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Strengthening Links Between Science and Governments for the Development of Public Policies in Latin America

POLICY BRIEF

MONITORING AND EVALUATING THE CAPACITY TO ADAPT TO CLIMATE CHANGE. HOW TO LEARN BY DOING AND ITS IMPLICATIONS IN DECISION MAKING

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KEY MESSAGE

Multidimensionality and uncertainty are intrinsic characteristics of all complex phenomena and, as such, they must be properly and explicitly incorporated into the decision-making process. The successes or failures of decision implementation can generate learning and promote cycles of continuous improvement, if one understands the associated causal mechanisms. For this to occur, it is crucial to count on continuous and robust indicators and assessments of vulnerability, adaptation capacity, and resilience of the sectors or environments of the societies of interest facing the effects of current and future climate variability.

Executive summary

Adaptation to current and future climate variability constitutes a significant challenge for all decision-making processes due to the multiplicity of factors, dimensions, and the level of uncertainty involved. These processes include certainties and uncertainties, generally not explicitly or formally assumed.

The international financing of climate change adaptation processes requires monitoring and evaluation of the measures, actions, strategies, and policies adopted. In view of the above, this document proposes alternatives for the construction of assessment and monitoring systems of vulnerability, adaptation capacity, and the resilience of systems or sectors in the face of current and future climate variability, as a key component of public policy design and evaluation.

Evaluation systems constitute the fundamental pillar of adaptive governance or experimental policy, a conceptual and organizational framework that takes into account complexity and uncertainty in public policy design, in addition to promoting learning about successes and failures, as well as continuous improvement.

Resumen ejecutivo

La adaptación a la variabilidad actual y futura del clima constituye un considerable desafío para todos los procesos de toma de decisión, debido a la multiplicidad de factores, dimensiones y nivel de incertidumbre involucrados. Dichos procesos comprenden certezas e incertidumbres, generalmente no explicitadas o asumidas formalmente.

El financiamiento internacional de los procesos de adaptación al cambio climático demanda el seguimiento y evaluación de las medidas, acciones, estrategias y políticas adoptadas. En este marco, el presente documento propone alternativas para la construcción de sistemas de evaluación y seguimiento de la vulnerabilidad, la capacidad de adaptación y la resiliencia de sistemas o sectores frente a la variabilidad actual y futura del clima, como un componente clave del diseño y evaluación de las políticas públicas.

Los sistemas de evaluación constituyen el pilar fundamental de la gobernanza adaptativa o de la política experimental, un marco conceptual y organizacional que incorpora la complejidad y la incertidumbre en el diseño de la política pública, además de promover el aprendizaje sobre los aciertos y fracasos, así como la mejora continua.

Introduction

The analysis and management of a socio-ecological system´s vulnerability presents great challenges due to the multiplicity of climatic and non-climatic factors affecting it. It requires the design of cross-cutting policies, as well as coordination among multiple factors that condition sensitivity and adaptive capacity, such as price variability, land tenure regime, access to credit, productive and income diversification, poverty and extreme poverty levels, education, and access to information. In this context, public policy design requires the interaction between multiple disciplinary domains, perspectives, and knowledge systems (Fig. 1, Table 1).

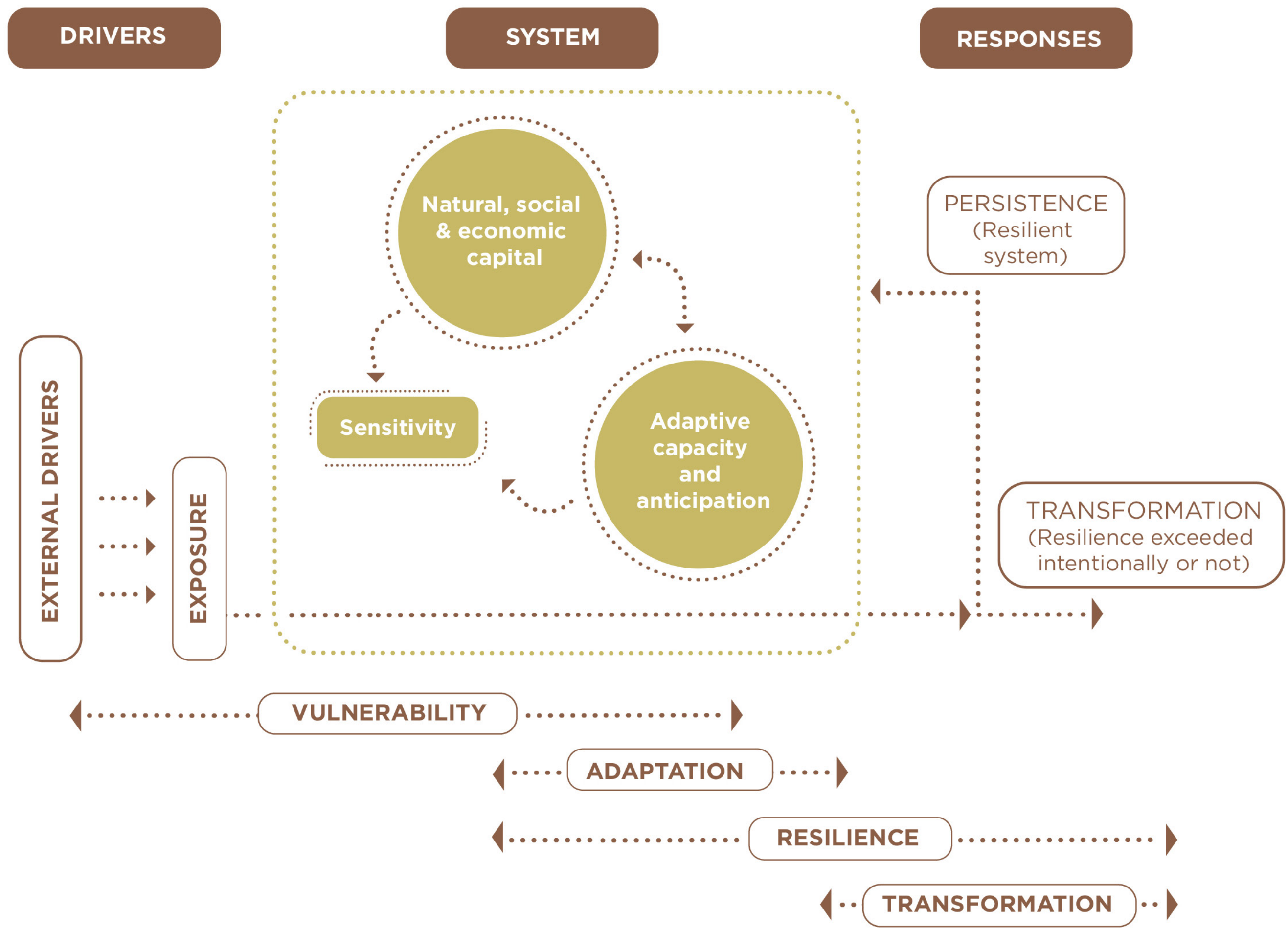

Fig. 1. Diagram of external factors (drivers) and system responses according to the degree of exposure, interactions between drivers (climatic and non-climatic), the system´s intrinsic properties (natural, social, economic capital, adaptability, and anticipation) that condition sensitivity to external factors or shocks. Sensitivity is assessed according to the system's response to external factors. Persistence indicates that the system's responses favor sustaining its main characteristics (or configuration) over time. In cases where resilience is exceeded and the system acquires a new configuration, transformations occur, which may be intentional or not. Diagram adapted and translated (1).

Table 1. Conceptual approaches in the management of socio-ecological systems, fundamentals and emphasis. Translated Table (1).

Conceptual approach	Changes in external factors	Mechanisms considered	Complementary approaches
Vulnerability	Known	System exposure and sensitivity	Adaptive capacity and resilience
Adaptive capacity	Known and unknown	Learning, innovation, anticipation	
Resilience	Known and unknown	Positive and negative feedback, adaptive governance	Adaptive capacity, transformation
Transformation	Directional	Learning from a crisis	Adaptive capacity and resilience

Important efforts have been made to predict future conditions, particularly climatic conditions, trade relations, and social and economic dynamics. It is important to keep in mind that scientific evidence has a degree of uncertainty that is generally not explicitly stated or included properly in instrument and policy design. Distinguishing between the sources of uncertainty is key because they require different methods and approaches for the decision-making processes. Epistemic uncertainty derives from the imperfect knowledge of a system, while ontological uncertainty is related to the inherent variability and unpredictability in the system´s behavior or performance (2-4). The interaction between uncertainties stemming from the different systems (social, economic, natural) has added another layer of complexity in strategy, plan, or policy formulation (5, 6). This lies, to a large extent, in the imperfect knowledge we have of human behavior, and the inherent variability and unpredictability of this behavior. Uncertainty in economic, social and political systems is as much, or more critical for the formulation of strategies, plans or policies, than the uncertainty associated with natural systems or with the climate system itself. Finally, the fact that there are multiple actors involved in these processes, each with their own beliefs, opinions, preferences and interests, and hence their own interpretations of the same information, gives rise to a new type of uncertainty, that is, ambiguity (2).

In view of the above, the analysis of climate change vulnerability during recent years has been the focus of research of various disciplinary domains, particularly climate and political sciences (7, 8) and socio-ecological systems (9). The variety of epistemological and ideological approaches applied and disciplines involved has generated multiple definitions and methodological approaches for conducting vulnerability assessments (10-13). Three major approaches stand out depending on the initial analysis perspective: biophysics, social and integrated. Biophysics emphasizes threat analysis, the social investigates to what extent each component of the system is vulnerable and why, and the integrated articulates the previous two (13).

Parallel to this, Füssel and Klein (8) state that vulnerability assessments are changing their focus from the identification of potential impacts mainly oriented to the implementation of mitigation measures, to the definition and prioritization of resources for adaptation measure implementation.

Within this framework, the incorporation of new analysis scales, the consideration of non-climatic factors (e.g. variation in commodity prices, land use transformations) and multi, inter and transdisciplinary approaches, have promoted greater involvement on the part of beneficiaries in the process of evaluation and design of alternatives (ranging from concrete measures to public policies or institutional architecture).

There are many scientific studies consisting of quantitative vulnerability assessments performed for different systems. Within this framework, the generation of vulnerability indices is remarkable (8, 14-17). This approach is the most commonly used because indices facilitate a simple interpretation and they identify the contribution of the associated socioeconomic and biophysical factors (18). Also, they are very useful for monitoring and studying trends, and are applicable to various spatial and temporal scales (19). In spite of this, quantitative assessments have crucial theoretical and operational limitations, mainly associated with subjectivity on the choice, weighting and integration of the variables (20).

According to Füssel (21), all existing climate variability indices have substantial conceptual, methodological, and empirical limitations that include lack of focus, lack of a solid conceptual framework, methodological errors, and problems related to access and data management. These characteristics seriously limit learning (and hence adaptation) and our understanding of the causes of success or failure in policy, strategy or measures. International funding, important in promoting the capacity to adapt to climate change, included this challenge in the last two years. This is an aspect of special relevance for Latin America because of its limited tradition in conducting public policy monitoring and evaluation. However, the time required for constructing monitoring and follow-up systems, and those established in the financing schemes, show scale discrepancies that sometimes promote several of the pathologies indicated by Füssel (21).

Proposal

How do we address the challenges from a perspective of public policy design and monitoring vulnerability and adaptive capacity? First, a robust (statistically based) evaluation of the sectors of interest is something that can be done long term, since it involves creating good databases and their interrelationships, filling key information gaps, having qualified human resources in the field of multivariate statistics and machine learning, combining quantitative approaches with qualitative approaches pertaining to the social sciences and social psychology, and creating spaces and platforms where knowledge systems of the different fields of science, managers and users can interact (22). During this process it is advisable to develop evaluation systems that combine the available statistical information with the opinion of experts, scientists and users, in order to form semi-quantitative evaluation schemes. FAO's study (23) "Tracking adaptation in agricultural sectors" is an important step in this direction (it is practical and operational) and can be easily modified and adapted to other sectors of interest.

FAO's contribution proposes four main categories of indicators: natural resources and ecosystems; production systems; socioeconomic attributes; institutional architecture and public policy design. The first group's indicators reflect the state of the environment and its interaction with agriculture or productive systems. They provide information on the role that natural resources and ecosystems play in agricultural activities, as well as the availability of aquatic resources in terms of quantity and quality, among other things. Production system indicators show the productive performance and its temporal variations, which depend on climatic and non-climatic controls. The set of socioeconomic indicators refer to access to markets and basic services, provision of social protection and education, access to credit, technologies, practices and meteorological information, among other things.

The institutional capacity and the role of public policy refer to the degree of institutional coordination, and the ability to formulate and implement effective adaptation policies. The design of public policy should be participatory, and priorities and options should be clearly identified. It should include options for implementation and monitoring of actions.

A score of 0 to 10 is assigned to each category where 0 represents a low adaptation and 10 a very high adaptation of the sectors analyzed, as well as the components and attributes considered (Fig. 2, 3) (Table 2).

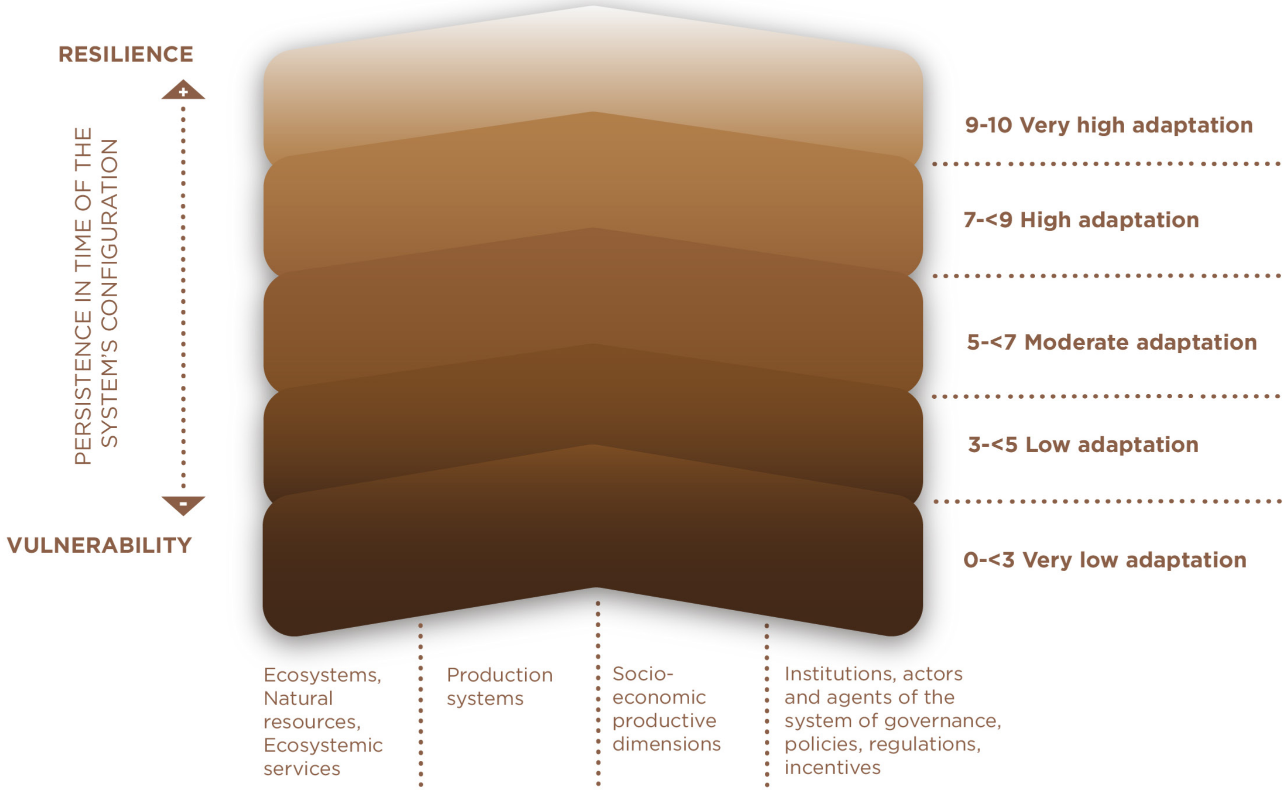

Fig. 2. Evaluation diagram based on ranges of different key components. Some of the attributes considered are quantitative in nature, for example: impact on grain production in the face of a drought (production system component) (see Fig. 3). In other cases, qualitative indicators are included, for example: level of user participation in the design or implementation of policies or strategies. The combination of a large variety of indicators of diverse nature and scale makes it difficult to integrate. In this sense, the range scale facilitates the integration of the indicators. Translated and adapted from FAO (23).

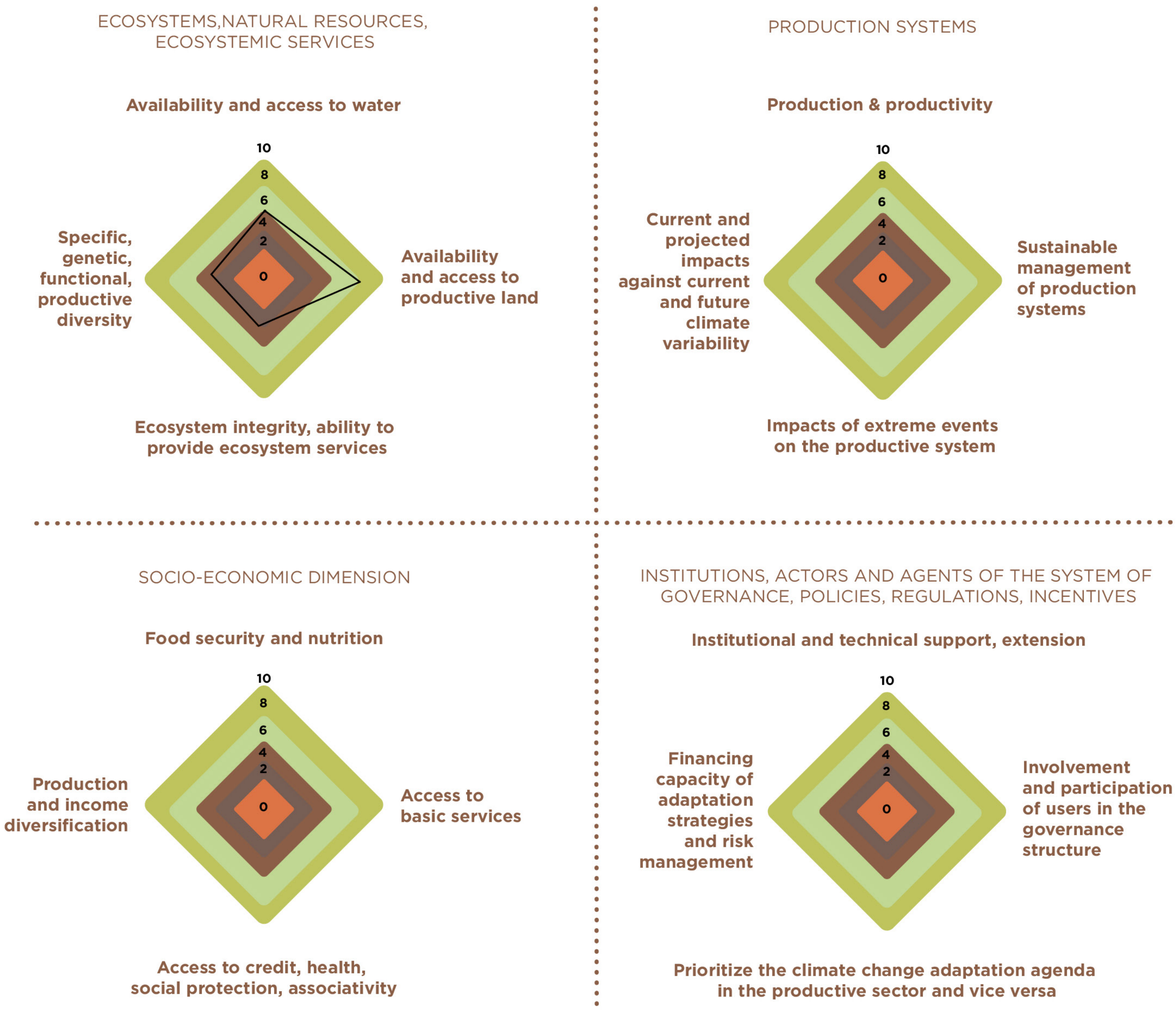

Fig. 3. Indicators developed for each major component (or subsystem) considered. The spider diagram facilitates the integration between the different indicators, and the same approach can be used to integrate the results of the four major components. An example of a hypothetical evaluation is shown in the upper right. It is important to clarify that the strategy can include a number of indicators greater than 4, as many as appropriate. Translated and adapted from FAO (23).

Table 2. Conceptual basis for assigning the adaptation ranges indicated in Figs. 2 and 3. Translated and adapted from FAO (23).

Adaptation Level	Score	Description
Very Low	0-<3	System (broadly applied term to designate natural resources, ecosystems, production systems, socioeconomic or institutional dimensions or attributes) exposed to various external factors related to climate variability, highly sensitive. The high degree of exposure and sensitivity determines an extreme vulnerability to the impacts of external forces. The system has a reduced capacity for adaptation and resilience, and the recovery time is considerable even if the drivers occur at low levels of intensity and magnitude.
Low	3-<5	Very exposed system and sensitive to climate variability and change, therefore, very vulnerable. It has low resilience, however it can recover when external climatic factors occur at low intensity, but not at higher intensities. The system has a certain capacity for adaptation and can cope with external climatic impacts of low intensity. In summary, system highly vulnerable to climatic factors of medium and high intensity.
Moderate	5-<7	Moderately exposed system and sensitive to climate variability. It has resilience due to a moderate capacity for adaptation. The impacts can be significant due to failures in adaptation strategies or lack of coordination between levels. The system has the capacity to respond at local or spatially limited scales, however, it requires external support in high intensity weather events with a wide spatial extent.
High	7-<9	System less exposed and sensitive to climate risk, the impacts are moderate due to adequate well-planned and coordinated adaptation strategies. Adaptation strategies are designed from a medium and long term perspective, and there is a good capacity for anticipation. Case with high resilience. However, significant uncertainty linked to future climatic or socioeconomic conditions may limit the adaptive actions designed.
Very high-excellent	9-10	Very robust system and well protected against climatic forces. Important synergies between all of the system´s components, which condition a very high resilience at different intensities and frequencies of climatic shock

The large empirical databases (e.g. those created in economic, productive or social areas to identify patterns in time and space) are a source of good phenomenological descriptions (24) and hypotheses describing causal mechanisms, however they are not enough to fully understand causal relationships. For example, we can count on excellent quantifications and mathematical regressions on the impact of droughts on rainfed crop yields. However, to understand how the different dimensions condition the sensitivity of the system, its adaptation capacity, or resilience, it is essential to count on other sources of information and approaches.

We recommend analyzing the following scientific studies (20, 25-30) conducted in the context of Latin America, which describe in a concrete manner the challenges identified and possible approaches to explore.

Adaptation capacity and related decision making processes involve individuals, but also depend on interactions with other actors, guilds, or spaces where interaction occurs between the public and private spheres.

In this context, it is essential to consider the interaction between actors and agents, in order to understand how existing good and bad practices evolve over time, or which communication and extension strategies should be taken into consideration for the adoption of new practices, strategies, or public policies.

Finally, it is essential to take into account the territorial transformations produced in the area. In many cases, the most important factor related to increasing vulnerability of productive sectors is not associated with climate change but instead with changes in land use, either productive or social.

In summary, we need large databases and statistics created by public or private institutions. We also need in-depth case studies such as systematic evaluations of already designed and implemented public policies that combine quantitative and qualitative approaches and incorporate different types of knowledge. It is also advisable to include experimental approaches from the area of behavioral economics or social psychology. The biggest challenge is to achieve an adequate synthesis that draws together and values academic and non-academic knowledge relevant to a particular subject, in an effort to achieve greater impact on public policy design (31, 32).

Recommendations

A policy is a social construction based on different types of knowledge (33). The rationale behind a policy cannot be based solely on scientific evidence, and its values should be implicit in its discourse and actions (34). There is strong dependence between the objectives, actions, and strategies of measures or policies that have been designed or implemented, and the paradigms or worldviews behind them, which are generally not adequately explained (35). The first challenge is how to co-create knowledge or co-design strategies so that the diversity of knowledge, logic, worldviews, times, needs, interests can be articulated to generate a shared vision. The second challenge is how to mobilize people and transform collectively co-constructed visions into concrete actions. According to Meadows et al. (36), "Vision without action is useless, but action without vision does not know where to go or why to go there." Having a vision plays a crucial role in strategy building, and combined with critical thinking, it can connect with people's motives and aspirations and lead to intentional and informed action (37).

A fragmented and rigid vision of reality lacks the flexibility, uncertainty, novelty, experimentation, and constant adaptation needed to address the problems raised in this study. However, the implementation of bridge structures could facilitate the exchange and cooperation between actors, and hence overcome the state´s classical fragmentation (38). Along this line, we recommend Ryan's work (39) on the responses in the institutional architecture of Latin American countries in the face climate change.

In addition to this, it is crucial to develop experimentation skills in the face of unpredictable and changing problems, and learn by doing (in Aristotelian terms), which requires tolerance in the face of the unknown, uncertainty, and failure. As a prerequisite, changes in organizational functioning (normative, structural and functional framework), and new capacities and competencies are needed to be able to advance towards decentralization processes.

It is advisable to include the basic components of adaptive management and its correlation in the field of adaptive or experimental governance (40): a) establish a framework of objectives and shared vision (in simple terms, a road map) and, at the same time, define criteria to measure its achievement; b) promote the appropriation of the actors and agents responsible for the implementation and monitoring of the measures or strategies at the local level, facilitating flexible mechanisms and autonomy so they can be applied to the particular condition of each context; c) in return, local actors and agents must report regularly on their actions and participate in evaluation processes where the results are compared mainly with those who have used different means to achieve the same ends; d) the objectives, criteria and decision-making procedures are regularly reviewed by a wide circle of public and private actors, providing answers to concerns and alternative solutions that have been revealed in the evaluation processes. And again the cycle repeats itself. The suggested strategy cannot be developed without assessment systems of vulnerability, adaptive capacity, and resilience. In this way, learning, continuous improvement, greater transparency and efficiency of the different resources are encouraged.

Alternatives to explore

A- Public policy design related to adaptation to current and future climate change variability, requires robust vulnerability assessment systems that allow us to identify main changes in time and space, as well as the associated causal mechanisms. The construction of evaluation and monitoring systems requires long-term strategies and efforts, and should be viewed as a process. In the initial phase of this process, the use of qualitative-quantitative evaluations proposed by FAO (Tracking adaptation in agricultural sectors) that involve different dimensions and approaches with simple proposals for information integration are recommended.

B- The emergence of adaptation strategies, as well as their incorporation or adoption, depend on decision-making processes at the individual level that communicate and interact with multiple actors and agents, and depend on particular socio-economic contexts. Both conditions are dynamic and must be analyzed and included in public policy design using in-depth case studies, complementing the construction of databases and historical statistics.

C- Adaptive governance or experimental policy offers a conceptual and organizational framework to incorporate complexity and uncertainty in public policy design. It promotes learning from successes and failures, and it fosters continuous improvement.

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