From policy strategies towards individual reactions: A case study-driven analysis of the role of shocks for climate resilient development

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Abstract

Climate change impacts are major challenges for economy and society. Structural change is becoming imperative, focusing on climate resilient development, including mitigative and adaptive approaches. However, a current mismatch between capacities and the policy strategies and instruments fails to encourage climate resilient development. Based on a mixed-methods approach, using document analysis as well as semi-structured interviews with stakeholders and affected individuals, this paper elaborates how climatic and non-climatic shocks can lead to major changes in policy strategy development, promoting transformative changes and effectively leading to higher climate resilience. Following the IPCCs' concept of Climate Resilient Development Pathways, we use three case studies in Austria to analyse the role of shocks over three phases, their effect on policy strategies, and how these strategies impact specific reactions of affected individuals. The shocks cover flood, multi-seasonal drought, and the COVID-19 pandemic.

While after the shocks several existing and intended strategies were adapted and implemented to support affected individuals' coping and policy strategies were partly revised, we do not find any transformative power of the shocks, due to multiple factors. General system performance is negatively affected by disconnected governance levels, fragmented sectoral perspectives and the lack of taking regional particularities into account by higher-level strategies. In the case of overarching, binding strategies and objectives, the implementation of policy instruments at subordinate level is better supported. At the individual level, we find no joint realisation of mitigative and adaptative measures being triggered by policy strategies. Yet, there is also no clear cut which reactions were actually triggered by the shock or by parallel factors, such as long-term planning, staff availability or rising energy costs. Revised policy strategies and instruments should include binding elements, regional differentiation, flexibilisation, as well as incentives for regional transformative adaptation towards climate resilient development.

1. Introduction

Shocks are characterised as exogenous, rare, harmful, disruptive, and urgent events that may overstretch current coping capacities (Grossman 2015; Dolan 2021). In the recent past, various shocks through natural hazard events around the globe, such as the wildfires and thunderstorms in North America, or the severe droughts in South-Western Europe had heavy impacts on regional economic, social and ecological systems. In addition to the deplorable human losses, damages to material assets are estimated at US$ 250 billion for 2023 (Munich RE 2024). Losses caused by extreme weather events are likely to increase in the near future as regions continue to experience the ongoing impact of global warming (Dottori et al. 2018; Blöschl et al. 2019; Koks et al. 2019; IPCC 2022; Raymond et al. 2020).

Climate resilient development pathways (CRDPs) are trajectories for integrating climate change adaptation and mitigation to realize the goal of sustainable development, navigating the complex interactions between climate, social and ecological systems (IPCC 2022). Different actors, influenced by factors such as science, local knowledge, or the media, are both active and passive in designing and navigating CRDPs. Climatic or non-climatic shocks, e.g. droughts, floods or COVID-19, might disrupt these pathways. Especially the COVID-19 pandemic revealed the vulnerability of current societal and economic systems to shocks and stresses (IPCC 2014, 2022). Shocks often enable substantial reorientation of policy strategies (Thaler et al. 2020) by opening a policy window where existing policy arrangements that are designed only for managing routine developments may be discarded for a period of rapid policy evolution (Penning-Rowsell et al. 2006; Jones et al. 2016). However, radical and catalytic change happens rarely after a shock (Solecki & Michaels 1994).

In this paper, we illustrate the role of shocks by tracing policy strategy development and reactions of affected individuals over three phases based on the CRDP concept: before, during and after a shock. In the first phase (termed: *strategy development*) we include the underlying system performance prior to the shock (Farley et al. 2007; O'Donovan 2017), that is, how various stakeholders at different governance levels had managed previous conditions and had put specific policy strategies and instruments into place to prepare for and anticipate eventual shocks. How these stakeholders assess the policy problem and design policy strategies to deal with it is typically coloured by their predominant (policy) narratives (Sabatier 2007; Zahariadis 2007; Biesbroek 2021; Kammermann & Angst 2021; Zhou et al. 2021) and beliefs (McBeth et al. 2005; Shanahan et al. 2011; Shanahan et al. 2013; Jones et al. 2014; Crow & Jones 2018). The second phase (termed: *strategy application*) is kicked off by a climatic or non-climatic shock, resulting in a realignment of pathways that is shaped by already implemented strategies or by ad-hoc emergent instruments that are developed in response to the shock. The third phase shows the actions and outcomes of those affected by the shock (termed: *strategy impact*), including societal as well as individual protective and/or non-protective responses (Grothmann & Reusswig 2006; Babcicky & Seebauer 2019; Kuhlicke et al. 2020; Seebauer & Babcicky 2021; Noll et al. 2021), which are shaped by the individuals' risk and coping appraisal (Grothmann & Reusswig 2006; Babcicky & Seebauer 2019; Kuhlicke et al. 2020).

We use three case studies from different regions and sectors in Austria to analyse the role of shocks over the three phases of CRDPs, in particular how policy strategies evolve in consequence of a shock, and how these strategies impact specific reactions chosen by affected individuals. Covering diverse shocks, policy domains and affected individuals, our three case studies are: a) residential relocation after a flood, b) agricultural water management after a multi-seasonal drought, and c) tourism investments during and after the COVID-19 pandemic. The selected case studies are highly heterogeneous, to allow for different views: While, for example, there is long-standing experience with water management measures in the case of drought (Iglesias and Garrote 2015), the COVID-19 pandemic was an entirely new experience (Gössling et al. 2021), triggering the transfer of established climate policy instruments (e.g. promoting local renovation) as a reaction to the pandemic's impacts on the tourism sector. Relocation, on the other hand, is a unique and highly contested adaptation measure that has so far only been implemented as a last resort, but will likely gain importance as climate risks increase. In all three case studies the long-term recovery and prevention of future shocks have the potential to advance climate change adaptation as well as mitigation agendas.

2. Method

a. Description of case studies

The three selected case studies show empirically how shocks meet policy strategies and may promote transformative change towards lower carbon emissions and higher climate resilience. Table 1 presents the case studies' main characteristics.

Table 1: Main characteristics of case studies

	Case Study 1: Flood	**Case Study 2: Multi-seasonal drought**	**Case Study 3: COVID-19**
Region	Eferding Basin, Northern Austria	Seewinkel, Eastern Austria	Tyrol, Western Austria
Area	60 km²; rural; residential sprawl of nearby urban region of Linz in federal state of Upper Austria	450 km²; rural area east of Lake Neusiedl in the federal state of Burgenland	12,648 km²; federal state; mostly rural; many tourism municipalities; located in the Alps
Population at risk	About 700 households	About 1,000 farms cultivate about 33,000 hectare	About 21,800 accommodation providers with about 341,000 touristic beds
Shock (most recent hazard event)	Danube flood 2013	Multi-seasonal drought 2018-2022	COVID-19 pandemic 2020-2022
Individuals affected (unit of analysis)	Residents (private households)	Farmers (family businesses)	Tourism entrepreneurs (hospitality managers/owners, mostly family businesses)

In the paper, we differentiate between regional and local level. Thereby, the term regional comprises the federal state level as well as the whole area of Seewinkel and Eferding Basin, whereas the term local refers to the municipal level, villages as well as sites of private houses, farms or touristic accommodations.

The Eferding Basin is located upstream of the City of Linz, the capital of the federal state of Upper Austria. Upper Austria is among the economic centres of Austria, including large international companies in steel and chemical production, high-tech companies in the ICT-sector, small-medium enterprises as well as an important agricultural sector. The Eferding Basin is characterized by small-scale farming and single-detached family buildings, many of them constructed since the 1970s when the floodplain was claimed for settlement after the construction of hydropower plants along the

Danube river (Dolejs et al. 2022). Many inhabitants of the region commute to the nearby city of Linz. The region is highly prone to flood events, experiencing floods in 1954, 1967, 2002 and most recently in 2013 (Blöschl et al. 2013). After the 2013 flood, the public administration foresaw the realization of planned relocation of more than 180 private-owned buildings complemented by technical mitigation measures with total costs of € 96 million (Land Oberösterreich 2024). The policy problem in the flood case study is that the shock of the 2013 flood showed that unadapted housing on the floodplain is no longer tenable and that extensive public flood protection is neither affordable nor feasible. This raised the question how to enter a CRDP that modifies existing buildings or constructs new buildings that comply with both floodproofing and energy efficiency.

The Seewinkel region is located in the Austrian federal state of Burgenland, at the Hungarian border, characterized by a semi-arid pannonian climate. Important economic sectors are agriculture and summer tourism, concentrating around Lake Neusiedl and the regional vineyards. Drainaging regional wetlands started in 1945 to gain more land for agriculture, which led to low groundwater levels in periods of low precipitation (Blaschke and Gschöpf, 2011). However, agricultural irrigation highly relies on groundwater (Mitter and Schmid, 2021; Valencia Cotera et al., 2023). Droughts are recurring in the region and their severity peaked in the last years. In particular, farmers experienced severe droughts in 2003, 2013, 2015, 2018-2022 with related impacts of reductions in yield quality and quantity and thus income. The multi-seasonal drought in 2018-2022 represents the starting point of this case study. Facing the challenge of groundwater shortages (due to changing precipitation patterns, higher average temperatures etc.), the policy problem in the Seewinkel is defined as the gap between the impacts of drought on farms' economic viability on the one side, and the current combination of water-demanding land use and insufficient measures to adapt to droughts on the other side.

Tyrol has the highest economic dependency on tourism of all Austrian federal states. In 2018, tourism's direct and indirect contribution to the gross regional product was 19,7% (Fritz et al. 2021). In 2019, before the COVID-19 pandemic, 12,4 million tourists caused 49,6 million overnight stays, whereof 92% were generated by foreign tourists (Tirol Werbung 2024). The tourism industry in Tyrol is characterized by a high share of SMEs, especially family businesses (Kallmünzer et al. 2017). Historically, tourism developed predominantly endogenously, controlled by regional entrepreneurs and capital (Bätzing 2015). Even before COVID-19, climate change was considered a mid-term but grand challenge for Tyrolian tourism. Climate change will shorten potential ski seasons and declining snow availability will require more intense technical snowmaking (Steiger & Scott 2020). However, COVID-19 turned out to be one of the greatest challenges for tourism, as travel warnings and strict border controls significantly reduced the flow of foreign tourists (Peters & Steiger 2023). In Austria, the entire accommodation sector was locked-down by the authorities in the winter season 2020/21. To reduce the loss of revenue existing funding programs for tourism were increased and new COVID-specific funds were introduced. The lock-down situation also provided the opportunity for major conversion work that would normally have a massive impact on ongoing operations. The policy problem consists of the fact, that despite ambitious sustainability goals, the strategies at both national and regional levels suffer from a lack of binding measures, practical implementation, interdepartmental coordination and fragmented sectoral perspectives. This hampers the development of sustainable hotel and mobility infrastructure, leaving the region vulnerable to ongoing and future challenges in tourism sustainability.

The case studies provide a spectrum regarding the onset of the shock, the role of climate change in the policy problem, and the affected individuals. Flood and COVID-19 are momentary, stand-alone events, whereas multi-seasonal drought is an incremental, cumulative stressor. Flood and droughts are exacerbated by climate change, whereas COVID-19 had no direct cause in climatic conditions. However, all three shocks provide a window of opportunity for advancing CRDPs that integrate issues of climate change adaptation and mitigation.

b. Data and analytical approach

We apply a mixed-method approach (Tashakkori et al. 2021) for triangulation and cross-checking from different perspectives, combining document analysis with semi-structured qualitative interviews. This approach allows comparison, control and confirmation of the collected data and the interpreted results, while avoiding narrow, oversimplifying explanations.

The initial document analysis compiled policy documents published at European, national and regional level, to reconstruct system performance and policy strategies for the three case studies. In each case study, semi-structured interviews were conducted with key stakeholders to complement the document analysis, select the most relevant instruments within the policy strategies and to get deeper insights into regional strategy development (flood: n=14; multi-seasonal drought: n=14; COVID-19: n=12). In the flood case, the interviewed stakeholders represented regional associations and governmental agencies for water engineering, spatial planning, disaster aid, or climate coordination, which had been involved in the planning and implementation of the planned relocation process, were responsible for disaster aid payments or designed policy strategies and funding instruments for climate adaptation or mitigation at the national and federal state level. To cover the local authorities, all mayors from the Eferding Basin were interviewed. For the multi-seasonal drought case agricultural interest groups, regional water authorities, water cooperatives, regional associations, and mayors were interviewed, which had extensive experience in the planning and implementation of water management strategies in the region, and represented the agriculture, water and nature conservation sectors. For the COVID-19 case, key stakeholders in the tourism sector were approached at regional and local level, according to whether they influence or participate in the decision-making process (e.g., tourism association representatives, marketing representatives, experts responsible for tourism strategies at the regional level). In all case studies, stakeholder interviewees were recruited based on their mention in the analysed documents, previous research activities of the authors and website portals; subsequently, sampling was expanded by the snowball-technique.

Moreover, in each case study, semi-structured interviews were conducted with affected individuals to understand their perception of as well as their reactions to implemented strategies and instruments (flood: n=17; multi-seasonal drought: n=20; COVID-19: n=18). In the flood case, households were recruited from the address lists of previous research activities, aiming for balanced representation by relocation decision (stay/leave: n=8/9), biographical stage (aged younger/older than 50 years: n=8/9) and coping outcomes (Seebauer & Winkler 2020a). In the multi-seasonal drought case, farmers were purposefully selected to cover a broad scope of agricultural activities, focussing on arable farming and viticulture (conventional/organic: n=7/13; main crops permanent/arable: n=6/14; with/without irrigation: n=17/3). To approach potential interviewees, farmers already known from previous research activities, as well as farmers recommended by advocacy and advisory representatives were contacted. Interviewed farmers were asked to recommend further affected farmsteads they knew in the region. In the COVID-19 case, tourism entrepreneurs that received a subsidy by the federal state of Tyrol (Tiroler Tourismusförderung) were approached. Efforts were made to include a diverse range of accommodation categories. Initial contacts were made with tourism entrepreneurs known from previous projects and those recommended by tourism association representatives. Additionally, interviewed tourism entrepreneurs were asked to recommend further potential interviewees within the region.

All semi-structured interviews were conducted face-to-face between November 2022 and July 2023 and lasted 60-90 minutes each. Interview audio recordings were transcribed word-for-word for analysis. Following the CRDPs the interview guideline addressed three phases (Table 2): (1) strategy development, (2) strategy application, and (3) strategy impacts. Interviewees were instructed to refer to the last recent hazard event when describing impacts of and reactions to the shock (see Table 1).

Table 2: Main interview topics

Phase 1 – Strategy development	Stakeholders and their area of action
	Policy narratives and beliefs
	System Performance - Policy Problem
	Policy strategies (pre-shock)
Phase 2 – Strategy application	Shock
	Implemented strategies (instruments, post-shock)
Phase 3 – Strategy impact	Risk appraisal
	Coping appraisal
	Non-protective responses
	Individual reactions

We employed qualitative content analysis (Mayring 2010), using MAXQDA and Atlas.ti software for coding the interview transcripts. Responses were structured in a category system following the phases and elements based on the CRDP concept.

3. Results

a. Case 1: Flood in Eferding Basin

Phase 1 – Strategy development

In the flood case, the European, national and regional governance levels intersect but lack coordination between levels and between adaptation and mitigation efforts. Various European directives demand integrated flood risk management and strict reductions in carbon emissions. At the level of residential buildings, the EU Floods Directive and the EU Energy Efficiency Directive call for property level flood risk adaptation measures and improved energy efficiency (EU 2007, 2023). In Austrian flood risk management, the main responsibility lies with the federal states under the umbrella of the non-binding National Adaptation Strategy (BMK 2024). Municipalities at the lowest governance level decide on spatial planning but otherwise have only a consulting role. By contrast, the reduction of carbon emissions from housing is assigned to the national level, and federal and municipal stakeholders are expected to promote the roll-out and uptake of national policy instruments. Insufficient coordination between these strategies leads to inconsistent policy objectives, funding schemes and involved stakeholders. For instance, the federal Climate and Energy Strategy of Upper Austria claims to integrate adaptation and mitigation goals, but lists housing and flood hazards as separate and unconnected activity areas (Land Oberösterreich 2022). Flood risk management follows a paradigm of public structural measures (Seebauer et al. 2023). There exist no funding schemes for flood-proofing of private buildings, only disaster aid payments which are available after a flood event but focus on recovery from flood damages and on rebuilding as before the flood. A national subsidy scheme supports building insulation, retrofitting of roofs and windows and changing to a non-fossil heating system; however, the overall renovation rate is low because of unattractive incentives (Umweltbundesamt 2023).

Before the 2013 flood, it was already evident to the regional administration that the (implicitly) agreed protection level of a 100-year flood return period could not be maintained in the Eferding Basin within the dominant technical-oriented narrative of public flood protection by means of linear built infrastructure. Thus, the market-oriented narrative of providing awareness building and economic incentives for households to adapt their buildings on their own accord, that had already been common in mitigation policy, gradually gained traction in adaptation policy as well. These policy narratives met a mentality of do-it-yourself and self-reliance among households with personal or inter-generational flood experience, and a mindset of over-dependency on public protection among those who had recently moved to the region (Seebauer & Winkler 2020b). Nevertheless, both the adaptation and mitigation policy strategies built on the acceptance and willingness of the home-owners to take action. A small circle of policy entrepreneurs at the federal level pushed regional strategies by means of long-term collaboration; still, they acted within their respective policy silos and did not consider mitigation benefits from adaptation strategies and vice versa.

Phase 2 – Strategy application

In the days and weeks immediately after the shock, flood-affected residents received substantial resource inflow in terms of volunteer workforce for cleanup and repair, as well as monetary support from disaster aid payments (which is provided by the regional authority) and charity donations. These resources were, however, directed (directly and indirectly) at restoring the situation prior to the flood. In the light of the excessive damages, the public administration finally abandoned their habitual technical-oriented narrative and introduced a planned relocation strategy with the aim to minimise the level of exposure in the Eferding Basin. Households were compensated for 80% of their building's value if they volunteered to move away from the floodplain and demolished their former home. Households who opted to stay were subjected to a building ban that prohibits extending or modifying their homes. The relocation strategy was designed after a previous application a decade ago in the nearby Machland-Nord area, with the major difference that in Machland-Nord the decision to stay or leave had to be taken jointly by the whole hamlets, whereas in the Eferding Basin households took this decision individually (Thaler et al. 2020). Moreover, in Machland-Nord the hamlet communities were offered land plots outside the risk zone to resettle together, whereas in the Eferding Basin the households had to acquire building plots on the open housing market.

The policy instruments for climate change mitigation in the private housing sector had already been implemented pre-shock and were not changed by the shock of the 2013 flood. Both funding for energy efficient building renovation and standards for new construction had evolved since the 1990s, turning stricter in parallel to increasingly stringent national carbon emission reduction targets. Those households who relocated and rebuilt in a flood-safe location had to comply with strict energy efficiency regulations for their new homes. However, these standards only required a specific maximum energy consumption per floor area (in kWh/m^2 per year) and therefore did not preclude backfire effects from rebuilding larger than the original houses in the floodplain had been. As further indication of lacking policy coordination, the disaster aid, donations and relocation compensation were paid out to remunerate lost assets and did not prescribe or incentivise any building improvements regarding flood-proofing or energy efficiency. However, this bundle of adaptation and mitigation policy strategies met a constrained housing market with increasing price levels for properties and real estate. Latecomer households were further confronted with inflation and rising credit interest rates following the Ukraine war. Together, this meant that affected households faced high uncertainty both from the future flood risk in the Eferding Basin and from their housing options.

Phase 3 – Strategy impact

Almost a decade after the flood and the announcement of the relocation strategy, all interviewed households acknowledge the persistent flood risk. As next flood, they picture a large-scale disaster with water at chest level on the ground floor but at the same time they are highly uncertain regarding the return period and damages of a future flood. Similar to denial as a non-protective response, they shirk from specific considerations what such a disaster would entail for their livelihood.

Among those households who left the floodplain, the policy strategy lead to two-sided reactions. Public disaster aid, insurance and donations were paid out to refund the costs for restoring damaged private assets. Households spent these payments for quick recovery and for re-establishing their damaged homes for having a place to live. However, when they eventually moved out and demolished their former home these interim investments turned out to be wasted. Their new homes are obviously no longer exposed to flooding, as they had to move out of the floodplain, and are highly energy efficient because of mandatory building codes for new construction and because heat pumps are now (compared to the construction period of their former homes) a common heating technology. Thus, in principle, the shock of the flood and the related policy strategy incurred substantial gains regarding climate change adaptation and mitigation. However, most households built their new homes with a larger living area; thus, part of the efficiency gain was offset by increased energy demand. These households compensated the emotional loss of their previous residence by aiming for a 'perfect home' with more space and extended facilities (such as air conditioning). When planning the new home, they only considered the short-term residential needs of their current family constellation. Now, a few years later, they realise that their new homes are oversized as their children have moved out or the grandparents have passed away. Only few households deliberately downshifted to smaller housing because their children had already left the parental home, because they prepared for barrier-free living in older age, or because of financial restrictions. Farmer households are entitled by Austrian law to build anywhere on their cropland regardless of zoning specifications but local authorities must approve whether the building construction plan qualifies for a farm and not just a residential building. Thus, some farmers who relocated were obliged to oversize barns and garages but were restricted in their residential areas which partially buffered their overall backfire in the size of living area.

Among those households who rejected the relocation offer and decided to stay in the floodplain, the policy strategy mostly failed as these households improved neither flood protection nor energy efficiency of their buildings. In their coping appraisal, they claim high self-efficacy for tackling emergency and repair measures during an eventual flood. However, they consider most preventive flood-proofing measures as futile against an overwhelming flood risk and implement only minor adaptation measures such as flood-resistant floors and plasterwork or prepare furniture and machinery to be easily broken down and carried to a higher level. They have insulated their roofs, but refrain from wall insulation because they expect that Styrofoam plating will retain humidity from floodwater, leading to mold and damages to wall integrity. Few have installed heat pumps; most stick to wood-chip heating instead because they have excessive wood fuel available from their own forests and therefore have no incentive to switch to more efficient heating. However, many plan investing in photovoltaic panels. Building modifications are implemented in a do-it-yourself manner, typically as part of upkeep and maintenance and unrelated to their flood experience. These piecemeal modifications are not notified to the authorities and therefore do not show up in building registers. On a positive note, the building ban of the relocation strategy was effective in preventing living area increases. However, selected savvy households had quickly obtained construction permits before the building ban entered into force. As these permits could not be revoked, these buildings now feature increased living areas and consequently pose higher flood risk and energy demand.

b. Case 2: Multi-seasonal drought in Seewinkel

Phase 1 – Strategy development

EU, national and regional policy level affect agricultural water management in the Seewinkel region. At EU level, the Common Agricultural Policy (CAP) intends to shape the agricultural sector. Currently, it is designed to contribute to the adaptive and mitigative ambitions of the European Green Deal, including the Farm to Fork Strategy and the EU Biodiversity Strategy. Austria's agri-environmental programme 'ÖPUL' is implemented within the CAP. Designed to support farmers and rural stakeholders to secure the achievement of the EU strategies' goals, it specifies operational and bureaucratic requirements. National policy strategies, such as the Austrian National Water Management Plan (implementation in six-year cycles, started in 2009), as well as cross-border panels, such as the Austrian-Hungarian Cross-border Water Commission, affect regional policy strategies. At regional and local level, water authorities of the federal state of Burgenland, the Chamber of Agriculture Burgenland, the authorities of the national park "Neusiedler See – Seewinkel" and water cooperatives are mentioned as main stakeholders representing and coordinating different interests in land and water use.

The predominant policy narratives and beliefs regarding the policy problem are twofold: For farmers, on the one hand, the economic aspects are prevalent, as their main goal is to make a decent living from their farm, and to preserve the (family) business. Stakeholders, on the other hand, also stress the status of the groundwater body, the preservation of unique ecosystems, national food security, the value of regionally produced food and the preservation of regional tourism as main policy goals. In comparison, the stakeholders primarily promote a technical-oriented narrative, such as the funding of more efficient irrigation measures which is more strongly propagated than, for example, changing to water-saving crops. Irrigation management and the discussion of an irrigation ban show a rules-oriented spin of narratives.

The evolution of the policy problem was already evident before the shock, due to previous droughts. However, sectoral perspectives prevailed in policy design, with limited coordination and integration between the crucial agriculture, water, and nature conservation sectors, leaving the region vulnerable, especially as climate change progresses. However, the regional government introduced a 'task force' in 2018 which should promote cooperation between the sectors in the future.

The national strategies were connected to water quality and management but only few directly addressed drought (for example subsidized drought insurance). Specific measures of the ÖPUL programme supported greening or reduced soil cultivation and, hence, affect agricultural water management directly and indirectly. This pattern continued after the shock.

Phase 2 – Strategy application

The national government opted not to provide any compensation for farmers after the shock. This decision was taken because of a regulatory amendment in 2018, specifying that state aid is not available for losses resulting from insurable risks (such as drought risk). The the multi-seasonal drought 2018-2022 stimulated regional stakeholders' discussions about revising or refining existing strategies, as well as about developing new strategies to tackle the policy problem. Existing strategies included the monitoring system of the groundwater level as well as technical approaches such as backwatering, more efficient irrigation systems, external water supply from other water bodies, and breeding drought-tolerant crops. In the aftermath of the shock, the monitoring system of the groundwater level was tightened with stricter warning levels, leading to irrigation restrictions for certain crops and technologies during daytime. Backwatering has been implemented only locally but could be extended in the short-term, given, for instance, the provision of financial resources.

The shock has also increased the pressure for supporting water and energy efficient irrigation systems at the large-scale (e.g. drip irrigation). While already common for vineyards and orchards, consulting initiatives have been extended to introduce such technologies also for field crops. Subsidies for investments in irrigation infrastructure have partially been increased for conventional but also for more sustainable irrigation infrastructure. For external water supply, different options regarding its source (e.g., surface water from Austrian or Hungarian part of Danube) and destination (i.e., to Lake Neusiedl or the groundwater body) were discussed. Though the shock has clearly fueled discussions, many decisions are still pending and stakeholders stress the long lead time of large-scale projects. Stakeholders also highlight the breeding of drought tolerant crops as a long-term endeavor. However, the responsibility for providing new breeds is mostly delegated to the private sector. A new strategy that has been addressed very cautiously is the introduction of groundwater pricing, as a control mechanism for groundwater use and an incentive for the selection of less irrigation-intensive species and varieties.

The shock led to a change in narratives and as such in policy strategies: Before the shock, irrigation bans were already part of the policy strategy, but not yet in force. With a rule-oriented policy narrative becoming more important after the shock, a local irrigation ban during daytime was executed in the most affected municipalities. Some of the interviewed farmers understand the need for the ban to preserve groundwater. Others are more critically and worry about more intensive irrigation during nighttime with no ultimate effect on water demand, as well as about being forced to irrigate under adverse – e.g. windy – conditions. Similarly, stakeholders warn that incentives for more efficient irrigation systems may lead to an increase in the total irrigated area.

Phase 3 – Strategy impact

Farmers show high awareness for climate change and droughts, yet risk perception varies widely ('all is getting worse' vs. 'changing weather is normal'). At the same time, they tend to differentiate between the future of their own farm and the future of the sector in the region, which they expect to be very challenging, especially for those without sufficient measures in place. The findings illustrate the background of farms being residencies of private people (attachment, worries and psychological stress) and simultaneously business locations (cognitive risk perception focusing on the economic viability of the farms).

Regarding coping appraisal, farmers show a high degree of self efficacy. Most assess their implemented measures against drought as sufficient and as the best they can do. No cases of inaction appear in our sample, as all farmers emphasize that they realize drought adaptation measures within the range of their possibilities.

Funding measures are implemented if they match the farmers' goals and operational strategy, often as add-on support (i.e. windfall benefit) to existing or already planned measures. While we do not find any non-protective responses regarding drought-related measures, we find to some degree fatalism, in the sense that weather and climate are conceived as beyond the influence of regional stakeholders and farmers.

In general, regular exchange among farmers as well as mutual 'learning by example' is reported, leading to a high degree of response efficacy. Additionally, many see themselves as frontrunners and leading examples for others. However, there are also complaints about free-riding 'copycats' who even receive funding for adopting measures that frontrunners had applied at their own risk and cost.

Besides from the fact that we have not found inaction, the farmers' individual reactions show a pragmatic mix of measures, shaped by factors external and internal to the farm. External factors include available strategies and accessible funding instruments, as well as contracts regarding varieties and commodity prices. Internal factors include the farm's economic situation and technical infrastructure. Good practice examples for farmers' climate resilient individual reactions include the implementation of water saving irrigation, water saving soil cultivation or changing to more drought tolerant crops. Poor practice examples include high share of water-demanding crops. However, the farmers' individual reactions cannot be strictly attributed to the shock, as some measures are already in place for decades or the result of other entrepreneurial decisions (e.g. gross margin of crops, challenges in weed control, crop rotation).

The agricultural sector has a high potential and need to contribute to climate change mitigation. Yet, the measures implemented by farmers focus on drought adaptation and hardly leverage benefits for climate change mitigation, such as solar-powered water pumps or greening and reduced soil cultivation for carbon sequestration.

c. Case 3: COVID-19 in Tyrol

Phase 1 – Strategy development

The tourism sector in Tyrol is governed by a variety of political instruments, including strategies, laws, and subsidies at both national and federal level. A diverse array of local, regional, and national stakeholders is shaping these instruments. At the national level, the main tourism strategy is formulated through "Plan T - Masterplan for Tourism" (introduced in 2019). The national strategy is complemented by regional efforts, particularly the Tyrolean tourism strategy "Tiroler Weg" (introduced in 1999 being regularly updated before and after the pandemic), which is not legally binding but aims to provide strategic guidelines to partners, particularly tourism associations and regional tourism organizations. The recent edition of Tyrol's regional tourism strategy emphasizes quality over quantity, advocating for a reduction in the number of touristic beds and the integration of ecological, economic, and social sustainability into tourism practices. Some aspects of the regional tourism strategy have been incorporated into regional acts and legislations (e.g., Tyrolean Tourism Law 2006-2022), such as the implementation of sustainability managers in all 34 tourism associations.

However, the regional tourism strategy lacks binding power, concrete implementation measures, and specific funding information.

Despite ambitious sustainability goals, the strategies at both national and regional level suffer from a lack of cohesion and coordination with similar strategies from other departments and fragmented sectoral perspectives. The narratives and beliefs underpinning these strategies are varied. While eco-oriented narratives, such as those addressing carrying capacity, land use conflicts, and resource use, are present, economic narratives dominate the discourse, aiming to safeguard and promote tourism. Market-oriented, liberalism, and individualism perspectives further emphasize economic incentives, such as subsidies, and individual responsibility. Before the COVID-19 pandemic, it was already evident that Tyrol's tourism sector needed to become more sustainable in terms of adaptation as well as mitigation, particularly concerning carrying capacity and resource use. Despite the ambitious aims, the strategies often fall short in practical implementation and interdepartmental coordination. The fragmented perspectives and lack of binding measures leave the region vulnerable to ongoing and future challenges in tourism sustainability.

Phase 2 – Strategy application

Since a situation like COVID-19 had never occurred before, there were no instruments in place that could be used to support affected tourism entrepreneurs. During the pandemic, existing policy instruments were revisited and re-purposed for coping with the pandemic, or instruments were newly conceptualized. The funding volume for Tyrolean tourism support increased substantially. While in 2019, subsidies of € 224,597 were approved for investments of € 4.1 million, this multiplied to € 1.65 million subsidies (+638%) and € 36.8 million investments (+793%) in 2020 and € 2.9 million subsidies (+74%) and € 40.1 million investments (+11%) in 2021.

In some of the revisions and in the development of new instruments, there is a noticeable increase in the inclusion of climate protection and sustainability aspects in regional tourism strategies and the Tyrolean tourism funding guidelines. For instance, the Tyrolean Tourism Law was revised to legally incorporate sustainability coordinators for destination management organizations. Therefore, it has become mandatory for all 34 destination management organizations to employ a sustainability coordinator, whose task is (among others) to create annual sustainability reports. Financial support programs also saw a stronger integration of climate aspects, such as the amendment of guidelines to ensure that investment projects focus on energy efficiency and resource conservation and to integrate ecological criteria, such as the ‘ban on fossil fuels’ and the promotion of ‘ecologization’.

During the peak of the pandemic, many strategy revisions appeared to have happened ‘coincidentally’. The process often began before COVID-19, with prior developments setting the stage. However, the pandemic created a political window of opportunity that allowed for changes towards the incorporation of more sustainability, being driven by various political stakeholders and especially the Green party. Interviews with tourism stakeholders indicate that the pandemic provided the necessary momentum and political opportunity for strategic changes, heightened awareness, and allowed time for strategic work.

Thus, the pandemic was not the initiator but rather the final impetus for changes in laws, subsidies, and strategies that had already been circulating or were on the back burner.

Additionally, the pandemic brought to the forefront questions about the new strategic positioning and direction of tourism. In the process of strategy changes, the role of certain stakeholders in the tourism system is highlighted, who play a significant part in navigating and advocating changes in policy strategies. The Tyrolean tourism strategy “Tiroler Weg”, published in 2021 in its current version, was mentioned by several interviewees from tourism associations and public administration as representing a strategic shift of how tourism development in Tyrol is desired for the future. However, it remains complex to discern the precise role of the pandemic as a shock event in triggering these changes, especially amidst multiple overlapping crises.

Phase 3 – Strategy impact

Interviewed tourism entrepreneurs’ risk appraisal shows that COVID-19 is perceived as a one-off event and that other risks are currently more urgent. The pandemic coincided with other urgent issues such as the Ukraine war, energy supply challenges, inflation, and the lack of staff availability in the tourism sector. This overlapping of crises introduces a fuzziness regarding which reactions of tourism entrepreneurs were specifically triggered by the pandemic versus other parallel developments or factors.

Climate risks for tourism are acknowledged but not experienced as an immediate threat, also due to well preparation of the sector. On the contrary, Tyrol is perceived as a net winner of climate change as the Alps are seen as a refuge from serious climate impacts elsewhere (e.g. heat waves, droughts).

The coping appraisal of interviewed tourism entrepreneurs shows a very diverse degree of self efficacy. While some interviewees stress that it is within the scope of action of each individual to contribute to climate change mitigation, others would like to act, but do not see how they could do so.

Interviewees’ individual reactions show that the phases of the lock-down were used by many businesses to implement outstanding projects. However, many of these plans have already been in the drawer, which suggests that the crisis was not necessarily a driver for profound changes but rather an accelerator of already ongoing processes. Mitigation measures include improving energy efficiency in hotels (e.g. switching to renewable energies, improving thermal insulation) or the connection to sustainable mobility services. Investments go hand in hand with financial incentives. Tourism as a cross-sectional topic has access to diverse opportunities for funding. However, the industry suffers from considerable confusion regarding the available information, often perceived as a ‘funding jungle’. This information overload represents a significant barrier that prevents many from timely approaching funding agencies. Often, this happens after construction projects have already begun or other investments have been made.

Good practices for tourism entrepreneurs include a repositioning of the tourism offer while creating climate-friendly products (e.g. renovation of existing infrastructure). Poor practices includes the creation of new offers that are energy intensive (e.g. thermal spas, indoor and outdoor pools).

4. Discussion

The article presents the role of shocks as potential turning points for climate resilient development pathways that integrate climate change adaptation and mitigation to realize the overall societal goal of sustainable development. We next discuss the interrelations between policy strategy, shock and individual reactions within and across case studies.

a. The role of shocks in Case 1: Flood in Eferding Basin

After the 2013 flood and the announcement of the planned relocation strategy, most households focused on a fast-recovery process with minor adaptation and mitigation efforts. This was mainly driven by the fact that they had marginal contact with governance actors, even at the municipal level, and hardly adopted the available policy instruments. They relied on their own technical expertise and did not access consulting apart from architects, construction engineers and informal contacts to neighbours or family. Nevertheless, the combination of policy instruments was partially successful by decreasing the number of exposed households in the floodplain and achieving energy savings at the newly constructed buildings because of building regulations at national and regional level.

Both the policy strategy and the households frame choices on building modification within a market-oriented narrative. The policy strategy has a narrow scope on voluntary funding schemes and forgoes other instruments such as consulting, regulations (apart from building codes and the building ban) or taxes. Households describe their building decisions in monetary terms as balancing costs and effort with the expected benefits. Thus, the degree of adaptation or mitigation mainly depends on the willingness and financial capabilities of households, and backfire seems logical if households are able and willing to pay for larger living areas. Furthermore, households often describe the funding schemes (except the relocation compensation payment) as an add-on windfall profit to choices they would have taken anyway. Overall, the results show that a broader societal transformation process was not reached even after a radical risk management strategy such as planned relocation. One core reason is the lack of a broader policy coordination between climate adaptation and mitigation policies by the national and regional government.

b. The role of shocks in Case 2: Multi-seasonal drought in Seewinkel

The dominant narratives of economically viable farms and problem solution via technical measures promote an irrigation focus that had already been present before and was maintained in revised form after the multi-seasonal drought 2018-2022. The regional water management strategy that is currently in effect limits total groundwater withdrawal to preserve the regional groundwater body and includes the option of imposing an agricultural irrigation ban. European policy strategies, such as the CAP, are transposed into national funding schemes, but these nationally uniform schemes neither account for regional climate conditions nor for drought impacts. Consequently, farmers typically apply only for those funding schemes that conform with their own farms' goals and are not encouraged by the schemes to reorient their goals. The shock invigorated an ongoing debate on alternative strategies including external water supply, breeding drought-tolerant crops and tighter restrictions on groundwater use. However, this debate has not yet resulted in the implementation of new policy instruments and has not yet instigated new farmer reactions.

Irrigation is a contested issue where farmers' appraisals only partially align with the current policy instruments. When a local daytime irrigation ban was executed for the first time in 2022, some farmers reacted by investing in water-saving drip irrigation systems which are exempt from the ban. However, due to its technical setup drip irrigation is better suited for permanent crops than for arable farming, thus excluding a sizeable agricultural segment. Other farmers postpone irrigation investments as they face uncertainty and concerns regarding the future frequency of irrigation bans, insufficient grid connections to operate electrical water pumps in the open field, high work effort during installation or short device lifetimes from damage by ultraviolet radiation and rodents resulting in plastic residues from the irrigation tubes remaining in the soil. Investment funding often has an add-on effect because they support adaptation measures that farmers would adopt anyway.

c. The role of shocks in Case 3: COVID-19 in Tyrol

When the tourism sector in Tyrol was hit by the COVID-19 pandemic, a range of measures was implemented to support the sector. Subsidies were a crucial element of this package, which were both increased and expanded. The guidelines were revised to incorporate ecological criteria. However, the interviewees mentioned that most of the measures would have been implemented anyway, which indicates an add-on effect.

The COVID-19 pandemic was not the decisive, but a supporting driver for profound changes in the tourism sector. The initiatives for transforming the sector can be attributed to an ongoing process of change that had already begun before the shock. COVID-19 opened a window of opportunity to bring sustainability aspects into practice that had already been considered for some time, both in revising strategies and in realising hotel renovation and construction projects. These processes were driven by various political stakeholders, with the Green party playing a particularly significant role at both the state and federal levels.

d. Cross-case discussion

In **phase 1**, across all three case studies, system performance was impaired by prevailing conflicts of interests, fragmented sectoral perspectives and disconnection between governance levels, especially between the national and regional level. If non-binding, national policy strategies are not (sufficiently) recognised and transposed at the regional and local level. By contrast, EU directives as in the flood and the multi-annual drought cases lead to the implementation of national and regional strategies and measures. At the same time, overarching strategies hardly account for regional or local particularities. In the absence of EU-level pressure, as in the COVID-19 tourism case, national and regional strategies and measures tend to be inadequately implemented. Administrative departments act within their narrow area of responsibility and are not encouraged or obliged to coordinate with other departments in neighbouring fields. Additionally, the national and regional level pursue a long-term planning perspective, whereas the local level considers mainly short-term impacts and needs.

The lack of pre-shock policy coordination spills over to **phase 2** in that the policy instruments which are implemented to deal with the shock have a narrow scope that does not account for climate resilience. The respective shocks did not induce entirely new policy instruments, but brought options to the table that had been debated but not realised before the shock: In the flood case, the planned relocation strategy was introduced which was modelled after a previous application in a neighbouring area; in the multi-annual drought case, the threat of the irrigation ban was carried out for the first time; in the COVID-19 case, additional funding for tourism support was made available. However, these emergent instruments are not coordinated with other instruments that are already in place and therefore do not deploy to their full effect: In the flood case, the policy strategy overlooks the need to advance adaptation and mitigation among the households who stay on the floodplain; in the drought case, farmers lack funding and support to adopt water-saving irrigation or other drought management options; in the COVID-19 case, the financial support dedicated to sustainable tourism was hardly visible within an overall confusing funding landscape. Moreover, the policy strategy is applied in a uniform manner and does not differentiate between individual needs (in the flood case) or between different regions and hence climatic conditions (in the drought case).

Phase 3 shows that the policy strategies do not trigger joint realisation of mitigative and adaptive measures. Especially in the multi-annual drought case the focus is on adaptation with little mitigation happening at all. Mitigative measures are mostly implemented as a side benefit to adaptive measures (e.g. greening); only rarely they have the dedicated purpose of reducing carbon emission (e.g. electric instead of fossil fuel powered irrigation pumps). Households who relocated from the floodplain and rebuilt in a flood-safe and energy efficient manner are prone to a backfire effect from oversized floor areas that partially offsets the efficiency gains. The policy strategies of all three case studies prefer funding schemes over regulations. If regulations are present, as the building ban on the floodplain or the temporary irrigation ban, they serve as trigger for individuals to reflect on how they plan to prepare for future risk. In order to direct these plans to climate resilient development, the policy strategies rely on voluntary funding schemes, which do not have a steering effect but rather provide add-on incentives for individual intentions that would be realised anyway.

However, the effect of the shock as a distinct milestone on a climate resilient development pathway does not emerge as clear-cut from the empirical data, as might be expected from the transformation literature. In the multi-annual drought case and the COVID-19 cases, the reactions of farmers and tourism entrepreneurs are also driven by parallel developments such as long-term business outlook, staff availability, energy costs etc., which makes it hard to disentangle the unique effect of the shock. As all three case studies rely on qualitative interviews, we cannot exclude that the observed reactions to the shock could be coloured by the selection of interviewees. For instance in the multi-annual drought case, we could not recruit farmers with large-scale water-intensive crops who solely rely on irrigation. Moreover, the high self-efficacy of the interviewed farmers could also indicate a certain sampling bias, because less confident farmers who struggle with drought risk might be less willing to agree to an interview.

5. Conclusions

Following the Climate Resilient Development Pathways (CRDPs) concept we illustrate for three case studies the impacts of climatic and non-climatic shocks, tracing policy strategies and reactions of affected individuals as they develop before, during and after the shock, in other words, over the phases of strategy development, application and impact. While existing strategies were adapted and implemented to support affected individuals to cope with the shock, profound change in policy strategies towards sustainability or climate resilience did not happen. Thus, within the Austrian policy environment of our three case studies, we cannot confirm that climatic and non-climatic shocks have substantial transformative power (Moore et al. 2014, Grossman 2015). Instead, shocks should not be overrated in their relevance for initiating radical change (Solecki & Michaels 1994).

All three case studies, which are individually elaborated in further articles, are characterised by a policy problem that had been present and (to some degree) acknowledged by policy actors and affected individuals long before the shock. The shock revealed that the existing policy strategies may fix or at least alleviate the policy problem in the short term, but are insufficient to enter CRDPs. This is mainly because of a lack of policy coordination. The policy strategies are designed and implemented within their respective policy silos and do not leverage synergies for advancing climate change adaptation in concert with mitigation. Unless driven by EU-level requirements and goals, national and regional strategies fall short of a concise, target-oriented development. Besides a cross-sectoral perspective, climate resilient policy strategies should include binding regulations, regional differentiation and flexibility for individual needs. If such policy strategies were implemented in a foresightful manner, future shocks, which will most likely occur more frequently and more severely than in the past, could be used as an opportunity to enter and pursue CRDPs.

Declaration of interest statement

No potential conflict of interest was reported by the authors.

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