



Seven tools for creating adaptive policies

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ABSTRACT

Experience demonstrates that policies crafted to operate within a certain range of conditions are often faced with unexpected challenges outside of that range. The result is that many policies have unintended impacts and do not accomplish their goals. Adaptive policies are designed to function more effectively in complex, dynamic, and uncertain conditions. Based on over a dozen case studies on public policies relating to agriculture and water resources management in Canada and India, we conclude that there are seven tools policymakers should follow to create adaptive policies. Adaptive policies anticipate and plan for the array of conditions that lie ahead: (#1) using *integrated and forward-looking analysis*; (#2) monitoring key performance indicators to trigger *built-in policy adjustments*; (#3) undertaking *formal policy review and continuous learning*; and (#4) using *multi-stakeholder deliberation*. But not all situations can be anticipated. Unknown unknowns and deep uncertainty will always be part of policymaking. Adaptive policies are able to navigate toward successful outcomes in settings that cannot be anticipated in advance. This can be done by working in concert with certain characteristics of complex adaptive systems and thereby facilitating autonomous actions among stakeholders on the ground. To a degree, adaptive policy tools #3 and #4 can be used toward this purpose, but most directly, such autonomous tools include: (#5) *enabling self-organization and social networking*; (#6) *decentralizing decisionmaking* to the lowest and most effective jurisdictional level; and (#7) *promoting variation* in policy responses. This paper elaborates on these seven tools as a pragmatic guide for policymakers who find themselves working in highly complex, dynamic, and uncertain settings.

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1. Introduction

We are motivated in this work by the imperative for a sustainable future, a future in which decisions are made with careful, deliberative thought about positive and negative impacts as viewed from economic, social, and environmental perspectives, and with due regard for present and future generations. Fundamental to this pursuit is the ability of people to interact with each other and adapt to change. Public policies have an important role to play in fostering this ability. But for policies to be effective and to help people, the policies themselves must also give careful consideration to complex interactions and be able to adapt to conditions that can and cannot be anticipated. A policy that is unable to continue to perform in a dynamic and uncertain setting, or unable to detect when it is no longer relevant, is a policy that is more likely to hinder the freedom and capability of people to adapt to change.

To begin to provide relevant guidance for adaptive policymaking, we first undertook a comprehensive review of academic and professional insights on how to intervene effectively in complex adaptive systems as experienced by a range of sectors, including

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natural resources management, healthcare, transportation engineering, information technology, and international development. To study more closely the adaptive features of public policies, we examined and researched case examples from agriculture and water resources management within a context of weather uncertainty, and all of the socio-economic and ecological issues enveloped in the global climate change issue. From hundreds of interviews with farmers and water resource managers in Canada and India, we identified policies that have helped people and communities adapt to historic weather-related shocks and stresses. We did so based on the belief that such policies would be fruitful ground for researching specific adaptive policymaking mechanisms. And this indeed turned out to be the case. From over a dozen policy examples that we studied in Canada and India, we unearthed many specific and practical features that policymakers have employed to make policies adaptive. We draw from these examples throughout this paper to illuminate seven tools we observed that policymakers can use to create better policies in today's complex, dynamic, and uncertain world. We tested our ideas at numerous workshops and international meetings, and published a book as a guide for adaptive policymaking relevant for socio-ecological settings and the pursuit of sustainable development [1]. This paper is a synopsis of this work.

The specific case examples drawn on throughout the paper may resonate most closely with policymakers working in agriculture and water resource management sectors, and for policymakers dealing with climate change issues, because that is the context from which the cases were drawn. But the seven tools for creating adaptive policies are relevant to any complex policy issue, providing a means to craft and implement policies under dynamic and unpredictable socio-economic and ecologic circumstances. We are confident that the guidance provided in the paragraphs to follow will be a welcome addition to the policymaker's toolbox.

The tools outlined in this paper are the culmination of four years of research undertaken by the International Institute for Sustainable Development (IISD) based in Canada and The Energy and Resources Institute (TERI) based in India. Financial support and advice for this initiative was provided by Canada's International Development Research Centre (IDRC).

2. A brief history of adaptive policies and policymaking

Some of the first discussion about adaptive policymaking actually emerged in the early 1900s. Dewey [2] put forth an argument proposing that “policies be treated as experiments, with the aim of promoting continual learning and adaptation in response to experience over time” (in [3]). In 1978, Canadian ecologist C.S. Holling introduced natural resource managers to the notion of adaptive environmental assessment and management and paved the way for future thinking with regard to adaptive policies in socio-ecological settings [4].

In 1993 the term “adaptive policy” appears in the published literature in Kai Lee's book that integrated science and politics for the environment – as experienced in the highly contested issue of salmon fisheries restoration and hydropower development in the Pacific Northwest of the United States. Taking a socio-ecological perspective, Lee described adaptive policy as “designed from the outset to test clearly formulated hypotheses about the behaviour of an ecosystem being changed by human use” [5]. Around the same time Dennis Rondinelli recommended that international development efforts be re-orientated to “cope more effectively with inevitable uncertainty and complexity of the development process” [6]. He contends that one of the most promising ways to achieve this re-orientation is to use “an adaptive approach that relies on strategic planning, on administrative procedures that facilitate innovation, responsiveness and experimentation, and on decisionmaking processes that join learning with action.”

In a special issue of *Integrated Assessment* in 2003, Warren Walker and Vincent Marchau from the Delft University of Technology introduced a socio-technical perspective of adaptive policies and policymaking and took the concept to a more pragmatic level. Motivated by the uncertainties surrounding policies relating to transportation safety and design, they suggest that policies be “adaptive – devised not to be optimal for a best estimate future, but robust across a range of futures.” Their notion of adaptive policies includes policies *that respond to changes over time and that make explicit provision for learning*. This approach requires that learning and adaptation of the policy be made *explicit at the outset* and the inevitable *policy changes become part of a larger, recognized process and are not forced to be made repeatedly on an ad hoc basis* [7,8].

Bankes [9] provides some additional practical insight into adaptive policies. He recognized that “most policy problems involve complex and adaptive systems and that for those problems, the classical approaches of predictive modeling and optimization that have been used in decision support software are not appropriate.” He contends that for policies to be successful in a complex and adaptive world, policies will “need to be adaptive themselves,” and warns that relying on optimization techniques to develop policies based on the projections of a single model will produce static policies which make the “correct move” only for the best estimate model.

Holling's elucidation of adaptive management in 1978 is particularly noteworthy. Adaptive management can be described as learning by judicious doing. It is characterized by its flexible policies and the plurality of views that inform it; no particular epistemic community can possess all the necessary knowledge to form policy. Science, models, expert knowledge, and the policies based on them are not interpreted as ultimate answers, but merely as a means to guide a cautious process of intervention in complex ecosystems. The goal of management shifts from achieving a single target to an integrated view of maintaining ecosystem resilience, avoiding, for example, catastrophic and irreversible “flips” to other equilibrium states [10].

Also noteworthy for the evolution of adaptive policymaking is the *NeWater* project – an acronym for *New Approaches to Adaptive Water Management under Uncertainty*. Supported by the European Commission, this multi-partner research project ran from 2005 through 2009 and is based on the hypothesis “that sustainable water management requires an integrated approach but that integrated water resources management (IWRM) cannot be realized unless current water management regimes undergo

a transition toward more adaptive water management” [11]. The researchers describe adaptive water management “as a real paradigm shift in water management from what can be described as a prediction and control to a management as learning approach.”

3. Theoretical and conceptual foundations for adaptive policies

Many sectors of our economy are pursuing more sophisticated policy design and implementation approaches based on an understanding and appreciation of a new and higher degree of interconnectedness and dynamic consequences. The vast majority of these pursuits ground their recommendations for policy intervention in the theory or concepts of complex adaptive systems. There is a large and growing literature on this, and valuable insights can be gleaned toward identifying a set of principles to help guide adaptive policies and policymaking for socio-ecological systems.

Perhaps one of the most lucid descriptions of a complex adaptive system was provided by Glouberman et al. [12] while searching for ways to improve health in cities. They described a complex adaptive system as being...

“...made up of many individual, *self-organizing elements* capable of responding to others and to their environment. The entire system can be seen as a *network of relationships and interactions*, in which the whole is very much more than the sum of the parts. *A change in any part of the system*, even in a single element, *produces reactions and changes in associated elements and the environment*. Therefore, the effects of any one intervention in the system *cannot be predicted with complete accuracy*, because the system is always responding and adapting to changes and the actions of individuals (emphasis added).”

Most policy practitioners will identify with this as a reasonable depiction of the policy setting in which they work. Unpredictability and the presence of unknown unknowns are the underlying traits. This complexity comes from the adaptive nature of people (and the economy they create), combined with the adaptive nature of ecosystems. Both need to be analyzed and understood to the greatest degree possible to define the basket of policy input factors and potential outcomes that can be anticipated, but with some recognition that the system can never be understood or predicted with complete accuracy. The conundrum is that the contents of the basket of unanticipated factors and outcomes will never be clear. Certainly what at one point in time was not anticipated becomes anticipated through additional analysis and experimental and experiential learning. But the unknown unknowns will always be lurking around the corner. So analytical and deliberative efforts focused just on trying to determine what these are, are not what define an adaptive policy. It is how a policy can be designed and implemented in order to provide people and ecosystems with the best opportunity possible to deal adequately with the unknown that makes a policy truly adaptive.

Rihani [13] proposed that “at base, development is what nations do as complex adaptive systems, and what they do can be described as uncertain evolution that has no beginning or end, nor shortcuts, and few signposts on the way.” We subscribe to the idea that the interaction of humans and nature through socio-economic processes are complex adaptive systems.

For over a decade, leading thinkers in the business sector have promoted a systems perspective to identify solutions for complex management problems. For example, Peter Senge [14] based his best selling theory of organizational learning on systems thinking, which he described as “the discipline for seeing the structures that underlie complex situations and the best leverage points for change...it is the antidote for the sense of helplessness that everyone feels in this new age of interdependence.” He goes on to say that systems thinking offers a language that begins by restructuring how we think.

The recent study and application of complex adaptive systems can be seen in numerous fields including business management, healthcare, information technology, transportation, sustainable development, and international development. Within these fields, practitioners and researchers have been thinking about how to better craft policies that can be effective in highly complex, dynamic and uncertain settings. Table 1 summarizes these insights and can be thought of as a set of principles for how to intervene in complex adaptive systems.

For example, it has been proposed in the transportation sector that public policies be “adaptive — devised not to be optimal for a best estimate future, but robust across a range of futures” and that policies “respond to changes over time and make explicit provision for learning” [8].

In the healthcare field, it is recommended that policy interventions should promote variation because “introducing small-scale interventions for the same problem offers greater hope of finding effective solutions.” This is based on the understanding that “many interventions will fail and that such failures are simply a feature of how one develops successful interventions in complex adaptive system.” [12]. It is also understood that possible solutions undergo selection by the system. It is therefore important to include “evaluating performance of potential solutions, and selecting the best candidates for further support and development” [12].

In the forestry management sector, it is suggested that foremost for intervention in complex adaptive systems, policies must ensure that social capital remains intact — if local groups and their networks are disempowered individually or collectively, existing social structures are in effect invalidated and undermined [15].

In the natural resources management field it is understood that to build resilience in communities for complexity and change, interventions should promote self-organization by building networks of reciprocal interaction, matching scales of ecosystems and governance, and promoting variation and redundancy in actions [19].

Table 1
Principles for intervention in complex adaptive systems [1].

Stage of the policy cycle	Principles for intervention in complex adaptive systems
<i>Policy set-up</i>	<ul style="list-style-type: none"> • Respect history [12]. • Understand local conditions, strengths and assets [12]. • Understand interactions with the natural, built and social environment [5,12]. • Look for linkages in unusual places [15]. • Determine significant connections rather than measure everything [5]. • Public discourse and open deliberation are important elements of social learning and policy adaptation [16]. • Build trust, collaboration, consensus, identity, values, hope and capacity for social action [17]. • Use epistemic communities to inform policy design and implementation [18].
<i>Policy design and implementation</i>	<ul style="list-style-type: none"> • Create opportunity for self-organization and build networks of reciprocal interaction [12,19,20]. • Ensure that social capital remains intact [15]. • Promote effective neighborhoods of adaptive cooperation [20]. • Members of the population have to be free and able to interact [13]. • Facilitate copying of successes [14], [20]. • Clear identification of the appropriate spatial and temporal scale is vital to integrated management (the ecosystem approach) [21]. • Match scales of ecosystems and governance and build cross-scale governance mechanisms. • Promote variation and redundancy [5,19]. • Encourage variation [12,20]. • Balance exploitation of existing ideas and strategies and exploration of new ideas [20].
<i>Monitoring and continuous learning and improvement</i>	<ul style="list-style-type: none"> • Integral to design are the monitoring and remedial mechanisms – should not be <i>ad hoc</i> additions after implementation [5]. • Fine-tune the process [12]. • Learning and adaptation of the policy be made explicit at the outset and the inevitable policy changes become part of a larger, recognized process and are not forced to be made repeatedly on an <i>ad hoc</i> basis [8]. • Policies should test clearly formulated hypotheses about the behaviour of an ecosystem being changed by human use [6]. • Learn to live with change and uncertainty [19]. • Policies should be expected to evolve in their implementation [22,23]. • Increase information on unknown or partially unknown social, economic and environmental effects [5]. • Evaluate performance of potential solutions and select the best candidates for further support [12]. • Understand carefully the attribution of credit [20].

4. Seven tools for the adaptive policymaker

A brief history of the emergence of adaptive policies illustrates that this is not an entirely new concept. And in our field and desk research of policies in Canada and India, we observed many examples of policies that exhibit one or more features that have made the policy adaptive in some manner. But we are living in a much more complex and dynamic world today; therefore, the need for adaptive policies and adaptive policymaking approaches is now more urgent than ever. The time is right to take stock of the insights and lessons learned from existing and past policies and the available academic literature, and provide policymakers with a focused set of tools for policymaking in complex, dynamic and uncertain settings.

We have learned through this past century that policymaking is certainly not mechanistic. As we navigate progress in the 21st century, we must learn to see policymaking as adaptive – more like gardening¹: muddy, attentive and experiential, because we really do not know what growing conditions will prevail.

Our understanding of adaptive policies is framed by two types of capacities: (1) the capacity of a policy to adapt to anticipated conditions; and (2) the capacity to adapt to unanticipated conditions. The capacity to adapt to anticipated conditions is founded in an understanding and appreciation of cause-and-effect and outcomes. It is a capacity to help the policymaker deal with deep uncertainty; more specifically, a Level 3 type of uncertainty as introduced by Walker et al. [24, in this issue]. In facing Level 3 uncertainty, the policymaker is confronted by numerous plausible futures, the nature of which can be loosely anticipated through careful analysis and deliberation, but outcomes are not knowable with any certainty. This capacity to adapt to anticipated conditions is the more traditional of the two capacities, but is by no means a well-formed ability in most policymaking processes. A policy with this capacity can be crafted to:

- perform well under a range of anticipated conditions with little or no alteration;
- monitor changes in context and identify when these are significant enough to affect performance; and
- trigger built-in policy adjustments or deliberations necessary to determine policy adjustments to maintain performance or terminate the policy when it is no longer relevant.

¹ Based on conversations with Sholom Glouberman, Baycrest Medical Centre, Montreal, Quebec, Canada.

The capacity of a policy to adapt to unanticipated conditions is a much newer notion. Herein lays a new focus for policymaking. It is based on a holistic appreciation of system complexity, capacity, performance and dynamics. This capacity assists the policymaker in dealing with what Walker et al. [24, in this issue] refer to as Level 4 uncertainty. Unknown unknowns and surprises with serious consequences characterize this deepest level of uncertainty. The boundary between what is anticipated and unanticipated does change. What was unknown one day (the unanticipated), might well be known the next (now anticipated) and can be built into policy design. A policy with the ability to adapt to unanticipated conditions can be crafted to:

- accommodate unforeseen issues and changes in context for which the policy was not originally designed, but in ways that support the policy's goals;
- recognize emerging issues that will need to be addressed; and
- trigger further analysis and deliberation necessary to make policy adjustments to address emerging issues, maintain performance, or terminate the policy if it is no longer relevant.

Based on our review of academic and professional insights for working effectively in complex adaptive systems, on our research of specific policies exhibiting adaptive and maladaptive features, and on interviews with persons impacted by policy, we observe that the capacity of a policy to adapt to anticipated and unanticipated conditions can be facilitated using the following seven tools:



These seven tools are elaborated in the sections that follow.

#1. Integrated and forward-looking analysis

By identifying key factors that affect policy performance and identifying scenarios for how these factors might evolve in the future, policies can be made robust to a range of anticipated conditions, and indicators developed to help trigger important policy adjustments when needed [25].

Integrated and forward-looking analysis offers policymakers a way to view policy design retrospectively, prospectively, and comprehensively. These types of analysis are embodied in an approach referred to as scenario planning. Popularized by Royal Dutch Shell in the 1970s, scenarios are “frameworks for structuring executive’s perceptions about alternative future environments in which their decisions might play out” [26].

The scenario planning process fits nicely with the policy design process because the critically important first step in both is clarification. For example, policy set-up typically involves setting policy goal(s), identifying performance indicators and targets, and selecting policy options to consider (Fig. 1). Advancing more formally into the scenario planning process, the next step is typically to identify the key factors and higher level drivers that affect policy performance. These key factors are then assessed in terms of their relative importance to policy performance and also their relative uncertainty in terms of how they might evolve in

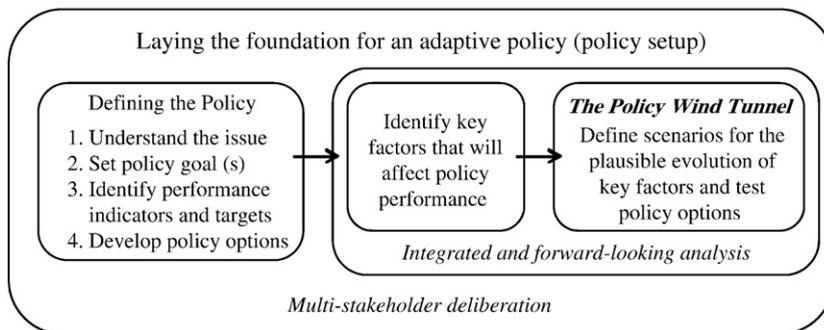


Fig. 1. Adaptive policymaking for anticipated conditions and the role of integrated and forward-looking analysis. Adapted from [25].

the future. Factors that are most important and most certain become a focus for risk analysis. Factors that are most important and most uncertain become the focus for scenario analysis. This latter step is the primary linkage and entry point to adaptive policymaking.

We observed in our case research an example of the analysis of key factors in the minimum support price instrument for Agriculture Price Policy (APP) in Punjab, India. The APP was initiated by the Government to provide protection to agricultural producers against any sharp drop in farm prices [27]. If there is a good harvest and market prices tend to dip, the government guarantees a minimum support price (MSP) or floor price to farmers, which covers not only the cost of production, but also ensures a reasonable profit margin for the producers.

The minimum support prices for major agricultural products are announced each year after taking into account the recommendations of the Commission for Agricultural Costs and Prices (CACP). The CACP takes into account all important factors including cost of production, changes in input prices, input/output price parity, trends in market prices, inter-crop price parity, demand and supply situation, parity between prices paid and prices received by farmers, etc.

- *Cost of production* – It is the most tangible factor and takes into account all operational and fixed demands.
- *Changes in input prices* – It has the ability to address an anticipated change in input price.
- *Input/output price parity* – It considers some anticipated uncertainties in the prices and thus facilitates adjustment.
- *Trends in market prices, international market price situation, inter-crop price parity, and effect on general price level* – It keeps track of changes in the market and influences the delivery of the policy.
- *Parity between prices paid and prices received by farmers (terms of trade)* – This anticipates a potential disparity and organizes this mechanism to address that.

In a scenario planning process for creating adaptive policies, if the policy outcomes assessed under a particular scenario do not perform well in relation to established targets for success, then three policy design questions should be addressed in order to help formulate an adaptive policy.

1. *Can a policy option be developed to perform in a range of anticipated future conditions?* This question deals with no-regrets type policy options. These are policies that are likely to work well no matter what anticipated conditions might prevail. Bankes [9] makes a practical and direct linkage between scenario analysis and adaptive policies. He suggested that “adaptive policies need to be evaluated on their robustness properties, not on their performance on any single case.” He advocates that scenario analysis can be used to find cases that break a proposed policy, and that such worst cases can stimulate policymakers to modify the range of possible policies to allow for combinations that hedge against these worst cases [9]. Lempert and Groves [28, in this issue] describe this notion as Robust Decision Making (RDM) and describe the use of scenarios to identify vulnerabilities and the actions and strategies necessary to ameliorate them.
2. *What are the potential adverse and unintended impacts of the policy and what actions can be taken now to mitigate or hedge against the consequences?* Walker et al. [29] and Marchau et al. [8, in this issue] point out in the context of transportation policy issues that adverse consequences “can reduce acceptance of the policy to the point where success is jeopardized.” They cite some of the vulnerabilities related to expansion plans for Schiphol international airport in the Netherlands. For example, noise can be a significant adverse consequence of an increase in capacity. They describe mitigating actions as possibly including buying out homes in the noise zone, subsidizing sound insulation, subsidizing real estate markets, and paying out compensation. Identifying the potential adverse impacts of a policy necessitates that the policy be reviewed periodically. This is the focus of adaptive policy tool #7, to be described later in this paper.
3. *How might the policy need to be adjusted in the future in order to continue to perform successfully and how will the adjustment be triggered?* It is certainly not always the case that a no-regrets policy option can be devised to perform successfully in a range of anticipated future conditions. In such instances, adaptive policymaking requires that critically important modifications to the policy be triggered and implemented at the appropriate point in time in the future. This requires monitoring changes in three types of indicators: (1) the key factors affecting policy performance; (2) system performance indicators that inform if the policy is achieving its intended goal(s); and (3) indicator s that monitor for potential unintended social, economic and environmental impacts. Such indicators are often referred to as signposts [8,29]. When a key factor moves outside the range considered in the design of the policy, a policy adjustment or reassessment is triggered.

#2. Built-in policy adjustment

Some of the inherent variability in socio-economic and ecological conditions can be anticipated, and monitoring of key indicators can help trigger important policy adjustments to keep the policy functioning well [30].

Built-in policy adjustment mechanisms help policies respond well in a variety of plausible and clearly identified future circumstances. They can speed up the process of response to conditions that are more or less anticipated. They can be used in complicated policy environments by separating the various policy issues into units wherein the understanding of the system is high, allowing for fine-tuning of the system and making adjustments that help reduce risks and maintain performance.

Built-in policy adjustment can be both *fully-* and *semi-automatic*. *Fully-automatic* adjustment can be used in a policy if the conditions that trigger the adjustment and the policy adjustment itself, can be pre-defined. *Semi-automatic* policy adjustment is similar to fully-automatic adjustment in that it requires pre-definition of the triggering conditions, but the precise adjustment

cannot be designed in advance. Some additional analysis and deliberation is necessary. The difference between *fully-automatic* and *semi-automatic* policy adjustment begins to define a continuum for how policy can be improved based on new information (Fig. 2). Further along the spectrum are cases where systems are comparatively less predictable and policy adjustments are manual, requiring a process of analysis and deliberation to review the policy, learn why it is not meeting its goals, and design the necessary improvement in the policy. A fully manual policy adjustment approach deals primarily with unanticipated conditions and is best dealt with through processes of formal review and continuous learning.

We observed several examples of *fully-automatic* policy adjustment in our research in Canada and India. Weather-indexed insurance in India is a particularly good example. It has emerged as an alternative to traditional crop insurance in India where settling a claim was a time-consuming process. Weather-indexed crop insurance is linked to the underlying weather risk measured by an index based on historical climate data, rather than the extent of crop yield loss. These weather insurance contracts have been found to offer quick payouts triggered by independently monitored weather indices and result in improved recovery times from weather-related stress. The built-in adjustment feature provides a simple mechanism for managing insurer risk and determining farmer eligibility for benefit payments, while passing along incentives to farmers to adjust to long-term change by providing appropriate signals calculated on the basis of actuarial risks [31].

In many situations, the precise policy adjustment requires some further assessment and deliberation. We refer to this form of policy adjustment as *semi-automatic*. An example of *semi-automatic* policy adjustment was observed in Canada's former Western Grain Transportation Act (WGTA) [32]. The freight rate for transporting grain across the Canadian Prairies was originally a fixed rate under the WGTA's predecessor, the Crow Rate. This fixed rate survived the better part of a century and had a disastrous impact on the upkeep of the rail transportation system. Under the new WGTA a variable transportation rate calculation was introduced, based on the railways' "cost of moving grain and intended to cover variable costs plus 20% toward constant costs." This cost was based on forecasts of grain volumes by the Grain Transportation Agency and on railway costs provided by the National Transportation Agency. The rate was also distance-based, designed to allow equal rates for equal distances [33].

#3. Formal review and continuous learning

Regular review, even when the policy is performing well, and the use of well-designed pilots throughout the life of the policy to test assumptions related to performance, can help address emerging issues and trigger important policy adjustments [34].

Formal review is a similar category of adaptive policy tool to built-in adjustment described earlier, in that it acknowledges that monitoring and remedial measures are integral to complex adaptive systems [5] and that it is necessary to constantly refine interventions through a continual process of variation and selection [12]. Yet formal review is fundamentally different from built-in adjustment. Built-in adjustment can anticipate what signposts to use and what actions might need to be triggered to keep the policy effective. Formal review, on the other hand, is a mechanism for helping to deal with unanticipated circumstances and emerging issues. It represents preset processes that occur even if the policy appears to be performing well. This regularly scheduled assessment process can be very useful in detecting emerging issues that can impact the policy's performance. McCray et al. [35, in this issue] are interested in a similar approach for adaptive policymaking. They endeavour to see policy adjustments made "without the ruckus", and that new knowledge be brought to old policies in a more thoughtful way, "one in which the underlying uncertainties are successively reduced – or at least better characterized – over time."

We describe the formal review and continuous learning mechanisms according to three aspects: (a) the types of *triggers* for the review; (b) the types of *review* that can result in policy learning; and (c) the types of *improvements* that can be made based on the learning.

(a). The triggers

Given the inherent uncertainty of the policy setting, there should be multiple ways in which a formal review of a policy is triggered. The first is based on a pre-defined time interval such as annual or bi-annual. This type of trigger is meant to help detect and track emerging issues, because, with such a time trigger, a review will occur even when the policy is working well and there

Anticipated Conditions (system well understood)	Anticipated Conditions (system not so well understood, but can be better understood over time)	Unanticipated Conditions (system not so well understood)
<i>Fully-automatic policy adjustment</i>	<i>Semi-automatic policy adjustment</i>	<i>Formal policy review and continuous learning</i>

Fig. 2. Spectrum of policy adjustments. Adapted from [30].

may be no apparent need for a review to be undertaken. But a time-triggered review may not be of sufficient periodicity under certain circumstances. If an unanticipated event occurs midway through a year and policy adjustment becomes necessary to avoid unintended impacts and ensure that policy outcomes remain on target, a second type of trigger is needed. Indicators of system performance, often called signposts, are helpful in this regard [7,8,24]. The complexity of most policy issues dictates that it is typically not possible to develop and track enough system performance indicators to detect the array of unanticipated circumstances. For this reason, the systematic tracking and distillation of stakeholder feedback is critically important for formal review and continuous improvement.

(b). *The review (the learning)*

Formal policy review is meant to assess if the assumptions for how the policy was intended to perform were accurate, and to study and implement any necessary changes to the policy. Ideally it should be both an analytical and a deliberative process to understand cause-and-effect relationships and to detect unintended impacts of the policy. The review process can also be in the form of a policy pilot to test out a policy on a smaller scale to assess its potential impact and how implementation mechanisms will perform.

Since the process needs to address unanticipated circumstances, its mandate and analysis should be wide-ranging and encourage creativity. Questions to be considered should include:

- *Goals:* Are the previously set goals still relevant? If not, what changes may be appropriate?
- *Current impacts of policy:* Is the policy as currently implemented having the intended impacts? Is the policy having unintended social, environmental, or economic impacts? Consideration should be given both to policy design and to its practical delivery.
- *Emerging factors affecting policy:* Are there new factors foreseen that might affect the efficiency or effectiveness of the policy in meeting its goals or cause the policy to have unintended impacts? What are the anticipated impacts of existing policy, given these emerging factors?
- *Overlap:* Does the existing policy overlap with other policies, including those from other levels of government or jurisdictions?
- *Management and administrative issues:* How could management and administration be improved?
- *Pilots:* What additional policy pilots or research tests are needed to better inform new policy instrument design and implementation?
- *New policy design:* Do new policy instruments recommended by the review process address issues of overlap, efficiency, and so on?

As noted above, one particular form of review process is the *policy pilot*. A review conducted by the Cabinet Office in the United Kingdom [36] focused on the role of pilot studies in policymaking. The study noted that “an important innovation in recent years has been the phased introduction of major government policies or programs, allowing them to be tested, evaluated, and adjusted where necessary, before being rolled out nationally” [36]. The study noted that the practice of policy pilots has been relatively widespread in the United States owing in part to its federal structure, which in many instances has implemented and evaluated a policy within one state before being rolled out nationally.

The practice of policy piloting was and still is common in the crop insurance industry. The early days of crop insurance in the United States adopted a trial approach after several policy failures. The experience in the United States likely influenced the Manitoba Crop Insurance Review Committee in Canada to recommend in 1954 that a crop insurance program make use of *test areas*. Their report cited that “certain groups favoured the setting up of test areas in which a crop insurance program could be trialed out and, if necessary modified before it was adopted throughout the province” [37].

In India, weather-indexed insurance was implemented on a pilot basis for various crops and locations by trying out different types of delivery models. The implementing agencies in India, ICICI Lombard and BASIX, have reported that this pilot experience was valuable to better understand risk parameters and the potential for commercial expansion [31]. It was also an opportunity to create awareness among farmers, build trust through timely payouts and improve the design in response to customer feedback. Moreover, the early pilot schemes offered by the private sector were followed by the entry of the public sector.

(c). *Improvement (the doing)*

There are essentially three types of recommendations that can emerge from the formal review process. One recommendation could be that no policy adjustment is required. It is also possible that the review process could recommend that the policy objective is no longer relevant under the new circumstances and, consequently, the policy should be terminated. A third type of recommendation from the review could be that a policy adjustment is necessary. In this instance there are four types of adjustments that can be made:

- An adjustment that can be made now to make the policy robust across a range of newly anticipated future conditions (without the need for future adjustments);
- A *fully-automatic adjustment* that can be pre-defined now and triggered at an appropriate time in the future;
- A system performance indicator is identified to trigger future analysis and deliberation for an anticipated policy adjustment, the precise nature of which cannot yet be determined (a *semi-automatic adjustment*); or
- Further analysis and deliberation is needed to better understand the issue and to determine how the policy should be adjusted.

#4. Multi-stakeholder deliberation

Multi-stakeholder deliberation is a collective and collaborative public effort to examine an issue from different points of view prior to taking a decision. Deliberative processes strengthen policy design by building recognition of common values, shared commitment and emerging issues, and by providing a comprehensive understanding of causal relationships [38].

Adaptive natural resource policies need to accommodate the diversity and dynamics of local biophysical conditions, as well as the unexpected trajectories of preference and social response to change. This means that decisionmakers should recognize the dimensions of diverse experience, knowledge, and user needs. In a complex and rapidly evolving world, public deliberation provides access to diverse and innovative perspectives and helps ensure adaptive responses [39].

The importance of deliberative processes at the local decisionmaking level can be seen in the experience of Hiwre Bazaar village in Maharashtra State in India. In a case study of community adaptation, the capacity of this village to adapt to climatic variability was illustrated to be demonstrably greater than that of other rainfed villages. Residents required less recourse to debt, and were able to maintain food stocks and production even in drought conditions, despite having only limited access to irrigation. The main differentiating factors were the village's strong leadership and deliberative processes for investment in water harvesting, irrigation management, introducing new cropping systems (even when these were not popular) and sharing lessons to spread innovations. The engagement of multiple perspectives at the village level, and the deliberation of evidence and experience in making choices, provided opportunities for social learning essential to strengthening resilience and adaptation [40].

Deliberation is commonly defined as “discussion and consideration by a group of persons (as a jury or legislature) of the reasons for and against a measure.” The term implies the reasoned consideration of evidence, careful forethought prior to decisions, and looking at different sides of an issue. In the context of public decisionmaking, the term implies a collective and collaborative effort to examine an issue from different points of view in order to share learning and build consensus prior to taking a decision.

We have chosen to make explicit the requirement that this process engage multiple perspectives to highlight the risk of structuring a consultative or deliberative process so as to reduce, rather than enhance, diverse engagement. Deliberative processes are always prone to manipulation because it is easier and quicker to make decisions if the range of input is limited or the legitimacy of alternative views is undermined.

Based on the literature reviewing public deliberation practice, its links to political and cognitive theory, and its application to natural resources management, we can describe the following characteristics of an effective multi-stakeholder deliberation process:

- Participation is voluntary [41].
- The effort is structured and led by skilled facilitators [42,43].
- The process is guided by explicit rules and procedures [42].
- All participants have an opportunity to speak, and all should feel that their views have been heard and considered without risk or prejudice [39].
- Participants include a broad range of stakeholders directly or indirectly affected by the decision [44].
- Deliberative proceedings are transparent and accessible.
- Participants engage each other on the basis of communication and open discussion.
- Deliberation is aimed at an explicit decision context [39]. It is not intended merely to generate opinions.
- Deliberation is most effective when conducted face-to-face [39,42].

#5. Enabling self-organization and social networking

Ensuring that policies do not undermine existing social capital; creating forums that enable social networking; facilitating the sharing of good practices; and removing barriers to self-organization, all strengthen the ability of stakeholders to respond to unanticipated events in a variety of innovative ways [45].

Glouberman et al. [12], in developing a toolbox for improving health in cities, recognized that complex adaptive systems “often spontaneously generate solutions to problems without external input or formally organized interventions. This self-organizing capacity is a free good that can be valuable in producing innovative and novel approaches to problems.” The capacity of individuals and groups to self-organize around problems, stresses, and crises has been well-recorded in social and biological literature and keenly affects the ability of communities to adapt to changing circumstances.

The relationship between social networks and resilience has also been highlighted in many contexts, including that of climate change impacts and responses. A well-known example to demonstrate the link would be that of the New Orleans flood in the United States in 2005. The day the flooding began to hit the community the hardest, locals remember there being no one around to help – the fire department was overwhelmed, much of the police force had left, and government representatives were in short supply. The army of volunteers that appeared in the middle of this chaos was attributed by Lejano and Ingram [46] to social networking. These volunteers, dressed in yellow t-shirts, carried vast amounts of emergency supplies and came from the Mormon Church. They displayed a strong sense of organization where other formal programs had failed. The authors use this as an example of the ability of an ongoing social network to respond to unexpected circumstances. The success of this social networking is attributed to the fact that it existed before the breakdown of formal relief systems, and allowed those within this network to communicate even when formal lines of communication (including phone lines) failed.

Self-organizing has been described as the process of social interaction around common issues that, from a policy perspective, enables the group to identify and implement innovative solutions. This process of self-organizing has been described as *social networking, building social capital, participation, and collaboration*. *Social networks* are a system of sustained, patterned relationships among actors [46] that facilitate the pooling of knowledge, concerns, and efforts toward a common cause.

These collaborations are often place-bound, implying that commonality among the members is important (of time, place, condition, joy, and suffering). This means that these groups are not just communicating, they are experiencing stresses together. This is an important impetus for self-organization in itself.

While the value of such social networks and self-organization is espoused in a wide range of literature, our primary interest lies in policy tools that will enable us to enhance such self-organization potential to create resilience and deal better with known and unknown stresses. Our search for supportive policy mechanisms has revealed the following key characteristics for policies to directly or indirectly enhance and enable self-organization and social networks as a positive mechanism to cope with uncertainty:

- *Ensure that social capital remains intact* [15]. If local groups and their networks are disempowered individually or collectively, existing social structures are in effect invalidated and undermined.
- *Create and promote effective spaces and issues for adaptive cooperation* [20]. Axelrod and Cohen [20] stress “proximity” as a driver for “interaction,” a concept akin to social networking. Promotion of such effective neighborhoods for adaptive cooperation could involve enabling community programs, or making community funding available to allow for a group to interact and determine the best use for the resources.
- *Facilitate copying through promotion of best practices and enhance leadership* [20]. In support of facilitating copying, Axelrod and Cohen [20] identify “following another agent” as an important enabler of interaction. In our policy case study from Canada on the Saskatchewan Soil Conservation Association, we noted that the “farmer-to-farmer” networking program allowed this sort of “copying.” Under this program, farmers who showed interest in conservation tillage practices were put in contact with a farmer in their region who was practicing conservation tillage. It was felt that farmers successful with the new and somewhat contentious technique would be the best leaders of change and would be best positioned to influence their peers.
- *Remove resource barriers to self-organization* [47]. Koontz [47] highlights the value of resources in enabling collaborative environmental management. He divides resources for collaboration into three broad categories: human, technical, and financial. While human resources include a collaborative effort's volunteers, leaders, and staff members, technical resources refer to knowledge about the environment, and about the local context, and financial resources are the funding and in-kind contributions that allow a group to conduct business and perform activities.

#6. Decentralization of decisionmaking

Decentralizing the authority and responsibility for decisionmaking to the lowest effective and accountable unit of governance, whether existing or newly created, can increase the capacity of a policy to perform successfully when confronted with unforeseen events [48].

In principle, having decisions made close to the citizens most affected is a way to provide better feedback and ensure that decisionmakers are well-informed about problems and effects of proposed interventions, as well as the nature of different interests. For policies directly concerning natural resources and ecosystems, decentralization should help decisionmakers notice significant change earlier, and mobilize affected local interests to address these changes more simply. The feedback loop between implementation results and policy goals can be effective even though it is informal, which can simplify policy design. Because local conditions and ecosystems vary widely, decentralization provides a way to implement policy more flexibly to ensure effectiveness and adaptation to change.

In studying how to build the resilience of communities for complexity and change in socio-ecologic systems, Berkes et al. [19] discovered that it is important to match scales of governance and ecosystems. More specifically, they note that common pool resource users, closely connected to the resource system, are in a better position to adapt to and shape ecosystem change and dynamics than remote levels of governance. Moench [49, in this issue] came to the same conclusion in studying embankment failures on the Kosi River in Nepal, and Wardekker et al. [50, in this issue] observed a similar trait in their exploration of the resilience approach for flood management in the Netherlands. The principle cited in the latter reference is “flatness” and stresses the importance of limiting hierarchies of decisionmaking because “early-warning signals observed at the bottom reach higher levels too slowly.” Principles for applying the ecosystem approach for natural resource management also highlight the importance for decentralization of decisionmaking. In 2000, the Conference of the Parties to the United Nations Convention on Biological Diversity endorsed the ecosystem approach and a set of twelve principles [21]. Among these were that “Management should be decentralized to the lowest appropriate level” (Principle 2) and that “the ecosystem approach should be undertaken at the appropriate spatial and temporal scales...that are appropriate to the objectives” (Principle 7). These insights remind us that policy and management efforts must be preceded by a careful determination of the best spatial scale at which to manage and govern a complex issue.

A good example of the usefulness of decentralization can be seen in one of the case studies undertaken for this project, namely that of the Conservation Districts in Manitoba, Canada. The Conservation Districts (CDs) were established over a period starting in 1959 and continuing today. They were tasked with managing soil and water conservation, and given small budgets and access to government staff expertise. They were governed by local boards of directors, but the boards were appointed by the provincial government. Their most interesting successes, from an adaptive policy viewpoint, have been in developing solutions to soil and

water management problems that were not foreseen or mentioned in their mandates. This success can be attributed, to a fair degree, to the fact that the local boards had to make their own decisions as to what issues to tackle and how to deal with them [51].

The potential for decentralization in any particular policy area will depend on the scale of intervention needed, the extent of local knowledge and capacity, and the structure of governance mechanisms for accountability and coordination.

Decentralization should consider the following in the context of the policy goals:

- *governance system* to be used, including responsibility both to local stakeholders and to senior levels of government;
- *geographic scope*;
- the *decisionmaking scope* to be given to the decentralized body;
- *access to revenues and the spending capacity* of the decentralized body;
- *staffing and resources* to be given to it; and
- the freedom of action and *entrepreneurial capacity* to be given to the decentralized body.

#7. Promoting variation

Given the complexity of most policy settings, implementing a variety of policies to address the same issue increases the likelihood of achieving desired outcomes. Diversity of responses also forms a common risk-management approach, facilitating the ability to perform efficiently in the face of unanticipated conditions [52].

Individuals, groups, communities, and systems have several defining characteristics that make them similar or different from each other. Some of these characteristics might be obvious, others not. Additionally, some characteristics might be latent, only to be revealed under stress at a later point in time [20]. This heterogeneity is instrumental in shaping the emergence of different responses from individuals, groups, communities, and/or systems even when exposed to the same stress. Diversity is indeed a key to understanding the structure and function of complex adaptive systems and enhancing their resilience to stress [53]. The ability to deploy a number of different responses enables a community to spread risk and create buffers in the face of shocks and stresses [19]. Any strategy that has a myopic focus and reduces the scope for variation faces a high risk of failure, especially when the strategy is based on an unreliable, uncertain hypothesis [54].

Variation in the policy realm simply means that several options are being used to achieve an intended outcome. Variation can be viewed as several “parallel experiments” being undertaken simultaneously with the aim of achieving a common objective. Glouberman et al. [12] recommend that policy interventions should *promote variation* because “introducing small-scale interventions for the same problem offers greater hope of finding effective solutions.” This is based on the understanding that “many interventions will fail and that such *failures are simply a feature of how one develops successful interventions* in complex adaptive systems” [12]. Within the context of adaptive policymaking, variation can promote learning, foster innovation, enhance performance, and accelerate the rate of delivery of critical services (which may include sanitation, drinking water, health, education, etc.) [55]. Wardekker et al. [50, in this issue] came to similar conclusions in exploring a resilience approach for climate change adaptation: principles of omnivory (the use of multiple approaches) and redundancy are important under conditions of complexity and deep uncertainty.

Promoting variation requires the policymaker to assume different roles:

- *Policymaker as Architect*. The policymaker acting as an architect can promote variation by designing and implementing a range of alternative options to meet the diverse needs of different stakeholders. This can be facilitated by: (1) using a mix of policy instruments; (2) exploring synergies with other policies; (3) providing opportunities for risk-spreading; and (4) undertaking cost-benefit analysis.
- *Policymaker as Facilitator*. Acting as a facilitator, the policymaker does not actually control what happens, but creates an enabling environment for variation to occur. Hence, the role of the policymaker in this context is to facilitate conditions that enable societies to create alternative approaches to achieve a common objective, or in response to a common issue, and requires being a “facilitator of learning” rather than being a “trainer” [51]. These actions include: (1) identifying influencing factors; and (2) removing barriers and facilitating variation.
- *Policymaker as Learner*. As a learner, perceiving and incorporating valuable feedback from the ground level of policy implementation is the core function of the policymaker.

We observed a good example of using a mix of policy instruments in the Government of Canada’s new Agricultural Policy Framework, “Growing Forward” in 2008 [56]. *Growing Forward* programs were developed based on consultations with over 3,000 participants from across the country. The programs are guided by a vision for a profitable and innovative agriculture, agri-food and agriculture-based products industry that seizes opportunities in responding to growing market demands and contributes to the health and well-being of Canadians [53]. The new suite of programs is designed to be more responsive, predictable, and bankable for farmers. The new approach advances agricultural stabilization policy into the proactive realm of risk management. The four programs that form the business risk-management approach are: *AgriInvest*, providing coverage for small income declines and allowing for investments that help mitigate risks or improve market income; *AgriStability*, providing support when a producer experiences larger farm income losses; *AgriRecovery*, providing a coordinated process for federal, provincial and territorial governments to respond rapidly when disasters strike, filling gaps not covered by existing programs; and *AgriInsurance*, an

existing program that includes insurance against production losses for specified perils (weather, pests, and disease), which is being expanded to include more commodities [57].

5. Reflecting on the seven tools for adaptive policymaking

We suggest in this paper that public policy can be designed to be more adaptive, even to unanticipated conditions, to reduce the risks of policy failure as circumstances change. This is helpful because policies that fail to adapt to key changes in their operating environment will not only fail to achieve their desired objectives, but may actually make things worse. For example, one of the cases examined in this project was the Canadian grain transportation tariff known as the Crow Rate. It started off as a policy tool to support both rail and agricultural development in western Canada. But after decades without revision, it became a barrier to profitability of the railways and this led to poor service for farmers. Had this policy been designed to respond better to changing circumstances, it would not have become inimical to its own goals.

The damage control needed when policies go badly “off the rails” can be extremely costly and time-consuming, both from a political and a professional standpoint. It is much more efficient in the long run to design adaptive features into policies so that less management effort is required and the timing and scope of revisions can be accommodated in the implementation process as a matter of course.

In addition to avoiding difficulties of failure over time, adaptive policy design can also help with gaining policy support. When implications or policy outcomes are uncertain, decisionmakers may well prefer to postpone decisions until the issues are better understood. This not only slows decision processes and clogs up policy pipelines, but in some cases, it can exacerbate the problem and further complicate the eventual need for action. However, if decisionmakers can be shown policy instruments that will be effective across a range of plausible futures, and can handle anticipated and unanticipated circumstances gracefully, there might be more willingness to make commitments that will unblock policy logjams.

As illustrated in Fig. 3, there are essentially four tasks that a policymaker needs to undertake in order to create and implement an adaptive policy. These tasks feed into the iterative policy cycle at different stages, and build in adaptability. The seven tools described in this paper will help policymakers undertake these tasks.

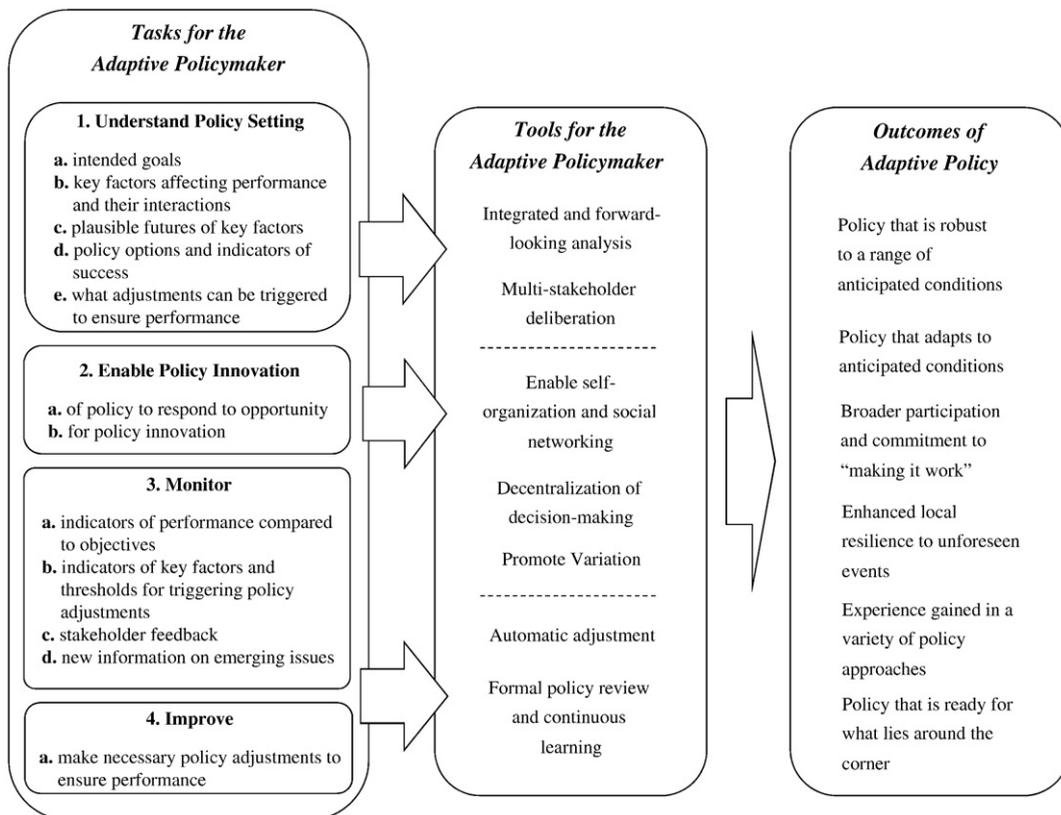


Fig. 3. Tasks and tools for the adaptive policymaker. Adapted from [58].

5.1. Task 1: understand the policy environment

The first task of the adaptive policymaker is to understand the policy environment within which they are operating. This includes a clear understanding of the intended goals of the policy as well as the key factors that affect policy performance; the plausible evolution of these key factors over time; policy options and indicators of success; and the types of policy adjustments that can be made in the future to ensure performance. Adaptive policymakers can make use of *integrated and forward-looking analysis* (tool #1) and *multi-stakeholder deliberation* (tool #4) to understand policy performance in complex settings and build consensus on how the policy might be adjusted to achieve its intended objectives.

5.2. Task 2: enable policy innovations

As we observed in the case studies, adaptive policies enable diverse responses to opportunities that emerge on the ground, or foster the capacity for innovative local policy implementation. These characteristics of adaptive policy help to address unanticipated circumstances by encouraging learning, innovation, and diversity. Enabling these kinds of capacities through policy design is therefore very important in complex, dynamic, and uncertain settings. The policy designer should look for opportunities to allow for multiple solutions to be developed and implemented for particular problems, and should also ensure that there are mechanisms to both monitor and share lessons from critical evaluation. These strategies not only manage risk of policy failure by diversification, but also foster the capacity of local organizations to identify and respond quickly to emergent opportunities or threats.

One tool discussed for enabling innovation of this type is to foster *self-organization and social networking* (tool #5). Another tool to foster innovation is *decentralization of decisionmaking* (tool #6). The rationale for this as an adaptive policy tool is that it puts responsibility closer to those who are most affected by change and enables quicker responses to local priorities. This is particularly relevant for ecosystem management, which must be managed at multiple scales, including the local, because of nested structures and overlapping functions. But such decentralization must be closely coupled with the provision of the necessary financial and human resources. A third tool highlighted in this paper is *promoting variation* (tool #7). Promoting variation itself encourages resilience, particularly when diverse processes and outcomes can be compared and lessons shared.

5.3. Task 3: monitor

If there is no monitoring of policy implementation in comparison to intended objectives, adaptive policy mechanisms cannot function. While this may seem obvious, most policies do not have regular, built-in monitoring mechanisms.

Formal policy review (tool #3) may be designed into policy implementation using monitoring and triggers. At a minimum, reviews should be triggered by the passage of a pre-defined time interval to ensure that emerging unanticipated issues can be detected and responses designed. But there are other important triggers, such as thresholds (ranges of validity) for indicators of key factors that affect policy performance, targets for policy performance, stakeholder feedback, and the availability of new data and information that challenge the original assumptions underlying policy design and performance.

Monitoring should be selective. There is no need or value to monitoring information that is not informative. So part of monitoring is identifying appropriate indicators that are clear, observable, and directly tied to the policy objectives through mechanisms understood from the first task. *Integrated and forward-looking analysis* (tool #1) using scenarios is a helpful tool to identify key factors that affect policy performance. Monitoring can then trace indicators of the key factors that are linked to particular scenarios to demonstrate what characteristics of plausible futures are being realized over time.

It is through systematic policy monitoring and formal policy review that the assumptions about how a policy will perform are tested and assessed.

We also observed that *built-in policy adjustment* (tool #2) was a particularly useful tool for making policy adjustments in situations where the key factors affecting policy performance could be anticipated clearly and potential adjustments defined in advance. But given the dynamic and uncertain nature of ecosystems, society, and our economy, few policy adjustments can be pre-defined and triggered at the appropriate time. Dealing with the 'unknown unknowns' requires more *formal policy review* and working with the adaptive tools for *enabling self-organization and social networking* (tool #5), *decentralizing decisionmaking* (tool #6), and *promoting variation* (tool #7).

5.4. Task 4: improve

The adaptive policy cases and tools described in this paper illustrate the importance of improving failing policies in the face of new conditions. Improvements can take many forms, such as: revision to the original policy objectives when they are deemed no longer relevant to the current circumstances; specific adjustments, such as *fully- and semi-automatic* policy adjustments using pre-defined triggers; or the need for further analysis and deliberation to better understand the issue.

But demonstrating the need for change does not guarantee that it will take place. Policymakers often face barriers to policy revision that have little to do with evidence. The more people affected, and the more powerful the entrenched interests, the more difficult a policy change can be to implement. The *decentralization* and *multi-stakeholder deliberation* tools provide ways to facilitate policy change. Deliberative mechanisms help to build consensus and identify common values underlying policy.

Devolving flexibility for policy change to the local level may make it easier for leaders to build consensus among divergent interests on the need for revisions to meet changing circumstances.

The adaptive policy tools of *integrated and forward-looking analysis*, *built-in policy adjustment*, and *formal policy review* help achieve policy improvement directly and in a traditional sense (i.e., policy change based on analysis and review). But it is very important for the adaptive policymaker to remember that tools for *enabling self-organization and social networking*, *decentralizing decisionmaking*, and *promoting variation*, also help achieve policy improvement through more contemporary means (i.e., through continual learning-by-doing and policy innovation on the ground).

5.5. Outcomes of an adaptive policy

Collectively, the seven tools described in this paper work together to help a policy achieve its intended purpose. As summarized in Fig. 3, the adaptive policy tools can help a policy be more *robust to a range of anticipated conditions* and to *adapt over time* as necessary. Together the adaptive policy tools help to *broaden participation and commitment* to making policy work. Perhaps most importantly, the use of adaptive policymaking tools can help to *enhance local resilience to unforeseen events*, gain experience in a variety of policy approaches to *learn what works and what does not*, and to *make policy ready for what lies around the corner*.

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