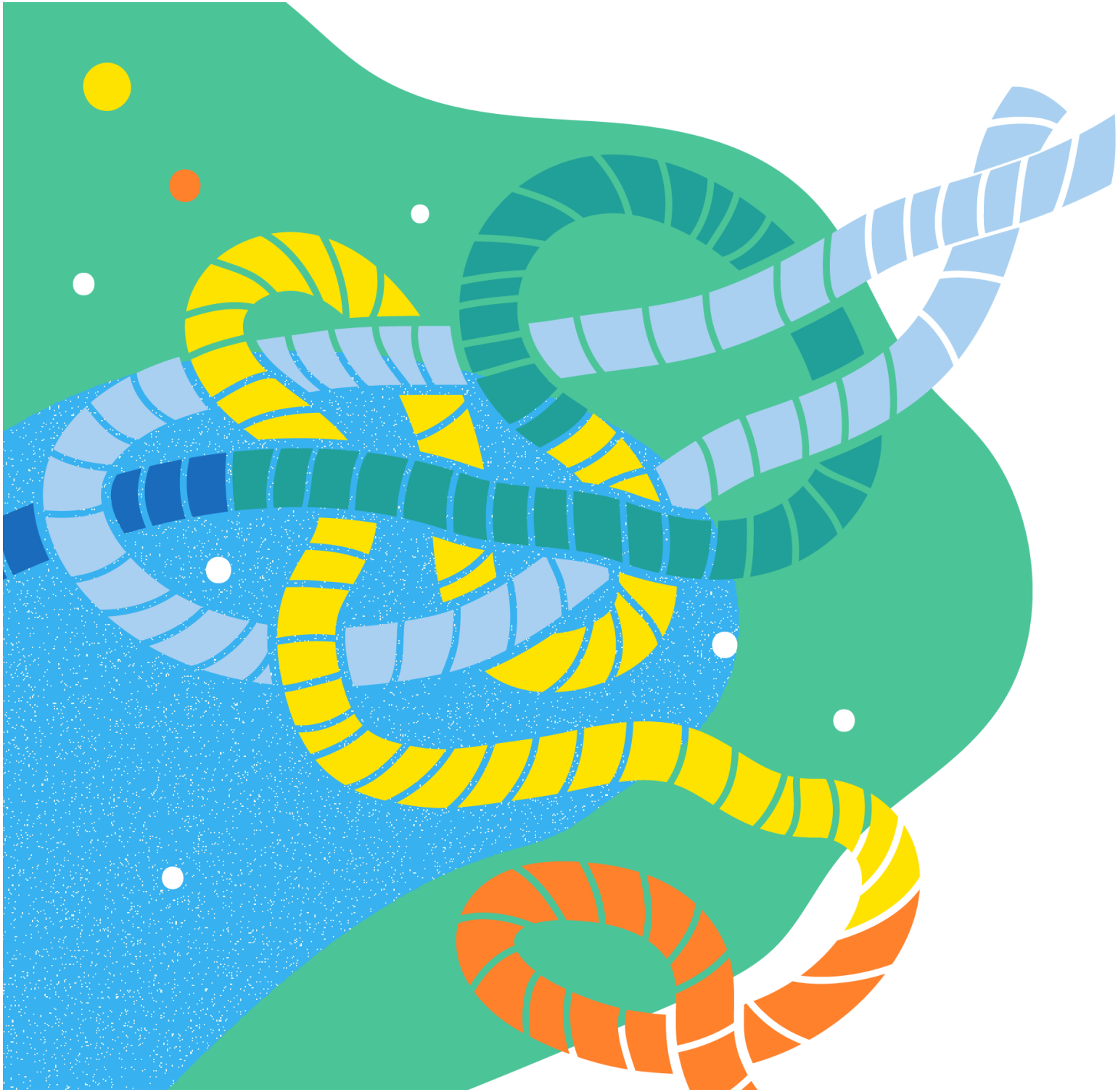

PHASE 3:

EXPLORING SYSTEM DYNAMICS

Exploring system dynamics is the core technical element of Wayfinder. The main objective here is to deepen the understanding of the dynamic relationships between key system variables that influence how the system works. This work builds on structured dialogue and analysis, and will require active involvement of key stakeholders*, people with 'technical' expertise, and people with advanced* systems thinking *skills.*

PHASE CONTENT

Module A: Understanding social-ecological interactions across scales

Module B: Exploring option space

Module C: Looking at alternative future trajectories

Evaluation, reflection and sense making

INTRODUCTION

Beginning with the conceptual system model developed in Phase 2 that illustrates relationships among parts of the system the task here in Phase 3 is to investigate how the system works. Thus, we focus on the interactions between key system variables that shape the current trajectory of development and that give rise to the dilemmas people experience. This exploration will lead to a set of informed hypotheses about how the system currently works, what the option space looks like, and where the system might be heading in the future.

Exploring system dynamics involves structured dialogue and analysis. While the stakeholders involved in the process will have knowledge and experience that is necessary for this exploration, you will most likely also have to consult with other people with insights to how the system works, such as scientists. The goal is to produce a robust systems analysis, which reflects the impact of important cross-scale interactions, and which will inform the strategies for change that you will develop in the Phase 4. Working collaboratively to integrate different perspectives, articulate assumptions, and to co-produce this understanding is key to ensuring the legitimacy of the process and the quality of the outputs.

PHASE CONTENT

In Module A, you develop simple models that illustrate how key system components interact to produce benefits and dilemmas. You then use these models to identify thresholds of potential concern in the system, as well as potential “lock-ins”, where the system gets trapped by reinforcing feedbacks that perpetuate an undesirable situation. Finally, you reflect on how system dynamics can change over time, as it moves through different cycles, and the potential influence of systems operating at different scales.

Module B deals with option space, which refers to the long-term capacity for adaptive and transformative change. Here you analyze how seven different dimensions of the option space are manifested in your system, and you assess how these dimensions have changed over time. Doing this analysis before you move into Phase 4 helps you to avoid creating new and potentially worse problems when trying to solve the immediate ones.

In Module C we look towards the future, scanning the horizon for new emerging drivers of change, and developing a set of future scenarios. We explore these futures by looking at how close they align with stakeholder’s aspirations, the benefits they hold for different groups of people, and how the option space is

affected. Thinking about the future as multiple alternative possibilities or trajectories, helps us remember the inherent uncertainty of the Anthropocene. Scenario planning may also help with identifying critical decision points, where action is required to avoid crossing a threshold in the system. Scenarios can also increase the robustness of the strategies you design.

OUTPUTS

Phase 3 will generate three concrete outputs. The first is a **model of system dynamics** (or set of models), that illustrate key interactions, thresholds of potential concern, and existing traps in your social-ecological system. The second output is an option space diagram, that illustrates how important dimensions of the option space have changed through time. The third and final output is an analysis of plausible future trajectories for the system, expressed as a set of alternative scenarios, where important drivers for change, key uncertainties, and critical decision points are identified. All outputs from this phase are essential to develop strategies for change in Phase 4.

MODULE A

UNDERSTANDING SOCIAL-ECOLOGICAL INTERACTIONS ACROSS SCALES

MODULE CONTENT

Work card 18: Developing simple models of key interactions

Work card 19: Identifying thresholds and traps

Work card 20: Cycles of change linked across scales

WORK CARD 18:

DEVELOPING SIMPLE MODELS OF KEY INTERACTIONS

The behavior of social-ecological systems is influenced by the interactions between its component parts. These include key variables that span different sectors and scales, and respond to system drivers. Over time, these dynamics lead to a particular development trajectory. This work card describes how to approach the question "how does this system currently work?"

ASK AT LEAST 5 WHYS

There is no one correct way of approaching the question, "how does this system work?". Exploring the relationships between key system variables that govern a system's behavior can be done in many different ways. Our advice is to start by qualitatively focusing in on the more slowly changing system variables (controlling variables), on potential thresholds and on key feedbacks.

Exploring system dynamics is the core technical element of Wayfinder. The main objective here is to deepen your understanding about how the system works, and how interactions between key variables in the system influence the overall development trajectory. Photo: iStock.

One way to start is to work backwards from the aspirations, system benefits and dilemmas by asking 'why?' Asking at least 5 'why' questions can often reveal a huge amount of detail about how a system works. For example, it is increasingly common that marine life gets trapped and killed by ghost nets. But why do fishers lose so many nets that then start drifting around? Why are fishers forced to go further out to sea where they are exposed to more intense storms? Why are middle men supplying fishers with

credit to purchase more powerful boats allowing them to travel further out to sea? Why do economic benefits of illegal fishing flow from the local fishers to wealthy operators located in other countries?
Remember the Iceberg figure we talked about earlier in the introduction and in work card 8? This drilling down into the system is designed to get you to look past the 'surface' issue (e.g. drift nets killing marine life) to discover the underlying dynamics (weak governance arrangements allowing wealthy external operators to exploit the local economic conditions). While it is tempting to jump to solutions, you should continue to drill down as far as you can. At this stage, it is important to really engage with the complexity of the system. It is important to recognise here that the process of drilling down and understanding complex systems is messy and at times overwhelming. Eventually however a clearer picture will start to emerge. Later on, once you have a good idea about which relationships are really structuring the system, you can revise and refine your systems model making it simpler by reducing it to the key variables and critical dynamics that will help you to identify leverage points for systemic change.

LOCATING THE DILEMMAS IN THE OVERALL SYSTEM DYNAMICS

This deep exploration of dynamics should help you to 'locate' the crux of the social-ecological dilemmas (figure 18.1), and also explain why the system generates a particular bundle of ecosystem services. Thus, the goal is to identify a smaller set of specific relationships between important system variables, given existing external drivers of change, that may explain the current state of affairs. A number of different tools can help you to approach this task.

- To explore how one key variable behaves in response to existing drivers of change (e.g. how availability of land declines in response to population growth), make a simple 'behavior over time graph'
- To explore how a dependent variable changes in response to an independent variable (e.g. how crop yields decline in response to soil salinity), make a simple 'dependent/independent variable' graphs
- To explore relationships between individual system components, make an influence diagram that links the variables together. See the attached case from the Wayfinder process in

Senegal, illustrating how key components in the pastoral system link to each other.

- To further explore interactions and feedbacks make a 'causal loop diagram' (figure 18.1), that characterizes the different feedbacks as either reinforcing or balancing. For example, education and income levels are strongly linked through a positive feedback, whereas social cohesion and crime are also strongly linked but through a negative feedback, meaning that the higher the social cohesion the lower the crime rate is, and the lower crime rate the higher social cohesion. See the attached case from South Africa, which shows a causal loop diagram of a fynbos system that has become dominated by invasive Wattle.

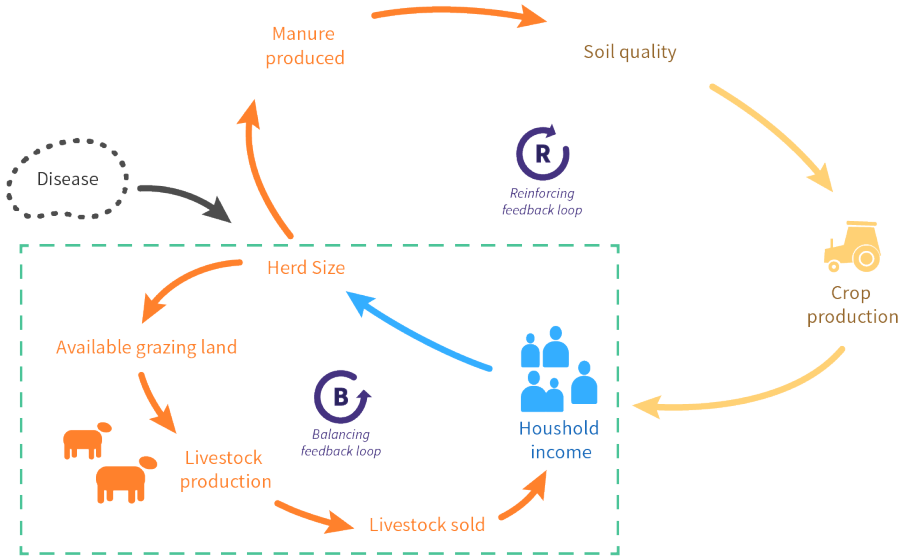

Figure 18.1. A causal loop diagram highlights how key social, economic and ecological system variables interact, in response to existing external drivers and shocks. These interactions sometimes take the form of feedbacks, which may either have a reinforcing or a balancing impact on system behavior. Locating a social-ecological dilemma in the overall system dynamics is important to be able to design effective solutions. In this stylized agro-pastorlist example, the problems evolve around the lack of grazing land which hampers livestock production, which also has an impact on farmland management. Illustration: E.Wikander/Azote

START QUALITATIVELY RATHER THAN QUANTITATIVELY

When analyzing system dynamics, there is a tendency to look to quantitative models. We want to stress here

that it is more important at this stage to identify the key variables and relationships between them, than to pursue a detailed quantitative model of a specific part of the system. Later on, quantitative models on specific system dynamics can be very useful to test hypotheses, but to start this analysis you may begin by simply drawing on a whiteboard or piece of butchers' paper, preferably with key stakeholders involved. This process is often enough to generate a set of key insights about how the system works.

Keep in mind that you are exploring and learning, so you should feel free to play around with different approaches until you feel you gain a better understanding of how the system works, rather than trying to get it exactly right with one specific approach. The aim here is for you, your coalition and key stakeholders to rapidly gain new insights into key system dynamics. If something is not working, don't persist with the same approach, instead try a different type of analysis, go up a level in complexity, change the starting point, come back to the issue later. or consult with someone else with a different perspective. It is also important to remember that while you have 'located' or framed the social-ecological dilemmas in one way now, that may very well change later, as your understanding of system dynamics evolves.

DOCUMENT ASSUMPTIONS AND EVIDENCE

Underlying any model are assumptions. For example, in a system that relies on irrigated crops, there may be assumptions made regarding the amount of water available, the suitability of the type of crops being grown, or the market value of the crops. It is critical to be clear about whatever assumptions exist about the system and how this is represented in the model. They need to be articulated and critically reviewed using data and evidence where available. Where data or other evidence is not available, you may need to test your assumptions through small-scale experiments as part of implementation. Also, you should consider if there are there opportunities to learn about your assumptions from others or existing activities that are currently taking place in the system or similar systems elsewhere.

The models that you create will never be exact or fully correct. You should rather see them as a developing hypothesis based on your current understanding and the information and evidence that is available at the moment. This mindset is very important for being successful in phases 4 and 5 of Wayfinder.

WORK CARD 19:

IDENTIFYING THRESHOLDS AND TRAPS

Once you have created a set of models that provisionally explain how the system works, it is useful to take a step back, look at these models, and reflect on specific types of system dynamics that are of particular importance for navigating towards a more sustainable, safe and just future. This work card describes how you can identify thresholds of potential concern and social-ecological traps.

WHAT IS A THRESHOLD OF POTENTIAL CONCERN?

Social-ecological systems change gradually but can also change abruptly. When they change abruptly, it is often because one or more thresholds in the system have been crossed, which leads to a change in system dynamics, including system feedbacks, whereby the system may start to develop along a different development trajectory. Sometimes that type of change is irreversible, at least from a practical perspective. These types of "regime shifts" have been identified in many different systems, including for example in clear-water lake shifting to turbid-water lakes, in coral reefs shifting to algae-dominated reefs and in savannahs becoming overgrown with bush. A regime shift can lead to a loss of important system benefits, in which case it can be regarded as a 'trap' (see below). A more detailed description of a regime shift can be found in the attached case from the Black Sea, which has shifted from a top predator dominated state to a jellyfish dominated state.

Girl swimming in a soup of algal bloom in the Baltic Sea, Gotland, Sweden. Sometimes social-ecological systems can shift abruptly, going through a "regime shift" whereby important system benefits are

lost. The recent shift to more frequent summer algal blooms in the Baltic Sea, related to to eutrophication and land use change, can be seen as a regime shift, where among e.g. opportunities for recreation are lost. Photo: A. Maslennikov/Azote.

Some of these shifts occur due to ecological thresholds, but keep in mind that there may also be social thresholds, beyond which the system starts behaving differently. Those are defined by social preferences, such as the critical number of people involved in an activity so that it becomes a new norm, the point at which the number of children at a school fall below the critical level for the school to remain open, the amount of produce required for a local food processing to commence, the distance at which it become no longer economically viable to transport food to a market are all examples of threholds, or the amount of forest destruction a community will tolerate before wanting to limit further logging.

BUILDING AWARENESS AROUND THRESHOLDS

Being aware of thresholds of potential concern in the system and actively working to avoid them is an important part of navigating towards more sustainable trajectories. But this is challenging, since thresholds are difficult to detect, and often only discovered after they have been crossed and the consequence are felt. A first step to keep track of potential thresholds in your system, is to build awareness around the existence of thresholds and the effects they may have on a system. Some organizations, such as the South Africa National Parks and the Avon Basin Natural Resources Management Agency in Australia, have fully integrated threshold monitoring into their management plans. In the Avon basin they have created a useful report-card type of approach to monitor and keep track of potential thresholds across different domains in their system (see attached case).

SOCIAL ECOLOGICAL SYSTEMS CAN GET 'TRAPPED'

In addition to thresholds, another particular type of system dynamics important to be aware of is "traps'. Social-ecological systems can become locked into situations that are undesirable but difficult to escape, i.e. they can get stuck in a trap. Traps arise due to self-reinforcing feedbacks between key system variables that keep the system locked into on an undesireable trajectory. In a trap, system benefits remain low or even decline over time, which is often the case after the system has undergone an unplanned regime shift. The

crossing of an important threshold in the system may change the dynamics so that a trap is formed.
A basic example of a trap is a household with low assets that is unable to invest in education, and as a consequence their potential for further accumulating assets remains low (figure 19.1). This is often referred to as a poverty trap, and they may have other important interacting variables as well, such as health or social capital. Another example of a trap are fishermen who buy bigger boats to compensate for declining fish catches. By doing so they become indebted and they have to fish even more (in absence of alternative livelihoods), with declining fish population as a likely consequence (see attached case on the Maine lobster fishery).

ESCAPING A TRAP

To navigate towards more sustainable futures, it is important to identify if the system, or parts of it, is caught in a trap. This has important implications for what kind of strategies you should design. Traps generally requires that we move beyond adaptive responses, towards more transformative change. Quick fixes that only treat the symptom of the problem are unlikely to unlock a trap. In fact, this may actually make the situation worse in the long run, as adaptive responses (in contract to transformative ones) have a tendency to reinforce current system feedbacks. Instead, to break out of a trap, you need to target the root causes of the problem and destabilize the feedback that maintains the situation. Unlocking a trap will often require coordinated efforts across sectors and scales. For example, in the poverty trap example above, it is unlikely that providing households with more capital will automatically lead to improved education levels, the education and (health) system might need to be reformed as well.

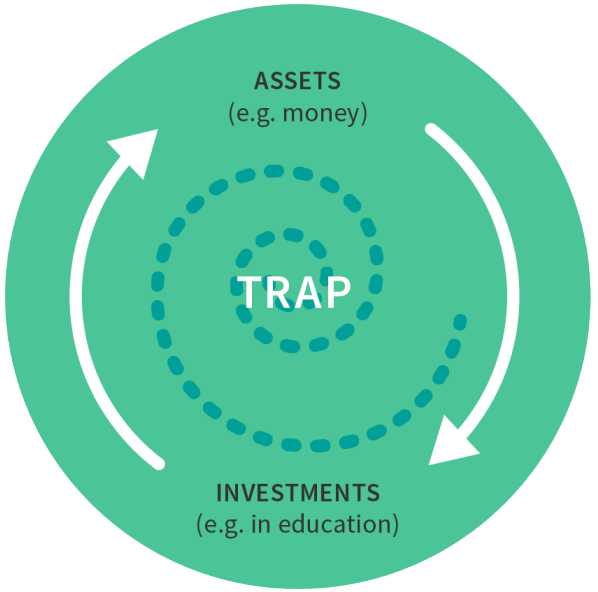

Figure 19.1. A simplified example of a lock-in situation, also called a trap. Reinforcing feedbacks keep the system in an impoverished state. In this simple example low levels of assets prevents investments in education, which further reduces the prospects for accumulating assets. Illustration: E.Wikander/Azote

Click here to learn more about traps and regime shifts by Jamila Haider, Postdoctoral Researcher with GRAID at the Stockholm Resilience Centre and Garry Peterson, Professor at the Stockholm Resilience Centre

IDENTIFYING THRESHOLDS AND TRAPS

A first important step in managing threshold and traps is simply to acknowledge that they may exist in your system. This is an important mind-set to adopt, because navigating towards a more sustainable future, will require that we take precautions and build buffers to thresholds, and that we respond in an appropriate way to traps. Then, to better understand these dynamics, examine controlling variables that change slowly, since they are often involved in both thresholds and traps.

Use the information that you collected in Phase 2, work card 10 on system benefits and work card 12 on historical changes, in combination with the detailed analysis of interactions between key system variables just performed in work card 18, explore thresholds of potential concern and the existence of trap dynamics in your system. Try to come up with a synthesized model of system dynamics that broadly explains how your system currently work. Use the attached discussion guide and two attached activity sheets to help your exploration and synthesis.

WORK CARD 20:

CYCLES OF CHANGE LINKED ACROSS SCALES

Another important aspect of system dynamics is how change happens over time. Many systems go through what can be described as cycles of change, passing through different phases. Systems experiencing these cycles are often linked together across scales, which has important implications for developing strategies to navigate towards a more sustainable future. This work card helps you analyze cycles of change in your system.

UNDERSTANDING SYSTEM DYNAMICS OVER TIME

You have now explored systems dynamics in some detail, and you should by now have integrated your understanding of system interactions, thresholds, and traps into a conceptual model that reasonably well explains how the system functions at present. However, systems change continuously, and it is therefore important to reflect on how system dynamics evolves over time.

Many systems go through what can be described as cycles of change, passing through different phases that can be characterized as: growth, maintenance, collapse, and reorganization. This pattern of change has been called an adaptive cycle. It reflects the development of a system from when it first becomes established, through a long period of maturing and stabilizing, where the system gradually becomes less flexible and more vulnerable to the shocks that sooner or later inevitably will hit the system, unravelling the structure and leading to collapse. This provides an opportunity for the system to reorganize and either rebuild in a similar way (through the same interactions between key system variables), or to adapt or transform along a new trajectory of development.

Forest wildfire in the Rocky Mountains, Bailey, Colorado, USA. Many systems go through cycles of change, passing through stages of growth, conservation, collapse and reorganization. Forest development, including their fire regimes, are a well-known example. Photo: iStock.

MEMORY AND NOVELTY

As discussed in work card 15, change over time in a system is influenced by what happens at other scales. As our world becomes increasingly connected, cycles of change are increasingly linked across scales (figure 20.1).

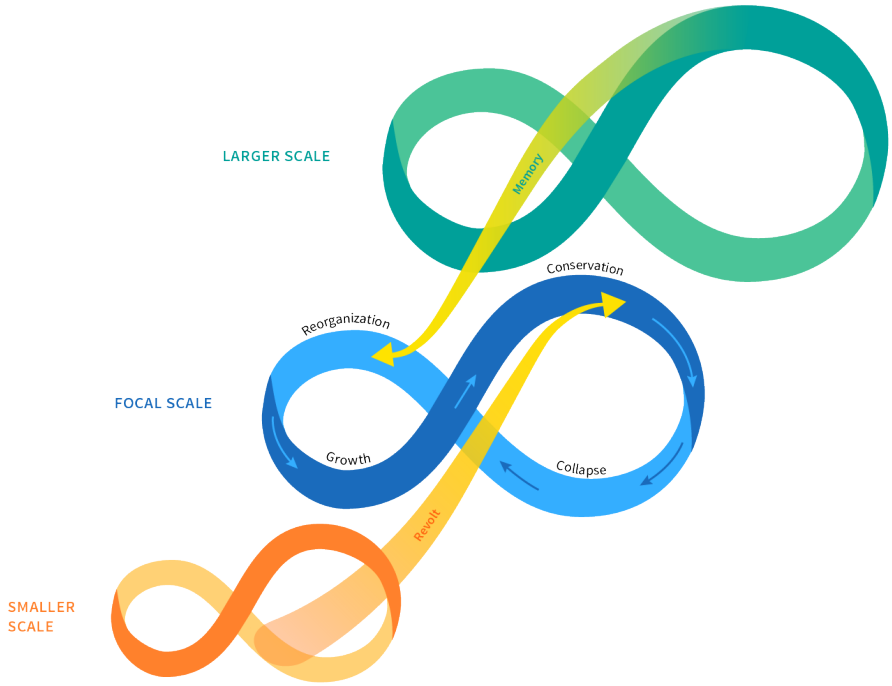

Figure 20.1. Adaptive cycle, linked across scales. Many systems go through what can be described as cycles of change, passing through different phases that can be characterized as: growth, maintenance, collapse, and reorganization. Larger scales often have a constraining effect on smaller scales, whereas events at smaller scales often create change at larger scales. Illustration: E.Wikander/Azote

At larger scales there may be national policies or market forces, but also environmental processes such as regional climate patterns that constrain what is possible at the focal scale during the reorganization phase and provide “memory” for the system. Similarly, at smaller scales, processes occurring at for example, the individual level, the farm level, or the community level, feed up into the system of focus. It is often through these smaller scales that novelty is introduced into the system, creating “revolt”, exemplified through many of the successful local social movements that we have seen in recent years that often have started as shadow networks operating in the margins of the system and challenging the current state of affairs until the system collapses at a larger scale.

These cross-scale interactions mean that solutions to many problems probably will lie outside the boundaries of the focal system. Importantly, this also means that proposed solutions need to consider the larger spatial and temporal context including how actions at one level may impact other places now and in the future. It is therefore useful to reflect on patterns of change over time in your system, and how it links to processes at other scales. The attached discussion guide can help structure your analysis of how cycles of change, linked across scales, may be relevant for your system.

MODULE B

EXPLORING OPTION SPACE

MODULE CONTENT

Work card 21: Developing locally relevant option space indicators

Work card 22: Analyzing trends in option space over time

WORK CARD 21:

DEVELOPING LOCALLY RELEVANT OPTION SPACE INDICATORS

Navigating towards sustainability is a continuous process and we need to nurture our capacity to adapt and transform to changing conditions. In Wayfinder we refer to this as maintaining or increasing option space within the system. This work card describes 7 dimensions that contribute to option space, and how you can start operationalizing these dimensions in your system.

WHY OPTION SPACE IS IMPORTANT

We live in a time of deep uncertainty, in a world increasingly characterized by shocks and surprises. As conditions change, so does the challenge of sustainable development. History is filled with examples of solutions that seemed like great ideas in the beginning, only to become part of the problem over time. Similarly, while solving one problem, we have often unintentionally created a range of new ones that we had failed to foresee. For example, while the green revolution brought about important increases in crop yields and led to a significant increase in wellbeing for many, indirectly and over time it also led to the displacement of farmers without secure land tenure, to severe effects on soil health and water quality as a consequence of excessive nutrient inputs, and to declining populations of important pollinator insects because of high pesticide use. Thus, while trying to solve the problems we face here and now, we need to make sure that we also maintain the capacity to adapt and transform in response to future change. In Wayfinder, we refer to this as maintaining option space within the system.

University students demonstrate during the People's climate march in Brisbane, Australia. Navigating towards sustainability is a continuous process and we need to nurture our long-term capacity to adapt and transform to changing conditions, such as a climate changing in unpredictable ways. In Wayfinder, we refer to this long-term capacity for navigating change as maintaining option space. Photo: iStock.

The idea of option space is akin to a system's general resilience, i.e. the system's capacity to deal with unforeseen change, shocks and stresses. Different resilience researchers and practitioners have operationalized this capacity in different ways, through some combination of principles that emphasizes issues such as diversity/redundancy, memory/learning/self-organization, connectedness/modularity, and leadership/participation.

OPERATIONALIZING OPTION SPACE

In Wayfinder we operationalize option space through seven dimensions. Developing these, we have primarily drawn on the work of scientists who describe a set of 7 principles relating to the resilience of ecosystem services. We have adapted this set to better fit with the broader framing of Wayfinder. In the Box 21.1 we list the 7 dimensions of option space that we propose, where the first three are important at an individual level, and the latter four relate to aggregated social, ecological or social-ecological levels.

Going through these dimensions, discuss how they translate to your system. Can you think of one or a few indicators for each dimension that is particularly relevant for your system? For instance, what aspects of diversity and redundancy are most important in your system? Is it the diversity of crops, or is it livelihood diversity, or the diversity of innovative practices?

Click here to learn more about the 7 principles for the resilience of ecosystem services by Oonsie Biggs, South Africa Research Chair, Social-Ecological Systems and Resilience Research at Stellenbosch University and the Stockholm Resilience Centre

BOX 21.1 – 7 DIMENSIONS OF OPTION SPACE

1. Foster biosphere stewardship and a culture of reciprocity – To have any chance at a more sustainable, safe and just future, it is essential that we, as humans, recalibrate our values. We must find ways to reconnect to ecosystems around us, we must become active stewards of planet Earth, and we must foster a sense of connection and reciprocity between people near and far.

2. Build capacity for complex systems thinking – Social-ecological systems are highly complex. Building capacity for complex systems thinking, where we consistently strive to look below the surface for explanations, is central for being able to navigate towards sustainability.

3. Encourage learning and reflexive practice – The most viable approach to managing and working within complex systems in the Anthropocene, where uncertainty, emergence, and surprise are

characteristic features, is one that focuses on learning. We also must stimulate innovation so that we have new sources to learn from.

4. Maintain social and ecological diversity and redundancy – System components with a diversity of responses, overlaps and back-up functions will provide key sources to draw on in the face of change

5. Manage cross-scale interactions and connectivity – In the hyper-connected world that we live in today, where global and regional trends affect all local prospects for development, and local actions aggregate up to produce systemic effects, managing cross-scale interactions and connectivity within social-ecological system is critical. This will both help us reduce the vulnerability to shocks that propagate though the system and enable diffusion of innovative practices.

6. Manage system feedbacks – Monitoring slowly changing system variables and identifying key system feedbacks is essential for creating both adaptive and transformative change. This includes identifying traps, where adaptive change in the short term may reduce the prospects for transformative change in the long term.

7. Promote inclusive and adaptive governance approaches, that integrate issues across sectors and scales – Promoting inclusive governance arrangements, where people actively participate in management decisions, through adaptive processes that respond to change and enable emergence, and that integrate relevant issues across sectors and scales, will greatly improve adaptive and transformative capacity over time

WORK CARD 22:

ANALYZING TRENDS IN OPTION SPACE OVER TIME

Having developed indicators for option space that are relevant in your context, the next task is to explore how the option space has changed over time. This work card describes a useful visual approach for doing just that.

REFLECTING ON CHANGES IN THE 7 DIMENSIONS

While social-ecological dilemmas are usually what interest people the most, the option space is related to the long-term capacity in the system to deal with the dilemmas. It is therefore important to spend a bit of time reflecting on how different dimensions of the option space might be changing, before moving into the problem-solving mode of Phase 4. A thorough exploration of trends in option space will point you to issues that are important to consider when designing your strategies for change, so that you maintain adaptive and transformative capacity over time and avoid creating new problems when trying to solve the immediate ones.

Commercial fishing boat off the West Coast of British Columbia, Canada. Exploring trends in option space highlights issues that are important to consider when designing strategies for change, so that you avoid creating new problems when trying to solve the immediate ones. This approach was used as part of a rapid resilience assessment of a herring fishery system in British Columbia. Photo: iStock.

Once you have decided on relevant option space indicators for your system (work card 21), you should investigate how each of these indicators have changed over time. Factors relating to ecological diversity and redundancy is generally declining in many systems, but for the other dimensions there may be more mixed trends.

DIFFERENT APPROACHES TO ASSESS CHANGE

Analyzing how the indicators have changed over time can be done in different ways, for instance through group discussions with key informants or other experts knowledgeable about the history of the system, through change detection surveys where you try to estimate the change based on people's perceptions, or where appropriate through quantitative analyses of existing timeline data on e.g. biodiversity trends, or income sources etc. Regardless of which approach you choose, it is important to select a time frame that is relevant for your system.

Figure 22.1 shows how you can synthesize the results through a simple spider diagram visualization, and the attached case details how this kind of approach was operationalized to quantify changes option space in a herring fishery in British Columbia, Canada. The attached discussion guide and activity sheet will help you explore changed in option space in your system.

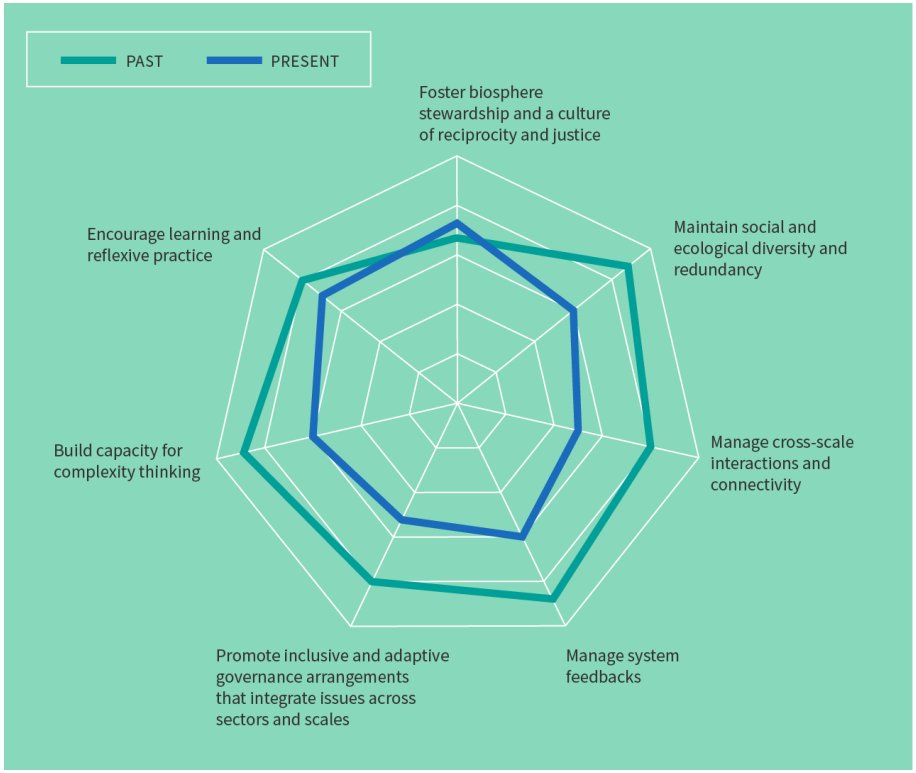

Figure 22.1. By measuring change in a set of locally relevant indicators for the seven option space dimensions, you can visualize how the option space have changed in your system over time. Illustration: E.Wikander/Azote

MODULE C

LOOKING AT ALTERNATIVE FUTURE TRAJECTORIES

MODULE CONTENT

Work card 23: Horizon scanning

Work card 24: Developing plausible scenarios

WORK CARD 23:

HORIZON SCANNING

A key insight in the Anthropocene is that although we should continue to learn from history, we must also be prepared for entirely new types of trends in the future, and emerging drivers of change. This work card describes how you can use horizon scanning to start engaging with an uncertain future.

A SYSTEMATIC APPROACH FOR IDENTIFYING NOVEL TRENDS

The planet is approaching critical planetary boundaries, and the hyper-connected reality of today means that new social trends can establish themselves faster and at larger scales than we have ever seen before. Before moving into Phase 4 where you will design strategies for change it is well worth the time to start thinking about how the future might be different from today.

Farmer looking at his coffee plantation, Brazil. Although we should continue to learn from history, we must also be prepared for entirely new types of trends in the future. Scanning the horizon for emerging drivers and trends is important to be able to develop strategies for change that will work. Photo: iStock.

Horizon scanning is a systematic process to identify and explore novel trends, which can serve as an early-warning approach for dealing with negative un-knowns, and a "bright spot detector" for emerging opportunities. Horizon scanning is often used to support policy decisions. In the area of conservation and biological diversity it has revealed such unexpected trends as the expansion of disease through the release of pathogens in melting permafrost. Horizon scanning has also revealed how technological trends, such as

plant breeding for salt tolerance, present opportunities for improved management.

There are different ways to go about conducting a scan of less well-known, but foreseeable, threats and opportunities. What is important is to use an approach that is systematic, rigorous and consults key sources of information. To conduct a solid analysis, you will likely also need to consult with experts outside of your system. Revisit the work you did previously on cross-scale interactions (Phase 2, work card 15, and Phase 3, work card 20) and use the attached discussion guide to help structure your exploration.

WORK CARD 24:

DEVELOPING PLAUSIBLE SCENARIOS

Based on your understanding of how the system currently works and the mapping that you have just done of emerging drivers for change, the next task is to develop a set of future scenarios. These should reflect a number of alternative, but plausible, future development trajectories for your system. This work card describes a simple approach to scenario planning.

ALTERNATIVE PLAUSIBLE FUTURES

Thinking about the future as a set of alternative possibilities helps us remember the inherent uncertainty of the Anthropocene. Therefore, it is useful to spend some time on scenario development before moving into the problem-solving mode of Phase 4, where there is always a risk that people become blinded by their ideal visions about how the system "should develop".

Photovoltaic power and wind turbines in the Mojave Desert, California, USA. Thinking about the future as a set of alternative scenarios helps us remember the inherent uncertainty of the Anthropocene. The purpose is to open up our thinking about multiple possible developments and how to make decisions when there is a high degree of uncertainty. Photo: N. Deshager/Azote.

It is important to remember that scenarios are not meant to be predictive. Rather, the purpose is to open up our thinking about multiple possible futures and how to make decisions when there is a high degree of uncertainty (figure 24.1). Depending on what the current trajectory looks like, and the emerging drivers of change, this might mean acting to prevent certain future developments and to actively move towards a new trajectory that better can fulfill the aspirations among people the system. Thus, in addition to increasing the general robustness of your strategies, scenario planning may also help you identify critical decision points in time, where actions may need to be taken to avoid crossing a threshold in the system or where you may take advantage of new opportunities that present themselves.

SCENARIO PLANNING

Scenario planning is a rapidly growing field of practice, and there are many different methodologies to choose from. Scenario planning can be time consuming, but if the purpose primarily is to open up your thinking about the future, as is the case here, it doesn't have to be. A good way to start a "light-pass" scenario exercise is to list and rank important drivers for change. The next step is to think creatively about how different combinations of these drivers (e.g. ++, +-, –, -+) might impact the system in the future. The attached case from the Makanya catchment in Tanzania, shows how this type of scenario planning approach helped thinking creatively about the future of smallholder farming and increasing the robustness of interventions made in agricultural water management.

Figure 24.1 Scenarios can be used to explore some of the plausible futures of a social-ecological system. This stylized representation reflects four potential futures of a farming system. The goal of using alternative scenarios is not prediction, but rather to engage with the range of uncertainties that exist about the future. Illustration: E.Wikander/Azote

In some cases, it might be worthwhile to conduct a more in-depth scenario exercise and some research might then be needed to determine the most suitable approach to use for your system and in your context with the time, capacity and resources you have available. Scenario planning can be combined with emerging tools such as *adaptation* pathways to map out the possible future trajectories of the system and how they may intersect at critical points in the future. The attached discussion guide lists a set of questions that cut across different scenario planning methods and can be used to stimulate thinking on how to integrate the scenarios you develop with your evolving system understanding, the change narrative that you have started working on, and the action strategies that you will be working on soon in Phase 4.

Click here to learn more about working with the future by Tanja Hitchert, Research Associate at the Centre for *Complex Systems* in Transition at Stellenbosch University

Click here to learn about the seeds of a good Anthropocene by Laura Pereira, Researcher Associate at the Centre for Complex Systems in Transitions at Stellenbosch University

EVALUATION, REFLECTION AND SENSE MAKING

EVALUATION

Before proceeding to the next phase, take some time to evaluate the quality of the process you have conducted so far, along with the quality of the data, information and content generated through this process. Use the list of conditions below to guide your evaluation. If you feel that you have not covered all points, we encourage that you revisit Phase three and see how to improve on the process or content before moving on to Phase four.

- System dynamics have been thoroughly explored,
  and feedbacks, thresholds and traps have been identified and analyzed
- Change dynamics over time have been considered, including the effects of cross-scales interactions
- The resulting systems model reflects the idea of requisite simplicity – it is as simple as possible without being over-simplified – and provides you with a good hypothesis about how the system works and why the dilemmas persist
- Relevant indicators for option space have been identified, changes in these over time have been analyzed, and the most problematic dimensions of option space have been identified
- Emerging drivers of change have been identified, and you have considered potential interactions between these
- Plausible future trajectories and their potential outcomes for different stakeholder groups have been explored
- Scenarios that are clearly undesirable for everyone have been identified together with action points to avoid these

REFLECTION

Having evaluated your work, it is useful to reflect more deeply on what you have learnt from the Wayfinder process so far. Use the questions below to guide this exploration. Make sure to capture your learnings, they will be important to guide you later on in the Wayfinder process.

- Can you distinguish between evidence and assumptions in the model of social-ecological

dynamics? Is the model supported by multiple knowledge types?

- How has your understanding of the dilemmas changed by exploring the system? Is the initial framing of the problems still appropriate?
- What key uncertainties around the system's future development can you identify? How will you deal with these, moving forward in the Wayfinder process and beyond?

SENSE-MAKING

Finally, try to make sense of what all this means for your ambition to navigate the system you are interested in towards a more sustainable, safe and just future. This is crucial to make sure you keep moving in the right direction.

- Given what you now understand about your system dynamics, emerging drivers for change, and plausible future trajectories, what level of change will be required to move towards a sustainable trajectory of development, and how acute is the situation?
- Where and how could that change be managed over time, which organizations and people will likely be key changemakers, and are they engaged in your process now?