



Urban shrinkage as a catalyst for transformative adaptation

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ABSTRACT

Transformative climate adaptation is argued to reduce underlying vulnerability whilst adapting to impacts. However, transformative actions may face resistance in post-industrial shrinking city contexts. Resources to act may be limited and social, cultural and economic links to high-emitting industries make conversations on climate action difficult. This paper assesses how transformative adaptation may be initiated in a post-industrial shrinking city, by evaluating the former coal mining city of Yubari in Hokkaido, Japan. Interviews with organisations and a residents' discussion group assess how citizens of Yubari experience social and environmental changes. A review of policies that support transformative adaptation in Yubari is undertaken. Although strong ties to Yubari's mining identity have constrained discussion on climate action, the need to physically shrink the city's size and engage third-sector organisations beyond local government created opportunities for transformative actions that also support adaptation. The findings support the existing shrinking cities literature. Place attachment can energise residents to take action and defend their locality against the worst effects of urban shrinkage. This highlights the value of intermediary organisations outside local government in initiating discussions on transformative actions towards climate adaptation.

POLICY RELEVANCE

The study contributes a climate adaptation angle to applied research and practice for cities facing demographic or economic shrinkage. Shrinkage can initiate transformative and disruptive actions, but limited resources can make it difficult for urban planners and environmental policymakers to promote resilience. The findings from Yubari show that planning decisions can reduce vulnerability from hazards and enhance resilience to shocks and stresses by reducing the physical footprint of the city and engaging third-sector organisations in managing the natural environment. When trust in local governments is low because of a perceived failure to anticipate problems of shrinkage, then intermediary organisations are needed to facilitate dialogue with citizens on significant changes to place that enable transformative adaptation.

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1. INTRODUCTION

This paper addresses the question of how to initiate transformative climate adaptation in a post-industrial shrinking city context. Shrinking cities are those experiencing decline in population, industrial activity or economic status. They may harbour large areas of vacant property and land (Carter 2018). Budgetary pressures in shrinking cities can constrain the ability of local governments to act (Mulligan 2021). Moreover, in localities that rely on high-emitting carbon industries for employment and economic sustainability, concern about implications for jobs, the local economy and sense of identity can make discussions about climate action challenging (e.g. Milnes & Haney 2017). The potential for shrinkage to initiate transformative practice in support of emissions reduction or broader sustainability measures has been recognised as an alternative to ongoing and unsustainable gradual decay (Coppola 2019; Mulligan 2021).

However, the potential for transformative adaptation in shrinking cities has received less explicit attention. This is a notable gap given that residents in shrinking cities may face heightened vulnerability to climate-related extremes. Increased vulnerability arises as a result of economic marginalisation, limited local government capacity and lack of investment in the local environment (Eraydin & Özatağan 2021). To understand the opportunities and challenges for transformative adaptation in a shrinking post-industrial city, this paper evaluates adaptation and broader environmental actions in the former mining city of Yubari in Hokkaido, Japan. It examines the extent to which transformative adaptation can occur as local residents negotiate environmental and socio-economic change plus ties to their coal industry heritage.

The core contribution this paper makes to the literature is thus: how can transformative climate adaptation be initiated and upscaled in a shrinking city, where local government resources are limited and where there may be a strong sense of attachment to a landscape and an identity associated with fossil fuel extraction? The characteristics of transformative adaptation outlined by Fedele et al. (2019) are used as an organising framework for the analysis. Fedele et al. (2019) characterise transformative adaptation as being restructuring (identifying leaders and engaging with bridging organisations), path-shifting (re-evaluating current assumptions, taking advantage of windows of opportunities), innovative (investing in research and experimentation), multiscale (creating cross-scale partnerships and engaging with multiple levels of governance), system-wide (developing multistakeholder and cross-sectoral collaborations, with landscape and participatory approaches) and persistent (institutionalising new practices, securing political support).

2. CONCEPTUAL BACKGROUND

Revi et al. (2014) explain that transformative adaptation is a non-linear change to systems. This can address root causes of poverty or failures in sustainable development, including the need for rapid progress on mitigation. Few et al. (2017) distinguish between *transformational* adaptation – which is adaptation that itself constitutes a step-change – and *transformative* adaptation, which they see as adaptation activity that can change other things. For the purpose of this paper, transformative adaptation is therefore considered to refer to actions that have a climate change adaptation component but which can initiate a step-change in the social and environmental context in ways that reduce vulnerability to climate change.

Adaptation actions with transformative or disruptive elements can hence tackle the underlying causes of vulnerability to climate changes, as well as energise other moves towards a fairer and more sustainable society. However, there may be resistance among residents and local-level political figures towards transformative adaptation if it threatens the sense of attachment residents have to the places in which they live (Clarke et al. 2018; Solecki & Friedman 2021). Leal Filho et al. (2022) hold that effective transformative adaptation actions must reflect the complexity of the institutions and sociopolitical systems that are specific to a locality, and that a deep understanding of place-specific historical and social contexts is vital when putting transformative adaptation into practice.

One domain where place attachment and transformative adaptation are especially challenging is in shrinking cities. Local government capacity and resources may be limited in these places. The physical and socio-economic nature of the city may be in a state of flux as the population and economy declines and under-utilised land increases (Mulligan 2021; Eraydin & Özatağan 2021). Evidence suggests that attachment to place can help remaining residents to organise themselves and initiate actions to protect against degradation of the lived environment (Berglund 2020; Pineda *et al.* 2023). Attachment to place can be a force for good in initiating or gaining support for transformative adaptation, and not a barrier in the way Clarke *et al.* (2018) find. However, Eraydin and Özatağan (2021: 7) argue that in shrinking cities ‘achieving transformative resilience in a structural context built on perpetuating instability caused by repeated shocks is a daunting task’. They call for more research into how grassroots movements and civic action can support transformative change towards resilience in shrinking city contexts. Identifying the environmental impacts or benefits specifically caused by shrinkage can be challenging, as different contexts may affect humans’ social and economic activities differently (Rave 2014). Coppola (2019) believes that shrinkage is a moment that has transformative potential but requires both critical scrutiny and links between critical thinkers, planners and policymakers if localised projects are to become part of systemic transformative action.

It is also important to outline how resilience is understood in this paper. Whilst resilience is sometimes presented as being in addition to or opposite to transformation (Walker 2020), Davoudi *et al.* (2013) explain that resilience involves cultivating preparedness and seeking transformative opportunities for change, and not only planning for or recovering from shocks. Carr (2019) similarly argues that alleviating shocks and stresses, rather than simply addressing their outcomes, is the pathway to achieving transformative goals. ‘Resilience’ for transformative adaptation is thus not about ‘bouncing back’ or retaining core functions. Rather, it is about being able to restructure or do things in very different ways.

3. CONTEXT: YUBARI AND LOCAL RESPONSES TO CLIMATE CHANGE

Yubari is located in Hokkaido, the northernmost island of Japan. The city’s economy and built environment developed around coal mining, which peaked in Yubari in the 1960s. The energy transition in Japan from the 1970s onwards meant reduced demand for domestic coal. Two major accidents in the early 1980s hastened the scaling-down of mining operations in Yubari. The last coal mine in the city closed in 1990. Today, smaller businesses continue to extract coal from waste deposited during full-scale mining, alongside exploratory trials into coal bed methane technologies, albeit these operations support only a handful of companies and several dozen employees (Yubari City 2021a).

The decline of coal mining in Yubari means that the city population was just over 6,500 in 2023, down from nearly 120,000 in the 1960s. Over half of this population are over the age of 65. Alongside population shrinkage, the end of mining in Yubari had two main effects. First, the failure to replace coal mining with an alternative economic base, and reduced tax revenues, forced the Yubari City Government to effectively declare bankruptcy in 2007. This placed severe constraints on the ability of the local government to provide services and manage the local environment. Second, Yubari was left with a legacy of buildings that required maintenance. These include schools, hospitals and local government offices that were built to support a much larger population. Yubari was also left with a large stock of housing, built to house coal workers. Many of these buildings have since either been demolished or closed and fallen into disrepair.

Since 2008, Yubari has undergone a programme of financial restructuring that has allowed the local government to invest in making the city more liveable for its elderly residents and for young families. The built environment in Yubari has changed significantly following the city’s financial restructuring. Under a ‘compact city’ vision, residents in the peripheral areas of the city have been encouraged to move to a new urban core in the central Shimizusawa district, where new housing for elderly people and also for young families has been constructed (see Figure 1) (Setoguchi *et al.* 2016; Mabon & Shih 2018). A new multipurpose community hall, including a library and nursery,

has since been built (see Section 5 for more detail). Areas at the edge of the city have thus in places been largely abandoned. Similarly, in 2019 Yubari's railway branch line (originally built for the transport of coal) was closed.

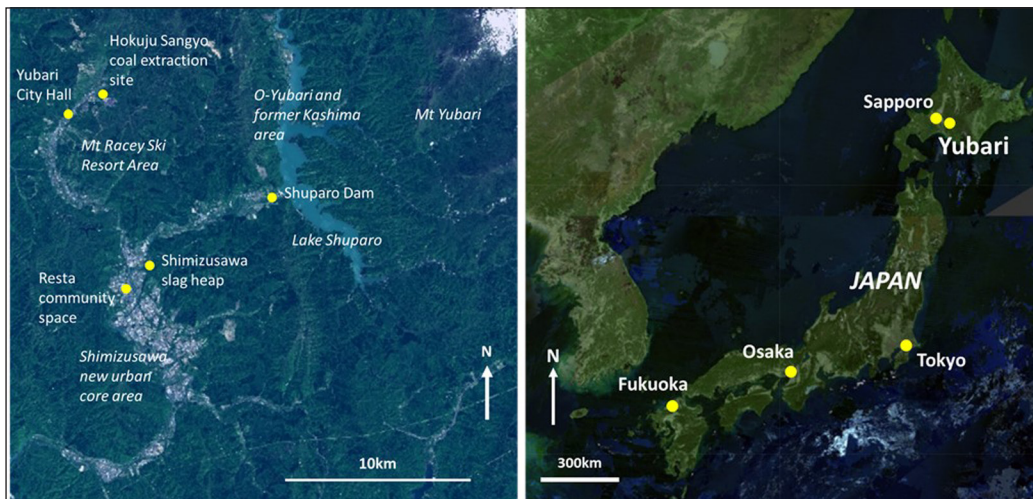


Figure 1: Location of Yubari (right) and key locations in Yubari (left).

Source of base maps: Geospatial Information Authority of Japan.

Yubari is a colder-climate city, with temperatures reaching an average high of around 24°C in summer but an average low of -11°C in winter. In terms of hazards and climate impacts, Yubari City's disaster plan lists river flooding, landslides and extreme snowfall (Yubari City 2023a). Among impacts relevant to Yubari, Hokkaido's regional government adaptation plan (Hokkaido Prefectural Government 2020) forecasts that climate change will allow new crops or expanded yields, but that this may be offset by increased risks from pests and diseases as well as impacts from periods of intense or unpredictable rainfall; biodiversity at higher altitudes will suffer from earlier or erratic snowfall; intense periods of rainfall will increase landslide risk in hilly or mountainous areas; and ski resorts may see a lack of snow. Moreover, the ageing population of the city means that Yubari has a large population who are at greater risk under a changing climate, and the constrained financial situation of the city means there are few people and resources to enact a comprehensive climate response.

Yubari's efforts to create a sustainable urban form and respond to climate change coincide with growing scholarly and policy interest in local government action on climate and energy transitions in Japan, which respect local social and economic contexts (e.g. Kiko Network 2021). Local authorities in Japan, including Yubari, have been mandated to make efforts to formulate climate change plans for both mitigation and adaptation under acts passed by the Japanese government. A growing number of local authorities, again including Yubari, have produced declarations on becoming 'zero-carbon cities' in support of Japan's obligations under the UN Paris Agreement (Yubari City 2023a). However, translating these plans and visions into tangible action may be challenging. Takao (2020) finds that effective transitions to renewable energy in Japanese municipalities are more likely if local mayors can engage different actors to reduce conflict when implementing policies. Trencher and van der Heijden (2019) highlight the tensions and synergies that can arise in Japan when national-level visions of energy and climate responses meet localised visions of sustainable low-carbon futures. The evidence from Yubari adds to this literature by exploring local-level adaptation and mitigation actions.

4. METHODS

Yubari is a useful case to explore the complexities of transformative adaptation in a post-industrial city. Yubari retains a small yet vocal lobby who see climate action as a threat to a fossil fuel economy and identity (reflecting Colloff et al. 2017). A strong place attachment to coal mining identity and to cultural heritage related to the coal, rail and power industries exists (reflecting Clarke et al. 2018). Resourcing and capacity constraints make local government-led participatory

approaches and implementation difficult (reflecting Leal Filho et al. 2022). Despite being a single case, Yubari can thus be seen as a critical or extreme case, which allows the ideas proposed in existing work – in this case on transformative adaptation in a shrinking post-industrial city – to be evaluated and refined (Yin 1984).

This study is based on ethnographic fieldwork conducted in Yubari since 2016 across multiple visits, and synthesises several data sources. First, semi-structured in-depth interviews were undertaken with respondents who were selected to represent a breadth of sectors involved in sustainability actions and responding to environmental changes in Yubari (Table 1). Semi-structured interviews with a small and focused sample of key informants were considered an appropriate method to understand the complex range of actors and actions that are taking place in Yubari. These interviews were especially valuable for pushing respondents to reflect further on the climate change and resilience aspects of their actions, as these are not so readily visible in ‘official’ documentation produced by the city authorities. Each interview broadly sought to cover:

- how respondents have experienced change in Yubari over the course of their life and work there
- what respondents see as the main challenges facing Yubari
- what respondents see as the main positives and opportunities for Yubari
- what respondents would imagine a desirable future to be for Yubari.

Each interviewee spoke mainly from the perspective of the organisation they represented; however, their own personal experiences as an individual occasionally entered the discussion.

RESPONDENT	SECTOR	NUMBER OF PEOPLE	DATE
Community organisation	Third sector: cultural heritage	1	January 2018
Community organisation 2	Third sector: cultural heritage	1	October 2021
Local government planner	Local government	1	April 2016
Local government planner 2	Local government	1	January 2018
Nature warden	Third sector: environment	1	October 2021
Tourism promotion organisation	Business/third sector: cultural heritage	3	April 2016

Table 1: Interviewees consulted

Second, a discussion group was held in Yubari in February 2023 with a group of 15 residents and stakeholders, on the broad theme of what a just and appropriate response to climate change is for Yubari and how daily life in Yubari has changed over the last five years. Participants were recruited to reflect different age ranges of people living in Yubari, from the youngest adults in the city (those aged 18–25) up to those aged 70 or over. The rationale was to stimulate discussion between residents on what they themselves saw as the biggest social and environmental changes in Yubari. Whereas the interviews provided contextual information and allowed the researchers to push further on how respondents saw the links between their own activities and climate change, the discussion group created more space for residents to talk together about the social and environmental changes that they themselves saw as most significant. The interviews were also targeted more on the views of organisations, whereas the discussion group focused on the views of residents as individuals. The discussion group followed a semi-structured format. After a short introduction on the idea of climate change responses and the lived environment, residents engaged in open discussion on the changes they had seen in Yubari in recent years, and what they saw as the most positive qualities of their locality. All of the interviews and the discussion group were undertaken in Japanese.

Outcomes from interviews and the discussion group and field observations were supplemented by review of relevant policy documents produced by the Yubari City Government and the Hokkaido Regional Government. This provided insight into the specific climate adaptation challenges and responses that have been identified as relevant to Yubari at different levels. Yubari's disaster prevention plan (Yubari City 2023a) and redevelopment masterplan (Yubari City 2021a) were also reviewed for context on the kinds of actions governmental actors are planning to adapt to climate change in the city. These documents were sampled to reflect the main areas of urban policy and planning under Yubari's governance structure, which were judged by the researchers to be relevant to transformative adaptation and responses to shrinkage – climate change and environmental planning; urban planning and land use; disaster prevention; and social welfare. These documents are cited in the findings and discussion where appropriate to provide additional explanatory context. Similarly, where appropriate, photographs taken during visits to Yubari are used to illustrate and provide additional explanatory contexts to the points raised in the interviews, discussion group and policy documents.

To group findings from disparate data sets qualitatively, the analysis took a form of guided content analysis (Cho & Lee 2014). This type of analysis categorises data under pre-identified headings or groupings, usually relating to existing literature and the research questions of a study, yet also leaves some interpretative and analytical flexibility for new themes and ideas to emerge alongside the pre-identified categories. Given the interest of the study in transformative adaptation in a shrinking post-industrial city, the six characteristics of transformative adaptation identified by Fedele *et al.* (2019) (restructuring; path-shifting; innovative; multiscale; system-wide; persistent) were used as the core categories for analysing and writing up the findings. Within these categories, particular attention was paid to the historical contexts (Leal Filho *et al.* 2022) of Yubari that led to opportunities or challenges for transformative adaptation in the present. Attention was also paid when categorising the data to where residents or organisations talked about their attachment to Yubari as a place, and whether their relationship to place shifted because of shrinkage or environmental change (Pineda *et al.* 2023).

5. FINDINGS

The findings are presented in relation to the characteristics of transformative adaptation identified by Fedele *et al.* (2019). It was found that in Yubari there is close overlap of actions that are path-shifting and innovative and of actions that are multiscale and system-wide. Accordingly, the findings for path-shifting and innovative actions and for multiscale and system-wide actions are reported together.

5.1. RESTRUCTURING

Fedele *et al.* (2019) see restructuring actions as a chance to identify the leaders and key agents that can promote deep social change, and to engage with bridging organisations to energise transformative adaptation. In Yubari, third-sector organisations have been especially important in promoting social change and in acting as bridging organisations, through two areas of action.

The first action is the management of natural landscapes and abandoned former industrial sites to reduce risks from natural hazards, weather extremes and slower-onset climate changes. The Shimizusawa Project NGO, founded in 2016 with the aim of protecting and promoting cultural heritage and community connectivity in Yubari, has a membership and management team largely consisting of younger Yubari residents and incomers. It has informally taken over responsibility from the local government and former mining operators for maintaining a large slag heap at the edge of the city. A slag heap is a pile of waste stones recovered during mining operations, typically piled up in a pyramid up to 100 m in height. In practical terms, management of the Shimizusawa slag heap means enhancing the biodiversity on the slopes, and conducting geophysical surveys to ensure the safety of the heap (interview with community organisation leader). Another NGO, the Yubari-kozakura-no-kai, has taken on the warden and monitoring duties for Mount Yubari to protect biodiversity and specific rare species, with additional voluntary activity to rewild sections

of the closed railway line. Yubari-kozakura-no-kai was founded in 1989 with the aim of protecting the nature of Mount Yubari and preventing development of a proposed ski resort. When asked why it started doing nature patrols, one motivation was the lack of local government support:

Well, there is no support from Yubari City Government. But as I'm interested in nature maintenance I'm appointed by Hokkaido Prefectural Government, so if I go to that patrol once, I'll get an allowance [...] There are places where the scenery is completely different from what it was 20 years ago [...] probably the result of the effects of global warming, and I think that it is indirectly affected, but the main issue is deer. In the case of Japan, one of the reasons why the number of Japanese deer has increased is that the bears and wolves have disappeared.

(Nature warden)

In this case, the regional government in Hokkaido provided some small-scale financial support in the absence of local government financing for biodiversity monitoring. The impacts on the mountain ecosystem from climate change are clear in the warden's response. However, biodiversity changes are – in the warden's view – a result of management practices and urban shrinkage change changing the environment for predators.

The second action by NGOs is building resilience by facilitating connectivity and support. This involves support to less-well-off residents beyond what the local authority can offer. Examples include children's lunch clubs, led by organisations such as the Shimizusawa Project, the use of former industrial spaces (e.g. slag heaps to enable community connectivity), environmental education (e.g. walking tours), and volunteer days to install benches and plant trees (interview with community organisation leader). An especially important part of these third-sector actions is providing support and connectivity for young people of high school age and under, who face restricted opportunities in the face of managed decline in the city (finding from discussion group).

5.2. PATH-SHIFTING AND INNOVATION

Path-shifting for transformative adaptation, Fedele *et al.* (2019) explain, is about re-evaluating assumptions on values and practices, and taking advantage of windows of opportunity to redirect development pathways. Innovation for transformative adaptation, meanwhile, entails investing in research and experimentation for adaptation options, as well as monitoring and evaluation (Fedele *et al.* 2019).

In Yubari, the 2007 bankruptcy presented one such window of opportunity. Owing to the financial restrictions imposed by the bankruptcy and need to reduce costs for service provision, local universities were able to initiate dialogue and innovate by proposing options for more sustainable and compact urban forms. This was a decision driven by the economic realities facing Yubari rather than a desire for environmental sustainability or climate resilience. When asked to explain how the local government came to the decision to 'shrink' the city, a local government planner explained that the bankruptcy presented an opportunity to plan the city differently with new actors in the planning process. However, this disruptive element was met with resistance:

[I]t is the result of the power of university students that the opinions of the city hall and the various opinions that the residents and children in the area want to think about are put together in this way. Even if the [city hall] staff do work, when the university students come and talk like this, it's completely different, so we're very grateful for this aspect as well [...] there are people who have an impression that these outer districts have somehow been abandoned, as if it doesn't exist at all and the population has disappeared. There were various situations where we explained that it's not like that.

(Local government planner 2)

As the planner explains, university students had a valuable role in overcoming a lack of trust in local government post-bankruptcy and in creating the conditions of trust for residents to begin to discuss what a resilient and sustainable future Yubari looks like. Notable also in the planner's words are the difficulties faced when discussing 'abandonment' with residents. Indeed, natural

decay – the less transformative response to economic and social pressures – was an extensive talking point in the discussion group session. Notably, residents did not talk about the removal of old mining infrastructure. Indeed, for younger participants who joined the discussion group, coal mining in Yubari had ceased years before they were born. Rather, residents talked about buildings and businesses that had disappeared following the closure of the coal industry, especially familiar places associated with daily life. These included the closure of the Sugawara home goods store in 2019, and of the major tourist hotels in the city, exacerbated by the Covid-19 pandemic. This created a lived environment that was vulnerable to damage and degradation under extreme conditions. For example, periods of heavy snowfall meant that empty houses and shops were collapsing under the weight of the snow, with nobody to clear the snow or to repair them (Figure 2).



Figure 2: Empty shops and buildings in Shimizusawa, Yubari, one with a collapsed second floor.

Conversely, planned relocation and shrinkage offers opportunities for transformative actions towards resilience. Under the Yubari Compact City vision, residents in the peripheral areas of Yubari have been encouraged to relocate to new housing in the urban core. This allows the city to deliver services and to support elderly or more vulnerable populations more effectively over a smaller geographical area (Yubari City Government 2021b). The approach in Yubari of shrinking the city into a more liveable urban form, with investment in new housing and community spaces, could be considered innovative given the novelty of the proposals compared to other municipalities in Japan also facing population shrinkage. The process for developing the Compact City Vision has been participatory and consultative, with students from nearby Hokkaido University surveying residents before a series of different ‘visions’ were drawn up and presented to residents across a series of consultations (Setoguchi *et al.* 2016). In terms of direct climate adaptation actions, planned shrinkage of Yubari has also allowed the city government to move people away from flood- or landslide-prone areas (interview with urban planner 1, Yubari City Government; see also Mabon & Shih 2018).

5.3. MULTISCALAR AND SYSTEM-WIDE

Multiscalar transformative adaptation means creating cross-scale partnerships and engaging with multiple levels of governance. System-wide means bringing together people from different sectors and creating partnerships across whole ecosystems or landscapes (Fedele *et al.* 2019).

There is limited evidence in Yubari of widespread and structured multiscale adaptation action that creates cross-scale partnerships and engages with multiple levels of governance. The city government and different third-sector organisations largely work separately on disparate projects. There are links between NGOs in Yubari and other carbon-intensive communities globally (especially Aberdeen, Scotland) on a small-scale basis to promote dialogue and mutual learning on experiences of everyday nature in an environment dependent on fossil fuel extraction (<https://oldtorry.org.uk/tep-yubari>).

However, there are initiatives within Yubari that have an explicit environmental focus, and can be considered system-wide as they create partnerships at a landscape and ecosystem scale. Work to rehabilitate the Shimizusawa slag heap is a good example of system-wide action towards transformative adaptation. A representative of a community organisation, when asked why they took on maintenance of the slag heap, explained that, in the absence of local government maintenance, they wanted to take steps towards ensuring the maintenance and safety of the slag heap in response to extreme events:

Nobody is responsible for maintaining them! We do this for free and don't pay anything either. If we didn't do it nothing would have happened so we moved first. We don't own or rent it, so we decided to put up the stairs first. Since we got permission only once and then volunteered to build stairs [...] If something happened it could be an issue. So even though it's perhaps not our responsibility to do so, we paid to have a survey done to confirm that the cracks [caused by the 2018 Eastern Iburi earthquake] had no particular effect in order to reassure the residents around us.

(Community organisation)

The work of the community organisation to ensure the safety of the slag heap in the immediate aftermath of a large earthquake in 2018 prompted a discussion about who is ultimately liable for the long-term management of the slag heap under more extreme rainfall and snowfall. Voluntary organisations have also taken on responsibility for maintaining the rich biodiversity that exists on the slopes, which was a result of residents going out and planting their favourite trees and species in the areas closest to their own homes, effectively treating the slag heap as their own 'back garden' (interview with community organisation). Although voluntary organisations have worked well to rehabilitate the slag heap and simultaneously realise a breadth of transformative outcomes for biodiversity and people, the Shimizusawa slag heap case does illustrate a critical challenge for transformative adaptation: namely, governance, financing and decision-making structures that are able to respond to the material and legal realities of climate-related hazards.

5.4. PERSISTENT

Persistent approaches to transformative adaptation are those that institutionalise new practices and regulatory frameworks, and secure political support and funding for long-term actions (Fedele et al. 2019). There are initial signs that some of the community-led actions in Yubari are becoming persistent in terms of institutionalising new practices and securing political support, e.g. Yubari City Government adopting its Zero Carbon City pledge in 2023 (Yubari City 2023b). Residents and local community organisations are beginning to adopt the international language of a 'just transition' to imagine a lived environment that prioritises the well-being of the young and the elderly but which also acknowledges and learns from the legacy that Yubari's various industries have left on the contemporary lived environment (e.g. Sato 2022).

Equally persistent are links to Yubari's mining past. These have led to caution among some councillors and local businesses about any kind of climate action, whether mitigation- or adaptation-focused. Yubari still has small-scale coal refining operations, and city authorities retain significant pride in their coal mining history (Yubari City 2021a). This pride in coal – coupled with a temperate climate and several years of heavy snowfall – has led to scepticism within the city about engagement with structured climate change planning in the way Japan's national government expects. Questions are also starting to be asked about what it means to pride oneself on being a city built on coal mining, and what the place of coal mining heritage and contemporary activity should be in a city

that calls itself ‘zero carbon’. This is well illustrated in an exchange between a city councillor and a local government division leader during a city council meeting in early 2023 (Yubari City 2023c: 15–20):

The city of Yubari is a carbon city, and Yubari’s identity can be said to be carbon. In this town where many people who used to work in the coal mines still live, we are now declaring ourselves a zero-carbon city [...] I assume that there is no opposition from citizens, whether they are former miners or not, to the idea of reducing CO₂ emissions, but I think that there is a sense of pride among former miners that this town was founded on the fact that they risked their lives digging for coal and that this helped to develop the country.

(City councillor)

[...]

Of course, we accept the feelings of those who have been involved in the coal mining industry, and we do not intend to neglect those feelings. However, as I have said many times, the reduction of greenhouse gases is a global trend, and even in our small community we can do something to help prevent global warming. I think that we have a role to play as Japanese or as people of the earth in preventing global warming, and that is all. We are also involved in the coal mining industry, so we feel that the people who were involved in the coal mining industry would understand this.

(Local government division leader)

[...]

In my earlier question, you said that you have no intention of neglecting former coal miners. I hope that you will not forget to address this issue.

(City councillor)

This exchange illustrates how attachment to a coal mining identity, and to a sense of place associated with coal mining, is used to justify resistance to even relatively benign pro-climate policies, let alone those that may have more transformative effects. Moreover, limited budget for staffing and turnover of existing staff within Yubari City Government may make it difficult to turn political and civil society support into persistent practices that support transformative adaptation.

6. DISCUSSION

6.1. PLACE ATTACHMENT AS A BARRIER AND ENABLER

Existing research (e.g. Clarke *et al.* 2018; Solecki & Friedman 2021) indicates that attachment to place can be a barrier to initiating transformative adaptation. Another body of work (e.g. Milnes & Haney 2017) finds that attachment to an identity rooted in fossil fuel extraction can override the sense of urgency to take climate change action, even when residents directly experience extreme events. In some ways, the findings from Yubari reflect this. For example, the exchange between a city councillor and local government official, shown in Section 5.4., about ‘respect’ for former mine workers under Yubari’s Zero Carbon City declaration reflects well the resistance to transformative climate action in former fossil fuel-producing contexts due to place attachment.

However, the shrinking cities scholarship also indicates that building a strong local identity and attachment to place among remaining residents can initiate disruptive change and avoid the most negative impacts of shrinkage on the lived environment. Place attachment can help to identify the most specific locations in a shrinking city that require preservation and enhancement (Pineda *et al.* 2023) or can help to galvanise collective action as resistance to further marginalisation (Berglund 2020). In Yubari, too, a sense of attachment to place is deployed to identify the places that need protecting the most under environmental and social pressures, such as the biodiversity of Mount Yubari and the Shimizusawa slag heap.

Yubari reflects existing literature on place attachment and transformative adaptation. Place attachment is seen as a barrier and a force for good in disrupting processes of unmanaged decline. This tension makes sense if one considers that coal mining and its associated infrastructure and impacts are only one part of a much broader story of change in and attachment to the lived environment for Yubari's residents. The landscape of Yubari is shaped by industrial processes within the city, by industrial processes it has enabled elsewhere, and by the constant change and flux of natural elements such as trees and plants as articulated by the nature warden in Section 5.1. Yubari shows how post-industrial shrinkage may be one of several factors driving change in the landscape, with processes that happen over decades and generations. Yubari thus illustrates the importance of not over-simplifying a narrative of shrinkage following the closure of fossil fuel industries, and of attention to landscapes and lived environments, when imagining place-specific transformative adaptation in shrinking post-industrial city contexts. The amount of time between when the last mine closed (1990) and the initiation of collaborative activities to manage the natural and social environment in the 2010s does, however, illustrate how slow the change in a formerly carbon-dependent community such as Yubari can be.

The complexities and tensions Yubari faces are reflective of Few *et al.* (2017) and the need for caution against the 'warmth' of the term transformative adaptation – especially when it is perceived that jobs, identities and legacies are threatened by transformative or disruptive interventions. The resistance to disruptive changes like large-scale relocation are articulated well in the words of the city planner in Section 5.1. Like Solecki and Friedman (2021), Yubari has resistance to transformative action. This is driven by attachment to a place identity grounded in fossil fuel extraction, as seen in the minutes of the city council meeting in Section 5.4. Yet the actions of cultural heritage organisations in Yubari to both preserve coal identity whilst also looking to a just and resilient future for Yubari illustrate that beneath the most vocal expressions of resistance to transformation there may be significant potential for practical consensus on actions that lead to transformative adaptation in a shrinking city context.

6.2. INTERMEDIARIES ARE VERY IMPORTANT

Intermediary organisations and institutions in Yubari can be the people that make transformative adaptation happen, especially in situations where a lack of funding or channels for participation can hamper municipal-led efforts to initiate and sustain adaptation actions (Leal Filho *et al.* 2022). What is notable in Yubari is that the people and institutions that are doing the most to energise transformative adaptation may not even take climate change or the environment as their core focus, let alone call what they are doing transformative adaptation. Indeed, many of the activities by third-sector organisations in response to problems faced in Yubari initially framed their activities as striving towards societal transformation for Yubari as a response socio-economic pressures, rather than resilience to the impacts of climate change *per se*. These include community restoration of the slag heap and creating a new community hub in the core of the city, as outlined in Section 5. Recently, however, community-led visions for the future of Yubari have expanded to explicitly address issues such as a just transition for the city that respects local mining history and identity, vulnerability in the face of climate hazards, and potential place-based stigmatisation due to the city's history of fossil fuel extraction (Sato 2022).

In shrinking city contexts, local government staffing and resources may be limited, and there may be a need for cooperation across scales and sectors to realise wider transformative potential from site-specific projects and interventions (Coppola 2019). Yubari illustrates that existing organisations, such as the Shimizusawa Project NGO or Hokkaido University, can act as valuable intermediaries for initiating discussions with vulnerable residents on what different governance systems and landscapes associated with transformative adaptation may look like. These organisations can help to implement actions that support climate adaptation and resilience. In post-industrial contexts that have relied on carbon-intensive industries, it may also be possible to gain traction for adaptation action by making links to the need for a 'just transition' that transforms not only the local economy and workforce but also the lived environment, in a way that does not create new inequalities or intensify existing ones.

Building on Few *et al.* (2017), what makes these actions transformative as opposed to transformational is that they enable a whole suite of changes to support societal resilience, as opposed to purely adapting to a changing climate. Given the activities that have been undertaken in Yubari since the 2007 bankruptcy in the absence of a major environmental shock, this is a good example of the kind of proactive transformative adaptation that Novalia and Malekpour (2020) advocate, even if these actions were not undertaken with a primarily climate adaptation focus.

One question that arises from this is whether actions can be considered a form of transformative adaptation if they realise transformative benefits towards societal resilience but are initiated with climate adaptation as only a peripheral aim. Further research could develop comparative research into potential for transformative adaptation in other post-industrial shrinking city contexts.

7. CONCLUSIONS

This paper set out to address the question of how to initiate transformative climate adaptation in a post-industrial shrinking city context. Local government resources and capacity are typically limited and concerns about implications for jobs, the local economy and sense of identity can make discussions about climate action challenging.

Yubari illustrates that place attachment to a carbon-intensive industry and landscape can in some ways be a barrier to transformative adaptation. However, it can also act as a catalyst for actions that build resilience and create the conditions for transformative forms of adaptation. Yubari's identity and landscape, formed on coal, in some cases creates resistance to the local government adopting pro-climate policies. Yet, at the same time, the desire to preserve the cultural heritage associated with coal, and to use this for environmental education and societal support, acts as a force for good in transforming the way the lived environment of Yubari is managed and how the most vulnerable are supported.

Yubari thus offers two insights for initiating transformative adaptation in shrinking post-industrial cities. One is the importance of recognising that carbon-intensive activity such as coal mining may only be one part of a much wider set of stories that shape residents' attachment to place. For example, in addition to its coal histories, Yubari has stories relating to trees, mountains, and everyday shops and buildings. Just like transformative adaptation itself, attachment to place, landscape and identity can thus be complex and multifaceted, and even in carbon-intensive contexts can be drawn on as a driver for energising transformative adaptation. The other is the role that third-sector organisations, especially those working in areas such as social welfare and cultural heritage, can play in initiating difficult conversations about what a comprehensive climate response spanning both mitigation and adaptation means for a landscape and identity formed on high-emitting carbon activity.

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AUTHOR CONTRIBUTIONS

LM led on the conceptualisation, literature reviewing, and analysis and writing-up of the findings. LM and MS co-led on research design and data collection, with LM leading on interviews and document review and Manami Sato leading on workshop design and facilitation. MS supported with collation of underlying data, and with analysis and interpretation of the data. NM supported with data collection, and with analysis, interpretation and translation of the data. All three authors reviewed the drafts and approved the final version of the manuscript.

LM and NM are husband and wife; and both are paying members of the Shimizusawa Project NGO, of which Manami Sato is also a director. However, no author or organisation stands to benefit financially from the publication of the paper or from the results and recommendations within it. All three authors have contributed to the manuscript in a solely personal capacity, and no external organisation or individual has influenced the design, analysis or writing-up of the paper.

DATA AVAILABILITY

Publicly available documents on which the paper is based are included in the reference list, with links to PDFs. Interview transcripts and discussion group notes cannot be shared publicly in the interests of confidentiality; however, requests for access to data will be considered on a case-by-case basis.

ETHICAL CONSENT

Informed consent was obtained from all participants for the interviews to be recorded, and for notes to be taken during the discussion group, and for the findings to be written up for publication. Ethical approval was granted by the Open University's Human Research Ethics Committee (HREC-4620).

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