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The California drought: Coping responses and resilience building

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ABSTRACT

Building resilience to extreme events is very complex. It involves consideration of climatic and non-climatic factors, human and natural environments and their dynamics, and governance systems that include groups with wide-ranging authorities, influence and interests. In this article, we analyse the effects of the latest multi-year drought (2011–2016) in agricultural production in California; impacts on food security; and coping responses of several actors. We found that despite the drought and water shortages, California continued to be the leading state for fruit and tree nuts and that it did not affect food security. We also found that these results were strongly influenced by the numerous policy, regulatory, institutional, and management decisions taken at the local, state and federal levels, as well as to availability of groundwater, the primary drought reserve. The California case can be considered an example for the rest of the country, and the world, that extreme events require extraordinary preparedness and response measures just to cope with them, not to mention adapting to them, and that building resilience is a long-term process.

1. Introduction

Water management and climate change and variability, as well as their numerous interlinkages and the extent of related hydrologic, economic, social, environmental and political impacts over time and space, have become of increasing global concern. Uncertainties that prevent us from forecasting the likely future multidimensional and multi-sectoral impacts of climate change make policy alternatives, management, governance and development decisions, as well as investment choices on adaptation strategies, most challenging under the best of circumstances. As a consequence, non-climatic factors have become more relevant. Resource use and governance—that is, decision-making by multiple actors with numerous and dissimilar interests, and the formal and informal institutions they form—are some of the most important ones (Tortajada, 2016).

From the anthropocentric viewpoint, there is the concern that the extent and speed of the effects on global and local human and natural environments will be such that policies and institutions will not be enough to provide appropriate and timely responses. This, in turn, will result in economic, social, environmental and political vulnerabilities that will expose humankind to risks of irreversible change. (Carrao et al., 2016; Mastrandrea et al., 2015; Turner et al., 2013).

Resilience is often mentioned in the context of climate change as the ability of a social or ecological system to absorb disturbances while retaining the same basic structure or ways of functioning, the capacity for self-organization, or the capacity to adapt to stress and change (IPCC, 2007). However, system complexity is such that the prevailing language of 'resilience' may not necessarily reflect the practical realities (De Bruijn et al., 2017). In many situations, there may be mainly coping responses to address, manage, or simply overcome adverse conditions to achieve basic functioning in the short to medium terms (IPCC, 2012), as in the case of California. Therefore, rather than assuming that coupled systems can gain resilience, it should be acknowledged that the dynamic nature of human systems, characterized by constant change, may preclude them from becoming resilient. As Folke et al. (2010) have noted, this requires further understanding of the coupled systems as interdependent systems that adapt or not, and also transform or also can be made to transform.

This paper investigates decision-making and resource availability as essential elements to build resilience in a changing environment. It is part of a series of analyses of impacts of extreme events on coupled human–environmental systems and on their perceived resilience (e.g. Kastner, 2016; Tortajada, 2016; Tortajada et al., forthcoming).

The focus of our analysis is the effects of the 2011–2016 drought in agricultural production in California and the possible impacts on food security. We also discuss the importance of groundwater as the primary drought reserve, the coping responses and the decisions that were taken with the aim to build resilience. Finally, we present the policies that were taken at the state and federal levels to ameliorate the impacts of the drought. Our findings indicate that there were numerous

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management, operational and policy arrangements that helped the farmers to cope with the situation in the short- and medium-terms. Equally, that there were policy responses that aimed at building a more resilient system in the long-term. Overall, it was groundwater availability what helped to sustain agricultural production of the most valuable crops.

2. Addressing uncertainty through decision-making

The current global discourse emphasizes that the extent of change the coupled human–environment systems are facing and will continue to face, requires a new paradigm (Béné et al., 2014; Linkov et al., 2014). This paradigm should provide responses to the innumerable unknowns, and prepare humankind for the uncertain future. It is expected to encompass novelty while being based on long-term knowledge and experience; be flexible enough to provide alternatives to all types of conditions; and be sufficiently robust to lead policymaking and institutional responses with a certain hand into the uncertain future.

The lack of such paradigm and thus of a related policy framework, plus the number of interrelated constraints —economic, social, environmental, political and technological— present a serious global challenge. This has resulted in insufficient preparedness of formal and informal institutions on the types of responses that are and will be needed to address the many future possible but uncertain scenarios. These responses include understanding the driving forces that will shape future situations and how they will affect the coupled human and environmental systems; identification of policy, institutional and governance gaps and the ways to address them; robust financial instruments; data and information to provide evidence base for policy decisions; and, most important, decision-making in which long-term planning and not political gains are the priority.

Change affects society at large. Therefore, effective responses require collective actions determined by the modes of governance. To build resilience and foster adaptive capacity, polycentric systems are considered to be effective (Biggs et al., 2012; Underdal, 2010). They include more efficient responses to abrupt or incremental change because of the diversity of partners, more active participation processes and more open decision-making as well as inclusion of plurality of views, knowledge and experience as they provide an increased range of options (Jordan and Huitema, 2014). Polycentric systems, however, can also compromise resilience building when the scale of governance arrangements is too large, when there is lack of ability to respond cohesively to a certain situation, or when there is inconsistency between the scale of governance and the objectives. Therefore, one should not assume a linear response between polycentricity and improved decision-making. This depends on the specific situation.

Decision makers are challenged with the what, when, and how of their decisions. They are often strongly criticized for not considering adequately available information, including scientific information. Science is a very important element of decision-making, but not the only one. There are many other considerations with strong economic, social or political implications that many times take priority over science. To support decision makers to plan for more robust systems increasing their resilience, academia could make an effort to translate the concept into practice. This could include, for example, identification of policy tipping points when policies do not meet societal needs any more, and mapping alternative strategies (De Bruijn et al., 2017).

One example is that of water resources in climate change scenarios where an important question is whether and how climate change-related information can be used for water resources management decisions that are going to affect economic, social and environmental interests (Biermann et al., 2016; Biswas, 2016; Gober et al., 2010; Mastrandrea et al., 2015). What elements should be considered, and what would be the best way to include them? Traditionally, management of water resources has been based on stationarity or historical variability for estimating and managing risks (Wasson et al., 2013). Since these principles are no longer valid, water systems have to be optimized in different ways. The extent of alteration to the means and extremes of precipitation, evapotranspiration and rates of river discharges due to anthropogenic effects makes it essential to identify new nonstationary probabilistic models of relevant environmental variables (Milly et al., 2008; WMO, 2017). This is fundamental for preparedness, to aim at developing robust water systems that can respond to uncertainties about future water availability and their impacts (Gober et al., 2010), always keeping in mind the complex relationship between climate and hydrologic variability (Sheffield et al., 2012; Swain, 2015).

In the case of California, policy responses to the drought at the local, state and federal levels were very comprehensive. They were supported by robust studies from academic, research, think tank and governmental institutions. We used these extensively to strengthen the arguments of this paper.

3. Building resilience to extreme events: droughts and possible impacts on food security

Resilience is often discussed in the context of climate change as the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change (IPCC, 2007). However, the related issues are much broader. Social and ecological systems have capacity to adapt to stress, and they have been essential to the progress of societies throughout the history of humankind. It has been the numerous local changes that have allowed systems to respond, cope and adapt.

In the case of climate variability and change, conceptual frameworks could be more useful for decision-making purposes if they referred more clearly to the non-climatic diversity of the local and regional contexts; if they considered the capacity of coupled human–environment systems to respond, cope and adapt to increasing stress; and if they studied the strengths and weaknesses of policy, institutional, governance, infrastructural and financial mechanisms that are necessary to fully function under different conditions. As discussed by Biermann et al. (2016) conceptual frameworks can be useful only when they consider broad cross-scalar perspectives and recognize the diversity of local and regional contexts and situations.

Some of the events related to climate and human change that expose the vulnerabilities of both human and natural environments are extreme events such as droughts and floods. They result in institutional responses (policies, management, governance or market mechanisms) that aim to re-establish a point of equilibrium for systems to respond and operate as soon as possible, initially in the short-term, and later on in the long-term. Their impacts depend on their severity and on the risks and vulnerabilities of the systems they affect, which in turn rely on policy and governance responses as well as economic, social, infrastructural and human and resource capacities (Mastrandrea et al., 2015).

Governance-wise, the most resilient States – normally the developed ones – will be those with functional, accountable and inclusive institutions that are able to overcome challenging situations and provide basic services efficiently and effectively (Rüttinger et al., 2015). States without such institutional capability are likely to be the most vulnerable.

Droughts are normal phenomena of all climates with characteristics that vary among regions. It is known that they are a reduction of precipitation from the long-term average and extend over a certain space scale for a specific period of time, resulting in impacts that vary in reach and intensity (FAO, 2015). Droughts produce complex webs of impacts that affect many sectors of society, both directly and indirectly, and result in numerous chain effects in all sectors, including the water sector (Fraser, 2013; Grigg, 2014; Mastrandrea et al., 2015; Swain, 2015).

There is the perception that droughts have become more