Chapter 14
Balancing Structural Conflicts Across Scales to Develop and Mobilise Adaptive Capacity

Abstract Building on the three stages of analysis presented in Part III, this first chapter of Part IV discusses the challenges of developing and mobilising adaptive capacity across the complex spatial and temporal scales that emerged as key themes in earlier analysis. Across the spatial scale, there is a challenge in balancing guidance and certainty from higher levels of governance with flexibility of autonomous actors to respond quickly to challenges at the local scale. Furthermore, adaptation to certain stress conditions within one scale or magnitude of change was found to not necessarily imply long-term adaptability to conditions whose persistence and impacts will be more pervasive.

Keywords Rhône, Canton Valais, Switzerland • Aconcagua, Region V, Chile • Long term adaptability • Short term reactive capacity • Tensions across governance scales • Adaptation to climate change and variability • Balancing flexibility and predictability

14.1 The Spatial Scale

A common thread that emerged in analysis of adaptive actions and related governance mechanisms was the underlying tension of balancing guidance and certainty from higher levels of governance with flexibility and autonomy of users and rights holders at lower scales. It is a challenge that is further heightened in times of stress in the case areas, which instigate a heightened involvement of central or regional government agencies, whether from a financial or organisational capacity. The results presented in the previous chapters in Part III elucidate the empirical evidence related to the sub indicators of adaptive capacity and thus allow for trade-offs to be identified in the relationship between the requirement for clear rules and certainty to guide the development of adaptive behaviour and rules to mobilise adaptive actions

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in extreme events with the requisite flexibility for local actors to react and plan according to their individual needs.

While clarity in rules and legal certainty is fundamental for accountability in water governance (see Part II), it can also lock ownership and use rights into codified norms that are based on out of date hydrological data and patterns. In terms of evidence in 'responsibility', coordinating and organising institutions are needed for inter-connected water policy and management particularly in the face of complex and uncertain challenges. But there is a need to recognise local individualities and needs, which can go unconsidered at higher levels of administration. While participative processes can address this dichotomy, they can also stall agreements on projects and frustrate multiple stakeholders (especially if not matched with requisite knowledge and information assets). Other studies have discussed similar challenges in relation to balancing legitimacy and accountability through IWRM based approaches with adaptive management criteria of flexibility, experimentation and self-organisation (Engle et al. 2011). Indeed, this trade-off is elucidated in their comparison of IWRM and adaptive management criteria in the case of Brazilian water governance. Engle et al. (2011) found that 'centralization of decisions in the hands of the technical agency may facilitate the implementation of experiments as well as afford a level of flexibility that may be incompatible with more decentralized systems'.

Evidence from the 'preparedness' indicators suggests that the rules at higher levels that guide stakeholders at lower levels for managing extreme hydrological situations need not only to take the local reality into account, but also be matched with capacity at local levels so that provisions can be effectively interpreted and implemented. Finally, all three indicators reveal evidence for the struggle to find a balance between autonomy and strength of user rights for managing their resource, while holding disparate actors together through a formalised set of enforceable provisions that allow for the sustainable management of the resource and bring actors together to resolve common problems. High levels of informality may devolve agency to lower levels, but if this is not matched with guidance, incentives and the requisite knowledge to cooperate on complex challenges, it is associated with policies that lead to the passive degradation of the SES.

The challenge through both these preparatory and reaction periods represent a balancing of the trade off between flexibility and predictability to optimise adaptive capacity. It may be described as the search for juggling structure, guidance, and policy certainty at higher administrative scales, in a manner that also facilitates and supports autonomous adaptations at local levels. Succesfully balancing this trade-off could help to maintain the ability of a governance approach to allow for both reactive and proactive adaptive capacity to be built and mobilised. To reiterate from earlier discussion, while reactive and autonomous adaptation is the ability to change and adapt to new threats or realities that have manifested (Tompkins and Adger 2005), proactive adaptation can in turn be categorised as longer term preparations for different scales of change.

Flexibility can be seen as short term transformation potential, i.e. the ability to change course, reorganise, and mobilise quickly if the SES is on an unsustainable

and dangerous trajectory, or faced with a sudden shock, by mobilising its ability to reactively adapt. On the other hand, predictability is linked to the need for legal certainty and guidance for building longer term transformational potential. It also refers to long term policy planning that enables a system to become proactive in its adaptation to a particular type of extreme. In order to not only develop adaptive capacity, but mobilise it to both variability and larger scale changes, the cases elucidate the importance of building both reactive and proactive adaptive capacity.

While proactive adaptive capacity can be associated with predictability and guidance at higher levels, reactive capacity is enabled through flexibility and autonomy at lower governance levels. One of the major challenges in climate change adaptation is therefore navigating this balance between fostering the flexibility needed to deal with an increase in the likelihood of complex and unexpected changes from climate change (Ebbesson 2010) while maintaining the certainty and guidance for longer term preparedness through legislative, regulatory and policy frameworks.

Other studies have focussed on the high level trade-offs that policy and decision makers face in any democratic system when considering climate change risks and adaptation, through socio-political and economic factors (Tompkins and Adger 2005). Short term political cycles, limited public attention on longer term challenges and judgements on risks and costs of climate change dilute the urgent context in which climate mitigation and adaptation should take place. Tompkins and Adger (2005) refer to the trade-offs between cost, risks and socio-political factors as being 'encompassed in the shape of the indifference curve between reactive and anticipatory management' (p 565), which are navigated by the institutional landscape made up of government and civil society actors, as well as individual agents. While in their article, both mitigation and adaptation are the unit of analysis, similar trade-offs are identified within the focus on adaptation alone. Trade offs are also present in decision making on investments at different governance levels for adaptation. Decision makers must decide at what level, and in what form (social, technical, financial) to invest limited resources (temporal, financial, educational).

Figure 14.1 suggests a representation of how this adaptation trade-off manifests across the suggested core tension in adaptive capacity. The figure purposefully does not represent this as a linear regression, from highly predictive enabling proactive adaptation while highly flexible facilitating reactive adaptation. It is not suggesting a linear relationship between the two elements of adaptive capacity, but more an intersecting connection, with elements of proactive adaptive capacity enabling succesful reactive adaptive capacity (e.g. TRC). Likewise, increasing numbers of reactions to extreme events may have the potential to impact longer term preparedness for climate change, by taking advantage of windows of opportunity to push through plans relating to adaptation. The proceeding section further discusses how this tension manifests across the different indicators, while the following section will propose a multi-scale framework to address the tension in the process of developing both reactive and proactive adaptive capacity.

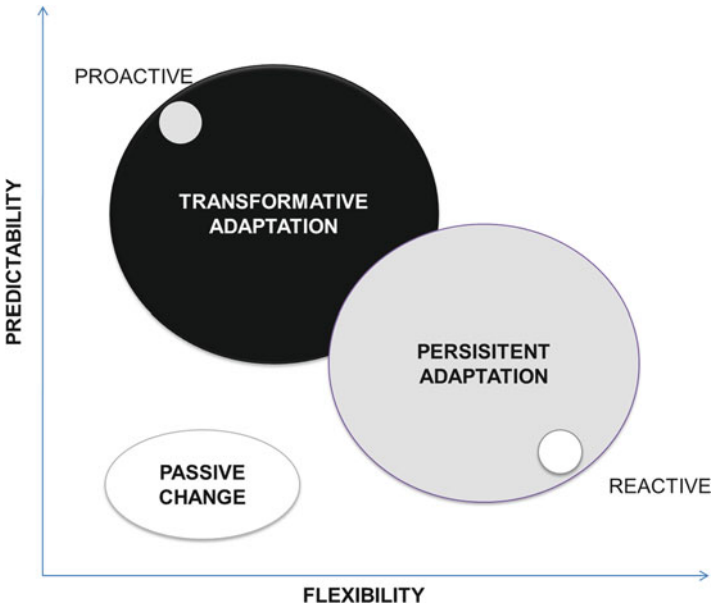

Fig. 14.1 Balancing out the core tension (flexibility and predictability) in order to generate both proactive (longer term preparedness to climate change impacts) and reactive (flexibility and quick reactions to climate events) adaptive capacity

14.1.1 Regime

Certainty and the rule of law are fundamental in a governance system to ensure governments are subject to the law, providing trust in their rule, predictability in planning decisions and security in longer term investment (Cosens 2010; Craig 2009; Ebbesson 2010; Ruhl 2009). *Regime* indicators represent the elements of the system that provide this level of predictability to guide the actions of institutions and individual actors in managing water resources. The legal and property rights framework is crucial for specifying ownership and use of water resources as well as the rules and regulations that determine the management of the water resources, which water rights owners must follow. *Regime* indicators of *ownership* and *responsibility* are important in clarifying the rules that denote rights, duties, privileges, power and responsibility (Ebbesson 2010) that impact how an SES is managed.

Within the Swiss case, federal and cantonal legislative provisions that provide the duties of ecological integration in spatial planning and integrated flood management are driving forces behind the transformative elements of the TRC (Fig. 10.2, Box 10.1). Furthermore, the subsidy mechanisms in the NFA for beneficial ecoligical outcomes and participatory approaches to commune level projects are also associated with more transformative approaches. On the other hand, in the Swiss case, the length of legal certainty bestowed upon the hydropower concessions as well as legislated priorities for irrigation within cantonal legislation, locks in set water

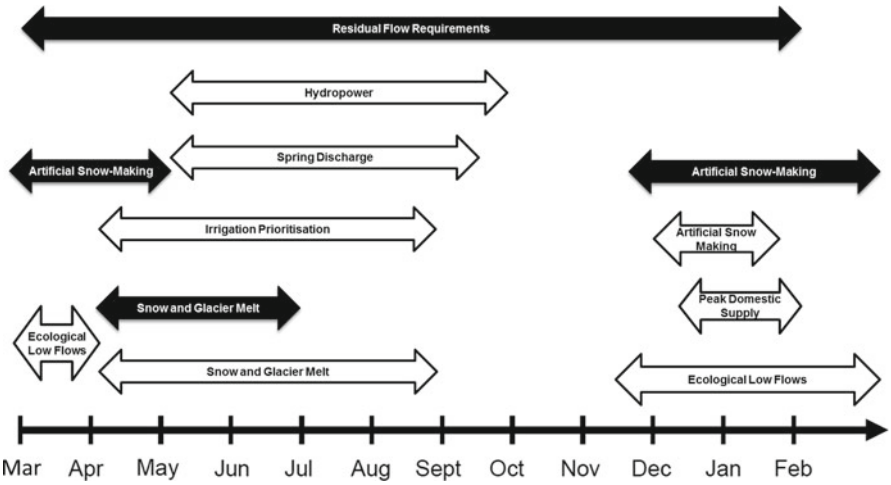

Fig. 14.2 Seasonal timeline of water uses (*White arrows* show the range of traditional water uses, and *black arrows* showing how these rivalries are developing with shifting seasonality and increasing exploitation)

allocations and priorities over timescales during which the hydro-climatic environment is projected to undergo significant change.

Figure 14.2 represents the complexities that shifting seasonality might imply for such long term codified rights, guaranteeing or prioritising allocation to certain users over or during set time periods (Hydropower Concessions, Law on the Use of Hydropower (Art. 42), WPA (Arts. 31, 33, 34 and 36)). It shows that there is genuine cause for concern, in that the multiple rivalries of the streams are gradually being subjected to either physical changes in seasonality or through increased variability, demand and new legislative requirements that are at present not being investigated in an integrated or holistic manner. While some stakeholders express concern that these increasing rivalries will be a challenge for management of water resources in the canton, it is presently still under the radar of cantonal legislators and sectoral policy makers.

Furthermore, any diminishment of spring water (for domestic supply) in relation to glacier melt is likely to be supplemented with increased groundwater exploitation that may have repercussions on surface water recharge. In the Valais, these challenges are in some way bridged by the complex balance of strong local autonomy and sovereignty of water rights with an increasing reliance on federal and cantonal subsidies that aim to encourage implementation of federal and cantonal ecosystem based provisions at the local level to foster a resilience based approach to increasing hydrological extremes. However, the residual flow requirements themselves are a more recent addition to the WPA, and so despite the importance of their role in the protection of the riparian ecosystem and health of the waterways, do have challenging repercussions for socio-economic based rivalries.

It is the common perception of the Chilean system that the unique level of autonomy of the water rights owners allows the system to be highly flexible and adaptive, since they are not constrained by the inefficiencies of government and thus can self-organise to manage solutions at their own level, amongst themselves. However, in practice, the water rights and legal situation in Chile are based on principles that neither promote conservation, preservation of currently scarce resources (though efficiency is an aim) nor protect vulnerable riparian ecosystems. The role of the water rights holders themselves, whether part of a Junta or not, is seen to be one of documentation and distribution rather than any responsibility for management of the resource. Yet in Chile, the subsidiary role of government within the neo-liberal model delegates as many responsibilities as possible to the private actor, leaving a gap between resource use and resource management, that currently no one within the basin is really filling. Even more problematic, the rights structure and information upon which the rights allocation has been based, has allowed for the legal over allocation of the basin, which due to the certainty of the rights themselves (guaranteed by the Constitution and Water Code), is inflexible and non-adaptive to decreasing availability of water.

14.1.2 Knowledge

Knowledge indicators encompass the long term development and integration of climate information as well as the perceptions of environmental issues; whether or not climate change is taken into account in planning and decision making timeframes. Often, stakeholders elucidated how climate change impacts seemed too distant, insurmountable or uncertain to incorporate into current *evaluation and planning*. While data may be at hand to adequately assist coping strategies with drought or flooding events, in depth studies, monitoring and climate projections may not be accessible for informing longer term planning strategies.

In the Swiss case, monitoring and assessment networks are maintained and used across multiple levels and sectors and there are a number of federal and regional studies and collaborations on long term climate change projections. While the MINERVE and TRC provide examples of climate change integration into longer term planning, at other levels (i.e. local) or in other areas of water management (water provision) long-term effects from climate change (e.g., shifting seasonality of hydrological regime; glacial melt tipping points) seem too far away or too daunting to incorporate into local water management planning. The examples of collaborative and iterative science driven projects can be found in the hydropower sector and the TRC project that integrates climate projections in an iterative and integrative manner for sustainable watercourse management for both short- and long-term coping. So, while the series of flooding events were seen to serve as a wakeup call for political and policy action on developing a longer-term integrative and uncertainty based approach to watercourse management, in most areas of the Valais, alterations in water availability

from changes in glacier and snow-melt have been more variable across the canton.

In the Chilean case, there are greater challenges in developing the baseline of adequate data to effectively manage water quality challenges and administer the allocation of water rights. However, interestingly, this is not linked to a low level of expertise, but rather to capacity challenges in the designated institutions for water management, as opposed to the other ministries or sectors that have a stake in water resources. It is the application of water and climate information to both short and long term water management decisions that is the challenge. Therefore, while there is evidence of climate change relevant studies and evaluations being present across sector-specific institutions, there is a struggle to apply this information thematically to water challenges and to holistic water management planning (e.g. reservoir and groundwater planning for Aconcagua Project).

Furthermore, the lack of relevance of water data and calculations for drought management and the historically short time periods used for water allocations, suggests a lack of applicability and appropriateness of information for both short and long term management. Other studies have noted the challenges of overcoming institutional complexity and inertia to ensure that models and data are not maintained after they have been rendered useless (Peters 1987 in Tompkins and Adger 2005). Furthermore, national level studies on climate change impacts and adaptation tend to be sector specific. There are also few mechanisms to objectively evaluate the ability of the local water system (physical and institutional) to cope with increased drought situations or integrate climate impacts into basin level water resource planning.

In both cases, observational awareness of climate change impacts do not automatically translate into an integration of climate change relevant adaptation strategies for coping with the longer term impacts of the change that is being observed. Additionally, the massive implications of greater magnitudes of change induce a level of apathy across different sectors (hydropower, domestic water provision) that reinforce the notion that planning for larger scales of change is pointless. In the Swiss water provision context, the acknowledgement that larger scale changes are likely to occur is tempered by the understanding that drastic impacts from glacier reduction will not manifest over the next generation, and therefore there is no need to include preparations for such impacts at present. However, it is the laws, contracts and infrastructural projects that are being planned now that will need to be relevant and adequate in 10–20 years, just as climate impacts heighten. Decisions made now could lock in the SES to out of date rules, data and management solutions just as the agreements, projects and contracts signed 20–80 years ago have locked in present day management in both case areas (hydro-power concession periods; water rights allocations; urban growth; spatial planning).

Another related challenge is matching the scales at which hydro-climatic expertise and knowledge is generated, deployed and communicated within the scales where adaptation actions are implemented and climate impacts are experienced. A challenge in the Swiss case, is matching the level of expertise with the local level at which water is mainly governed and managed. In the Chilean case, the main issue

is the level at which decisions and plans on water use are made; this tends to be presidential or ministerial (based heavily on neo-liberal economic prescriptions), while technical and operational experts are relegated to less prominent and end of pipe roles in the planning and management process.

The secularism, independence and role of technical and operational experts become even more important in adaptation issues due to the negative repercussions of maladaptation and the limited time frame which is now available for mitigation and adaptation to climate impacts. However, at the same time, political leadership is required in relation to climate change to ensure that the bigger, more complex issues are taken on board. This challenge manifests itself in both cases but very differently. In the Chilean case, regional technical and operational experts are seen to be handcuffed by central level politicians and central planning ministries, limiting their ability to apply their expertise, data and knowledge to the problems at hand. In Switzerland, the issue is the inverse of the top down challenge, with the federal and regional administrations unable to foster watershed based plans that would more integrally integrate ecosystem and climate concerns in water resources management.

14.1.3 Networks

Networks are important to both reactive coping (in terms of relationships and levels of trust between different water stakeholders) as well as longer term adaptability, in terms of the ability of actors to engage in the 'wider decision environment that will affect their longer-term resilience' (Tompkins and Adger 2004). The connectivity between actors is influenced by levels of trust, modes of negotiation and incentives for cooperation, all vital since connectivity alone does not lead to a willingness to cooperate during extreme climate stress. Knowledge networks are also vital for the integration of scientific data and information into long term planning and decision making processes, as well as for time sensitive access to monitoring data requisite for managing extreme events such as drought and floods.

Networks disseminate and share information and data as well as build or erode agreement and cooperation within institutions responsible for assessment and monitoring. Universities have been cited as important venues for dialogue and debate in order to facilitate learning across different sets of stakeholders (Garmestani and Benson 2010). Collaboration and information sharing across different actors and levels elucidates the extensive and pervasive challenge of getting stakeholders to cooperate and collaborate either formally or informally and the need for balance in power, authority, agency and autonomy across different sectors and levels of governance for effective coordination and collaboration to long term complex challenges as well as mobilising for ad-hoc extreme events.

There are challenges and impediments in both case areas to the effectiveness of existent networks for challenges relating to climate change. In the Chilean case, while there is a willingness to cooperate on single projects for shared benefits that

constitute hard infrastructural adaptations (e.g. reservoirs and wells), connections between different actors tend to be based on financial or economic incentives alone, with no other glue binding actors together (i.e. basin planning for a stable and sustainable system is lacking). The development of the *Mesa Tecnica de Aconcagua* in relation to the Aconcagua Project provides a platform for those in favour of the project to share information and present supporting findings to the DGA and other stakeholders in the basin. Elsewhere in Chile, *Mesa del Agua* have been set up as watershed boards, in a set of pilot projects developed by the DGA in the past decade (Bio Bio, Huasco, Copiapo[1]). However, these institutions have failed to incorporate the full suite of watershed stakeholders, reducing their ability to effectively build cooperation across divergent views but instead the opposing viewpoints in the Aconcagua Project and related groundwater management issues are as deeply entrenched as ever.

In the Swiss case, the networks that do exist tend to be sector specific, but based more on intentions of knowledge and expertise development than on specific projects. The TRC is perhaps one area where participation has taken a consultative form, in that the implementation plan was presented to the COREPILs post facto, and approval or commentary requested on a seemingly done deal, to the chagrin of agricultural stakeholders who stand to lose land as a consequence of the enlargement (NZZ 2009). An earlier inclusion of affected stakeholders into the implementation process through communication and information networks, as they exist for water provision and other mountain water challenges, may have allowed a better understanding for the benefits that such an enlargement could bring in the long run, rather than the short term implications of land loss.

Across these different administrative or spatial scales, too strong a commitment and concentration of governance actions, rules or autonomy at one level, whether it be higher or lower, can be seen to hamper the response at another level, eroding the fine balance that could enable more coherent adaptation strategies. The role of incentives and trust building in *networks* highlights the importance of balancing out mismatches in authority, autonomy and agency (see Part III, Chap. 12) to ensure that diverse stakeholders across the complex system have the right incentives to move collectively towards more integrated and adaptive approaches. Moreover, building more effective and functional networks across these administrative and sector scales is particularly relevant to water institutions because of the imbalances of natural and economic resources between upstream and downstream water users (especially notable in the Chilean case in the disagreements between the different Juntas).

The importance of balancing lower and higher levels of governance authority is matched by other recent research, reinforcing the empirical evidence that bottom-up governance and decentralisation is not as vital a characteristic for adaptive and

[1] MOP, Unidad Técnica, Programa de Manejo de Recursos Hídricos a Nivel de Cuencas Hidrográficas (PMRH), proyecto MOP-BM, volumen 1, informe, Santiago, 5 de febrero de 2001 (Dourojeanni 2010).

integrative management approaches as earlier theory had suggested (Huntjens et al. 2010). The approaches characterised as transformative or adaptive in the decentralised Swiss model were driven by top-down policy and legislative frameworks. However, these top down frameworks were in part informed by the strong voice afforded to environmental organisations within the Swiss direct democratic governance model (see discussion in Part II). On the other hand, the Chilean case represents a centralised model of governance where the lowest governance level is the user or rights owners, who through the Water Code are granted a high level of autonomy in the management of water resources. In both cases the autonomy of the lowest level of governance (in Chile this level is private, and in Switzerland it is public) limits the ability to proactively build solutions for broader more complex issues in water resources management.

Hence, evidence from the Swiss and Chilean cases reinforce the finding in Huntjens et al. (2010, 2011), that fine tuning the balance between bottom-up and top-down approaches may be more important than proposing the more simple solution of promoting bottom-up and decentralised governance for managing water issues. Public authorities at higher or lower levels, whether in a centralised or decentralised system, have an important role to play in conflict resolution, cooperation building and facilitation, priority and standard setting as well as certain levels of information generation and provision (Huntjens et al. 2010).

The importance of trust building for cooperation has been highlighted in a number of studies by Elinor Ostrom and her collaborators (Poteete et al. 2010), in the investigation of collective action for cooperative solutions to resource management challenges. It is the mix of the design principles relation to the availability of knowledge on short and long term impacts with the ability to share that knowledge equitably between actors that can in effect have more influence on cooperation and trust generation than top down policy or rule setting. Moreover, the Chilean case reinforces the evidence that in the absence of trust or respect for government, top down rule setting can also increase the challenges for enforcement and implementation (Ostrom 2010). Interestingly, in the Swiss case, stakeholders in the agricultural sector were not only aware of the research by Netting (1981) and Ostrom (1990), but also expressly pointed out that it was in the interest of the canton to foster elements of the common property systems that had managed the Suonen/Bisses systems for centuries, to ensure collective action and responsibility for irrigation and watercourses was maintained at the local level.

The TRC, as the example of a transformative outcome, aligns different regime and knowledge indicators for the development of a management approach that takes into account both anticipatory and reactive adaptive capacity development and mobilisation. The aim is not only to enhance longer term resilience of the flood prone areas of the Rhône valley, but also to develop information and knowledge networks that would take better account of climate change related increases in flow and limit their damage through flexible buffers (e.g. evacuation corridors, buffer zones). While non state actors, such as environmental organisations, played an integral role in shaping the legislative baselines of the project, the

participation of affected actors in the canton itself has been based mainly on consultation through commissions on the implementation of the project (COPIL/COREPIL).

A more innovative approach that involved the co-production of knowledge across multiple levels and stakeholders to develop the project, could help build cooperation across currently disenfranchised stakeholders (Huntjens et al. 2010; Olsson et al. 2006). Investing this time (earlier on in the project) has shown, as have other studies, a need to develop understanding, learning and thus foster cooperation across stakeholders when dealing with uncertainty and change, whether related to climate change or other variables (Stubbs and Lemon 2001).

14.2 Speeds and Scales of Change

While balancing flexibility and predictability is important to address the challenges between structure and autonomy across administrative scales, it is equally important to address adaptation to and preparedness for different scales of change as shown in Fig. 14.3 below. A community or system's adaptiveness to local climate conditions may not imply an ability to cope with changes or impacts at different speeds or scales, as is evident across both cases. The adaptive actions associated with historical variability, drought and scarcity are limited in terms of upscaling to face more complex challenges. Furthermore, in the Swiss case, perceptions of being well prepared for tougher climatic conditions in the Valais (in comparison to other areas of Switzerland) appear to lull sectors such as agriculture in particular into a false sense of security that managing climate impacts will not require alternative solutions or management approaches.

This is in keeping with other findings that suggest that adaptation to certain stress conditions (drought/rain shadow effects) within one set of parameters (historical variability) does not imply long-term adaptability to conditions whose persistence and impacts will be more pervasive (Folke et al. 2010). It also reflects empirical evidence from other studies of river basins that suggest experience of one type of extreme can the limit preparations for another form of extreme (Huntjens et al. 2010). Similarly, highly optimised tolerance theory (HOT) posits that systems that tend to become very robust to frequent kinds of disturbance may become fragile in relation to infrequent events (Carson and Doyle 2000). While in the flooding events in the Swiss case, high-impact low-frequency events are seen to have elicited a longer-term adaptive response to changing conditions at multiple levels, a transition which the TRC is on the cusp of. However, in other cases, events facilitate immediate adaptive behaviour, but fail to translate these smaller transformations into more permanently adaptive regimes, such as the response to increasing drought conditions in the Chilean case, local level responses to flooding events in the Swiss case (i.e. the backlash against the TRC), and the response to drought periods such as 2003 in the Swiss case.

Therefore, it reaffirms findings from other studies of the potential for short sharp shocks, such as trigger or focussing events, to become windows of opportunity for transition to a new water course management philosophy (Folke 2006; Herrfahrdt-Pähle 2010; Olsson et al. 2006). This in turn can enable more proactive adaptation to longer term creeping system changes, such as gradual changes in mean precipitation, changing seasonality and decreasing flows from glacier and snow melt. Tompkins and Adger (2004) also recognise this dichtomy in adaptation, both gradual and anticipatory as well as to single significant extreme events or shocks. But they add that both forms of adaptation should 'involve encouraging the evolution of new institutions that are sensitive to the resilience of the ecosystems they are managing and knowledgeable about the specific nature of the risks of climate change' (Tompkins and Adger 2004, p 10).

However the presence of capacity to adapt to one off events may not engender the mobilisation of capacity to respond to more gradual yet in the long run significant forms of change, as seen by the dichotomy of responses to inter-annual droughts in the Chilean case and the drier climate in the Swiss case in comparison to the more complex, inter-related and anticipatory changes to climate impacts on seasonality, variability and availability.

In the Swiss case, while the windows of opportunity that the flooding events opened were capitalised on, the rapid fading of the memory of those impacts highlights the importance of knowledge (information and communication) indicators, to ensure that both individual and institutional memory is maintained. Integrating opposing stakeholders into the tight communication and knowledge networks could be one means of finding more cohesive stakeholder acceptance of the implementation plan in a faster manner than the current top down communication and participation strategy that is in place through the newsletters and COREPIL. In the Chilean case, the high impact recent drought events, potentially, are providing a window of opportunity for a heightened level of self-questioning and stakeholder cooperation and collaboration to move beyond just the technical engineering solutions to security and supply challenges, but to also better enable the institutional setting to cope with increased drought impacts so that the resilience of the SES does not further degrade.

The informality of the Chilean approach grants freedom and autonomy to the user level to quickly react and find solutions to smaller issues (tourno). However, these changes and coping techniques (increased groundwater abstraction) have the potential for longer term degradation of the resilience of the ecosystem. The Chilean system is also characterised by high levels of mistrust between sectors and institutions that not only hamper the implementation of reactive adaptations but disincetivise collaboration across sectors and levels for solutions to the larger more complex issues. A focus could therefore be on enhancing the reactive elements of the system, but paying closer attention to how elements in the knowledge network indicators could improve proactive adaptation and lead to positive rather than negative transformation (more on this further down).

14.3 Navigating Structural Tensions and Trade-Offs Across Multiple Governance Scales

As discussed in Part I, in a number of studies, different iterations of flexibility or predictability are taken as indicators of adaptive capacity. While these approaches have theortetical support, the research presented in this book suggests that it might be more useful to utilise these two concepts as core tensions in developing adaptive capacity, rather than just another element of adaptive capacity. Thus, flexibility and predictability become a guiding tension through which to measure and balance adaptive planning (see Fig. 14.3). The next step therefore is to develop and propose a method for navigating this tension, in order to minimise the trade-off between the development and mobilisation of proactive and reactive adaptive capacity.

Striking the appropriate balance in the governance arrangement to develop flexible yet robust adaptive responses will present a constant, but evident challenge for policy and decision makers. Managing this paradox is key for decision makers to grapple with the challenge of how to develop an SES to be simultaneously well prepared and adapted (high proactive adaptive capacity, e.g., long-term and iterative planning, integration of uncertainty and climate change impacts) but also quick to respond (high reactive adaptive capacity, e.g., quick innovations and transformations in response to specific events) to the different scales of change. Building

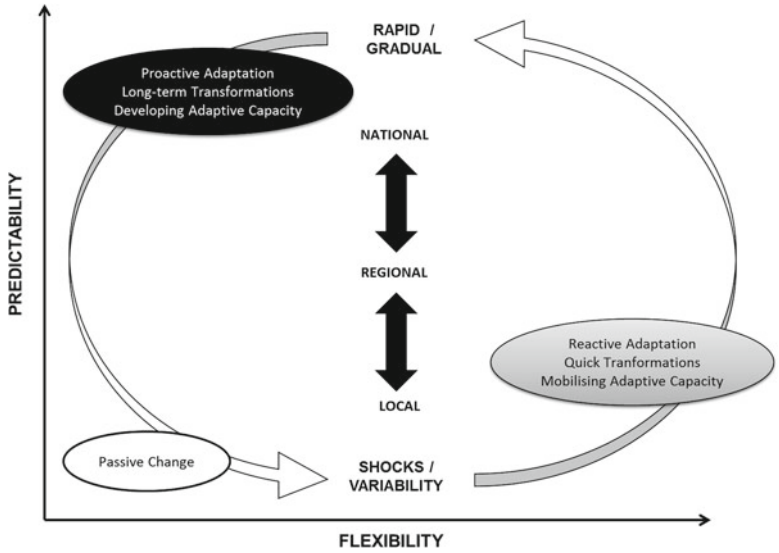

Fig. 14.3 Enhancing proactive and reactive adaptive capacity by balancing predictability and flexibility across different scales of governance (national, regional, local) and change (gradual and rapid)

adaptive capacity with 'regulated flexibility' through local preparedness and planning, while providing the necessary support, guidance, and resources at higher scales represents a challenging but initial step in the right direction to address the trade-offs in developing reactive and proactive adaptive capacity.

An area that policy and law makers should focus on is the challenge of how to best utilise legal provisions and regulations to guide and encourage adaptive behaviour without handcuffing water managers and stakeholders to codified rules which may be out of date in future years. In pursuit of this goal, more attention could be paid to how best to utilise elements of procedural law that provide structure while building in flexible instruments that provide a timeframe and process for review and the establishment of new goals that fit the present day reality, rather than the reality when the law was origionally crafted and passed.

In the Swiss case, the implementation plan of the TRC has provided for a period of review every 10–20 years, to ensure that the plan is constantly updated to be appropriate to the best available science. Lessons could be drawn from the provisions in the implementation plan that provide for this type of structured process of review in areas of contract and administrative law that govern hydropower concessions and irrigation prioritisation. Furthermore, lessons could be drawn for the Chilean case, where the rule of the Water Code and supposed legal certainty pertaining to water rights are major challenges for adaptation in the water governance system.

Legislation and property rights concerning water resources could be subject to provisions that allow for 10 year review processes of the underlying data upon which the assumptions for the validity of those provisions are made. While this still allows for goals and normative principles to be set in stable legal structures, since stationarity of the system cannot be assumed, greater flexibility for experimentation at lower governance levels could be provided for by enhancing the networks that already are in place (Cosens 2010). Establishing or strengthening the requisite institutional channels (formal forums and planning processes and informal networks with multi-purpose incentives) for collaborating amongst stakeholders and facilitating information exchange could also help address this particular challenge.

Both the cases highlight the challenges of integrating shifting hydrogical baselines into substantive law. Autonomy and strong property rights at the user level (Chile) or local level (Switzerland) can fragment adaptive responses, and present a major barrier to proactive and integrated planning and management of water resources for more complex challenges. However, referring back to Part I, jurists have highlighted that rights are an area of the law constantly re-negotiated and subject to cultural frames of reference. The Chilean water rights system has itself changed twice in the twentieth century. While this in itself has left the system quite broken and unclear, it does suggest that the current impasse over the Water Code and associated protection of constitutional water rights might not be as fixed and impenetrable as has been assumed.

Competing interests and non-integrated priority setting are two of the biggest challenges in developing more transformative and sustainable adaptive solutions in both cases. In order to balance competing interests at different political levels and

across the different sectors, decision makers should aim to simultaneously invest in bottom-up (community adaptation planning, integration of climate impacts into longer-term planning, and adaptive capacity assessments) and top-down efforts (national and regional level technical, strategic and financial support systems, long-term planning requirements, investment in shared scientific and adaptation databases, mechanisms for cross-region, cross-sector learning) as an initial step for joining up segregated and contradictory policy priorities across water stakeholders. Table 14.1 builds upon these ideas, by presenting a multi-scale framework to address the challenge and tensions implicit in adaptive capacity through more practical institutional mechanisms.

Table 14.1 draws on and develops from the framework set out in IPCC (2001) and Tompkins and Adger (2005, p 566). Proactive approaches relate to taking the longer term view through a number of approaches including planning process and guidelines, policy and legal frameworks that represent long-term and iterative processes that can integrate new information as it manifests. Reactive approaches relate to flexible mechanisms and networks that can rapidly respond with quick innovations and transformations to minimise short and long term damage from specific events.

At the national or federal level, a focus on both vertical and horizontal integration has been suggested. From a proactive perspective, efforts could be directed to providing stability in change, partnering ministries or federal administrative bodies to set more integrative policies on the basis of sound environmental and climate information. This process could be enabled by formalising knowledge relationships with appropriate bodies; in some contexts this might be intergovernmental bodies, in other NGOs or in other research institutes and universities. More formal interdisciplinary partnerships for policy setting would allow for a broader mix of information and knowledge (beyond traditional disciplines of lawyers and engineers) to inform the development or revision of legislation and regulation.

One evident challenge is that while policy should inform legislative developments, in governance contexts such as Chile and Switzerland, this can be a time-consuming and in some cases fruitless task. In Chile, the constricted and dogmatic nature of political dialogue on the Water Code and water resources reform limits the scope for addressing climate challenges through formal legislative change and reform. In the shorter term, it is worth focussing on the more dynamic elements of the system, i.e. informal elements and those that relate to knowledge and network indicators to foster approaches that are better equipped for quickly dealing with the challenges relating to climate change.

In Switzerland, evidence shows how federal policy making does filter into federal and cantonal legilsation. However, the timescales over which these policy priorities trickle down into actual rules at the canton and local level[2] can take years or decades, and even then, the autonomy of the communes can impede the effective

[2] http://faunavs.ch/?p=subject&tag=21&action=detail&id=12; http://www.vs.ch/Navig/legislation.asp?Language=fr

Table 14.1 Multi-scale framework to address tensions and trade-offs in developing adaptive capacity

Scale	Proactive	Reactive
National Federal and central governments National institutions and organisations Federal and national legislation & regulation	Robust national and legislative frameworks that merge aspects of water law, land use law, environmental law together with energy, mining and other sectoral laws that impact on water resources. Framework laws that set long-term planning requirements, but integrate flexibile mechanisms that allow for resetting goals as new information is uncovered. National and regional level technical, strategic and financial support systems, investment in shared scientific and adaptation databases, mechanisms for cross-region, cross-sector learning. Develop mandate of NGOs and learning networks as covenors and partnership developers. Time specific planning – i.e. distil complex model/scientific outcomes to temporally relevant pieces that are digestible for solution building at lower levels. Blue skies thinking: policy making process of identifying form of behavioural change needed to develop adaptive capacity.	Development of catastrophe management capacity – both financial and technical (i.e. conflict resolution; technical and knowledge assistance) to deploy at lower levels. Development of multi-scale governance networks that devolve decision making capacity in times of extreme events to lower levels of government administration. Develop mechanisms and institutional channels to provide a process for reviewing, revising and establishing new goals and priorities in the wake of extremes and disasters. Incorporation of best available technology and science/data into crisis management institutional frameworks to better reflect shifting hydro-climatic baseline on which these decisions are made.

Region Regional governments and administrations Basin organisations Regional institutions and organisations	Develop scientific networks to better connect science and management – focus on universities, NGOs, research institutes and science professionals knowledge sharing platforms and linkages with government planning, decision makers and water managers. Institutional mechanisms to translate national goals into the basin context – investing in, and where appropriate formalising, bridging organisations to link in top down and bottom up priorities, issues and solutions. Investment in regional collaboration to integrate lessons-learnt, knowledge and information across stakeholders and sectors. Create ownership of the planning process – investing in communication and education programmes at both regional and local level, rather than just consultation and participation.	Financial and technical preparedness plans so that federal or central level help can be rapidly coordinated to local levels in extreme periods. Investment in monitoring capacity and maintenance of up to date and relevant data. Enhance availability and accessibility through multiple communication channels and networks in the lead up to and during extreme events. Development of cross-sector or agency review panels – to ensure best available knowledge (from top down and bottom up sources) is integrated into rights, procedures and plans. Development of expedient and accessible conflict resolution vehicles in periods of heightened stress (i.e. developing institutional redundancy).
Local Municipality, commune levels User groups	Integration of climate impacts into longer-term planning, and adaptive capacity assessments through community adaptation planning. Particpation in planning process from a climate knowledge perspective, rather than just a presentation of final plans for approval. Development of local campaigns and activities to improve knowledge of climate impacts as well as variety of transformative approaches to adaptation – e.g. school and university competitions, advertising campaigns etc. Initiate dialogue on evolving property rights to better correspond with shifting hydro-climatic baselines. Development of access to bridging organisations with cross-scale and multi-disciplinary/sector foci for fostering trust horizontally and vertically.	Better matching of levels of autonomy with resources capacity or access to capable networks to enable better mobilisation of plans of action in extreme periods amongst rights holders or municipalities. Access to financial and technical support – with more balanced focus on both these aspects, not just financial access. Development of local networks that are connected through looser horizontal structures rather than rigid hierarchies to create ownership and faster response.

implementation of high level priorities or even provisions in the law. Furthermore, other studies have suggested that formal legal rules are more irrelevant than lawyers would tend to expect during extreme periods, due to their short advance notice period (Hurlbert 2009; IISD 2006). During these periods, more flexible and quickly accessible institutions are needed that can respond to stakeholder needs over periods of days, weeks or months.

However, this is not to discard the importance of addressing the challenges in the legal and policy framework, as these are core drivers of the developments of knowledge and network elements of the governance system. But to suggest that these longer term challenges should be seen in the context of proactive capacity building, while the quick wins in knowledge partnerships and conflict resolution mechanisms can be tackled, now, to develop capacity that can be better mobilised in the next extreme event. From a reactive perspective, while quick reactive capacity can best be mobilised at the local and regional levels, there are governance actions that, concurrently, can be implemented at the national level that can enable this process. National and federal actors should acknowledge that more extremes are likely to increase the need for larger financial support and enhanced financing mechanisms to support regional and local coping efforts, quickly and efficiently.

Craig (2009) suggests that lawmakers should think more creatively about means of restructuring legal safeguards so that public authorities have more flexibility to deal with climate change impacts. His suggestions include 'general planning requirements coupled with abbreviated administrative procedures for specific implementation decisions, periodic rather than continual judicial review for rationality, the ability to rely on post-decisional evaluations rather than pre-decisional justifications, and/or increased emergency authorities in order to achieve true capacity for adaptive management in the face of climate change impacts to resources and ecosystems' (p 55). Ruhl (2009) also suggests that in the interests of the law becoming more adaptive, those that shape the law should emphasise a shift from a preservation focus to one of 'transitionalism', in order to better allow for frequent reconfigurations that take into account trans-policy linkages and trade-offs across scales.

At the regional level the focus has been set to vertical integration, since the role of institutions and actors at this level can provide valuable linkages between top down and bottom up actions, in order to build trust, provide support, both financially and technically, and develop consensus between local needs and realities and national priorities. Establishing intermediaries and formalising bridging organisations, such as NGOs and universities could enhance the role of regional level institutions and actors in trust building across and between higher and lower levels of governance. Integrating scenario planning and analysis at this level would raise understanding of climate related uncertainty and provide a potential setting for collaborative knowledge networks between regional or national research institutions that could enable greater capacity and openness to learning at lower levels as well.

The networks developed for longer term partnerships could also improve monitoring and information flows during extreme periods. Furthermore, during crisis periods, higher levels provide critical support functions when local capacity may

fail or be inadequate. Therefore, the regional level focus to develop multiple mechanisms to provide this short term support function to assist local level capacity in coping with non-linear dynamics in SESs, would include investing in monitoring systems, leading indicators, scenario planning and communication and information flows (Langlet 2010).

The focus at the local level is on horizontal integration, namely connecting different sectoral actors and communities together to build cooperation for resolving long term complex challenges but also develop networks and knowledge that can be quickly mobilised to react in times of crisis, that may be redundant during 'normal times'. The call for a rapid evolution of property rights, needed in conjunction with climate adaptation (Ruhl 2009), is perhaps best addressed at the local level, where individual or company stakeholders own and negotiate water rights or use rights, rather than at higher levels of governance and then implemented at local levels. This is likely to be a complex and emotive process, but jurists and water rights owners (farmers, companies, utilities, municipalities) need to develop stronger partnerships to develop innovative solutions to resolve the challenges relating to the mismatch between the current and future hydrological realities and the obsolete baselines upon which their rights were formulated.

The development of bridging organisations (e.g. local assessment teams) that comprise multi-sector actors in the SES, could provide the requisite arena for trust-building, learning, conflict resolution and adaptive co-management and that would provide a dual role in facilitating proactive preparatory capacity as well as arenas for mobilising joint responses in crisis time that are not dependant on higher levels. Additionally, autonomy alone is meaningless without the requisite agency, plus access to financial mechanisms. Therefore enabling access to and development of financial and technical capacity are equally important. In turn, this requires regional and national levels to have the capacity and resources to assist the local level.

While policy setting and at the national level should still remain an adaptation priority for higher levels of government, until the constrictive elements of present legislation and regulation are transformed, the limits of their impact in developing capacity to manage the impacts of climate change at the local level should still be recognised. Table 14.1, therefore focusses on the mix of regime, knowledge and network based approaches and mechanisms that are invaluable complements to legislative provisions and fixed rules in meeting climate related challenges. Most importantly, in the absense of governments being able to effectively integrate water related policy priorities and legislative processes at the national level, focussing on the mechanisms in Table 14.1 could enable water stakeholders themselves to cross scales and sectors to develop a more joined up approach at the basin level for maximum benefits in climate change adaptation.

Some studies (Garmestani and Benson 2010; Herrfahrdt-Pähle 2010) have shown how these different scale, specific foci can be couched in the Panarchy model (Gunderson and Holling 2002; Chapin et al. 2009). These studies apply the Panarchy model to institutional change, thus matching institutions and governance actions to the appropriate level. Garmestani and Benson (2010) suggest matching up the institutional foci at higher governance levels to the phase of growth and accumulation

(the foreloop phase of r to K) characterised by slow and incremental transition. Conversely, faster changes at the lower governance levels should be matched up with the rapid phase of reorganisation that leads to renewal (backloop phase from Omega to Alpha). Between these different levels, bridging organisations and networks are vital to maintain open lines of communication, financial and operational support, as well as provide an arena for the accumulation and application of scientific information.

Traditionally, there has been a weighted focus on the legislative and infrastructural frameworks that structure water resources management, that is typical of what has traditionally been a sector dominated by mathematically minded technicians and engineers (Huntjens et al. 2010; Ingram 2011; Pahl-Wostl 2007). Engineers, mathematicians and economists stereotypically conform to the worldview that problems can conform to neat mathematical models. In other words, they tend to treat clouds as if they were clocks (Pearce 2002a). Complex systems however, tend to defy neat stereotypes, which is a partial explanation for the on-going challenge of meeting related challenges with paradigms and panaceas (Ingram 2011; Meinzen-Dick 2007; Ostrom 2007). It may be more useful to combine more nuanced indicators with a multi-scale framework that focuses not only on the rule based elements of the SES but also on the way in which information and knowledge is developed, shared and applied aims to embrace the complexities implied in developing and mobilising adaptive capacity, rather than ignore or constrict them. For more discussion of this latter issues, please refer to Chap. 15 on coping with and communicating uncertainties.

14.4 Conclusion

Emergent themes through the course of analysis presented in Part III revealed the tension in generating different forms of responses to different speeds or scales of change and across different spatial scales. The structural challenge of mobilising flexible fast responses in periods of drought or flooding was seen in juxtaposition with the corresponding need for a more predictable structure to guide longer term adaptation planning. These emergent contradictions in adaptive capacity were matched with concepts of proactive and reactive adaptive capacity to set out a means of navigating the structural tensions inherent in adaptive capacity. Analysis has shown that proactive adaptive capacity could be associated with predictability and guidance at higher levels, while reactive capacity could be enabled through flexibility and autonomy at lower governance levels. In turn, transformational responses are related to building longer term resilience in the SES, and are linked to proactive and preparatory adaptation. Persistent Adaptive actions provide smaller scale processes of change for quick and flexible reactions to events as and when they occur, to maintain the resilience of the system in the face of surprise.

Furthermore, this tension is influenced by different levels of governance and scales of change. A framework was presented in Table 14.1 as a means of navigating

this core tension across spatial and temporal scales through more nuanced indicators that address both reactive and proactive adaptive capacity. In coping with shifts in variability and increasingly recurrent extremes, institutions across the case areas showed varying degrees of ability to mobilise for different kinds of shocks. The development of the framework set out in the table and its underlying discussion aims to contribute new and more nuanced insights into means of developing both proactive and reactive adaptive capacity that contribute to both the growing body of literature and practitioners alike. The structure proposed in Table 14.1 could be used to develop adaptive capacity assessments that take these multi-scale challenges into account, and help guide decision makers and water managers to develop adaptation solutions that take both facets of adaptive capacity into account.

It is suggested that developing the capacity to both adapt proactively and mobilise reactively to different scales or speeds of change frames adaptive capacity in a way that focuses it both on the accommodation of uncertainty, as well as the short and long term transformational potential within a governance system. Focussing on the transformational potential of adaptive capacity should be about maintaining options and choices where possible and recognising that passive, steady state, command and control approaches have tended to cut off options when the ambient climate changes. For example dykes can only go so high, reservoirs can spill over or dry up if flows exceed or deplete beyond the parameters for which they were constructed. Pinpointing the elements of the governance system that enable more persistent and transformative adaptive responses is a means to developing adaptive capacity in order to create rather than minimise future water resources options. The indicators developed and presented in Part III, and the multi-scale framework presented in this chapter presents an approach that could be further developed to enable short term reactive capacity (e.g. crisis management, coping abilities) that would be more consistent with more proactive strategies.

The approach aligns reactive and proactive in one framework so that short term strategies would not counteract longer term proactive approaches that seek to maintain the resilience of the SES rather than exacerbate underlying challenges that potentially limit adaptation to greater magnitudes of climate change in the future. Water managers and adaptation planners would be well advised to pay closer attention to these different aspects of developing and mobilising adaptive capacity, to ensure that fostering one set of responses at one level, does not detract from or counteract effects for another form at a different level, thereby limiting either short term reactive capacity or longer term proactive capacity, both of which are equally important.

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