresses the second research question: Can ICT ensure efficient public participation with meaningful engagement in climate change adaptation? The research applied the second eParticipation level – in a form of online questionnaire. It further applied the third eParticipation level, developing, trough participatory modelling approach, a scientifically robust tool for the analysis of alternative adaptation measures, with a simple user-friendly interface – mDSSweb. The results obtained proved eParticipation to be efficient in terms of the time and money needed for participation and the collection and analysis of results, as well as the raw numbers of participants. This research empirically demonstrated the theory deduced in the Chapter IV – how eParticipation can benefit by being merged with traditional participatory practices, in this case with phone interviews and a final workshop. The former confirmed the acceptability and meaningfulness of the results. The latter upgraded this research from an exploratory scientific study to one that provides information for regional decision-makers.

[13] An earlier version of this paper was published under: Bojovic, D., Bonzanigo L., Giupponi, C. (2012) Drivers of Change in Southern European Agriculture: Online Participatory Approaches for the Analysis of Planned and Autonomous Adaptation Strategies in R. Seppelt, A.A. Voinov, S. Lange, D. Bankamp (Eds.) (2012): International Environmental Modelling and Software Society (iEMSs) 2012 International Congress on Environmental Modelling and Software: Managing Resources of a Limited Planet: Pathways and Visions under Uncertainty, Sixth Biennial Meeting, Leipzig, Germany.

5.1. INTRODUCTION

Agriculture is inherently sensitive to climate conditions (Adams et al., 1998; Parry et al, 2004, Anwar et al., 2012, Leclere, 2013). Climate change is expected to impact on agriculture in different ways in various parts of the world and this also applies to European regions (IPCC, 2007a; Olesen et al., 2011), while mainly adverse impacts are expected in Southern Europe (Schröter et al., 2005, Bindi and Olesen, 2011). The agricultural system is dynamic and continuously evolving, with farmers adapting to changing conditions (Reidsma et al., 2010). Modifications of farm practices happen in response to different external triggers, such as new market opportunities or failures (Sutherland et al., 2012), and also to climate change. These modifications are known as autonomous adaptations, i.e., farmers' responses to perceived changes in climate through the implementation of existing knowledge and available technology (Leclere et al., 2012). In adaptation policy, unlike climate change mitigation which is mostly policy-driven and depends on a top-down approach, decision-makers should support farmers in their adaptation activities (Reidsma et al., 2010). Nevertheless, the magnitude and rate of climate variation, with an escalating impact in certain regions such as Southern Europe, will require adaptation measures and strategies to consider both autonomous and planned adaptations (Bindi and Olesen, 2011; Anwar et al., 2012), i.e., it will be necessary to go beyond the adjustment of current practices and ensure technological and structural changes (EC, 2013b). The extent to which planned adaptation measures gain acceptance, which is crucial for their effectiveness, will depend on the people involved, specifically on understanding their motivation, knowledge, and perceptions (Tompkins et al., 2010). Given that planned adaptations are still at a relatively early stage of implementation (EC, 2013b), establishing a bottom-up participatory approach will enable policy-makers to collect fundamental information for designing measures that complement farmers' practices and respond to their needs.

The EU Strategy on adaptation to climate change (2013) suggests a flexible and participatory approach to climate change adaptation. Although face-to-face contact is often considered the most effective participatory approach, it is an intensive and time-consuming procedure usually limited to a target audience (Cornwall, 2000; Involve, 205; Hooghe et al., 2010; Luyet, 2012). Besides, the network society – a new form of social organization based on digital communication

and networking (Castells and Cardos, 2005) – presents an opportunity to step out of established participatory practice and to use new online spaces for public participation instead. In fact, in recent years the Internet has emerged as an effective and efficient information and mobilization tool (Kelly, 2012, Bond et al., 2012). eParticipation, in particular, has rapidly been gaining recognition as an important tool for broadening participation (Sabo et al., 2008). Based on the use of Information and Communication Technologies (ICT), eParticipation is a tool that promotes the inclusion of the public in participative and deliberative decision-making processes, thus contributing to a transformation of the relationship between politics and citizens (UN, 2007). This broadening of participation entails involving higher numbers of a wider group of stakeholders compared to traditional participatory practice (Phang and Kankanhalli, 2008; Calenda and Meijer, 2009; Meijir et al., 2009, Sabo et al., 2009). Ideally, this approach should enable the public to become more substantial actors in policy discussions and decision-making.

Recommendations for eParticipation at the level of the European Union (EU) are provided in the European eParticipation Summary Report (EC, 2009), which suggests embedding eParticipation within the EU's wider policy architecture. Accordingly, the EU has launched a number of online debates on public issues (Sanchez-Nielsen and Lee, 2013), including *Your voice in Europe*, a platform for consultation and discussion on the European policy-making process (http://ec.europa.eu/yourvoice/index_en.htm). These recommendations also have implications for eParticipation practice at national, regional, and local levels. For instance, the German federal government emphasized in its eGovernance 2.0 programme that the involvement of citizens and stakeholders in the decision-making process is of great significance (Albrecht et al. 2008). eParticipation has been implemented in different countries in a similar manner, namely being used as part of eGovernance for policy-relevant issues, such as communicating information on legal issues, trying to actively engage citizens in politics, and attempting to raise voter turnout (Macintosh et al., 2009; Sanchez and Lee, 2013).

Adaptation to climate change is becoming a priority amongst European environmental issues, as witnessed by recent initiatives and documents of the European Environmental Agency (e.g., the climate-adapt platform and the EU Strategy on climate change adaptation, 2013). As adaptation to climate change requires, farmers and decision-makers need to be involved together in the process of making major decisions on agricultural development required by these changes. This

chapter investigates the efficiency of the process and the meaningfulness of the engagement achieved using an eParticipation framework developed for enabling public involvement in climate change adaptation and in the analysis of alternative adaptation measures. The term eParticipation is understood in a broad sense in this research, including online engagement through questionnaires and online decision-support exercises with the aim of developing a new communication channel between farmers and decision-makers. Furthermore, eParticipation is combined with existing online networks to ensure the efficient dissemination of the initiative and the obtained results.

The research was carried out in the frame of the European project ICARUS – IWRM for Climate Change Adaptation in Rural Social-Ecosystems in Southern Europe. This project aimed at improving the management of water resources in agricultural systems that are already affected by climate change as well as by socio-economic and policy changes. The project was developed around three case studies: in the Veneto Region (VR) in Italy, in the Algarve basin in Portugal, and in the Jucar Basin in Spain. This paper demonstrates the significance of participation and, most importantly, the procedure and results of eParticipation through the involvement of farmers in the decision-making process in the VR case study. The obtained results were presented to the relevant policy-makers of the Veneto Region. As Italy is currently preparing a National Strategy for Climate Change Adaptation – the recommended instrument to inform and prioritise adaptation action and investment (EC, 2013a) – this topic is expected to gain more attention among local policy-makers throughout Italy in coming years.

The chapter first introduces the eParticipation framework and details the methods used in the research. The results of implementing the framework are presented in Section Three. Section Four discusses the findings and the performance of the framework employed. The paper concludes with the key messages from this research and recommendations for future research.

5.2. METHODS

5.2.1. eParticipation used in the ICARUS project

An eParticipation framework was developed to involve the public in suggesting and assessing adaptation solutions for reducing the negative effects of climate change (Fig. 5.1).

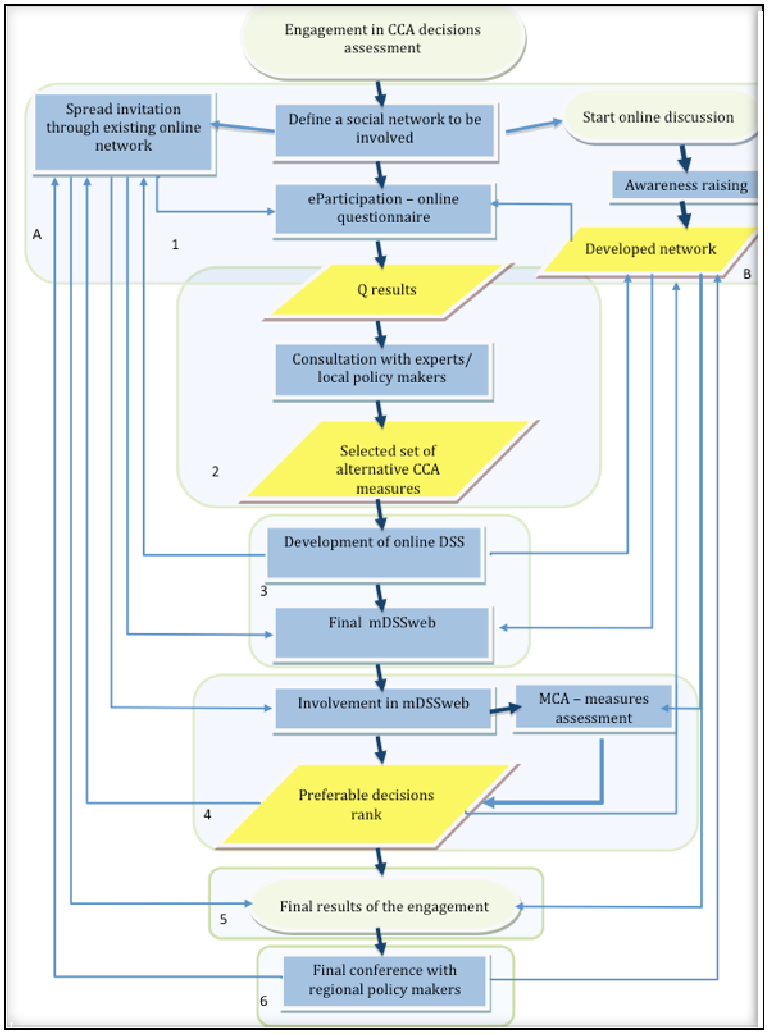

Fig. 5.1. The eParticipation framework implemented in the ICARUS project. The online network is defined (1A) and used to engage participants in a survey (1). The results are inputs for proposing alternative climate change adaptation (CCA) measures (2). The online decision-support system (DSS) is developed in a participatory manner (3). Alternatives are evaluated in the DSS, using multi-criteria analysis (MCA) (4). The final results are defined, taking into account feedback from the participants (5). The final results are presented to regional policy-makers (6). The right-hand side of the graph (from 1B down) presents alternative methods that can substitute or complement the ones on the left-hand side.

The first eParticipation phase entailed defining an online network to be involved in an online questionnaire. We used existing online networks for the questionnaire and for the dissemination of the online platform, as well as for the distribution of results. As an alternative, an online network could be developed by initiating a discussion forum or other form of online communication space on the issue of concern. This first phase opened the communication channel with stakeholders and allowed the identification of their perceptions of changes, autonomous adaptations, and planning priorities. The outputs were used as the main input for suggesting alternative adaptation measures, defined through consultation with experts. This was followed by the development of the online tool – mDSSweb – for the analysis and assessment of adaptation measures in a participatory manner. mDSSweb was applied in the subsequent phase for the involvement of participants in the evaluation of these measures. In the fifth phase, the results were checked with a set of participants through interviews. In the last phase the final results were presented to regional decision-makers at a concluding workshop. The output, as well as the intermediate steps, were shared with the participants from the network.

The main target group of this research were farmers from the three case studies of the ICARUS project, covering three different regions in Southern Europe. However, in this chapter we focus only on the Veneto region, the Italian case study. The Veneto region is situated in the northern part of Italy, with a population of about 5,000,000 people. The Utilised Agricultural Area (UAA) in Veneto is 811,439 ha, representing about 45% of its territory, and the number of registered farms is 118,850 (ISTAT, 2012). Veneto is one of the regions in Italy with the highest number of Internet users, reaching 58.3% of its population in 2012 (ISTAT, 2013). In 2012, Italy had the highest growth of Internet users in Europe and the fourth-highest growth rate in the world (comScore, 2013).

A second group involved in the research were the irrigation boards (Italian: *Consorzi di Bonifica*), which are public bodies in charge of irrigation water management, reclamation and flood defence. The third stakeholder group consisted of regional decision-makers, whom we involved in the definition of alternative adaptation solutions (after the first research phase) and to whom we presented the final results of this research (last phase).

5.2.2. First eParticipation phase – online questionnaire

The online questionnaire is an eParticipation tool that resembles its off-line counterpart but which has lower administration costs and a faster turnaround time, allowing the collection and analysis of results in a relatively short period of time (Phang and Kankanhalli, 2008). eParticipation conducted through an online questionnaire is suitable for collecting basic information on less explored issues (ibid.) such as autonomous adaptations, and proves useful in gaining an understanding of participants' attitudes towards the topic at hand.

The questionnaire used in the first phase of this research examined farmers' perceptions of current and anticipated changes in the environment, economy, policy, and society. It also analysed whether cropping and water management practices had already undergone any changes in recent years and whether farmers perceived a need for adaptation due to variability in climatic conditions and other changes. Finally, the first online questionnaire aimed at providing insights for suggesting a set of the most suitable adaptation measures and criteria for their evaluation.

Farmers were engaged via the existing online network of users of the Agro-Meteorological eBulletin published by the Environmental Protection Agency of the Veneto Region (ARPAV) and hosted on their website as well as distributed through an e-mailing list. The eBulletin is issued twice a week in the irrigation period and less frequently during the rest of the year. We used the eBulletin as a means of distributing a link to the online questionnaire to its 6,000 users. The link to the questionnaire appeared in each eBulletin issue published in the period between mid-July and mid-September 2011. The questionnaire was composed of 16, mostly close-ended questions, divided into two sections. The first section included socio–demographic information and descriptions of the farms in terms of size, income, and crop production. The second section investigated irrigation techniques, perceived environmental, economic, social, institutional and individual changes, and any environmental pressure that had been influencing farmers' agricultural practices over the previous 10 years. These questions were followed by questions on existing and needed adaptation measures in terms of crop and water management. The final questions explored the role of the eBulletin in supporting agricultural practice and revealed which additional information should be included to improve the eBulletin. Except for the first set, the questions were of a multi-response type. Most of the questions had fields available for additional comments, and the last one offered farmers the option of leaving their contact details

for further collaboration. In October 2011, a brief report with the main results from the questionnaire was published on the ARPAV's website and sent to all participants (Appendix II). In this way the results were not only presented to those who participated in the survey but also to the rest of the users of the eBulletin.

5.2.3. Online platform for the assessment of alternative adaptation measures – mDSSweb

5.2.3.1 mDSSweb structure

mDSSweb is an updated version of an existing decision-support system software, mDSS, capable of managing the data required for providing informed and robust decisions by enabling the integration of socio-economic and environmental modelling techniques and multi-criteria decision methods (Giupponi, 2007). An mDSS application typically foresees a workshop setting and demands that mediators guide participants through the participatory process. Furthermore, participants in mDSS can choose among different methods offered in each phase. However, the interface of the new platform provides only those methods that we predefined as appropriate for our specific case study, making it suitable for online use by diverse users. The mDSS framework, which comprises four main phases, was also maintained in this research:

1. **The Conceptual Phase** identifies the issues and explores the problem. In the case of mDSSweb, the Conceptual Phase is performed through the first questionnaire.

2. **The Design Phase** includes the identification of alternative options (measures) and the selection of decision criteria. The variables are organised in a matrix called the Analysis Matrix (AM), which is a table containing the indicator-values expressing the performances of the alternative options for each decision criterion. A new interface was developed for the mDSSweb platform, permitting participants to evaluate criteria in a table (the AM), based on their relative importance by means of tick-marks to be placed in Likert scales reported in each matrix cell (Fig. 5.2). The software then calculates criteria weights by means of another graphical interface based on the revised Simos procedure (Figueira and Roy, 2002) which allows for the hierarchical arrangement of criteria in a visual way (Fig. 5.3).

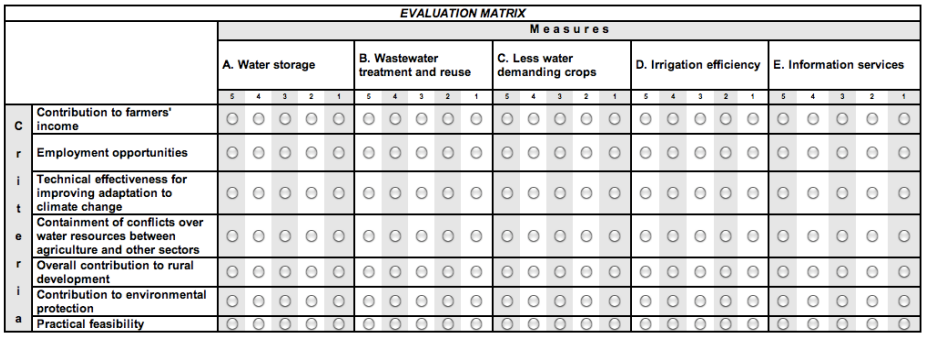

Fig 5.2. AM in mDSSweb

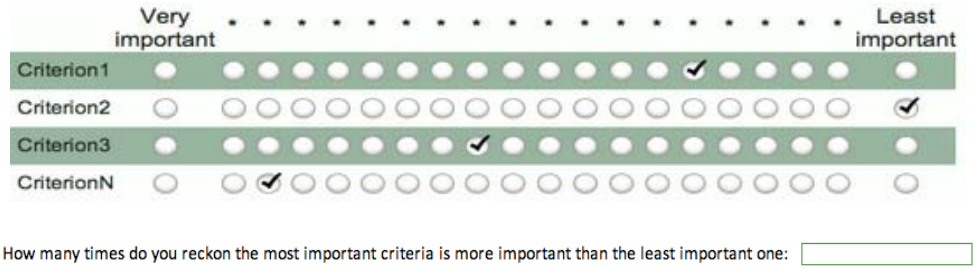

Fig.5.3. Criteria-weighting with the Simos interface developed for mDSSweb

3. The Choice Phase: Multi-Criteria Analysis (MCA) evaluation techniques are applied to judge all options in terms of their contributions to solve the problem through the elaboration of the criteria values stored in the matrix. Decision-rules aggregate the partial preferences of individual criteria into a global preference, enabling the ranking of alternatives. Among different decision-rules, we explored the inclusion of ELECTRE[14] and Simple Additive Weighting (SAW) within the mDSSweb prototype.

4. Group decision-making (GDM) is a final phase that facilitates the identification of a compromise solution. mDSSweb uses the Borda rule to calculate an overall score by combining all the individual rankings. The Borda rule attaches a number of points to each option equal to the number of options ranked lower than it, so that an option receives *n-1* points for a first preference, *n-2* for a second, and so on, with zero points for being ranked last, where *n* is the number of options (Young, 1974).

[14] The acronym ELECTRE stands for: Elimination et choix traduisant realité (*transl.* Elimination and choice expressing reality).

The possibility of assembling different methods with diverse complexity makes the platform flexible enough for engaging various groups of participants. Besides, the same interface can be sent to different sub-groups and the results collected separately (in different datasets), but in the same platform, which allows for better comparison of results. The platform was also translated into Spanish and Portuguese and the alternative measures and criteria for their evaluation were adjusted to the Spanish and Portuguese case studies.

5.2.3.2. Participatory design approach and testing of the mDSSweb prototype

An invitation to test the mDSSweb prototype was sent to a sample of those farmers who had given their full contact details in the first participation phase. The use of a participatory design approach involving participants in the modelling phase of the platform helped in the collection of their feedback on the initial shape of the mDSSweb platform and, accordingly, in the development of its final version. The other aim of involving the farmers was to obtain feedback on the five measures selected and seven criteria for their evaluation. The measures were drafted according to the outputs of the first online questionnaire, documentation review, and interviews with experts and policy-makers of the regional administration. The criteria were based on the interests and concerns expressed in the first questionnaire and allocated to the pillars of sustainable development (social, economic and environmental). For each criterion, the performance of the measures was evaluated using a five-level Likert scale, ranging from *very poor* (1) to *very good* (5). The results of AM and Simos weighting were aggregated by means of the ELECTRE III method, which led to the relative outranking of the measures. The ELECTRE III method is based on a pair-wise comparison of alternatives, using outranking relations on a set of alternatives. This means that an alternative *a* outranks an alternative *b* if *a* is at least as good as *b* and there is no strong argument against *a* (Rogers & Bruen, 1998; Shanian et al., 2008). Users were asked either to set three thresholds aimed at incorporating uncertainty into the model (indifference, preference and veto thresholds), or to select fixed thresholds which we developed for this particular exercise (for more information on the ELECTRE thresholds and the procedure developed for fixing them, please see Appendix I). Finally, the analysis of possible conflicts between differing preferences and the identification of a compromise solution among the results obtained from participants was performed in a group decision-making context using the Borda rule.

The farmers were afterwards contacted by phone in order to collect their feedback, to compare their expectations with the obtained results, and to gain additional inputs for refining the design of the mDSSweb prototype. An information platform is proved effective if users are enabled to carry out the intended task and if the platform fits the capabilities and needs of intended users (Goodhue, 1995; Arciniegas et al., 2013). The consolidated mDSSweb platform was subsequently used for the involvement of a broader group of farmers in the evaluation of adaptation measures.

5.2.3.3. Second eParticipation phase

An invitation to participate in the mDSSweb was sent through the same engagement channel, i.e., the Agro-Meteorological eBulletin, and was also disseminated through the contact list collected in the first eParticipation phase.

The platform collected results in the period between mid-July and mid-September 2012. The last page of the platform, showing the final results, remained active even after the exercise was concluded. We also used this page for communicating further developments of the project, for instance the reaction of decision-makers to the proposed tool and the obtained results.

The same platform, with modified open questions, was used to involve the irrigation boards in order to engage them in the evaluation of the same adaptation measures.

5.2.4. Triangulation of the results

Triangulation, as an integrated research approach that combines different methods (Denzin, 1970), was used for checking the meaningfulness of the results. Once the exercise had been completed, telephone interviews were conducted with a set of farmers from the contact database. The farmers were asked if the results of their own assessment of measures, calculated by the software on the basis of their evaluation, coincided with their intuitive judgments. We also asked their opinions about the overall results. Finally, we asked what the next step could be regarding the dissemination of the results, what they thought about the platform itself, and how it could be improved. In this way we cut across the qualitative-quantitative methods divide (Olsen, 2004) in order to validate the results obtained by this new method.

The final results of the eParticipation exercise were presented at the project's final workshop with regional policy-makers and representatives from the irrigation boards. Both the methods and the results obtained were presented, including the characteristics of the participants, followed by an open discussion. SWOT analysis (Strengths, Weaknesses, Opportunities, and Threats) was performed to obtain a detailed evaluation from policy-makers of the procedure and of the usability of the results.

5.3. RESULTS

5.3.1 eParticipation - first phase

The first eParticipation phase, using an online questionnaire, proved efficient because it enabled the collection of a high absolute number of responses (590) in a short period of time (less than two months). In addition, the digitalised form in which the results were collected sped up the analysis process. With 590 individuals having completed the questionnaire, the sample represented nearly 10% of the users of the eBulletin and 0.5% of all farmers (farms) in the region. The majority of responses (80%) were received within a 10-day period after the questionnaire had been launched (Fig.5.4). The participants came from farms throughout the Veneto region, except the mountainous north-west part where agriculture is more of a marginal activity.

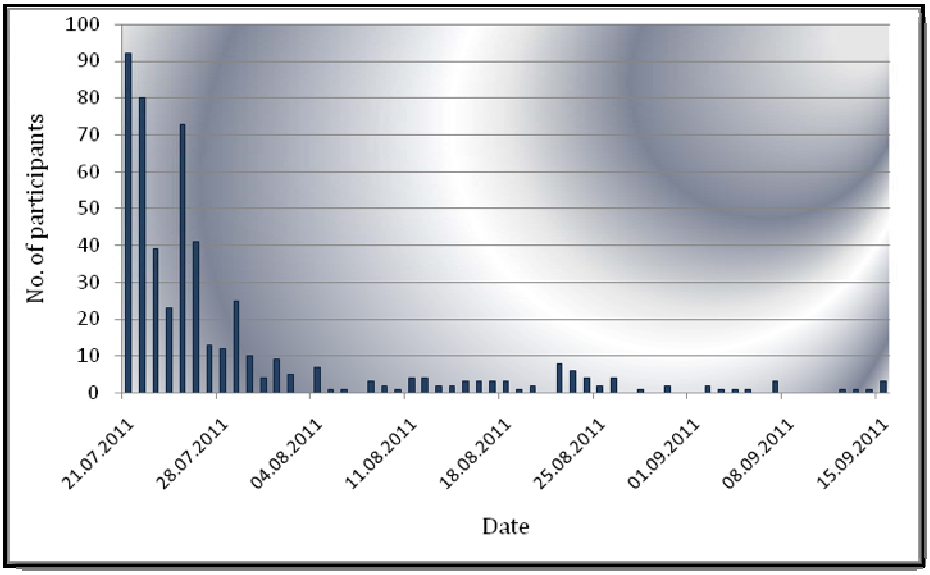

Fig.5.4. Response-collection process

As shown in figures 5.5 and 5.6, the survey reached farmers from different age-groups with different educational backgrounds, different amounts of utilized agricultural area (UAA), different agricultural practices and different levels of income-sharing between agriculture and other activities. These results, although not in line with the official agricultural census from 2010 for the whole region (Fig. 5.7), address and challenge the concern that only younger and/or well-educated farmers can be successfully approached via digital connections.

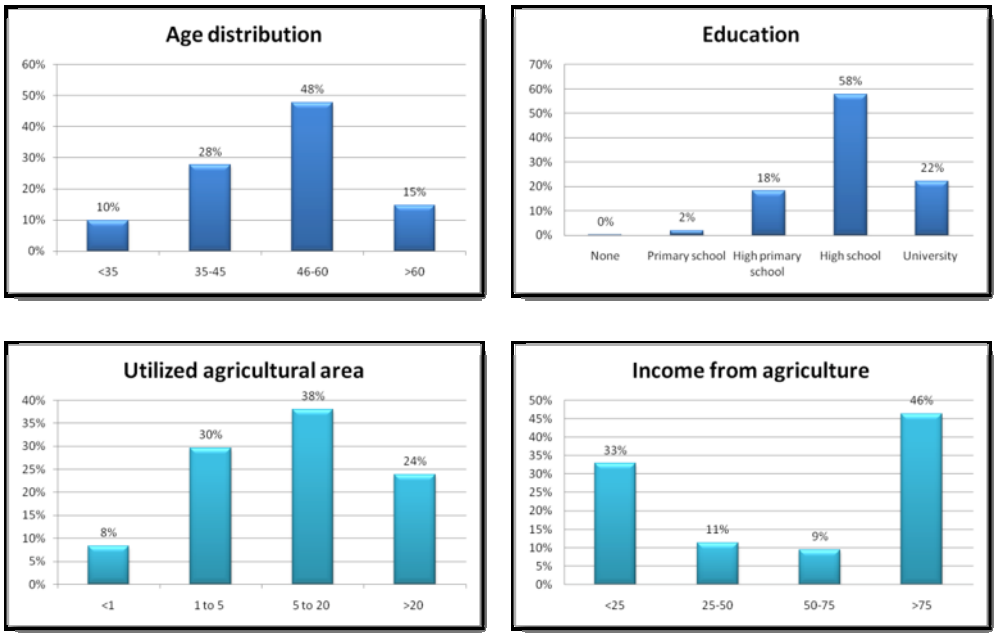

Fig. 5.5. Some characteristics of the farms from the phase one sample

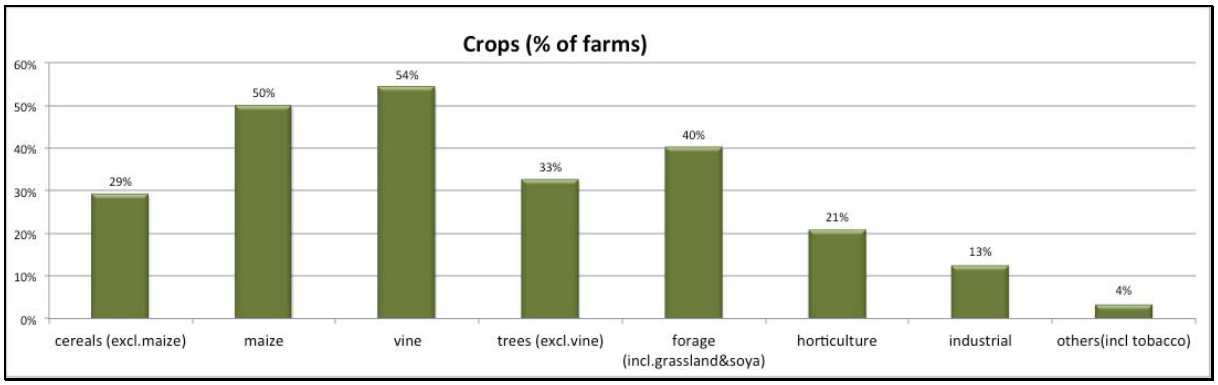

Fig. 5.6. Crop production in the sample

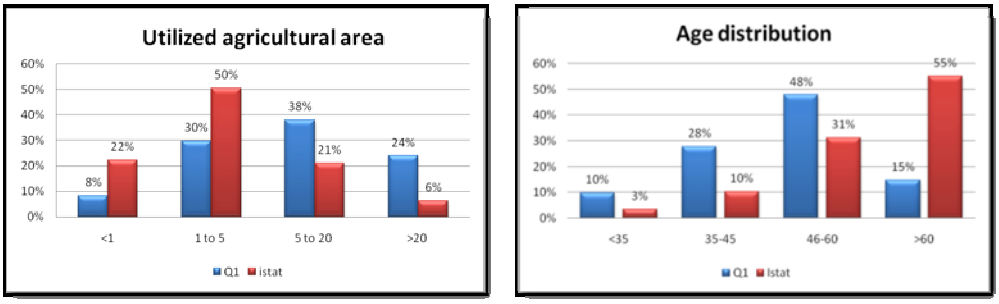

Fig. 5.7. Some comparisons between official statistics from ISTAT (agricultural census 2010) and the obtained results

Identifying farmers' perceptions of change and resulting autonomous adaptations is important in order to understand which adaptation options for agriculture are preferred and feasible in the Veneto region. The most frequent response (53%) was that measures concerning crop and water management adaptations would be necessary in the future. The most common agronomic interventions already in place were those involving diversification of crop species or varieties and the introduction of integrated pest control. Commenting on this question, farmers suggested organic farming, together with the introduction of biological pest control. This answer suggests a rather high interest in organic farming in the sample, although according to the census there are only 1,003 organic farms in Veneto (0.8% of all the farms) (ISTAT, 2012). In addition, the results show a high percentage of specialized farmers, mainly wine-grape producers (54%) among the participants (Fig. 5.6).

The farmers from the sample had also undertaken changes in water management. The most common water management change was in irrigation technologies (49%), although many farmers changed water volume and irrigation-turn frequency as well (45% and 40% of farmers respectively).

Analysis of the questionnaire also revealed the type of support farmers would like to receive through the eBulletin for improving their farm management and dealing better with water scarcity (Fig. 5.8). From these responses it emerged that 52% of farmers wanted additional information in the form of seasonal weather forecasting.

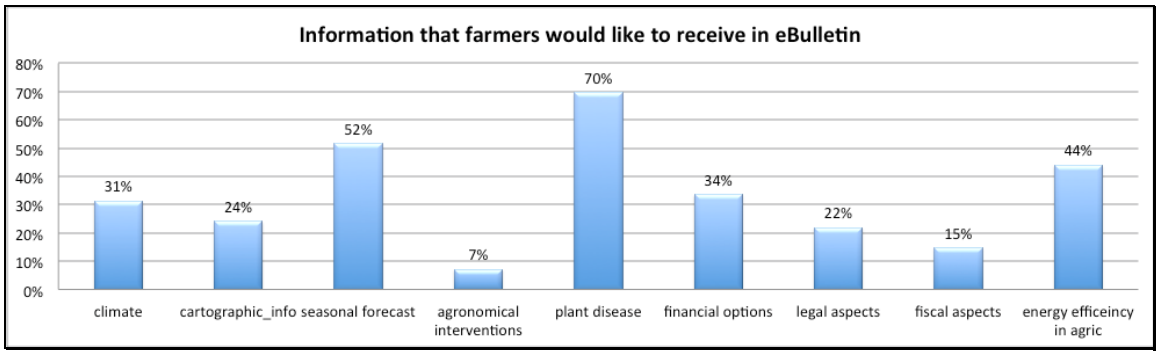

Fig. 5.8 Issues that farmers would like to be informed more about through eBulletin

Together with the analysis of autonomous adaptations already in place, the results of the first round of participation made it possible to map farmers' perceptions of changes in the economy, environment, and society, and their positions concerning needed and existing adaptation

measures. This was an important input for consolidating the adaptation measures to be evaluated in the second phase. The results of the questionnaire showed that farmers were predominantly worried about economic change, followed by concern over environmental changes (Fig. 5.9). Their comments showed that farmers were also worried about the future of agriculture, as farms have been being abandoned by the youth.

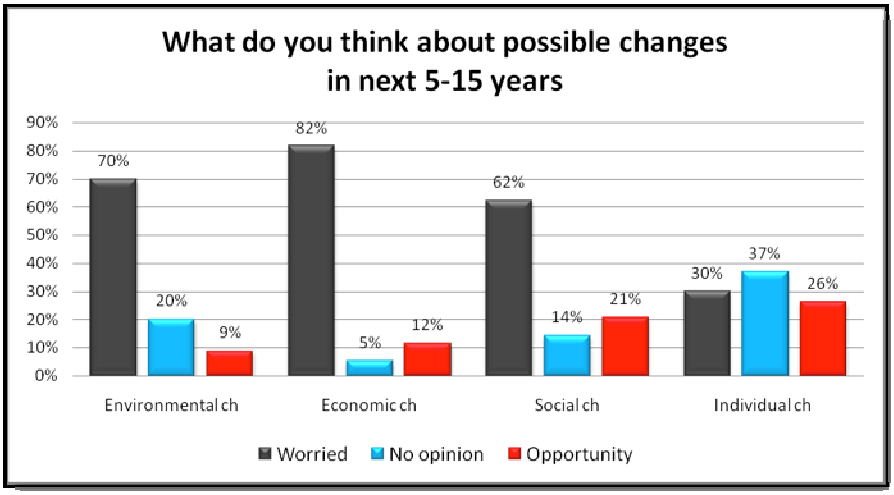

Fig. 5.9. Opinions about possible changes in the next 5–15 years

The results showed that 90% of the participants were aware of environmental change as a pressure on agriculture over the past 10 years, with 58% of farmers reporting a tangible perception of shifting seasons, 55% reporting changes in precipitation, 45% reporting changes in temperature and 42% reporting a higher incidence of droughts.

The results of the first questionnaire were further discussed with experts, and five measures (directions for investments) were identified (Table 5.1): A – the use of reservoirs for flood retention and water storage; B – the prioritisation of crops requiring low amounts of water; C − investments in high-efficiency irrigation technologies (sprinkle and drip irrigation); D – the improvement of existing agricultural information systems (on weather forecasting, pests and diseases, irrigation requirements, etc.); and E − new climate services for longer-term adaptation (seasonal weather forecasting). Moreover, based on the concerns and needs of farmers and the inputs from experts, the following seven criteria were identified for ranking the measures: contribution to farmers' income; return on investment; adaptability to potential future climate change; contribution to the resolution of conflicts regarding water allocation; rural development; environmental protection; and feasibility.

As demonstrated in Table 5.1, answers and comments from the questionnaire directly shaped the development of measures and criteria. For example, the frequent response from farmers that they would like more information in the eBulletin about seasonal weather forecasts motivated the proposal for investments in *New climate services for longer-term adaptation (seasonal forecasting)*. Likewise, the frequently made comment that organic farming and biological pest control are needed in agriculture in the Veneto region suggested the importance of environmental protection for our participants and we thus proposed it as one of the criteria.

Table 5.1. Answers and comments (**C**) to the questions (**Q**) (centre) suggested adaptation measures (left) and evaluation criteria (right). Notice that the last criterion (technical feasibility) was not recognised by farmers, but suggested by the experts from the region.

MEASURES	*SOME QUESTIONS*, MOST FREQUENT ANSWERS AND COMMENTS	CRITERIA
	***Q**: Perceptions of changes?*	Contribution to farmers' income
	• Economic change • Environmental change	Return on investment
	C: Uncertain future of agriculture	Rural development
	***Q**: Noticed Environmental Changes?* • Changing seasons, precipitation, temperature …	Adaptability to potential future climate change
Prioritisation of low-water-requiring crops	***Q**: Crop management changes (adaptation)?*	
	• Species or varieties diversification • Changes will be necessary in the future	
	C: organic farming, bio. pest control	Environmental protection
Use of reservoirs for flood retention and water storage	**Q**: *Water management changes (adaptation)?*	
	• Necessary in the future	Contribution to resolution of conflicts regarding water allocation
	C: need for drip irrigation, water conservation, construction of cisterns, complains about the quality of service	
Investments in high efficiency irrigation technologies (sprinkle and drip irrigation)	***Q**: Do you practice irrigation?* • 75% practice irrigation • 29% micro-irrigation • Non irrigated farms more worried about environmental change	
New climate services for longer-term adaptation (seasonal forecast)	**Q**: *More information in eBulletin about?* • Plant disease, Agronomic interventions, Seasonal forecast	
Improvement of existing agricultural information systems	**Q**: eBulletin does not contribute enough to? • Reducing use of herbicides, Reducing irrigation frequency	

5.3.2. eParticipation second phase - mDSSweb

The procedure to be implemented in the mDSSweb and the suitability of the measures and criteria proposed for the Veneto Region case study were tested with a random group of 12 farmers selected from amongst those who gave their contact details in the first research phase. Farmers were asked to evaluate the measures via a prototype mDSSweb. In the interviews that

followed, participants praised the measures chosen as being particularly apt to the needs of the Veneto region and as options for future investments. They also added comments on the platform prototype, most importantly to keep the Simos procedure, which they regarded as sufficiently intuitive, while simplifying the Choice phase – the ELECTRE module – which they regarded as too complex. Thus a new mDSSweb interface was developed using the SAW approach instead. SAW is a rather simple decision method that applies additive aggregation of decision outcomes, controlled by weights expressing the importance of the criteria (Giupponi et al., 2006). This module automatically calculates the results of analysis without asking the participants to set the parameters. The final set of elements defined according to the participants' contribution was that of the Likert scale - Simos - SAW - Borda. In line with the first questionnaire, we also introduced open-ended questions about the characteristics of each farm in order to obtain better identification of the sample, and provided additional space for comments at the bottom of each page. The result of this participatory modelling was a consolidated platform for the assessment of alternative adaptation measures, mDSSweb (Fif. 5.10), which is composed of five consecutive web pages, easily adaptable to other eParticipation cases, with different thematic interests, and a number of criteria and options.

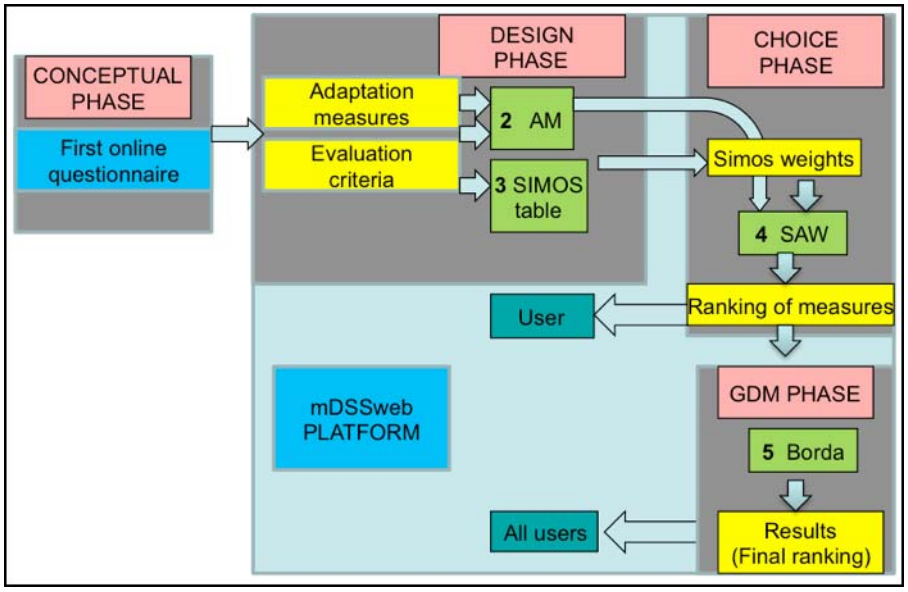

Fig. 5.10. mDSSweb framework: red squares represent the mDSS phases; blue squares represent different tools; yellow squares represent results; and light green squares represent different methods (interfaces). After an introductory page (not presented), an AM interface (p.2) allows stakeholders to evaluate the measures according to the given set of criteria, which is followed by another interface for criteria-weighting through the Simos method (p.3). In the following interface (p. 4), the user sees a graphical presentation of his/her own ranking (outcome of SAW). The ranking resulting from the aggregation of all individual responses, through the Borda rule, is presented in the last interface (p.5).

Notwithstanding this rather demanding procedure, the mDSSweb exercise resulted in a high number of participants completing the procedure (170) within a relatively short period of time (two months), thus proving its efficiency for the purposes of eParticipation. The final results of the evaluation procedure (the aggregation of all the participants' preferences) were automatically calculated in the platform and presented to users. In-depth analysis of individual preferences and open-ended questions, together with comparison of the results obtained in both phases, allowed for a better understanding of the farmers' expectations of future adaptation policy (for more details, see Bonzanigo et al., 2013 and Appendix III).

We used the contact database from the first questionnaire and obtained 77 responses. The link for the mDSSweb was also launched through the eBulletin and gained another 93 responses. The preferences of the respondents were quite consistent, with the majority preferring Strategy C – Investments in high-efficiency irrigation technologies. This was followed in second place by Strategy A – the use of reservoirs for flood retention and water storage, while the other three measures received significantly lower scores in the Borda evaluation.

The mDSSweb platform allowed for the identification and comparison of preferences of different groups, such as farmers from different irrigation boards or municipalities (for more details, see Bonzanigo et al., 2013). Moreover, an invitation for participating in mDSSweb was also sent to the second stakeholder group, the irrigation boards of the Veneto region. With nine out of 10 irrigation boards taking part, plus the institution that coordinates their work, an interesting finding was that their preferred ranking was the same as that chosen by the farmers.

The platform was easily translated into the projects' different languages, Spanish and Portuguese, and tested in all three case studies. Although the extent of success varied in the three case studies, language was certainly not a barrier to engagement. The platform was also translated into English in order to broaden dissemination beyond the geographical scope of the project.

5.3.3. The triangulation process

In order to obtain feedback on the usability of the results obtained through eParticipation and on the mDSSweb platform itself, telephone interviews were conducted with several of the farmers (five in total) who participated in this exercise.

The interviewees confirmed that the individual results coincided with their expectations. However, they had different opinions regarding the final ranking of the measures. The interviewees mainly confirmed that measure C – *Investments in high efficiency irrigation technologies* was the logical preference of farmers in the Veneto region, while one participant considered that C was not a feasible adaptation option since it was too costly. He argued that in his municipality it was primarily important to secure water reserves and only then to invest in more efficient irrigation, which was in line with his individual assessment of measures in the exercise. Another participant agreed that farmers should first insist on A – *The use of reservoirs for flood retention and water storage*, and that only then could measure C be implemented.

The interviewees placed a high value on agro-meteorological information, including weather forecasting, and expressed the view that such information should be better communicated and promoted. Thus they expected that measures D – *Improvement of existing agricultural information systems* and E – *New climate services for longer-term adaptation* (seasonal forecasting) should receive more attention in the future with the further spread of Internet use. The participants confirmed that the selected five measures were the main directions for development and intervention, although they believed that the research could have benefited by obtaining a more realistic picture if it had allowed for more alternatives.

One remark was that the platform could have employed more colloquial language, although the platform itself was considered to be simple and user-friendly, proving its effectiveness.

According to the interviews, the participants followed the development of the research through the last page of the platform, which was regularly updated with the most recent results of participation in the platform and with updates on ongoing activities in the project concerning the dissemination of results. Newsletters with the research results were also recognized as important for providing feedback to the farmers and maintaining their interest in this issue. The importance

of the common experience provided within this research was recognised, as well as the importance of communicating these results to the administration at different levels.

5.3.4. Feedback from policy-makers

At the end of the project a final workshop was organised with regional policy-makers and representatives of irrigation boards. The workshop participants were presented with both the methodology and the results of the two steps of this research.

The options which ICT offer for establishing communication between farmers and the administration was discussed with policy-makers. The general opinion was that eParticipation adequately added to an emerging trend of using ICT in communicating issues related to agriculture, primarily through online agro-meteorological bulletins and through the Piave web portal, an integrated portal for agriculture in Veneto.[15]

It was concluded that, in the current circumstances of limited financial resources, all possible sources/tools, including ICT, should be used to contribute towards improving the quality and effectiveness of decision-making.

The results of the SWOT analysis conducted after the discussion showed that policy-makers recognised as beneficial the fact that eParticipation reduces the distance between farmers and policy-makers. They also recognized the importance of having a channel for obtaining direct inputs from farmers, particularly for understanding which activities they already practice to address the issue of water management and climate change. The participants acknowledged the efficiency of the eParticipation process in terms of the time and money needed to conduct the research, and also its suitability for repeating the process and thus monitoring the results. Finally, policy-makers recognised the potential of this method to offer other services, such as involving citizens in discussions on different issues of public concern. However, participants were concerned about a possible selection bias arising from the fact that the Internet is not used by all farmers, and thus constitutes a limitation of this method when statistical analysis is required. At the end, the participants agreed that they could expect an expansion in the use of this method in the future.

[15] http://www.piave.veneto.it/web/guest/home (Accessed 14/11/2012)

In order to inform the farmers about the outcome of this workshop, a short summary with the main conclusions was presented on the last page of the platform.

5.4. DISCUSSION

This research developed a new framework for public involvement in climate change adaptation and tested it, in this chapter, through a case study of farmers' engagement in selecting preferable adaptation measures in the agricultural sector. Second eParticipation level – online questionnaire, opened new communication channel with the farmers, third level – collaboration on the selection of a preferred solution was performed using mDSSweb. The results from these two participatory activities were reported and disseminated in a form of newsletters, informing farmers and, thus, improving, first eParticipation level.

Involving farmers in testing the feasibility of mDSSweb resulted in rejecting the platform prototype which we had initially estimated as the most suitable for this case study and the development of a platform with a more intuitive interface (i.e., the ELECTRE module was replaced with SAW). Being a more complex procedure, ELECTRE could have been opted out of as being perceived as a 'black box' analysis (Hajkowicz, 2008). The possibility of tailoring the tool to different uses and users (for instance, a more complex version for a more scientific audience or policy-makers, or a simpler version for non-experts) whilst maintaining a straightforward methodological setting serves to broaden its applicability.

Furthermore, the collaboration between scientists and stakeholders on the development of tools resulted in mutual learning and better design of the scientific research. Scientists have been encouraged to reach out to the general public and to spread knowledge on climate change (Boykoff, 2012; Nature, 2012). The link between scientists and the public could be facilitated with access to the Internet and new online spaces. Accordingly, scientists played an important role in the present research, being involved in the development of the tool and in data analysis, as well as data dissemination and communication. The engagement of scientists throughout the process and lasting communication with participants can increase the chances of its success. This makes scientists effective actors in climate change participation, facilitating knowledge-gathering and sharing.

The flexibility of the platform is reflected in the possibility of its being translated in different languages. Language is sometimes perceived as a barrier to the engagement of diverse participants, particularly in the case of online spaces. For example, O'Neill and Boykoff (2010) argue that blogging on climate change is mainly an Anglo–Saxon dominated activity. Thus a multilingual platform like the one described in this paper addresses this challenge.

The results of this research suggest that a pre-existing online network of users is an important condition for conducting successful eParticipation, involving high numbers of participants and obtaining meaningful results (as confirmed through triangulation of the results). At the initial stage of our research on eParticipation as a potential tool for supporting the development of climate change adaptation policy, we attempted to engage participants in similar exercises using the Internet in a broader sense, e.g., through Google advertisement and similar tools, but we failed to engage a large audience (see Chapter III). When an existing network cannot be identified, it is recommended that a discussion forum on the issue of concern – or another form of online communication about that issue – be launched to establish an online network of users that can later be engaged in eParticipation (Fig. 5.1–1B). However, the high level of responsiveness in the Veneto case study could also be attributed to the high level of Internet use in this region.

The efficiency of eParticipation is demonstrated in terms of the short time needed for participation and the rapid collection and analysis of results. In the case of the online survey, it is highly unlikely that a similar number of responses would have been achieved (i.e., 590 from all agriculturally active parts of the Veneto region) by conducting traditional interviews, particularly with limited resources. Due to the complexity of the procedure, involvement in decision-support tools is most often conducted in workshops with a limited number of participants (usually up to 20). However, the mDSSweb platform involved 170 participants in the process of evaluating adaptation measures. Thus, although eParticipation is limited to Internet users, it still allows for stepping out of the 'invited participation' approach, particularly considering that Internet access is becoming commonplace in most parts of the world, covering more than 34% of the global population (IWS, 2012) and approaching 60% in some regions of Italy. Moreover, one of the EU's priorities for rural development, also to be adopted by the Veneto region's Rural Development Programme 2014–2020 (paragraph 6, RV, 2012), is that of social inclusion and

economic development in rural areas. A special focus under this priority is given to promoting the accessibility, use and quality of ICT in rural areas.

The digital divide, usually perceived as one of the major constraints of eParticipation (Bekkers, 2004; EC, 2009), seems to be less and less of an obstacle to the application of eParticipation tools. The digital divide, it is argued, particularly affects the older population and less educated groups (Norris, 2001; Jensen, 2003, Bertot et al., 2010). However, the sample from the first research phase shows that the oldest age group was engaged as well, while most of the participants belonged to the middle age group (46–60 years old). The participants also differed in their educational backgrounds, with the group who had completed high school having the highest number of representatives. Furthermore, according to other parameters such as UAA, crop production and income from agriculture, we see that the farmers differed in their interests in agriculture/agricultural practices. Some agricultural practices, such as grapevine production, were overrepresented. Having a significant percentage of farms with vineyards could suggest that wine producers, whose business is dependent on marketing, either have personal interests in networking or generally use the Internet more than other farmers.

The common perception amongst policy-makers that farmers are detached from climate change issues appears to be misconceived. The survey revealed that farmers are already aware of long-term changes. For instance, environmental change has already been observed by most of the farmers from the sample (90%). Thus the results suggest that the awareness-raising stage may not be a necessary first step before communicating and discussing possible solutions to the problems associated with climate change. Furthermore, famers are worried about economic and environmental changes but, to some extent, optimistic about individual changes (Fig. 5.9), which could indicate their readiness to find solutions to current climate-related problems by themselves.

The results of the evaluation process showed that the preferred adaptation measure is option C – *Investments in high efficiency irrigation technologies*, which coincides with the most common water management adaptation measure to cope with water scarcity, as revealed in the first questionnaire (performed by 49% of the farmers). Measures D – *Improvement of existing agricultural information systems* and E – *New climate services for longer-term adaptation (seasonal weather forecasting)* were not ranked highly (in third and last place respectively). Nevertheless, farmers generally expressed a wish to receive more climatic information in the

eBulletin and 52% of famers showed an interest in receiving seasonal weather forecasts (Fig. 5.8). As explained by one participant in the follow-up interview, the importance of agro-meteorological services, particularly online services, is expected to gain more attention through better promotion and with the expansion of Internet use. The increasing frequency of climate change-driven repercussions on agricultural productivity, such as prolonged droughts, may also enhance interest in seasonal weather forecasting in the future. Finally, bearing in mind the fact that the preferable options are location-specific and could vary from place to place, it would be interesting to expand the analysis in the future on the participants' geographical locations or administrative regions. Such information could also be useful for regional irrigation boards.

The results were triangulated by combining eParticipation with telephone interviews. Traditional social research tools such as phone interviews and workshops are a useful complement to online approaches, while feedback from participants is particularly important when innovative methods are being used without sufficient empirical background. Moreover, although the use of MCA ensures a structured and objective evaluation of alternatives, it may not necessarily coincide with intuitive decision-making processes (Hajkowicz, 2008). The interviews confirmed the acceptability of the results and the usability and so effectiveness of the method, and highlighted other elements that should be considered in further research, such as finding suitable language for the engagement of the general public. The fact that the obtained results overlapped with the expectations confirms the meaningfulness of the proposed process.

Experience gained in this research suggests that upgrading the exercise from exploratory scientific research to the provision of information to decision-makers could be a positive stimulus for participation. Namely, lack of interest and low responsiveness often constrain participatory practices, and eParticipation is not free of these obstacles (Sanchez-Nielsen and Lee, 2013). As participation is a voluntary activity, and people are generally inundated with information from diverse sources, including the Internet, it is challenging to find appealing information and to motivate participation. However, farmers showed interest in participation in this research, which, as some comments suggest, could be partly attributed to the final goal of the study, i.e., presenting the findings to decision-makers.

Finally, not only the online network of farmers but also decision-makers can be involved in this assessment of alternative adaptation options. mDSSweb can be tailored to different uses, so that

the same tool could be applied with a different level of complexity, and all gathered results compared, if used in the future for a formal process of decision support. For instance, the ELECTRE interface, which gives more options to users (e.g., to set parameters), could be suitable in a guided workshop with stakeholders, while instead of using a Likert scale, experts could assess measures in more detail using real values for criteria performance. Furthermore, the preferences of farmers obtained through the online exercise would be accessible for discussion, and this in turn would contribute to an informed and transparent decision-making process. Stakeholder representativeness could be ensured in this formal decision-support activity by officially inviting recognised farmers' associations and by weighting groups of respondents (e.g., by the number of farmers each group represents), in order to achieve proportional participation and a role in the final decision, unlike in the case of our exploratory exercise where farmers were involved based on their interest and willingness to respond to our invitation.

5.5. CONCLUSIONS

The Internet has been recognised as providing a new space for the expression of public opinion and governmental institutions already use eParticipation to keep citizens informed on matters of public concern, such as legal issues and politics. The contribution of this research is in demonstrating the usability of this rapidly evolving but still underexplored online participatory approach in a new field. The framework presented in this paper applied eParticipation techniques to the field of climate change adaptation, opening a new communication channel between the public and policy-makers, two stakeholder groups that have traditionally been detached and creating conditions for a more transparent and informative decision-making process.

In the Veneto region, where both an established network of agro-meteorological eBulletin users exists and the average rate of Internet penetration is high, eParticipation proved an efficient approach in terms of the numbers of participants involved and the amount of time invested. Although the case study does not allow for generalisation, it provides indications that diverse groups of farmers can be reached through eParticipation, which challenges established concerns about the limitations of this approach, such as the most common objection regarding a digital divide. The flexible design approach offered by the presented platform makes it suitable for different groups of stakeholders, from farmers to policy-makers. In addition, the platform is multilingual and can easily be extended to other countries beyond Italy and adjusted to different case studies. A well-developed online network proved to be an important precondition for the success of the suggested participatory framework. However, we can expect different engagement approaches to become feasible with further Internet proliferation. Moreover, stepping out of the analytical approach and presenting results to decision-makers can be a good motivation for public participation.

eParticipation is not a ‘silver bullet’ solution to ensuring effective participatory practice. Rather it should, as demonstrated in this paper, be complemented by traditional participatory practice, particularly by interviews for results triangulation and workshops for presenting and discussing the results and involving policy-makers. Combining both approaches delivers strong results for formal decision-making processes and should be applied until the further expansion of the Internet makes representative participation feasible online.

The future development of the mDSSweb platform could benefit from integrating geo-spatial tools, such as web-GIS, which could facilitate recognition of participants' locations and provide geographical characterisations of their preferences. This could be an asset for decision-makers who can thereby receive information in a transparent way about autonomous adaptations in place and public preferences in different parts, triggering a rethinking of existing policies and improving the development of new polices.

Finally, this eParticipation framework could be applied to the analysis of other climate change related problems and solutions, or any other decision-making processes that demand collaboration with the public.

CHAPTER VI: AN ONLINE PLATFORM FOR SUPPORTING THE ANALYSIS OF WATER ADAPTATION MEASURES: Experience from the C3 Alps project

Bojovic, D., Cojocaru, G., Giupponi, C., Klug, H, Morper-Busch, L., Schorghofer, R.

This chapter shows the ongoing research that further develops the online tool presented in the previous chapter, enabling more profound third level of eParticipation. The research presented in Chapter V recognized that the mDSSweb platform could benefit from integrating geo-spatial tools such as maps and web-GIS, facilitating recognition of the participants' location and providing geographical characterisations of the adaptation preferences. The new platform, incorporating interactive maps, aims at providing information about autonomous adaptations in place and public preferences in different locations.

6.1. INTRODUCTION

The Alps are called the water tower of Europe since the hydrological regime of the Alps has an important influence on the water balance of the central Europe. The natural abundance of water in the Alps supplies major European rivers such as the Danube, Rhine, Rhone and Po (the Alpine convention, 2009).

With its high orographic, topographic and climatological complexities, the Alpine Space is expected to be affected by climate change differently than other regions within Europe (Bogataj, 2007; Zimmermann, 2013). Regional adaptation activities should be identified and tailored to the specific regional vulnerabilities (Rannow et al., 2010), emphasising the spatial component of climate change adaptation (Eikelboom and Janssen, 2012). The impact of climate change in the Alps will be unevenly distributed in space and time, e.g., an annual increase in precipitation is expected in the north-western Alps, whereas there will be decreasing trends in the south-eastern Alps (Auer et al., 2007). Furthermore, loss in glacier mass volume, permafrost melt, and decreasing snow cover may reduce summer discharge and reduce water availability in all the regions dependent on the water supply from the Alps (Beniston, 2003; Steger et al., 2012). All

this may result in the Alps experiencing a higher frequency of drought periods in the summer (Espon Climate, 2009).

Water is thus recognised as an important sector to be considered in the adaptation of the Alps to climate changes, with cross-sectoral significance (EEA, 2009b; Beniston et al., 2011). The importance of a specific Alpine water dimension has been acknowledged in recent years with the holding of a conference on "The Water Balance of the Alps" in Innsbruck in 2006, for example, and with water selected as a topic of the Multi-Annual Working Programme of the Alpine Conference (MAP) for 2005–2010. These efforts have further emphasized the importance of including a broader group of stakeholders in discussions over water management in the Alps (Alpine Convention, 2009).

Regarding the planned adaptation practices in Alpine countries, national adaptation strategies have already been adopted in some of these countries and preparation of such strategies is underway in others. Implementation at regional and local levels, however, is still largely lacking (Clisp, 2011).

Against this background, the C3 Alps research project[16] builds on the results of previous projects and initiatives on adaptation to climate change in the Alps, seeking to synthesize, transfer, and implement in policy and practice the best available knowledge on adaptation. By applying a knowledge-transfer concept driven by the information and communication needs of project target groups, the project optimizes the usability of available knowledge resources in an attempt to bridge the gap between the generation of adaptation knowledge and its application in real-world decision-making. The project involves stakeholders in different ways, through the dissemination of findings, organising events, and eParticipation in the form of online surveying and collaboration on problem-analysis and solution-finding, in order to support bottom-up adaptation measures in the Alpine regions and municipalities, to contribute to the implementation of national adaptation strategies, and to disseminate alpine adaptation capital within the Alpine community and beyond.

[16] http://www.c3alps.eu/index.php/en/ (Accessed 25/11/2013)

Stakeholders were first involved in this project through eParticipation by means of an online questionnaire aimed at analysing the information needs and communication habits of the project target groups. The results of the questionnaire revealed the strong interest of stakeholders in visualised and geospatial information such as maps and graphs (details are presented in section 3.4.). The presentation of spatial information through web tools depends on and should be shaped by the user community and their information needs (Mittlbock et al., 2012). Therefore, the results of the survey were an important stimulus for integrating interactive maps in the following level of eParticipation. Besides, previous studies have proved maps to be useful in providing an interface between tools and end-users (see, for example, Malczewski, 2006; Arciniegas et al., 2013).

At this level of eParticipation, stakeholders are empowered to collaborate on the analysis of alternative adaptation measures and suitable solutions using a platform that combines a spatial tool, i.e., Map Viewer, and a decision-support component – mDSSweb. Participatory mapping enables access to local knowledge, allowing for place-based research that can inform local governance processes (Stocker et al., 2012).

As stated above, water is recognised as an aspect of cross-sectoral importance in the Alps and this participatory exercise therefore focused on water management. More specifically, we decided to analyse in a participatory manner the adaptation of the Alps to expected future water scarcity as an area where the behaviour of every individual is of particular significance.

The aim of this level of eParticipation is to contribute towards increasing the diversity of the audience and the numbers of participants involved in project activities, particularly given the multi-lingual interface of this pan-alpine interactive platform. The online platform will instantaneously show results of the participation activity aimed at proposing preferable adaptation measures in different regions of the Alps.

6.2. BACKGROUND

The C3 Alps research project builds upon the idea of 'Capitalisation', i.e., generating knowledge that is usable and useful to adaptation decision-makers, effectively transferring this knowledge to target groups and putting it to actual use (http://www.c3alps.eu/index.php/en/). The project aims at real-world impacts on decision-making by generating new forms of adaptation knowledge targeted at user needs, transferring this knowledge to decision-makers and taking action in regions and municipalities. Among different activities aimed at fulfilling this aim, the project develops an integrated synthesis knowledge base on climate change, the Knowledge Inventory Portal (KIP) (Fig. 6.1). KIP presents a state-of the art knowledge base on climate change impact and adaptation measures and strategies in the Alps, where end users can search, discover and analyse these options according to sectors, topics and regions. This knowledge inventory is composed of the Catalogue Service Web platform (C3 – CSW), with structured information on climate change impact and adaptation options, the C3 website (C3-Web), the C3-Alps Map Viewer (C3-map), and the C3-Alps tool for the analysis of adaptation measures (C3 mDSSweb).

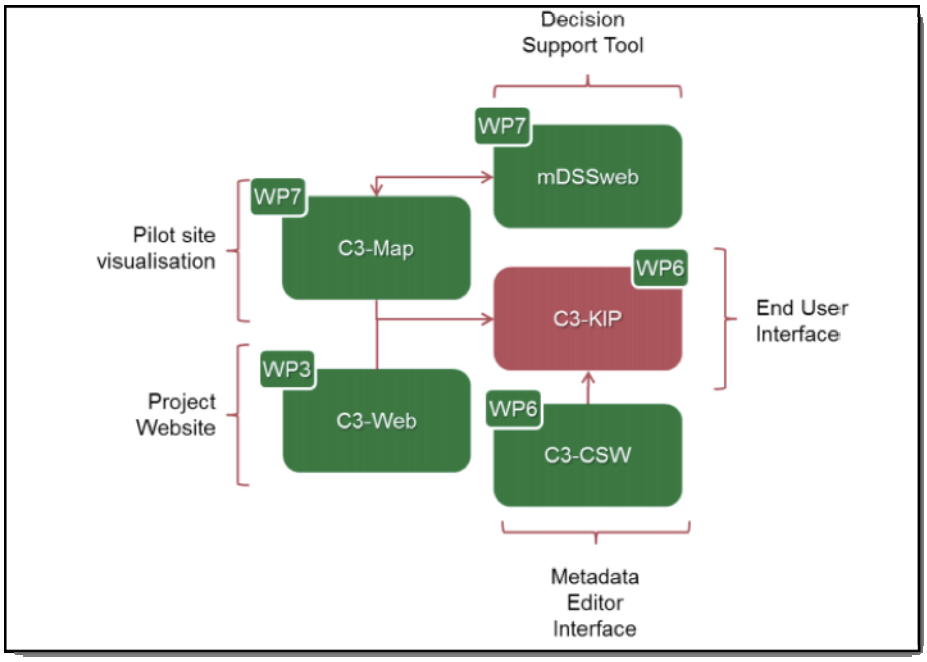

Fig. 6.1 The C3-Alps Knowledge Inventory Portal and surrounding tools (from Klug et al., 2013).

The rest of this chapter details the development of the C3 mDSSweb tool.

6.3. THE C3 TOOL FOR THE ANALYSIS OF ADAPTATION MEASURES – C3 mDSSweb

The C3 mDSSweb tool includes a component for Multi-Criteria Analysis (MCA) of adaptation options integrated with the Map Viewer. The C3 Alps Map Viewer[17] is an interactive map presentation based on Google Maps. The MCA functionalities are provided by the C3 mDSSweb component developed from the previous mDSSweb tool version presented in Chapter V of this dissertation. While the Map Viewer provides the routines for geo-localisation and the display of results, mDSSweb guides users through the elicitation and sharing of their preferences and expectations regarding a set of climate change adaptation measures, identified by the project consortium as being of specific interest in the field of water resources management and climate change.

The new version of the tool has the following distinctive features:

1. Improved visualisation and more effective communication of climate change adaptation solutions, with visual and geospatial features to provide a platform suitable and appealing for target stakeholders.

2. A multilingual interface, available in all main Alpine languages (French, German, Italian and Slovenian), as well as in English to overcome the problem of the language barrier and allow for the tool to be used throughout the Alpine Space.

3. Grouping facilities to identify divergences and to explore compromise solutions and preferences driven by geographical distribution or other distinctive features of the respondents.

[17] http://portal.c3alps.eu/userguide/!C3AlpsMapViewer.pdf

6.3.1. C3 mDSSweb description

The C3 Alps Map Viewer is the first interface with which the user is prompted and provides the spatial component of the exercise. On this page, the user can select a language: English, German, Italian, French or Slovenian. After selecting the Adaptation Measures Survey Option, the user is guided to provide their email address and select a location as a reference point by geo-tagging, i.e., placing a point of a specific location on the map background (Fig. 6.2). After that the user is redirected to the mDSSweb component of the platform. The user interface of the mDSSweb component of the software is composed of four pages.

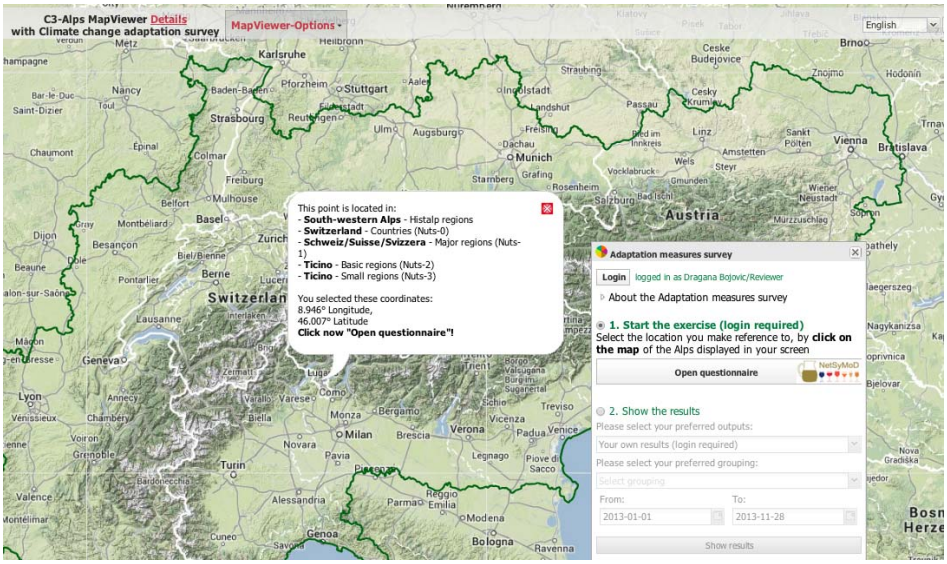

Fig. 6.2 Map Viewer – beginning of the participation exercise

The first page of the mDSSweb component briefly explains the exercise and introduces the evaluation criteria.

The second page presents alternative adaptation measures and enables their evaluation against a set of criteria. The qualitative evaluation of alternative measures is performed through an interface with which the user fills in the Analysis Matrix (AM), with measures in the columns and criteria in the rows (Fig. 5.2). Specifically, the user attaches a value in each cell of the matrix to express their expectations as to the performance of each alternative measure for every evaluation criterion. The proposed values range from 1 (very low performance) to 5 (very high performance). For example “very high” in the cell of Criterion X for Option A means that the

respondent believes that Option A could have a “very high” performance in terms of “criterion X” if implemented. Respondents’ judgements are saved as scores, then weighted and summed up for each option to obtain the score and ranking.

After the compilation of the AM, the user arrives at the third page to weight criteria according to their relative importance. The weights are decided upon through a graphical interface and then calculated with the revised Simos procedure (see Fig. 5.3). The technique allows any user/stakeholder, even if they are not familiar with multi-criteria decision analysis, to think about and express ways in which they wish to express the relative importance of criteria in the given context (Figueira and Roy, 2002). The interface developed for the mDSSweb platform permits participants to evaluate criteria by placing tick marks along a scale of relevance, thus allowing for their hierarchical arrangement in a visual way.

Using MCA evaluation techniques, alternative options are evaluated against their performances by applying aggregation algorithms to the set of values stored in the AM and in the criteria weight vector. For the sake of simplicity and transparency, the mDSSweb adopted a simple algorithm called Simple Additive Weighting (SAW) in which the final score of each adaptation option is calculated with the sum of the criterion values, weighted by the vector of weights.

The forth page offers users the link to return to the C3 Map Viewer where they can visually explore the results of their own analysis, as well as the results of other participants and the overall result.

6.3.2. Design of the exercise

This particular exercise analyses alternative measures that can help the Alpine Space to adapt to water scarcity resulting from climate change by delivering these findings to decision-makers involved in the development of adaptation policies and strategies in the Alps and elsewhere.

The following set of climate change adaptation measures from the field of water resources management was identified by the C3-Alps project consortium:

A. Improving water infrastructures and reducing leakage, thus saving water by controlling and limiting water leakage from inefficient and/or ageing municipal and agricultural water distribution systems. This is an engineering-based measure.

B. Improving water efficiency and conservation in households and hotels, thus reducing water wastage by decreasing the water consumption of households and hotels. This measure involves choosing more water-efficient devices, products, and practices. It may be supported by specific codes, protocols, and certifications, and in extreme cases (drought periods) it may include restrictions and rationing that may temporarily limit certain uses of water, for example the irrigation of lawns and car washing. This is a set of voluntary and behavioural measures.

C. Introducing wastewater treatment and reuse, involving the reuse of domestic water from baths, showers and sinks (grey water) for toilet flushing, laundry/dish washing and gardens. The grey water from households and hotels could also be reused in industry and agriculture, e.g., for irrigation, greenhouses, and industrial processes. This measure reduces overall demand for water, thereby easing pressure on available water. This is a combination of technological and management measures.

D. Undertaking awareness-raising campaigns and promoting behavioural changes (focussing on tourists), involving campaigns for promoting awareness of the impacts of climate change on water availability and the active role that tourists can play in reducing the negative consequences of water use. Public awareness is important to increase enthusiasm and support, stimulate self-mobilisation and action, and to mobilise local knowledge and resources. Tourists are informed about simple water-saving actions they can take in their daily routines. This behavioural measure can be combined with other technology or management options.

E. Improving planning instruments for water saving, thus protecting water resources through improved planning instruments to reduce the water requirements of targeted sectors and to enable the optimal use of available water resources. These planning instruments include zoning, financial incentives and disincentives, regulatory measures, market-based instruments, strategic planning for catchment and resource management, including water use for artificial snow. This alternative includes a vast catalogue of measures to be implemented through planning instruments and legislation.

The alternative measures are evaluated against a set of criteria defined on the basis of previous experiences in the field (in particular through the ClimWatAdapt project,[18] Florke et al., 2011). The following criteria were selected:

- Effectiveness – the extent to which the adaptation measures directly contribute to reducing the system's vulnerability to the expected impacts of climate change.

- Efficiency – the characteristic of measures that bring higher benefits in comparison to their costs of implementation, including transaction and monitoring costs.

- Environmental performance – the potential contribution of a measure to improve or protect the state of the environment, for example by contributing to pollution abatement, the conservation of natural habitats, natural resources and ecosystem services.

- Side-effects – the unintended outcomes, both positive and negative, of the adaptation measures, going beyond their specific scope: e.g., positive effects on employment, or negative side effects on different environmental aspects.

- Contribution to the resolution of conflicts – the potential contribution of a measure to limit existing conflicts, for instance conflicts amongst different sectors competing for the same water resource.

- Performance under uncertainty – the capability of the measures to maintain their performance under a wide range of uncertain future changes in climatic and socio-economic conditions. Measures that meet this requirement may be either robust to uncertainties or flexible in design and implementation.

The aim of the exercise is not to find a winning solution but rather to identify and understand the preferences of different actors and groups of actors, as well as their expectations, in order to deliver these findings to those involved in the development of adaptation policies in the Alps. Accordingly, the emphasis is not on the final solution but on different interpretations of the evaluation exercise. After finishing the exercise, the user returns to the C3 Map Viewer where they can visually explore the results. Individual results are presented through two main graphs:

[18] http://climwatadapt.eu/ (Accessed: 18/06/2013)

- Overall performance of adaptation measures and criteria contributions – the SAW results are reported by the platform in the form of a histogram in which the length of the bars are proportional to the scores and the colour segments show how the weighted performances of each criterion contribute to the overall performance of a measure (Fig. 6.3).

- Sustainability performance – the performances of the measures are balanced according to the three dimensions of sustainability: economic, environmental and social. These performances are presented in a triangular chart in which scores are calculated for each dimension by assigning the criteria values to one or more sustainability pillars. Ideally, options should be presented as equivalent triangles. Alternatively, they denote the fact that the three dimensions are not balanced (Fig. 6.3).

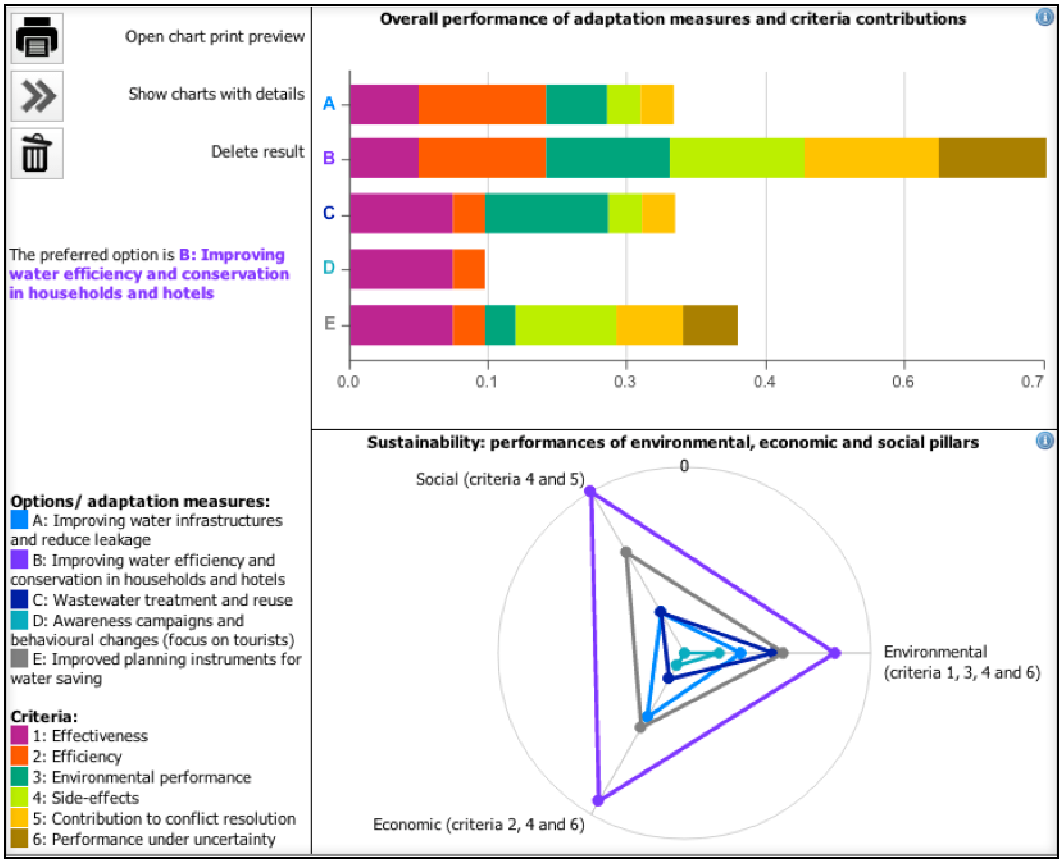

Fig 6.3 Overall performance of adaptation measures and criteria contribution (upper chart) and Sustainability performance (Lower chart) – the winning option B better fulfils the social, than economic and environmental dimensions, while the option C has the best environmental performance

Two additional graphs enable going deeper into the details of the intermediate results:

- Evaluation of the options against the criteria – a polar graph shows how the adaptation options perform according to the criteria considered before weighting (Figure 6.4). A regular polygon shows similar performances, while irregular shapes denote notable differences between the alternative options. Polygons with vertices closer to the centre of the chart denote poor performances while vertices close to the external rings show good performances.
- Relative importance of criteria – a pie-chart shows the relative importance (weight) assigned to each of the criteria (Figure 6.4). These weights are used to calculate the final score, i.e., overall performance and sustainability performance.

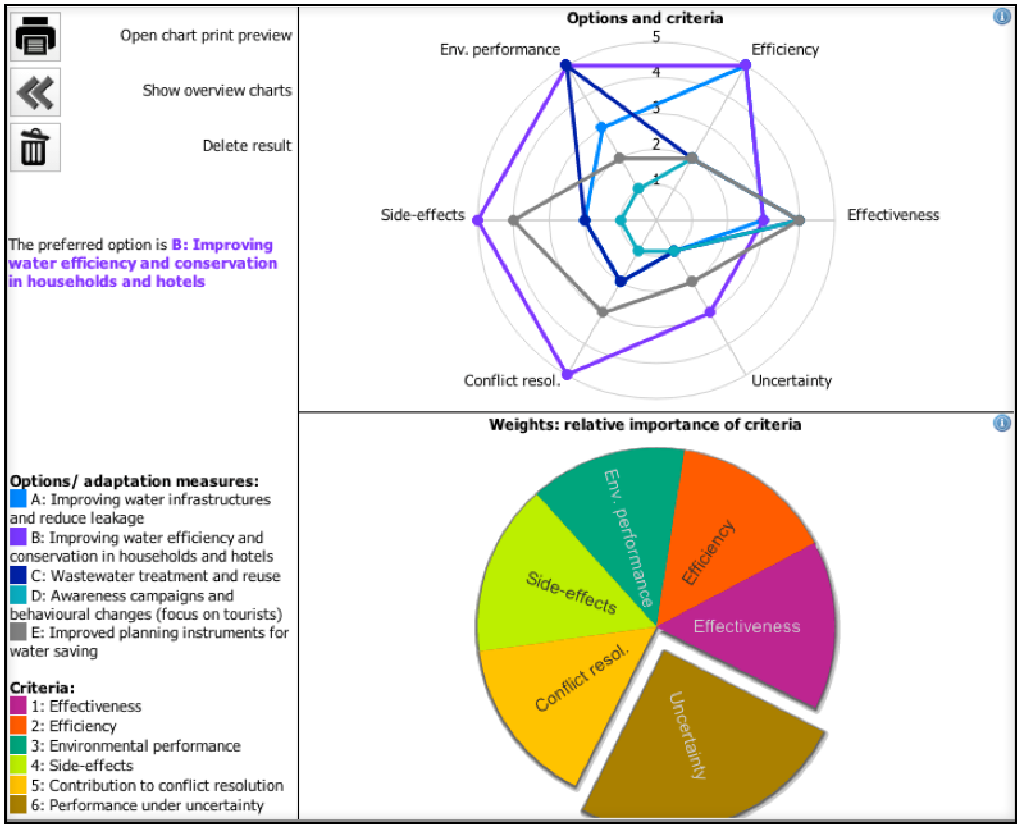

Fig. 6.4 Evaluation of the options against the criteria before criteria weighting (upper chart) and Criteria weighting (lower chart)

The individual results are tagged to the corresponding locations on the map of the Alps provided by the C3 Map Viewer. This allows for regional analysis of the results. Individual results are combined in a summary screen showing a synthesis of all the collected contributions.

Under the option the overall results, the user can see the aggregated result that considers the assessments made by all the participants who have taken part in the exercise. Graphical and geographical displays present the aggregated preferences by sub-groups and by spatial distribution. i.e., the group result of participants in individual geographic regions, which can refer to a country or different NUTS (Nomenclature of territorial units for statistics) levels (Fig. 6.5).

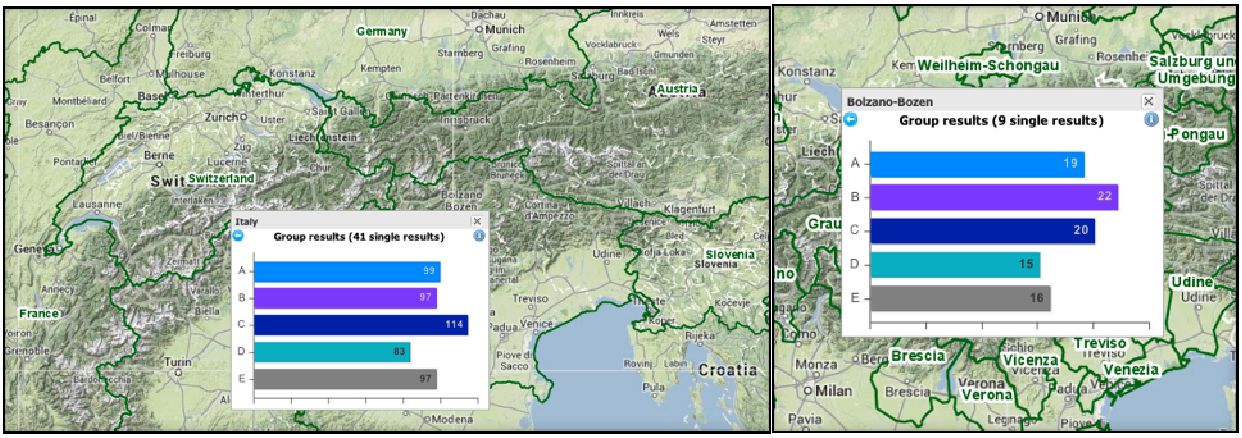

Fig. 6.5 Group results according to the country distribution (left) and small regions (NUTS3) (right)

Epilogue

This exercise of analysing adaptation measures with the C3 mDSSweb tool is currently under preparation. Participants in this exercise will be mobilised using online networks, including the mailing lists of the project partners, but also the already established online networks from the Alpine region (e.g., CIPRA[19] – the alpMedia newsletter users' network). The results will be collected in a period of one month and analysed thereafter. This ongoing research will determine to what extent and in what ways visualising tools, in particular maps, can support online public participation in climate change adaptation.

[19] Commission Internationale pour la Protection des Alpes (International Commission for the Protection of the Alps)

CHAPTER VII: CONCLUSIONS

This dissertation comprised three research papers, a summary of experimental research, and an outline of ongoing research. It is built around two research questions set out in Chapter I. This final chapter draws together the main conclusions by providing a summary of the findings of each chapter, suggests further research and outlines policy implications.

7.1. RESEARCH CONCLUSIONS

Chapter II addressed the first research question – *What is the role of information and communication technologies in today's participatory processes?* – by introducing the major features and concepts of eParticipation and social media. eParticipation has been advocated by EU institutions as an approach that can improve public inclusion in politics. This research has contributed to the body of knowledge on eParticipation by investigating how it can be applied to climate change adaptation. Chapter II further explained the connections between the concepts of social capital and adaptive capacity in the online world. This chapter presented a theoretical framework for eParticipation in climate change adaptation, suggesting the following three levels of eParticipation:

1) *Informing and engaging* participants, which can be done through an existing online network or by setting up an online forum where scientists can be engaged in providing answers to the public. By enabling communication and knowledge-sharing, this activity could serve to activate latent social capital.

2) *Consulting and involving* the public, which can be performed through online questionnaires. The surveying of a large number of participants facilitates the identification of existing knowledge gaps, which can then be addressed back through the first eParticipation level. This level can provide through online surveys information about individual and collective behavioural responses to climate change, including existing autonomous adaptations. This information is typically lacking or difficult to obtain about a large number of participants using traditional approaches such as face-to-face interviews or workshops.

3) *Collaborating and Empowering* can be achieved through actively involving the network of participants established in the previous levels in problem analysis, in exploring possible solutions and identifying preferred solutions. This collaborative exploration of possible climate change adaptation solutions could be performed through online decision support platforms. This level of participation contributes to adaptive capacity by enabling collective decision-making.

Combining eParticipation and populated online networks, the proposed framework successfully addresses the issue of insufficient engagement which is recognised as a potential flaw of both traditional and eParticipation. Moreover, it suggests that the societal trend towards online networking may show communication and participation via social media as better corresponding to current public needs and habits. In particular, an important role is assigned to scientists who are encouraged and enabled through this framework to reach out to the general public and spread knowledge about climate change. The use of this framework, which results in collaboration among scientists, policy-makers and the public, is expected to guide further policy development and inform it on commonly agreed preferred solutions.

Chapter III summarised the experimental exercises with eParticipation conducted throughout the work on this dissertation. These experiments provided first-hand experience with online tools and different eParticipation approaches. Based on this experience, the theoretical framework developed in the previous chapter was put into practice, as presented in chapter V. The results showed that an important precondition for successful eParticipation is to identify a group gathered around an issue of concern (or a specific profession or interest), including mailing lists and different online groups (e.g., Facebook groups). These findings go beyond assertions made in the literature about the central importance of bridging versus bonding relations, i.e., different strengths of connections between members for characterising online social networks, and gives practical suggestions as to how online networks can be used to mobilise participants.

Regarding the use of social media advertising, the experiments proved more successful when using ‘structured’ online social networks where interest groups can more easily be identified and targeted with online advertising than when using broader media such as Google advertising, which targets a diverse audience. However, even for the same online social networking service (e.g., Facebook), the success and efficiency of involvement demonstrated different results in various countries, depending on the population, the popularity of the network, and the

development of online marketing. The results of the experiments also proved that language can be a barrier to participation and that multilingual participatory platforms are beneficial when approaching participants in more than one country. These experiments indicated the decreasing significance of the digital divide as an obstacle for using online spaces for public participation, at least in the sample of countries dealt with in this dissertation.

Another contribution of Chapter III is that the experiments included different social groups, amongst which were the general public, cyclists, members of the public administration and climate change experts. Although the findings cannot be generalised, the similar results found in experiments with a variety of social groups confirms that the findings do not depend on the specific characteristics of individual social groups. Finally, the diversity of the audiences reached in these experiments indicates the potential of web-based tools to engage a broader public on the topic of climate change.

Chapter IV compared eParticipation with traditional participatory practices, drawing on the theoretical findings from Chapter II and the empirical experience presented in Chapter III. The comparison was made against a set of different criteria, including: initiators of participation, recognition, representativeness, levels of participation, transparency, accountability and efficiency. This chapter suggested what each process could learn from the other and the ways in which the processes complement one another. The main conclusion was that the adoption of a combined approach in environmental decision-making can reap benefits in terms of increased efficiency by overcoming the resource-demanding nature of traditional participation, as well as greater reliability of results by overcoming the common flaw of eParticipation arising from the sometimes unknown identity of participants.

Chapter V reported on the implementation of the eParticipation framework in a case study of adapting agriculture in Northern Italy, thus addressing the second research question: *Can ICT ensure efficient public participation with meaningful engagement in climate change adaptation?* The research applied the second and third levels of eParticipation (and by providing additional information it also partly satisfied the first eParticipation level) to engage farmers from the Veneto Region of Italy in the analysis of solutions for climate change adaptation. Farmers were mobilised using a pre-existing network of users of the agro-meteorological eBulletin. The results obtained proved eParticipation to be efficient in terms of the time and money needed for

participation and the collection and analysis of results, as well as the raw numbers of participants. The participants belonged to different age and educational groups, addressing and challenging the concern that only younger and well educated groups can be reached using online tools. The results revealed that farmers were already aware of long-term regional climate changes and identified the existing adaptation practices in use. Information on these practices is often not available on a wider scale, despite the fact that such information can be highly significant to the task of improving the quality of adaption policy by informing the design of measures that complement farmers' practices and respond to their needs.

This research empirically demonstrated how eParticipation can benefit by being merged with traditional participatory practices, in this case with phone interviews and a final workshop. The phone interviews confirmed the acceptability – an important aspect of effectiveness – and meaningfulness of the results. The final workshop, with participation by representatives from the local administration and irrigation boards, upgraded this research from an exploratory scientific study to one providing information for regional decision-makers. Feedback from the regional decision-makers showed their interest in using eParticipation in future to improve communication with farmers and increase their participation in decision-making. Furthermore, we considered this particular step of presenting the results to decision-makers as a positive stimulus for motivating stakeholders to participate.

Chapter V presented the development of a new online platform, mDSSweb, for facilitating problem-and-solution analysis of adaptation in a collaborative manner. The tool itself was consolidated using a participatory modelling approach whereby farmers were involved in testing the feasibility of the mDSSweb prototype. This iterative process helped in understanding the functionality of the new tool and the production of a more user-friendly tool. The collaboration between scientists and stakeholders on the development of the tool resulted in mutual learning. Moreover, the engagement of scientists throughout the process, together with lasting communication with participants, contributed greatly to the success of the research. This was confirmed by the participants, who declared that they had followed the development of the research through the regularly updated last page of the platform and acknowledged the usefulness of the newsletters presenting summary of the research findings. The language barrier was addressed by translating the platform in different languages, which broadened its

applicability outside the territory of a single country. This is particularly important where cross-border problem analysis is needed, as in the case of climate change.

Chapter VI detailed the ongoing research, further developing the online tool presented in the previous chapter. The research presented in Chapter V recognized that the mDSSweb platform could benefit from integrating geo-spatial tools such as maps and web-GIS, facilitating recognition of the participants' location and providing geographical characterisations of the adaptation preferences. Considering the spatial impact of climate change effects, spatial information is particularly important for designing adaptation measures and strategies. The new platform incorporating interactive maps, combined with eParticipation, could be an asset for decision-makers, providing them with information about autonomous adaptations in place and public preferences in different locations.

7.2. FURTHER RESEARCH

Besides integrating geo-spatial tools with eParticipation, in order to consider participants' location and spatial elements of climate change adaptation, other tools could be in the future work applied in order to improve usability of eParticipation.

We have already shown in different chapters how eParticipation can be combined with the traditional participatory practice, used in qualitative research, such as in-depth interviews and workshops. However, combining eParticipation with different statistical methods can facilitate results manipulation and provide additional insights.

Some examples of these statistical methods are univariate models, multivariate choice models or Heckman's sample selection model. These computationally simple statistical models allow for the analysis of binary (e.g., whether to adopt or not) or multiple decision options (when the number of choices is more than two), permitting for clearer interpretation of, sometimes, abundant results obtained through eParticipation. Results from online questionnaires could feed these models and allow us to explore factors conditioning specific choices or combination of choices undertaken by participants, or to measure the expected change in probability of a particular choice being made with respect to whether an individual has a characteristic or not (Jones, 2007). This could be important information for a decision-making process. An example of combing eParticipation with the Heckman sample selection model is provided in the Appendix III. In the future research, eParticipation process should be designed in the way to collect information for a more representative sample, close to the whole population in general, to be fed into statistical models. Still, eParticipation is an entirely voluntarily process and we should not expect that it can obtain a perfectly representative sample of participants. We could, however, correct for this bias with Heckman sample selection model so that robust conclusions are derived. Depending on the research objective, it is also worth exploring alternative statistical tools (e.g., univariate or multivariate models) to analyse determinants of public choice of adaptation options or other characteristics.

Furthermore, computational social science, and in particular analysis of large online social networks could be in the future merged with eParticipation research, particularly if we continue using social networking sites for reaching out participants. Capturing different behaviour aspects in SNS offer ample opportunities for research that would otherwise be impossible or unacceptable (Bainbridge, 2007).

New tools for large data graph mining are used to display large networks in real-time. This presentation of social networks could enable tracking relations between participants and the rest of the particular SNS universe. This could unveil power relations among the network, while identification of the underrepresented groups could help improving equity of the eParticipation process. Studying networks' dynamics can also help detect 'influential' individuals (individuals who are able to influence other individuals in a social network), or key e-spokespersons. These persons could be a link to other participants.

Not only is the network dynamics analysis interesting for further research, but also the content analysis. The automation of content analysis and text mining methods, and semantic Web in general, have allowed interpretation of vast quantities of data into information. Our knowledge base on adaptation is rapidly growing and we should learn how to harvest fresh knowledge and relate these emerging findings to demands. It could be the role of scientists, as has already been emphasised in this research, to act as "brokers" of information between different groups that would not otherwise be in contact.

7.3. POLICY IMPLICATIONS

This doctoral dissertation has sought a solution to the policy question of how to improve public participation in climate change adaptation. In suggesting new solutions to this challenge, this dissertation offers cross-cutting research combining social and political science, climate change science, and information and communication studies. Not only does this research contribute to the field of eParticipation by going beyond the role of eParticipation in politics, it also offers useful knowledge on eParticipation to climate change decision-makers. However, eParticipation is not presented as a panacea for this policy question but rather as an alternative to traditional participation and an approach that can be combined with well-established participatory approaches.

Bearing in mind the novelty of eParticipation and the still insufficient amount of knowledge generated about this scientific field, this dissertation could not focus only on scientific literature and experience offered by academia. The research explored different aspects of eParticipation. In particular, this work was conducted by looking into the practical experience of the civil society sector with eParticipation, as well as experience in the marketing sector. Drawing on the body of knowledge about social media, our experiments with eParticipation provided first-hand experience in the use of online tools in the area of public engagement with climate change. By implementing the previously developed theoretical framework in the case study, this dissertation provided empirical evidence regarding the efficiency and meaningfulness of eParticipation. However, the results obtained in the case study cannot be generalised because these results can be attributed to the high level of Internet penetration in this region and the existence of an established network of agro-meteorological eBulletin users. Likewise, it is important to acknowledge that this dissertation only signals the opportunities for participation offered by Internet proliferation, since the presented research focused only on parts of Europe. After North America and Australia and Oceania, Europe has the highest level of Internet penetration, with more than 63% of the population online. Nevertheless, even the world regions with the lowest Internet use have recorded significant increases in their online populations, e.g., an increase of more than 2% of the population of Africa in the period 2011–2012, from 13.5% to 15.6% (Internet World Stats, 2013). Thus eParticipation could become feasible worldwide in the near future. Moreover, the Internet is a relatively new media in some developing countries, meaning

that a new opportunity to take part in online discussions and decision-making could be embraced in societies not yet overwhelmed with online information, especially since climate change adaptation is of the utmost importance for some of these regions.

Not only can we expect eParticipation to become a feasible tool in the future, but new initiatives and new findings are already emerging in this multidisciplinary, dynamically evolving field. Namely, during the course of work on this dissertation, new initiatives and developments emerged in Europe and Italy that can both support our research and also gain from findings presented in this work.

The EU Strategy on adaptation to climate change, published earlier this year, prioritises flexible and participatory approaches to support timely and planned adaptation action. The Strategy further suggests bridging the knowledge-gap on frameworks, models and tools to support decision-making, while a multi-criteria analysis is recommended for ranking and selecting preferred adaptation options. Furthermore, the Strategy recommends that affected stakeholders should be involved in discussing and deciding upon evaluation criteria and their weightings for identifying an appropriate, highly acceptable set of adaptation options. This dissertation supports the Strategy's recommendations by proposing a framework and tool for involving a broader group of stakeholders in adaptation. It also proposes a way in which participants can collaborate in suggesting evaluation criteria, and more specifically in ranking criteria using a scientifically robust revised Simos procedure with a simple user-friendly interface.

The EU Strategy on adaptation to climate change recommends the development of national adaptation strategies as instruments at global level. A national adaptation strategy is currently being developed by Italy and the implementation of the strategy would be facilitated by taking into consideration regional and local experience of adaptation. The results of this research, involving farmers from the Veneto Region in discussion and in finding solutions to climate change adaption, could inform the implementation of the National Italian strategy, as suggested in Appendix III.

Finally, from a practical perspective, this research developed the mDSSweb tool as a multilingual platform for problem-and-solution analysis of climate change adaptation. The main empirical work was conducted in collaboration with the Veneto Region and the results of the

study, together with the tool, were presented to the regional policy makers. The study showed an efficient way of consulting with farmers on the issue of adaptation, which was facilitated by using the existing online network of eBulletin users. The regional office has continued activities in this vein. Namely, the Veneto Region has an integrated portal for Venetian agriculture.[20] In summer 2013 this portal launched online consultations aimed, firstly, at initiating online discussion on the Rural Development Plan 2014–2020, then at facilitating the discussion of potential new strategies, and finally as a means of shaping preferable measures. These steps correspond to the three eParticipation levels suggested in this dissertation. This particular portal is open to all interested actors, though it also has a restricted area that can be entered only with a password. This restricted area is designed to obtain more formal and expert opinions.

The Vento region's online portal is probably only one of many similar initiatives currently taking place around the world. These initiatives will provide more empirical evidence about the use of ICT for enabling public involvement in environmental protection, rural development and climate change. This gives us grounds for confidence that the pioneering work demonstrated in this dissertation will not remain purely experimental or of purely scientific interest but will have a real-life policy implication in an increasing number of cases and examples. Further similar developments could pave the way for founding theory in this emerging field and for establishing the practice of eParticipation in a broad range of public issues.

[20] http://piave.veneto.it/web/piave/il-progetto

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APPENDIX I: Fixing ELECTRE III thresholds in the ICARUS exercise for an user friendly interface

Appendix I of this dissertation details how we developed fixed thresholds for the ELECTRE III method. The presented thresholds aim at simplifying the participatory procedure that involves ELECTRE III. They were particularly developed for the Icarus exercise. However, the approach presented in this Appendix can be adapted for and implemented in other case studies.

In order to incorporate uncertainties, common for any valuation approach, Bernard Roy, woh first proposed ELECTRE method, introduced three thresholds in ELECTRE III:

1. **q** - the indifference threshold, beneath which the decision maker is indifferent to two project option valuations,
2. **p** - the preference threshold, above which the decision maker shows a clear strict preference of one project option over the other,
3. **v** - the veto threshold, where a 'discordant' difference in favour of one option greater than this value will require the decision maker to negate any possible outranking relationship indicated by the other criteria (Roy, 1978).

The starting point in fixing the thresholds is that **q** and **p** are linked to the margin of error/uncertainty associated with the criterion in question, while **v** is set at a value noticeably greater than **p** (Rogers and Bruen, 1998). Roy et al. (1986) suggest that the value of a threshold should involve both the estimation of error in a physical sense and a subjective input by a decision-maker. Maystre et al. (1994) interpret **q** threshold as the minimum margin of uncertainty associated with a given criterion, and **p** threshold as the maximum margin of error associated with the criterion in question. Rogers and Bruen (1998) conclude that the thresholds, by being connected to imprecision, error or uncertainty, are directly related the accuracy of the criterion valuation. Finally, they suggest the **q** should define the point at which one option is measurably distinguishable from the other, while **p** should define the point at which one option is perceived to be clearly preferable to the other. On the other hand, **v** threshold is related to the discordance conditions. The discordance index begins to register above zero at the preference threshold, and reaches its maximum value at the veto threshold. Thus it is often valued at three

times, five times or ten times the value of **p** threshold (Rogers and Bruen, 1998)**.**

Roy (1986) suggests that the ratio between **v** and **p** thresholds should be held constant for each criterion, but the smaller the criterion weight the larger the value of **v**/**p**. According to the author, this effect is neutralising the mechanism of veto for the criteria of lesser importance while making it an important factor in the decision process for the most important ones. In the other words, the further **v** is from **p**, the smaller effect will be of the veto threshold on the overall outranking of one option over another.

ICARUS-Veneto case study consists of 5 alternatives (strategies), each evaluated through 7 criteria. Considering that physical values of these criteria are not present, but only ranking of their importance, fixing of **p** and **q** thresholds should be based on an estimated error in a subjective input of participants. The lickert scale in the questionnaire has five grades, that present five values, from 1-5, of the criteria in the Analysis Matrix: very good = 5, good = 4, neither good nor bad = 3, rather bad =2, very bad = 1.

I assume that the expected evaluation error is one grade (eg. between *very good* and *good*), thus **1** presents a base for calculating **q** threshold.

Two grades difference should present an unambiguous message that one option is perceived to be clearly preferable to the other (eg. *good* vs. *rather bad; very good* vs. *neither good nor bad*). In this case **2** is the base for calculating **p** threshold.

v presents the maximum value of the discordance index. I suggest that veto should be used only in the case one criterion has two extreme values in two strategies (*very good* vs. *very bad*). Thus **4** is the base for calculating **v**.

The suggested formulas for calculating the thresholds are the following:

q(Cn)=W(Cn)*1+0.0009
p(Cn)=W(Cn)*2–0.0009
v(Cn) = W(Cn)*4 – 0.0009

where Cn is a criterion belonging to a finite set of criteria - {C1, C2...Cn}, in our case n=7, W is a weight of a criterion n, calculated and normalised through the SIMOS method, $0<W(Cn)<100$.

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APPENDIX II: ICARUS Newsletter

This newsletter reported the results obtained in the eParticipation first phase to Veneto farmers and everyone else interested in the research.

The newsletter was prepared in the Italian language and disseminated using Agro-Meteorological eBulletin and email addresses provided by the participants. The enclosed document is the same newsletter translated into English for the purposes of dissemination of the project findings.

ICARUS - IWRM for Climate Change Adaptation in Rural Social Ecosystems in Southern Europe.

Agriculture, irrigation, and perceptions of current changes in the Veneto Region
Online survey - responses boom

ICARUS questionnaire

The Euro-Mediterranean Centre for Climate Change, in collaboration with University Ca'Foscari of Venice and Regional agency for environmental protection of Veneto, within the ICARUS project conducted an online survey on agriculture, irrigation and perceptions of changes in the Veneto Region.
The questionnaire explored farmers' perceptions on climate change and possible existing or necessary autonomous adaptation measures. The questionnaire was distributed through an online bulletin - AgroMeteo Informa in the period July – September 2011, and it collected almost **600 responses**.

The most represented range of utilised agricultural area lays between 5 and 20 hectares (38.2%), followed by farms between 1 and 5 hectares (29.5%). 46.2% of the respondents derive more than 75% of their income from agriculture, yet a significant share are also part-time farmers - 32.7% rely on agriculture for less than 25% of their total income. The main crops are wine (55%) and maize (50%) (Fig.1). 25% of participants responded that they did not use any type of irrigation system, 40% irrigate only in extraordinarily dry periods, and 35% have a structured irrigation system on their farms(Fig.2).

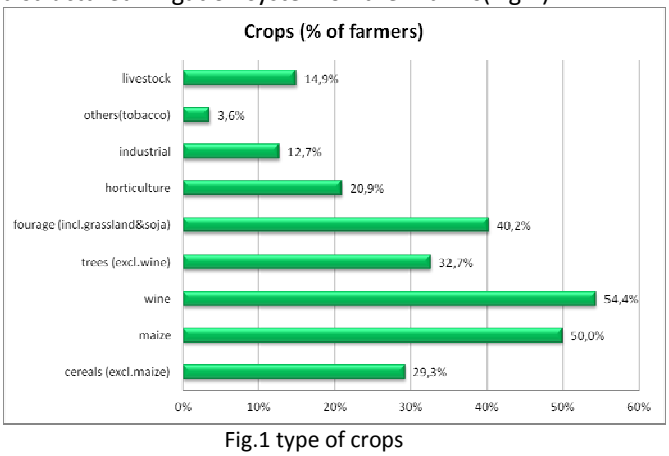

Fig.1 type of crops

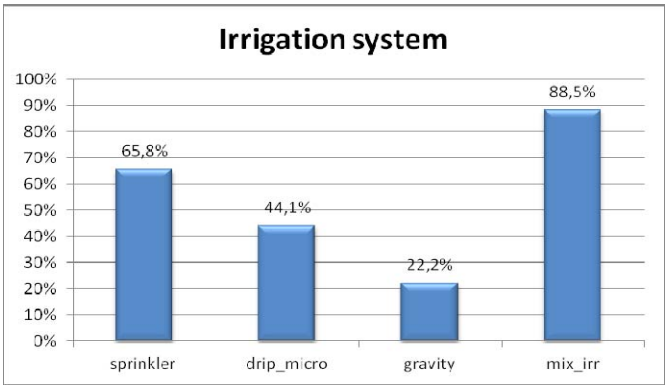

Fig.2: irrigation system

Almost half of the respondents, 48%, are between 46 and 60 years old, whilst only 10% of the participants are below 35 years old.

Opinion over existing changes and their impact on the agricultural sector

Figure 3 presents **environmental changes** that have been influencing agricultural practices in the recent years, according to participants. Amongst extreme weather events, farmers placed at the first place hail, followed by strong winds and prolonged drought periods. Farmers are also worried about invasive species, weeds' resistance to pesticides, and increasing plants' vulnerability to diseases.

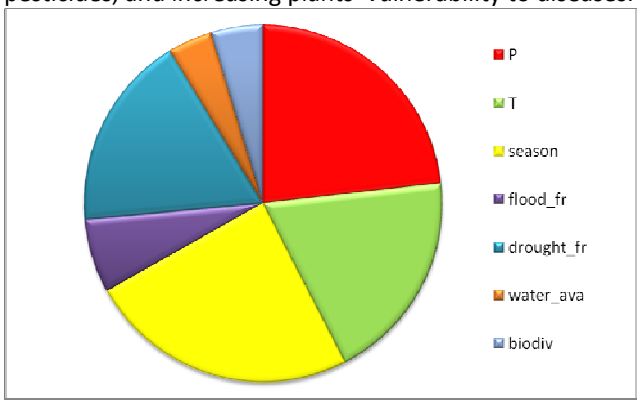

Fig. 3: Environmental changes that have influenced farms practice in the recent years

Environmental changes are the most important once as they influence the production (qualitatively and quantitatively), that affects economic changes, market strategies, related investments etc.

The economic change is the most important one as it determines a family livelihood…

Water management changes not only will be necessary in the future, but more than 40% of the participants have already modified the volumes of water used, and irrigation techniques and technologies. In terms of solution, drip irrigation is the technique that most farmers have considering.
In order to improve water management, there is a high interest for receiving information on climate change, water resources management plans, early warning systems and flood management, new irrigation techniques and agricultural policy. There is especially high interest in **agricultural policy**, largely thought of as under-communicated.
Regarding **crop management**, most of the participants are aware that changes will be necessary in the future. Some

measures that they have already implemented are, in order of representativeness, variety diversification and integrated pest control, followed by changes in tillage.
Statistical regression allowed the identification of linkages between farms characteristics and adaptation practices already in place. **Adaptation in water management** practices seems to be most common amongst farmers who already have structured irrigation in their farm and those who are aware of the fact that environmental changes may deepen in the future. Changes in **crop management** only seem to be more likely amongst farmers that rely for a small share of their income on agriculture and amongst those who do not have structured irrigation on their farm. Finally, it is likely that farmers who have already modified **water AND crop management** practices derive a high percentage of their income from agriculture, have already got efficient irrigation infrastructure (sprinkler and drip) on their farm, consult information services available and have partook in some trainings on climate change. They generally have a perception that environmental changes will increase in the future.

Online bulletin - Agrometeo Informa

Farmers generally consider the information from the online bulletin useful for their **farm management**, and most of them agree (60%) that it contributes to optimising agronomic practices (Fig.5).

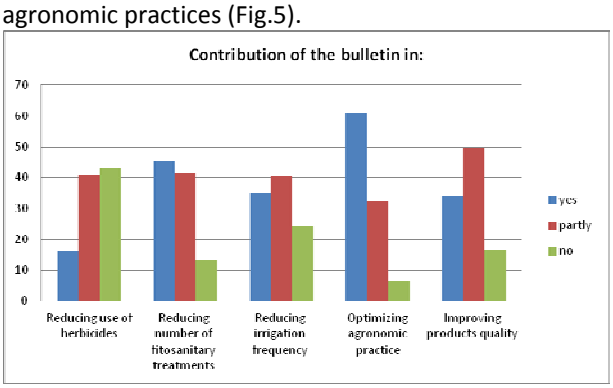

Fig.5: Benefits of the online bulletin

Figure 6 illustrates suggestions for the improvement of the online bulletin *AgroMeto Informa.* A common opinion, according to the additional comments, is that more information is needed on how to **reduce the use of herbicides**, and on plant diseases.

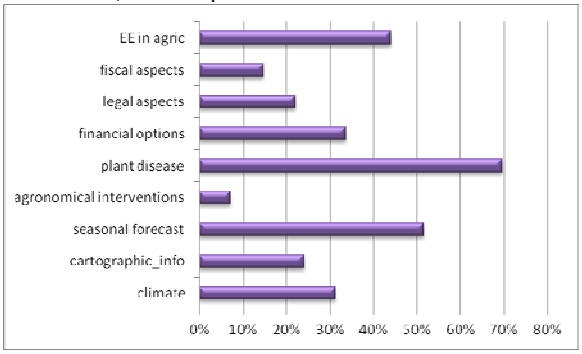

Fig.6: suggestions for improving online bulletin

Conclusions

The first impression from the online questionnaire is that there is a **high participation of the farmers**. Communication through the Internet is thus proposed as an effective means that will increasingly be utilised in the future for information exchange with farmers (particularly with those from most specialized farms). Not only may we obtain in this way useful information on actual adaptation in place, but also farmers may be more proactively involved in proposing ideas and designing guidelines for the development of more effective agricultural policy.
The survey offered a primary examination of the perceptions regarding climate, economic, institutional and individual changes, farmers opinion about existing and needed adoptions in agricultural and irrigation practice, as well as the availability and need for adequate information.

At the moment it is difficult to prioritize, however, I think that the actual climate changes can present problems for the future generations.

A final positive remark on the exercise is that more than 350 of the respondents expressed an interest to collaborate with us in the following project phase to consolidate adaptation measures. They will be contacted for the second phase of adaptation measures evaluation.

Edited by Laura Bonzanigo, Dragana Bojovic and Carlo Giupponi
In collaboration with Alberto Bonini, Federica Checchetto (ARPAV)
For questions and clarifications: laura.bonzanigo@cmcc.it

ICARUS project is financed by ISPRA and coordinated by Prof. Carlo Giupponi on behalf of Euro-Mediterranean Centre for Climate Change and in collaboration with Polytechnic University of Valencia and Atlantica University of Lisbon. The general objective of the project is to develop and propose measures for adaptation to global changes, through an evaluation of scenarios of change and water saving strategies in agriculture. For more information please visit:

http://www.cmcc.it/research/research-projects/icarus-1/icarus

APPENDIX III: The informative role of farmers' perceptions of change for the development of robust climate change adaptation policies : A case study from Italy

Appendix III presents an article published in the proceedings of the First Annual Conference of the Italian Society for Climate Sciences: Climate change and its implication on ecosystem services and society. It details how eParticipation can be combined with a statistical model – the two-step maximum likelihood procedure (Heckman, 1976). The results are based on the sample collected in the ICARUS project first eParticipation phase (see chapter 5.3.1). First step - selection model – extrapolates from the full sample those farmers who perceived climate change and identifies what characterises them, while in the second step the outcome model denotes farmers' adaptation to climate change, conditional upon whether this has been perceived. The latter group is a sub-sample of the first stage. This gives rise to a sample selection bias, since we only consider those who perceived climate change, whereas there might be some farmers who adapted even though they have noticed no change, and we might wish to understand adaptation activities and preferences of farmers in general. A method to correct for this bias is the Heckman sample selection model, which is estimated by a two-step maximum likelihood procedure.

SISC First Annual Conference

The informative role of farmers' perceptions of change for the development of robust climate change adaptation policies – a case study from Italy

Bonzanigo L.[1,2,3*], **Bojovic D.**[1,2], **Maziotis A.**[3], **Giupponi C.**[1,2,3]

[1] *Ca' Foscari University of Venice, Department of Economics, Venezia, Italy;*
[2] *Euro-Mediterranean Center on Climate Change, Climate Change Impacts and Policy Division, Venezia, Italy*
[3] *Fondazione Eni Enrico Mattei, Sustainable Development Group, Venezia, Italy*
**Corresponding author:* laura.bonzanigo@cmcc.it

Abstract

Most likely unavoidable, the changing climate calls for fast adaptive actions. The recent EU Strategy on Adaptation to Climate Change promotes National Adaptation Strategies as a key instrument to inform and prioritise adaptation measures. The agricultural sector in particular has always been adapting at the farm level. Today, on-going autonomous farm adaptations must be complemented with medium-term structural and planned adaptive actions, in order to reduce the overall vulnerability of the agricultural sector. To investigate the individual adaptations and understand which are motivated by a changing climate and why is a fundamental step when designing policies, to increase their chance of adoption and maximise the resources available. This research combines (i) an online participatory approach – eParticipation – to collect Veneto Region (VR, Italy) farmers' responses and identify their adaptation measures and (ii) a Heckman selection model to analyse the factors determining farmers' perceptions of change and the choice (if any) of adaptation options. The results both confirmed that this is an efficient approach for ensuring broad participation, and demonstrated that planned adaptation measures designed with informed consideration of farmers' concerns and responses to change have a higher chance of being accepted by farmers. These preliminary results could importantly contribute to the quality of the Italian NAS. Particularly, this paper offers an approach for a bottom-up, robust development of further adaptation polices. For the methodology's transfer to "real" policy-making, we recommend extending this proposed method for the design and assessment of adaptation policies to farmers' organisations and local decision-makers, in order to increase the representativeness of the interested parties. This would both ensure the policies' aptness and their broader acceptability.

Keywords: *Climate Change, Autonomous and Planned Adaptation, Agriculture, Decision-Support, eParticipation, Heckman model*

1. INTRODUCTION

The EU Strategy on Adaptation to Climate Change (EC, 2013a) recommends the involvement of stakeholders in discussions about adaptation options, as a useful means for reaching consensus on an appropriate selection of sets of adaptation measures. The EU strategy also recommends that short-term autonomous farm adaptation should be coupled with structural and planned adaptive actions. In order to develop these guidelines for adaptation in agriculture, a suggested first step is to understand farmers' response to perceived changes, namely what autonomous adaptations are in place, bearing in mind that climate together with other socio-economic and market changes influence farmers' decisions (EC, 2013b). Such information is of great significance to guide future adaptation strategies, also at the national level in Europe. National adaptation strategies are a recommended key analytical instrument to inform and prioritise adaptation measures (EC, 2013a). 15 EU Member States have already adopted an adaptation strategy, while work on its development is in progress in Italy. Providing a first hand information on farmers' adaptation practices and an explanation on to what extent they are determined by some specific socio-economic and environmental settings, could be an important contribution for the Italian National Adaptation Strategy (NAS).

This paper shows what processes Italian policy-makers could follow for developing robust adaptation plans for the agricultural sector. It suggests measures that complement those already in place at the farm level, via the identification of nearly 600 farms' main characteristics and stance on change and adaptation and the quantification of the most determinant factors for adapting farming practices. This information at a larger scale would guide policy-makers on developing an implementation plan for the possible adaptation measure identified in the NAS. The research originates from the hypothesis that different socio-economic and environmental factors, including location within a specific area, affect the perceptions of and adaptation to climate change – and in turn are critical for the success or failure of a policy. Hence, these considerations should be included in the analysis of short and long term policy scenarios.

The paper's contribution is twofold. In academic terms, it is to the authors' knowledge the first study in Europe which examines farmers' autonomous adaptation by collecting data through a structured online participatory method and analysing it with the Heckman two-step model. This study pioneered this approach to inform the design of a Multi Criteria Decision Support System for the evaluation of preferred adaptation options, in an effort to set up a communication space for end-users and policy-

makers. A recent study which first explored autonomous adaptation in European agriculture (Léclere et al., 2013), attempts to quantify the effect of farm-scale autonomous adaptations at a European level in response to changes in climate, by coupling the STICS generic crop model with the AROPAj microeconomic model of European agricultural supply. It concludes that the estimated losses of the agricultural sector in face of climate change would be significantly lower if autonomous adaptation were considered. It suggests that policy-makers should include these considerations when designing In terms of contribution to policy-making, this paper builds on the research by Léclere et al. (2013), by presenting policy-makers with guidelines for the inclusion of analysis of autonomous adaptation in the design of robust adaptation plans around Europe, and in Italy in particular, for the agricultural sector.

2. MATERIALS AND METHODS

The study uses data from a farmers' survey of a sample of 587 mixed crop and livestock farmers in the VR of Italy. First, an eParticipation framework, an online approach developed by Bojovic et al. (2012, 2013), allowed the collection, through an online questionnaire, of farmers' perceptions of change and the major measures that they apply to adapt to it. Then, following the approach of Maddison (2006) and Deressa et al. (2008, 2011), a Heckman selection model was developed to investigate into the factors determining farmers' perceptions of and adaptation to climate change.

eParticipation for data collection

A broad public participation in the climate change adaptation field can improve the understanding of the cognitive aspects of adaptation, like perceptions and motivations (Lopez-Marrero, 2010), that have often been neglected in favour of economic, material, and institutional aspects of adaptive activities (Hobson and Nirmeyer, 2011) whilst in practice they are crucial for a policy's adoption. eParticipation is generally used for obtaining public opinion on less explored policy issues, which informs the design of a new policy (Phang and Kankanhalli, 2008). This research focused on the collection of VR famers' perception of -- and reaction to -- changing conditions (that affect their agricultural practice).

In the first eParticipation step, we contacted users of an online Agro-Meteorological eBulletin, published by the regional Environmental Protection Agency (ARPAV), via a link to the survey. Besides standard socio–demographic information and farms' characterisation, the questionnaire collected farmers' perceptions over present and expected environmental (i.e. water scarcity), economic, policy and societal changes. Moreover, it enquired whether farmers had been adjusting their cropping practices and water management and what these changes depended upon. Although difficult to

characterise via a questionnaire, an attempt was made to identify whether the adoption of specific farming practices was influenced by government policies, market expectations, expectations of fast financial returns and/or by changing environmental conditions.

The second step of the eParticipation phase included a prioritisation of potential adaptation measures in agriculture. These were drafted according to the outputs of the first online questionnaire (i.e. concerns over future water scarcity), considerations of the main focus of 2014-2020 VR Rural Development Plan (improving information, water efficiency, and enhancing biodiversity), and interviews with experts and policy makers of the regional administration.

EC Guidelines on developing adaptation strategies (2013c) suggest involving actors in discussing and deciding on criteria and their weightings for the prioritisation of adaptation options in order to select a set of options with a high level of acceptance. In this case study, criteria were selected according to the interests and concerns expressed in the first questionnaire. The collection of answers and comments left by participants during the first phase of eParticipation strongly supported the choice of adaptation policies and criteria for their evaluation – whose evaluation is described in Bonzanigo et al. (2013). Choices extrapolated qualitatively from the results were discussed with policy makers, in order to ensure the measures' meaningfulness in terms of directions of investments to be adopted by the VR. Results from the first questionnaire were also used as the main input for the Heckman model's database.

Heckman Probit Model

Most of the existing studies analyse the correlation between perception of climate change and adaptation strategies by employing binary and multinomial (logit and probit) techniques (Komba and Muchapondwa, 2012; Kurukulasuriya and Mendelsohn, 2006b and 2008; Deressa et al., 2009; Bonzanigo et al. 2013, Piya et al., 2012). However, adaptation to climate change can also be understood as a two-stage process: perceiving change (first stage) and then deciding whether or not to adopt a particular measure (second stage) (Maddison, 2006). The second stage, defined as the "outcome" stage, is considered a sub-sample of the first stage, the "selection" stage. It is thus likely that the outcome will be non-random and different from the sample of farmers who did not become aware of climate change in the full sample (Mandleni, 2011). This creates a sample selection bias and therefore a two-step maximum likelihood procedure (Heckman, 1976) was employed to correct for this (Deressa et al. 2011).

The selection model extrapolates from the full sample those farmers who perceived climate change and identifies what characterises them, while the outcome model denotes farmers' adaptation to climate change, and is conditional upon whether this has been perceived (Deressa et al. 2011). In the selection model, the dependent variable represents whether a farmer has perceived climate change. It is defined as a function of perception of past temperature and precipitation changes, seasonal shifts, increased flood and drought frequency, changes in water availability, and biodiversity. Based on the perceptions of climate change, literature, and data availability, the explanatory variables include agricultural income, age of the farmer, presence of irrigation infrastructure, maize, vineyards, trees (excluding vineyard), cereals (excluding maize), livestock, industrial crops, sprinkler irrigation only, drip irrigation only, mixed irrigation [1], availability of information on climate change, location of farmers, temperature, and precipitation.

With respect to the outcome model the dependent variable represents whether a farmer has or has not adapted to climate change. Based on climate change adaptation literature and data availability, the explanatory variables are the percentage of agricultural income over the total income, education, age, Utilised Agricultural Area (UAA), presence of irrigation infrastructure, maize, vineyards, trees (excluding vineyard), forage (including grassland and soya), industrial crops, horticulture, the presence of sprinkler irrigation only, the presence of drip irrigation only, the presence of mixed irrigation, the awareness that climate change adaptation (CCA) is necessary in the future, future social and economic change and, finally, farms' location. While Tab.1 depicts the variables used for the Heckman probit specification, a detailed description of all the variables collected from the survey of the farmers in the VR is provided in Bojovic et al (2013) and Bonzanigo et al (2013).

It is worth noting that explanatory variables can either be dummies (i.e. take value 1 if a farmer has a particular characteristic and 0 otherwise), such as for instance "the presence of sprinkler irrigation only", or can be inserted as aggregated categories. Following the approach of Kebede and Adane (2011) and Bonzanigo et al. (2013), and allowing for a flexible relationship between the perception of - and adaptation to - climate change and the categorical variables, these are divided into groups, number corresponding to the numbers of the categories utilised for their identification. Hence, age is divided into four groups, under 35 (age1), between 36 and 45 (age2), between 46 and 60 (age3), and above 60

[1] From the questionnaire: *only* stands for only one type of irrigation practice, while *mixed* irrigation includes various irrigation practices. Please note that the question allowed for multiple answers.

(age4) years old. UAA is divided into farms with less than 1 ha (UAA1), from 1 to 5 ha (UAA2), from 5 to 20 ha (UAA3), and with more than 20 ha (UAA4). The presence of irrigation is divided into no irrigation (irrigation0), emergency irrigation (irrigation1) and structured irrigation (irrigation2). Moreover, agricultural income is divided into less than 25 per cent of the overall income (agriculturalIncome1), from 25 to 50 per cent (agriculturalIncome2), from 50 to 75 per cent (agriculturalIncome3), and above 75 per cent of the overall income (agriculturalIncome4). Location of farmers was defined at the Provincial level: Padova (location1), Vicenza (location2), Verona (location3), Treviso (location4), Venezia (location5), and Rovigo (location6).

Actual temperature and precipitation changes were matched against farmers' location through a spatial analysis, in order to extrapolate whether a direct link exists between the measured climate and farmers' perceptions of environmental changes. Temperature was defined as the change in average summer temperature for the period 1991-2004 compared to the reference period 1961-1990. It was distributed into five groups, since there were significant changes in its trend over time. The first one includes a change in temperature from 0.5 to 1°C (temperature1), 1 to 1.5 °C (temperature2), 1.5 to 2 °C (temperature3), 2 to 2.5 °C (temperature4), and 2.5 to 3 °C (temperature5) for extreme values. Precipitation was defined as the change in average summer precipitation for the period 1981-2010 compared to the reference period 1961-1990 expressed in percentage.

Overall, this division into groups allows the analysis to capture -- and give more emphasis to -- the variety of the sample. In the initial run, education was also divided into different categories, but due to the lack of model convergence, these sub-categories were dropped from the final model specification. Therefore, only farmers' age, UAA, presence of irrigation, farm's location and temperature were maintained as proxies for, respectively, farmers' experience (age), the size and the structure of the farm (irrigation, location), capturing the effects of farmer socio-economic attributes and farm's assets on the perception of and adaptation to climate change. As proxies, for each variable one category was omitted from the model in order to avoid the 'dummy variables trap', i.e. the existence of perfect collinearity in the regression models if a dummy variable were included for every category (Jones, 2007; Veerbek, 2004). Together, the chosen categories, age1, UAA1, agriculture income1, irrigation0, location6 and temperature5 define the "reference individual", the constant term which outcomes of the model should be compared to.

Explanatory variables	Mean	S.D.	Description
Age	2.675	0.843	Categorical 1
Education	4.175	1.013	Categorical 2
Utilised Agriculture Area (UAS)	2.775	0.906	Categorical 3
Agriculture income	2.693	1.342	Categorical 4
Sprinkler irrigation only	0.287	0.045	Dummy, 1 if there is 0 otherwise
Drip irrigation only	0.159	0.366	Dummy, 1 if there is 0 otherwise
Mixed irrigation system	0.213	0.410	Dummy, 1 if there is 0 otherwise
Irrigated farm	1.124	0.740	Categorical 5
Trees (excl.vineyard)	0.327	0.469	Dummy, 1 if there is 0 otherwise
Maize	0.500	0.500	Dummy, 1 if there is 0 otherwise
Wine	0.543	0.498	Dummy, 1 if there is 0 otherwise
Fourage (incl.grassland and soya)	0.402	0.491	Dummy, 1 if there is 0 otherwise
Cereals (excl.maize)	0.293	0.456	Dummy, 1 if there is 0 otherwise
Horticulture	0.209	0.407	Dummy, 1 if there is 0 otherwise
Industrial crops	0.127	0.334	Dummy, 1 if there is 0 otherwise
Livestock	0.149	0.357	Dummy, 1 if there is 0 otherwise
Expectation of future economic change	0.932	0.252	Dummy, 1 if there is 0 otherwise
Expectation of future social change	0.831	0.375	Dummy, 1 if there is 0 otherwise
Climate change adaptation (CCA) necessary in the future	0.870	0.336	Dummy, 1 if there is 0 otherwise
Information on climate change (useful & available)	0.349	0.477	Dummy, 1 if there is 0 otherwise
Temperature	2.573	1.095	Categorical 6
Precipitation	-0.068	0.035	Continuous, (%)
Location	3.189	1.656	Categorical 7

Tab.1 Description of model variables for the Heckman probit selection model

3. PRELIMINARY RESULTS AND DISCUSSION

The online questionnaire proved to be a successful means for collecting information about farmers in the VR. 587 answers were collected in two months and provided an extensive amount of details on the state of the art of adaptation (to climate and other changes) in the Region.

90% of the participants observed one or more environmental changes in the past ten years (Tab.2). Of the total sample, the diversification of cropping patterns, and changes in land management techniques and irrigation technologies are the most frequent adaptation measures, whereas shifting sowing times and changing irrigation turns through agreements with the Irrigation Boards (IBs) are the least practiced. Overall, 25 per cent claim not to have implemented any changes in their farming practices, whereas 34 per cent have modified only their cropping systems, land management techniques, and/or pest and weed control; 11 per cent have changed their water management practices only, and 30 per cent have done both crop and water management change. Of those who have not adapted, 87 per cent claim to have witnessed environmental changes and 84 admit that they will need to adapt their

agricultural practices in the near future. Interestingly, only about half of those who are interested in extension services and trainings, including climate change, have access to them.

Environmental changes	Percentage of respondents
Precipitation	47,4
Temperature	39,2
Seasonal shifts	49,9
Flood frequency	13,6
Drought frequency	36,3
Water availability	8,2
Biodiversity losses	9,5
Number of respondents: 587	

Tab.2 Farmers' perceptions of local changes (no limit on the number of choices was imposed)

Results from the Heckman probit model

The results from the Heckman probit model are depicted in Tab.3, where the marginal effects measure the expected changes in the probability of both perception of and adaptation to climate change with respect to any change in the explanatory variable.

The results from the selection model suggest that the availability of information on climate change affect the perception of environmental change significantly and positively. This means that the more information on climate change a farmer has access to, the more he/she is likely to have highlighted while answering the questionnaire that his/her farm management is being affected by a changing environment. Instead, farmers' age and the presence of irrigation infrastructure influence the perception of climate change significantly but negatively. The older the farmer is the less likely he/she is to have noticed climate change. The results from the outcome model indicate that the percentage of agricultural income, the presence of irrigation on the farm, the cultivation of maize and forage (including grassland and soya), and the farmers' location affect positively and significantly adaptation. The actual changes in precipitation and temperature trends do not seem to contribute significantly to farmers' proactiveness in adaptation, although more than 80% of the sample recognises that adaptation will be necessary in the (near) future. This is not surprising, as climate change is normally perceived through extreme weather events, thus those who adapted were probably stimulated by more frequent single extreme events rather than by the overall change in the Region as a whole and by information on changing climate.

	Adaptation Model				Selection Model			
	Regression		Marginal values		Regression		Marginal values	
Explanatory variables	Coefficients	P level	Coefficients	P level	Coefficients	P level	Coefficients	P level
Agricultural income (=2)	***0.551***	0.048	***0.119***	0.010	-0.212	0.447	-0.035	0.494
Agricultural income (=3)	0.170	0.523	0.043	0.494	-0.009	0.977	-0.001	0.977
Agricultural income (=4)	0.259	0.174	0.069	0.170	0.133	0.518	0.019	0.516
Education	-0.056	0.420	-0.015	0.421				
Age (=2)	-0.117	0.672	-0.032	0.678	-0.197	0.591	-0.031	0.612
Age (=3)	-0.296	0.261	-0.079	0.262	-0.144	0.682	-0.021	0.683
Age (=4)	0.180	0.569	0.045	0.545	**-0.636**	0.096	-0.126	0.185
UAS (=2)	0.363	0.156	0.091	0.126				
UAS (=3)	0.299	0.288	0.077	0.271				
UAS (=4)	0.322	0.354	0.079	0.312				
Irrigated farm (=1)	***0.506***	0.003	***0.129***	0.002	-0.219	0.363	-0.033	0.374
Irrigated farm (=2)	***0.513***	0.009	***0.127***	0.005	***-0.598***	0.019	***-0.101***	0.035
Maize	0.184	0.288	0.049	0.288	-0.226	0.263	-0.033	0.263
Wine	-0.190	0.246	-0.050	0.242	0.140	0.441	0.021	0.445
Cereals (excl.maize)					0.247	0.286	0.034	0.252
Trees (excl.vineyard)	**0.289**	0.096	**0.074**	0.080	0.031	0.874	0.004	0.873
Fourage (incl.grassland & soya)	***0.358***	0.048	***0.093***	0.040				
Livestock					-0.133	0.560	-0.021	0.585
Industrial crops	0.183	0.519	0.046	0.489	0.173	0.576	0.023	0.537
Horticulture	0.080	0.642	0.021	0.634				
Sprinkler irrigation only	-0.213	0.232	-0.059	0.249	0.138	0.520	0.019	0.502
Drip irrigation only	-0.253	0.229	-0.073	0.260	0.030	0.910	0.004	0.908
Mixed irrigation system	-0.285	0.131	-0.082	0.156	0.010	0.966	0.001	0.966
CCA necessary in the future	0.293	0.146	0.086	0.179				
Future economic change	0.221	0.404	0.064	0.438				
Future social change	0.237	0.191	0.068	0.218				
Information on climate change					***0.620***	0.002	***0.081***	0.000
Location (=1)	***0.873***	0.001	***0.189***	0.000	-0.215	0.522	-0.034	0.551
Location (=2)	**0.514**	0.094	***0.112***	0.033	0.161	0.699	0.021	0.670
Location (=3)	***0.561***	0.048	***0.126***	0.015	-0.052	0.891	-0.008	0.893
Location (=4)	***0.551***	0.045	***0.127***	0.018	0.125	0.760	0.017	0.748
Location (=5)	***1.002***	0.001	***0.185***	0.000	-0.344	0.383	-0.060	0.455
Temperature (=1)					0.344	0.491	0.043	0.419
Temperature (=2)					0.228	0.630	0.031	0.607
Temperature (=3)					-0.012	0.978	-0.002	0.978
Temperature (=4)					0.278	0.550	0.036	0.495
Precipitation					2.059	0.429	0.301	0.426
Constant	-1.001	0.118			***1.609***	0.039		
Total observations	502							
Censored	50							
Uncensored	452							
Wald Chi sqaure (zero slopes)	61.89, P<0.0004							
Wald Chi sqaure (independent equations)	3.61, P=0.0574							

Note: **Bold** (***italic***) (**underlined**) significant at **10%** (***5%***) (**1%**) probability level, respectively

Tab.3 Results from the Heckman probit selection model

Results from the participatory development of adaptation measures and criteria

The first online questionnaire provided results useful for the choice of adaptation measures and criteria to be submitted for a second round of evaluation by the farmers. Tab.4 below exemplifies the links between answers and selected measures and criteria. For instance, questions about perception of change showed that farmers are primarily worried about economic (82%) and environmental change (70%), while commenting on this question, farmers expressed their concern over the future of agriculture in the VR.

STRATEGIES	*SOME QUESTIONS*, MOST FREQUENT ANSWERS AND COMMENTS	CRITERIA
	Q: Perceptions of changes? • Economic change • Environmental change **C:** Uncertain future of agriculture	Contribution to farmers' income Return on investment Rural development
	Q: Noticed Environmental Changes? • Changing seasons, precipitation, temperature …	Adaptability to potential future climate change
Prioritisation of low-water-requiring crops	*Q: Crop management changes (adaptation)?* • Species or varieties diversification • Changes will be necessary in the future **C:** organic farming, bio. pest control	Environmental protection
Use of reservoirs for flood retention and water storage	Q: *Water management changes (adaptations)?* • Necessary in the future **C:** need for drip irrigation, water conservation, construction of cisterns, complains about the quality of service	Contribution to resolution of conflicts regarding water allocation
Investments in high efficiency irrigation technologies (sprinkle and drip irrigation)	*Q: Do you practice irrigation?* • 75% practice irrigation • 29% micro-irrigation • Non irrigated farms more worried about env. change	
New climate services for longer-term adaptation (seasonal forecast)	Q: *More information in eBulletin about?* • On: Plant disease, Agronomic interventions, Seasonal forecast	
Improvement of existing agricultural information systems	Q: eBulletin does not contribute enough to? • Reducing use of herbicides, Reducing irrigation frequency	

Tab.4 From the online questionnaire to the strategies and criteria to be applied in the second eParticipation phase, where these were assessed and ranked (source: Bojovic et al., 2013)

This result is reflected in the following three criteria: *Contribution to farmers' income; Return on investment; Rural development.* Similarly, farmers' frequent underlying of organic farming and biological pest control as a growing trend in the Region, led to the choice of *Environmental protection* as an additional criterion. Moreover, results analysis showed that 75% of farmers practice irrigation, and more specifically 29% micro irrigation, while non-irrigated farms are more worried about environmental change, as it also appears in Tab.3. Moreover, nearly 50% of responses showed that water management adaptation would be necessary in the future, particularly through the introduction of drip irrigation. This was translated into the measure *Investments in high efficiency irrigation technologies (sprinkle and drip irrigation).* Other relations are presented in the Table 4. Once strategies and criteria were defined, a second questionnaire was submitted to farmers for their evaluation. Nearly 200 farmers and 10 IBs participated to this second round, despite the more technical nature of the questionnaire. The ranking presented in Fig.1 emerged from farmers' and IBs' preferences. Both farmers and IBs reveal a clear preference for the structural measures of improving irrigation efficiency. However, it is interesting to note that strengthening the existing information services scored a higher rank than changing crops. This further underlines the significance that information plays in reducing the system's vulnerability, and in its turn, promoting adaptation -- evidence that the results of the Heckman model also support. It also highlights the need for improved communication between policy-makers and farmers.

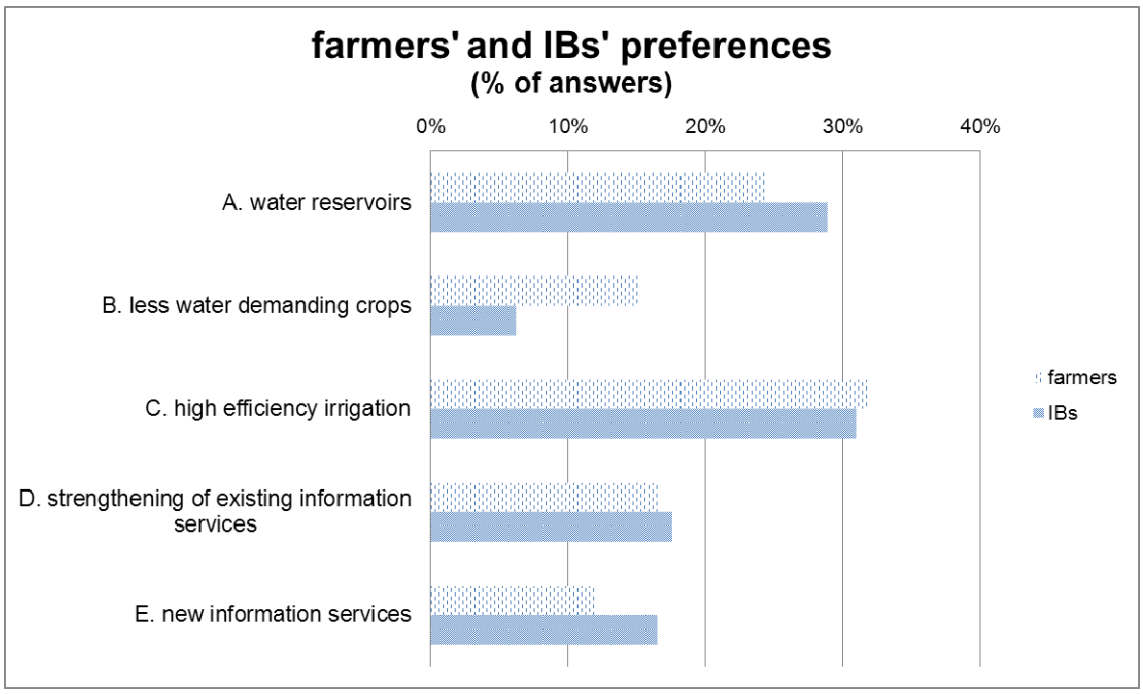

Fig.1 Farmers' and IBs' preferences in the VR

This research, although still at an exploratory stage, shows that the large majority of our sample of farmers (75%) have adapted to climatic changes perceived in the last 10 years. The high losses suffered by VR farmers during the 2012 summer drought, however, highlight scope for more and concerted policy-encouraged adaptation. It emerges that specific farms and farmers' characteristics are important determinants of the likelihood of the farmer to adapt farming practice to on-going and expected changes. Information appears a crucial driver of adaptation – and building on those farmers that successfully switched their practice to climate-smarter ones may be a means to reach to a wider number. Moreover, results from the second questionnaire underline that public intervention is required in terms of infrastructure for higher efficiency irrigation (or irrigation per se here it is not currently available) and for increasing capacity of water supply.

4. CONCLUSIONS

The work presented in this paper is still in progress and it was carried out in an exploratory mode, in order to verify what practical added value this research could contribute with to the policy-making process, and in particular to the design and implementation of the climate change adaptation strategy in Italy. The work emerged from the need identified in the White Paper "Adapting to climate change: Towards a European framework for action" (EU, 2009), where a call for further work on identification of vulnerability to climate change and support in developing appropriate adaptation measures was voiced. The recent EU Strategy on Adaptation to Climate Change (2013) reiterated the crucial role of involving stakeholders in climate change adaptation processes.

This paper argues that by combining qualitative (eParticipation) and quantitative approaches (Heckman model, spatial analysis), useful data on changes on the ground can be collected and informative results can be produced, which can guide the design of climate change adaptation strategies in several ways, particularly in terms of methodological approaches:

- eParticipation, if structured in the way suggested, can support the collection of an extensive number of data, useful for both evaluating the adaptive nature of agriculture in a given study area and designing and testing the adaptation polices required to reduce local vulnerabilities of agricultural systems.

- The Heckman probit model can highlight crucial factors that facilitate and hinder implementation of adaptation measures by farmers – which is an advantageous entry point for increasing chances of success of policy implementation.
- Communication between the top and the bottom of the policy ladder can be facilitated with the methodology proposed, contributing in turn to a robust planning process. Decision-makers should thus promote autonomous adaptation whilst at the same time ensure adequate support where actors need it and interventions that lay beyond individual possibilities but are needed to reduce the climatic vulnerability of rural areas.
- In terms of specific results, those produced in the exercise are surely informative on the state of the art of adaptation in the VR, but in order to be integrated in a real policy-making process, we suggest that the involvement of farmers' organisations and local and regional institutions is critical for reducing the selection bias of our sample and for involving a policy-relevant number of opinions.

Next steps will include the quantitative evaluation of farmers' drivers and pressures of change with respect to their farms' characteristics. The assumption is that farmers adopt a new technology only when the perceived utility from changing management practices is significantly greater than the old methods (Deressa et al. 2010). The objective of this final phase of the work is to end with (i) a bottom-up yet quantitative mapping of climate change adaptations in the agricultural sector in the VR, with a clear identification of its positioning against the EU orientation and the National Adaptation Strategy, and (ii) a list of actions for Italy, which can be labelled possibly as adaptation measures, relevant to the coming National Adaptation Plan, due to be completed by December 2013.

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