

DECISION MAKING AND ADAPTATION PROCESSES TO CLIMATE CHANGE

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Introduction

The phenomenon of climate change imposes a wide range of risks and also opportunities for human and natural systems worldwide. In this context, the South American region is no exception. This region presents projections of expected impacts on climate and its effects on water resources, both human supply or for different economic activities, as well as increased risks of disasters, floods and droughts, changes in production patterns given changes in climate, etc. Additionally, considering the pattern of development that has followed Latin America in terms of its dependence on natural resources, their vulnerability is evident to climatic threats in the region (León, 2008; Magrin et al., 2014). In order to understand and face these risks and opportunities, decision-makers, public and private ones, need a clear orientation regarding how these expected changes can or cannot impact in their spatial scope, which actions are necessary to take other actions, how to implement these actions and how these actions last or are controlled in the future. This has to be done based on scientific knowledge explicitly considering the particular needs of each situation with the purpose of being incorporated into the internal decision-making processes of each organization.

This work will collect and reflect on the ways that decision makers relate to the information available in order to make it part of their internal processes in a context of vulnerability to climate variability and change so we can begin the road adaptation to climate change.

1. Decision-making process

The decision-making process, within organizations of different nature, is possible to define as “definition of problems process, data compilation, alternative generation and selection of action course”. (Hellriegel, Slocum, Woodman, 2011).

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Consequently, different organizations, of different type and size, are either permanently faced with this process, by means of internal elements of the organization or motivated by external elements, as a variation of the exchange rate, normative and/or legal aspects of their particular context, etc. As explained herein below, the climate change would be introduced in this context as a factor to consider within the multiple decisions made to the interior of an organization.

Making decisions to the interior of an organization bears an internal hierarchy with its own focuses. Therefore, an operative level is that which develops routine works and where the type of decisions are generally programmed. That means, they bear certain kind of triggers which defines certain kind of answer (for example, the fall of an inventory below a determined number implies the restitution of certain quantity of product or in another example, because of being in a particular month and due to certain humidity conditions or health status it is determined the application of an agrochemical in particular for crop development, etc.). At the other extreme, we can find the strategic level, which corresponds to senior management and overall planning of the operations of the organization. At this level is more relevant the decision-making unscheduled and unstructured, which require a systematic analysis of the problems presented and the choice of solutions within logical alternatives (eg the decision to expand operations to a new area geographical, buying some new technology, change in operations traditionally performed, etc.) (Hellriegel, Slocum, Woodman, 2011).

On the other hand, the decision-making process might be discretized in different steps, discussed here below. They are equivalent steps to the ones defined in the adaptation processes to climate change:

- Problem identification and analysis.
- Decision criteria identification and weighting.
- Priority solution definition.
- Generation of solution options.
- Evaluation of generated options.
- Election and application of the best option.
- Evaluation of results

It is under these characteristics and with these theoretical elements in which different organizations, either implicitly or explicitly, face their different needs to confront evolution or change processes, where the simple availability of scientific and technical information is not always enough to make good decisions (Bell and Lederman, 2003; Pidgeon and Fischhoff, 2011). Now, we shall review how climate change appears as a new relevant element within this context, with its own characteristics, difficulties and challenges.

2. Climate Change and Organizations

Adaptation to climate change is not a new subject. Throughout history, societies, their organizations and their different activities have shown a strong capacity for

adaptation to changes in environmental and climate conditions by changing the areas where different activities are performed, modifying crops, or exploring new alternatives to construction or new techniques in the production chain. However, the rate of change in climate, which has recently been observed and the rate of change projected for the future, strongly overcomes to any change speed observed by humanity in the past, which calls for a special and urgent awareness of decision makers to consider these new, changing and uncertain conditions.

In this way, decisions related to climate and its future evolution bear similarities and differences with another type of long-term decisions. Common elements include the utility of having a framework considering the risk in a wide scope, as well as the need of considering the uncertainty of projections of future biophysical and social conditions. Among differences, the phenomenon of the climate change includes perspectives of longer terms and affects a wider range of components of the social and biophysical system compared to other phenomena (Jones et al., 2014).

Decisions in organizations, whether public, private or civil society organizations are related to climate change from a common angle. This relationship is based on their actions or projects may add to the causes or reduce the consequences of climate change or because these actions may favor other organizations or parts of society to change their situation against the risks of climate change.

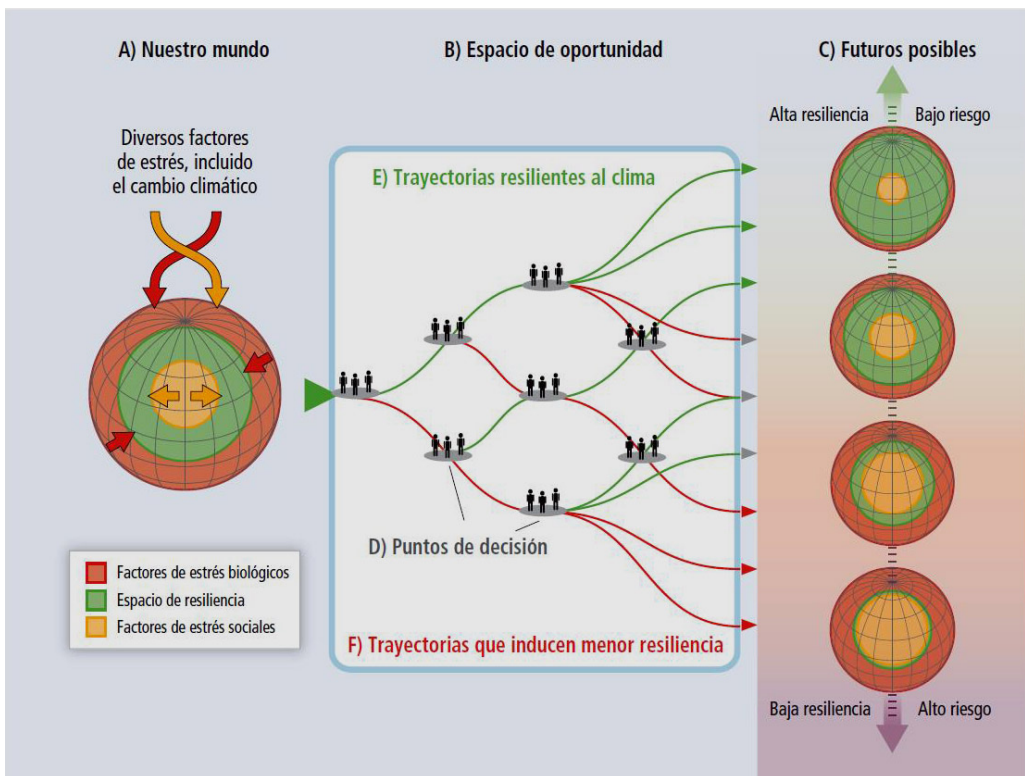
Decisions associated with the second case, corresponding to the adaptation problem to climate change (and the focus of this paper) correspond to actions or projects which make organizations be more or less exposed to climate change. It threatens or opportunities, or because these actions may favor the possibility that other components of their systems be more or less exposed to these same threatens or opportunities¹. However, it is important to recognize that the need to include climate change in this decision-making process, either for evaluation of new projects or review of the processes in the organization, it is not always obvious. A process of reflection in which it is determined whether the activities of the organization are related in some way (directly or not) with environmental variables that are expected to be affected by climate change is necessary. Under this scenario, it is quite possible that some productive sectors or certain types of organizations do not need to include this new external factor because the relation of their activities and decisions to climatic factors is very indirect or distant (requirement climate sensitivity). In other situations, the relative size or the temporary nature of their activities in relation to multiple external factors do not need this type of analysis (requirement of permanence and scale). These topics shall be deeply discussed in later chapters dealing with decision process related to climate change.

After this first analysis and having framed the basic need to initiate an adaptation process to this changeable climate, it shall be necessary a thorough evaluation of the particular needs of adaptation, the scopes of the generated initiatives. Also their interaction with other activities and other elements of the systems, in order to later define whether it is pertinent and necessary to assume the costs implied by the incorporation of the climate change adaptation as part of the decision-making process of an organization. These are the topics to be discussed below.

3. Adaptation to Climate Change:

In a context where it is necessary, to generate a response to expected changes in climate systems and decision makers must face a process to adapt to new conditions. They must reduce their vulnerability by modifying actions and internal processes of the organization, aiming to achieve a future state that is resilient to change and do not compromise the system. (Picture1). One of the main characteristics of this process is that it is made under important uncertain conditions, due to the characteristics of the climate change phenomenon, which makes necessary to consider and quantify the impact this has on the decision-making process (Jones et al., 2014).

Picture 1. Opportunity scope for decision making under different decision making scenarios. (Burkett et al., 2014)



The nature of this uncertainty is due to several causes: inability of being able to project GEI emission rate in the future. Also our inability to represent in a real and detailed fashion future climates at scales where it is necessary to implement the adaptation; our incapacity to fully understand the relations the climate has, and also our inability to understand the relationships that have the weather with the activities of organizations or

technological development capacity that will have the organization to meet the challenges of the future. As an example, for farmers of a certain basin, the challenge of the adaptation is trying to understand the magnitude of the change in the temporary nature of the streamflows in a certain place of the basin, and be able to quantify impacts at economic levels as well as other aspects of its productive activity. But also the costs and benefits of the different alternatives of adaptation for the fulfilment of immediate and long-term objectives, with the lowest uncertainty level, which allows to take the necessary decisions to achieve these objectives.

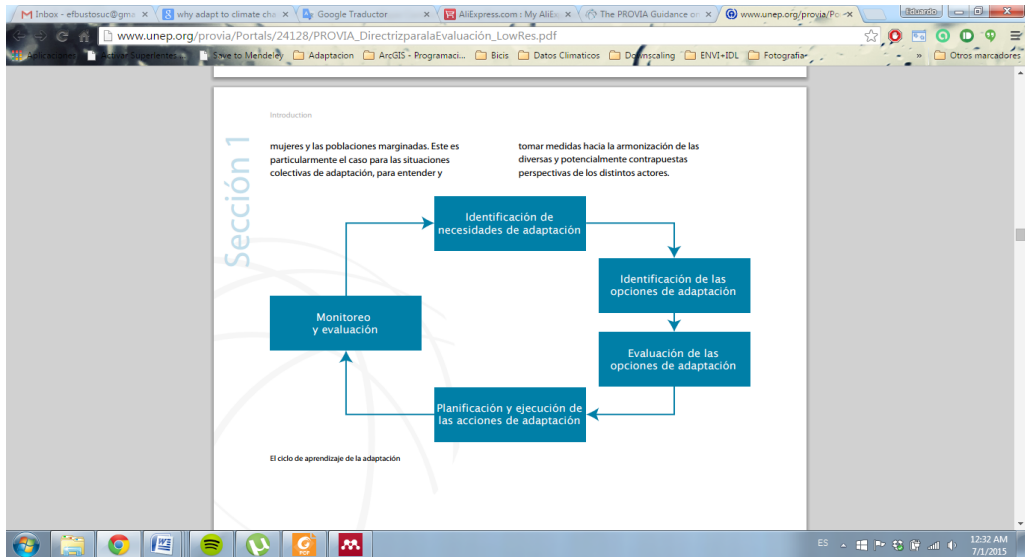
It is also necessary to differentiate the own uncertainty of not certainly knowing the evolution of the future climate and the one which is inherent to complex and not linear systems in which different activities are inserted, such as the current climate system, the social system, etc. This differentiation should be taken into account in the decision-making process; it shall also define, within this uncertain framework, the risk level according to which certain decisions shall be made or not.

The process of disclosing these action alternatives might include interesting and innovating ideas to implement, but not all those alternatives might be useful to actors. According to the characteristics of the corresponding system, the availability of information and interaction nets among the different actors and their particular processes, there exists the possibility of leading to “bad adaptation” or “maladaptation”. This means, considering and implementing measures and actions, which increase the risks, associated with future climate change, even if they are short-term attractive alternatives, generating, as a result, a more vulnerable system. (Barnett y O’Neill 2010). The climate change adaptation is an essentially local activity upon which the immediate context is very relevant regarding external conditions. Below we present some basic guidelines on decision-making processes regarding climate change adaptation.

a. The process

To face this number of complexities and uncertainties, it appears the need to summarize this process to be able to, without making opposing simplifications, face this process in a modular and progressive way, considering not only the answer to vulnerability scenarios determined by the current climate variability, but also taking into account that generated by climate change. This process must cause consideration and analysis stages inviting the decision maker to identify in which adaptation stage is, and therefore, which are the actions to take. This revision regarding this systematization of the process is based on PROVIA – UNEP (2013a) guide that considers the conceptualization of 5 stages of an iterative process, which are represented in the following figure:

Figure 2. The cycle of climate change adaptation.



Source: (PROVIA-UNEP, 2013a).

The explanation of these stages is presented in the following paragraphs. The follow-up or access to the cycle process requires the setting of certain basic criteria, which allows the decision maker to establish and/or explain its reference framework to make decisions. This should also allow knowing its scopes and limitations, among which there are empirical, theoretical, normative and practical elements. Once established, these elements shall permit the access to stages corresponding to the interest of the decision maker. This interest will respond to their different nature, not only in action environment but also different scales, focus, interests and development grade of the adaptation process, which might access to any of the process stages.

• Identification of the adaptation needs

A very important element in this stage is to identify the observed and/or expected climate impacts in the system based on the knowledge internally generated in the organization related to the climate factors. But also, and in a very important way, the access to information of projections, available simulation models or other reliable sources of information which help to improve the understanding of the system, etc.

Additionally, it is at this stage of the process in which it is important to think how and why the activity or organization is defined as vulnerable to changing climate conditions. Since not all the organizations need to invest in the process of initiating an adaptation, since they are not strongly affected by climate change and consequently it is not a critical factor to introduce into the decision-making process. The nature of the activity, and especially its temporal horizon and scale should be defined when recognizing the climate sensibility of a system relative to the sensibility of other external factors. In

projects or small scale initiatives, the weight of local factors is much higher than global scale factors (for example the design of a road connecting relatively close zones has to include an important quantity of conditioning factors from which a future change in the rain intensity or its effect in the early erosion of the pavement, might be a minor factor). On the other hand, activities or projects with a close time horizon (with short life cycles), as for example the harvest of an annual crop (for example a cereal) different from the harvest of a permanent crop (for example a grapevine) have to consider climate factors. Also their possible variations also in short term horizons (a year or months) where it is not possible to evidence long-term structural changes linked to climate change. A complete discussion of this initial decision process (or screening) can be found in a context of climate change adaptation and infrastructure decisions in CCG-UC (2013).

After this initial decision level, you must analyze the possible current and future impacts linked to climate change. The concept of vulnerability is critical in this process. According to the special report SREX of IPCC (2012) which deals with the management of risks, extreme events and disasters in relation to climate change, vulnerability is understood as the tendency or predisposition to be adversely affected by changes in climate conditions. Such predisposition is an internal characteristic of the affected element and therefore, it depends on factors such as the political-economic conditions, ways of operating, and internal inequalities in the systems. The vulnerability is a consequence of diverse historical, social, economic, political, cultural, natural resources, institutional conditions, and the environmental conditions and their corresponding processes. The risk or impact of an adverse climate situation exists when any system is exposed and vulnerable to that situation.

This definition of risk and its relation to the concepts of exposure and vulnerability helps to outline the role of social factors (for example, inequality in the access and use of information) in the constitution of risks to be affected by changes in the conditions in which activities are developed. Following this definition, different grades of vulnerability shall generate a different damage and loss level in similar conditions of exposure to physical events of a given magnitude. (Dow, 1992; Wisner et al., 2011). Therefore, this definition generates a working stage where vulnerability decrease must be approached, as for example, from the access to technologies, economic situation, education level or other relevant social aspects.

The adaptation as well as the risk management to disasters search to reduce the factors affecting the systems vulnerability, modifying the environmental and social/human contexts which contribute to the risk related to climate, consequently, creating an improve in sustainability conditions and social and economic development. It is at this point where it is important to consider the adaptation to climate change as a central element, not only of individual actions of organizations but also as the way in which society as a whole faces a changing future.

Additionally, it is necessary to recognize an important aspect when defining how particular realities of the organizations or systems in the adaptation process are inserted, which shall be described below. On one hand, the current vulnerability status can determine that actions and objectives of adaptation shall have to realize and pay attention to

factors that make the system be at risk nowadays. Such is the example of Ganges river delta in Bangladesh, where the environmental factors, such as the current natural climate variability sets up a risk situation which makes the focus of the adaptation strategy and its actions be first and foremost driven to decrease this vulnerability and reduce current impacts (Brower et al., 2007). Opposite to this, systems, which their current vulnerabilities have already been approached, and present a current low risk, such as the case of Rotterdam city located in Rhine river delta in Holland, may advance in strategies focused on future vulnerability conditions, which means an adaptation process different from the process assisting current relevant vulnerabilities. (Kwadijk, et al., 2010). In both cases, the delta of Ganges River or delta of Rhine River, we find similar situations of adverse hydro-climate events exposure (low elevation plateaus and expose to floods of fluvial or coastal origin) but with current vulnerability conditions very different which imply different adaptation needs as well.

• Identify alternatives of adaptation

If a need of adaptation is determined in the previous stage, which, as discussed before, comes out of the importance of considering the climate as a relevant factor in the activity, the following step is to identify the ways in which determined actions perform these identified needs. For example, an analysis of impact and vulnerability to climate change might have found that, due to changes in temperature patterns and a minor flow availability, certain types of agricultural activities (eg. field crops), shall be vulnerable in certain zones of the country. For example, it could be proposed a change in the traditional crop for one suitable to these new conditions, a geographic change in search of a new place with original conditions, etc. Following this scheme, private actors behave following particular interests of their organizations, looking for the activity subsistence and profit.

In many situations, conflicts may arise among the individual preferences of private actors and social welfare, for example, when a common resource is over-exploited or the private options point out to generate a potential risk not identified by its particular processes. Therefore, it is necessary to understand the nature of the interdependence and the conflicts and interactions among the different actors involved, not only the ones related to the organization sector but also other actors using resources, such as their approach to external initiatives which might modify the scenario in which the adaptation options are generated. An example of the type of actions, which even when they could be defined as adaptation actions to climate change, finally result in an increase of vulnerability of the system as a whole. For example is the building of a great reservoir, which without the adequate territorial planning may incentive the use of side fields to the growth of new agricultural lands, finally generating a less flexible system. (Vicuña et al. 2014). In this case, it appears that vulnerability is higher than the initial situation, where an extreme event, which overcomes the design levels of the reservoir, might finally finish in a disaster, which might have been avoided by means of another type of actions (this is known as *safe development paradox*, IPCC, 2012).

• Evaluate the different alternatives of adaptation

According to the methodological guide PROVIA-UNEP (2013a), the purpose of this stage is to balance and assess pros and cons of the different options and identify those options best adapting to the objectives of the adaptation actors. This has to be done by considering a consequence analysis, costs-opportunities, interaction with other actors, synergies or interferences due to or on activities of other actors, through different available methodologies of analysis, such as multi-criteria analysis, cost-benefit analysis, strong decision making, among others. They are also considered participative methodologies, which search to gather the opinion of other actors involved in the problem, as well as intuitive focuses based on the experience and learning.

It is important to highlight at this point the need to include in the evaluation of identified alternatives the aggregated effect of the measures packs considered, in order to be able to identify potential processes of wrong adaptation, which might be hidden for the individual evaluation of the measures.

• Plan and implement the adaptation

Following the process and once one option has been chosen among the evaluated alternatives, it is necessary to advance with its implementation, considering practical aspects concerning their start-up. Budget, temporal horizons, coordination of involved parties, etc. are relevant aspects.

It is necessary to make a plan to implement the chosen measures – and then to implement it with all the complexity that this means since it is necessary an important analytical work that gathers the identified measures with the decision-making process belonging to the organization. In certain occasions, this causes the definition of a measure to be not a concrete plan and action, being limited by the lack of connection between the measures and motivations and the objectives of the organization. Therefore, it is important the role of the person leading and/or coordinating the process to the interior of the organization in order to keep an action plan aligned to the objectives, stating priorities and an implementation strategy of such priorities.

• Control and evaluate the process

When implementing the measures, the process should be controlled and evaluated to make sure it advances as foreseen, identifying problems, documenting the obtained results, changing the way if necessary, taking lessons from experiences, with the purpose of taking advance of the important investment of resources and efforts, which the previous stages of the process imply.

The control and follow-up of a project may have several purposes, such as: 1) to evaluate the advance in the performance of the established tasks; 2) to determine whether the tasks are fulfilling the objectives of the adaptation initiative; 3) to evaluate the functioning of the team and the members of the team; 4) to examine the participation

of other people in the process; 5) to combine the perspective of interested parties on the nature of that commitment (the process and the content as well); or understand how good you are when learning and how the learning is providing information for the following steps. Evaluation goes beyond control since it includes a value judgment regarding the performance of an intervention of adaptation, based on the criteria being controlled.

b. Information and communication availability for decision-making

All stages of adaptation cycle and reflective process before mentioned need to have information, which allows reporting each involved decision. This information must have a characterization and potentially a quantification of uncertainty, with the necessary space and time resolution according to temporal horizons inherent to the activity, which ones allow to adequate or “adapt” the operations and guidelines of the organization to these new conditions. In this perspective, one of the main factors why this type of systematic analysis is not widely used, are the highly necessary requirements of information and knowledge to be able to face these processes. But also the fact that the information and knowledge generated is not necessarily being produced by the research centers and universities in the way and with the focus on the particular needs and as requested and used by the final user.

For example, the needs of communicational products of a small farmer are different from the ones a big irrigation organization needs to inform its particular processes of decision making. Considering the previous point, it is evident that both actors differ in the type of content they need, the time and space scale in which is generated the information, the level of depth or detail. Likewise, it is necessary to think about which type of questions will be able to answer through the generated content, besides all the aspects derived his audience condition and his media consumption behavior.

Due to this complexity, the advance in research regarding how to improve the communication, participation process and the construction of capacities, as well as the relation among the research groups and decision makers appears as a very important topic. Mainly with the purpose of letting users of such research enlarge their alternatives, clarify and help in the election of measures favoring the consideration of the best decisions in order to achieve the desired results. (PROVIA, 2013b).

Relations between decision maker and knowledge

Even when existing this need of “useful” information from the different organizations, several decision makers at a political level have concentrated almost exclusively on increasing the provision of scientific information by research centers and universities, generating research which might lack utility regarding the real needs of decision makers (Lahsen and Nobre, 2007; Sarewitz and Pielke, 2007).

The interactions and associations among scientists and decision makers are each time more recognized as a much more complex process than the simple transmission of information from producers with scientific knowledge and their users (Jacobs and Pulwarty, 2003; Vogel et al., 2007).

Likewise, the concentration of efforts to increase the provision of scientific information may mean that scientists cannot be producing information considered inherent and useful for decision makers, and can simply produce research that is not useful for the decision-making process (Cash et al., 2003). At the same time, users can have specific unsatisfied needs of information, or cannot be conscious of the existence and availability of potentially useful information (Stone et al., 2001).

Therefore, with the purpose of helping decision makers, the connections or links between the offer and demand of scientific information need to be reviewed and improved so that the community of knowledge generators can produce the media products useful now of being incorporated into the decision-making process.

Important challenges appear in this interaction. It is necessary to improve the communication process between the scientific environment and the decision-making process. From the academic perspective, the focus is normally set in the publication and communication of results to the peer communities, through scientific publications, attendance at congresses and other theme meetings. Likewise, fast and effective ways of communication and collaboration with decision makers do not always exist, consequently appearing gaps between those ones generating knowledge and those ones who are users of such knowledge. For example, the type of language used in this paper, the type of product generated and the strategy of use of media is an important element to consider for an effective communication process, and therefore, the interaction between both sectors.

Consequently, it is necessary to create dialogue and work together between the academy and decision makers. It corresponds to the research team to propose projects and initiatives, which imply, from their conception and as an important part of the activities, a permanent interaction with other actors, picking out concerns, identifying needs and proposing, together, solutions corresponding to each situation. Following this idea, in Latin America, there are diverse cases where actors, scientific community and public policies creators have participated in collaboration and exchange processes dealing with themes linked to climate change adaptation. There follows, as an example, some of these initiatives (Table 1):

Table 1. Multisectoral collaboration initiatives for climate change adaptation in Latin Americaⁱⁱ.

Institution	Project
Central América	
Global Water Partnership	Generation of pilot Project together with communities bearing a high component of innovation, with the purpose of improving resilience to climate change
Cathalac	Hydric Security and Climate Change in Central America and Caribbean region

Ecuador	
Empresa Pública de Agua Potable y Saneamiento – EPMAPS	Reduction Plan of losses and consumption and climate change adaptation
Colombia	
CIAT	Strengthening and projecting to climate change regional node South Pacific.
Corpocaldas	Decision-making support in the basin in a participative way and within the climate change context.
Brazil	
CEMADEN	Strategies of Scale Adaptation in basins under uncertainty, no-stationarity and disaster risk.
Bolivia	
Fundación Agua Sustentable	Strengthening of local investments and adaptation to climate change plans in the Bolivian High Andean Plateau
Argentina	
U. Nacional de Cuyo – Centro Aquasec	Hydric Security and vulnerability of small farmers in the Province of Mendoza.
Fundación Bariloche	Adaptation of hydric stress in Comahue region – Argentina
Chile	
Centro de Cambio Global UC	MAPA Project: Maipo Plan of Adaptation
Centro de Cambio Global UC	Support system to decision making to reduce vulnerability in front of variability and climate change in irrigation agriculture.

4. Conclusions:

Along the last decades, the climate change phenomenon has become a relevant factor when reviewing the current dynamics and future projections of organizations. It has generated the need to think about how the climate variables and their effects on the

systems are related to the activities of the organizations, demanding an explanation of effects, synergies, and interrelations existing between both elements.

The decision-making process, as part of processes belonging to organizations, raises a reference framework, which involves the need to face a climate change adaptation process. It is within this dialogue, where strategies and processes searching for explanation of adaptation needs, definition of action alternatives, their evaluation, planning, implementation, as well as their control are inserted, with the purpose of facing the uncertainty, risks and potential impacts associated with an uncertain future climate, and therefore assure the sustainability of the activities over time.

Nevertheless, It is necessary to be cautious at the moment of effectively considering whether the climate change shall be considered as a factor to include in the decision-making processes of the organizations. There exist the risk of entering into the adaptation process, even when the particular characteristics of certain organizations are not directly or indirectly related to the climate variables, with the corresponding implied costs. This is the reason why it is necessary an exhausted analysis of sensibility pertaining to the activity of current and future climate conditions.

Under a wider perspective, it is also necessary to think about the need for a strong public action, which must have as purpose the risk decrease, taking into account that the particular initiatives of adaptation may turn into restrictions in the adaptation global capacity of the system.

Finally, the communication, in its role of transferring knowledge and information from the research groups towards decision makers, is a fundamental tool to reduce vulnerability and increase the participation and commitment of different actors for the adaptation processes to climate change. Here, the creation of links among academic, public and private organizations and civil societies through co-production initiatives of knowledge, even when raising important coordination challenges, appears as one of the strongest ways to face, as a society, the adaptation challenge to climate change.

5. Notes

- i The first case corresponds to the issue of greenhouse gases mitigation, where there is an important and complex decision making process which is not explicitly discussed in this paper.
- ii References to each Project in Annex 1.

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Cathalac: Hydric Security and Climate Change in America Central and Caribbean region

Link/reference: <http://www.cathalac.org/es/proyectos/1715-h2o-adaptar-seguridad-hidrica-y-cambio-climatico-en-la-region-de-america-central-y-el-caribe>

Ecuador:

Public Company of Tap Water and Sanity– EPMAPS: Reduction Plan of loss and consumption and adaptation to climate change

Link/reference: <http://www.aguaquito.gob.ec/plan-de-reduccion-de-perdidas-y-consumos/plan-de-reduccion-de-perdidas-y-consumos-y-adaptacion-al>

Colombia:

CIAT: Strengthening and projecting the regional node of South Pacific climate change

Link/reference: <http://dapa.ciat.cgiar.org/fortaleciendo-y-proyectando-al-nodo-regional-de-cambio-climatico-pacifico-sur/>

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Fundación Bariloche: Adaptation to hydric stress in Comahue region - Argentina

Link/reference: <http://www.climagua.org.ar/>

Chile:

UC Global Change Center: Project MAPA: Maipo Adaptation Plan

Link/reference: <http://www.maipoadaptacion.cl/>

UC Global Change Center UC: Project FONDEF – Platform El Molino

Link/reference: <http://www.plataformaelmolino.cl/>

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DECISION MAKING AND ADAPTATION PROCESSES TO CLIMATE CHANGE

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Abstract: Climate change imposes certain challenges not only to ecosystems but to societies as well. The change in environmental conditions makes necessary to review the decision-making process related to adaptation to climate change. This review should consider future risks or current conditions of vulnerability through existing mechanisms in organizations or societies. From this analysis onwards, processes must be developed allowing, either to prepare the way to face expected future impacts or to decrease the current vulnerability regarding climate by creating more resilient systems. In this context, the role of the academy, as a knowledge source, results fundamentally. Nevertheless, this highlight the need to review and improve the communication processes from academy towards different interests groups by means of the co-production and strengthening of links among different society components.

Keywords: Process of decisions, adaptation, climate change, scientific co-production

Resumen: El cambio climático impone una serie de desafíos tanto a los ecosistemas, como a las sociedades. El cambio de las condiciones ambientales sobre las cuales se desarrollan las actividades de distinta índole requieren revisar los procesos involucrados en la toma de decisiones con miras a la adaptación al cambio climático, ya sea considerando los impactos directos de las condiciones futuras, o el riesgo para sistemas actualmente vulnerable, en dinámicas que ya existen dentro de las organizaciones y las sociedades. A partir de este análisis, se deben desarrollar procesos que permitan, ya sea preparar el camino para enfrentar los impactos futuros esperados o disminuir la vulnerabilidad actual frente al clima, generando sistemas más resilientes. Es en este espacio donde el rol de la academia como generador de conocimiento es fundamental, lo que implica la necesidad de revisar y mejorar los procesos de comunicación hacia sus distintos grupos de interesados mediante la co-producción de conocimiento y el fortalecimiento de vínculos entre los distintos componentes de la sociedad.

Palabras clave: Proceso de toma de decisión, adaptación, cambio climático, co-producción científica.

Resumo: A mudança climática representa uma série de desafios para os ecossistemas e para a sociedades. As mudanças das condições ambientais colocam a necessidade de rever

os processos envolvidos na tomada de decisões tendo em vista a adaptação às alterações climáticas. A partir desta análise, devemos desenvolver processos que possam abrir o caminho para lidar com os impactos futuros das atividades humanas, no sentido de reduzir a vulnerabilidade atual para o clima e gerar sistemas mais resilientes. É neste espaço que se consolida o papel da academia como um gerador de conhecimento fundamental, que implica na necessidade de rever e melhorar os processos de comunicação com seus diversos públicos através de co-produção de conhecimento e reforço dos laços entre diferentes atores que compõem a sociedade.

Palavras-chave: Processo de tomada de decisão, a adaptação às alterações climáticas, co-produção científica.
