



Resilient Livelihood Styles: An enriched perspective on household livelihood resilience in the sensitive natural environments of Indonesia

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Abstract

Livelihood resilience has rapidly gained relevance in discussions and policies concerning groups and communities challenged by diverse natural and man-made adversities. Most studies seeking to understand how people respond, recover and adapt to shocks and stresses focus on changes in material or financial resources on the community or larger scales. They thereby often disregard differences in household-level practices and the influence of social-cultural structures in building livelihood resilience. We adopt the concept of livelihood styles to explore a more differentiated and ‘subjective’ conceptualisation of resilient livelihoods. By applying a mixed-methods approach, we scrutinised the ways in which various livelihood styles have evolved to adapt to their changing environment in the Maninjau caldera, Indonesia. We found that different livelihood styles show differing levels of adaptability in terms of resilience. This is largely due to the historic evolution of styles and the way in which they are embedded in social structures. Styles that show higher levels of resilience to changes in the natural environment also appear to be more contumacious towards development interventions that are geared towards new forms of living with the objective of raising people’s income. As such, we show that a resilient livelihood styles perspective offers a way of identifying and interrogating the characteristics that build resilience of household livelihoods that better reflect the reality of local households. It can contribute to the development of more inclusive interventions and policymaking in ecologically sensitive areas that take account of and anticipate transformational environmental changes and the creation of sustainable livelihoods.

Keywords Resilient livelihoods (styles) · Resilience · Social-ecological systems · Water pollution · Waterscape · Indonesia

Introduction

Many water bodies in the world are under immense threat and concerns about climatic ‘extremes’ and the impact of industrial, agricultural and domestic activities on water quantity and quality are rapidly growing (Haddeland et al. 2013; Smoll 2008). Difficulties with such changing aquatic environments are particularly felt by communities that are part of these waterscapes, due to

their inherent relationships with their surroundings (Irvine et al. 2016; Karpouzoglou & Vij 2017). Those living on the edges of lakes commonly use lake water for their domestic water supply, irrigation, fisheries, aquaculture, hydropower, religious ceremonies and recreation. Changes in the quality of the water and the accompanying environmental effects put intense pressures on health and lifestyles and can hamper economic and social development (Kundzewicz et al. 2007).

In addressing such issues, resilience has become a catch-all term in discussions, policies and programmes on climate change adaptation and disaster risk reduction (Bahadur et al. 2013; Jones & Tanner, 2015; Walsch-Dilley et al. 2016). The growing body of literature on resilient societies seeks to understand how people respond to, recover from and adapt to shocks and stresses that affect livelihood outcomes (e.g. Alexander 2013; Manyena 2006; Tanner et al. 2014). Most have focused on changes in material or financial resources, often referred to as capitals (e.g. Carpenter et al. 2001, 2005;

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Leslie & McCabe 2013; Lindstädter et al. 2016; Nelson & Stathers 2009; Speranza et al. 2014; Quandt 2018; Walker & Salt 2006), induced by environmental issues, while the importance of daily life structures and especially the influence of social dynamics remain largely overlooked (Obrist et al. 2010; Tanner et al. 2015). Although the lens has shifted to give greater attention to human livelihoods, much of the discussion on livelihood resilience remains focused on community or higher levels and neglects differences in household-level practices for building livelihood resilience (Abrams et al. 2019; Berkes & Ross 2013; Brown & Westaway 2011; Quandt 2018; Szoenyi et al. 2016). As Agrawal and Gibson (1999) argued, researchers and development practitioners need to stop thinking about communities as ‘homogenous’ and instead recognise internal variability and differences. Development interventions should align with these existing divergent livelihood practices in order to be effective. Rather than focussing on interventions of a technical, material or financial nature, an inclusive approach that pays proper attention to various dimensions of existing livelihoods, including the social-cultural and ecological, is necessary to be effective and for communities to be able to cope with and anticipate external shocks and stresses (e.g. Miller et al. 2010; De Jong & Kuipers 2020).

In this paper, we aim to contribute to the knowledge-building on framing household livelihood resilience by presenting a case study that explores the patterns of practices used by households to shape their lives in a changing natural environment. We focus on the extent that livelihood styles, based on social-cultural, economic and geographical aspects (De Jong 2013; De Jong & Kuipers 2020), allow for adaptation both within as well as beyond existing patterns of practices. By scrutinising the ways in which these various household livelihood styles have been shaped to adapt to a changing environment, we aim to shift the focus of policymakers from looking for ways to enhance the wider society’s resilience through a focus on economic objectives, towards a more encompassing approach.

By combining quantitative and qualitative research methods, we look at the resilience of various styles of living while recognising the day-to-day demands, habits and customs of the local community. More specifically, we attempt to create a deeper understanding of *the ways in which livelihood styles are shaped to adapt or evolve over time in the face of environmental changes*.

Data was collected over a 5-month period in 2018 and 2019 on the south side of Lake Maninjau among communities that live on the intersection between lake and land. Lake Maninjau provides an excellent case for studying livelihood resilience: the area is prone to earthquakes and landslides, and it is one of 15 lakes in Indonesia that are classified as being in a critical condition due to pollution (Istijono et al. 2016; Yanuar 2019). The water quality in Lake Maninjau has declined significantly over the past three decades,

primarily as a consequence of aquaculture (Fukushima et al. 2017; Henny & Nomosatryo 2016). The local population is dependent on the lake’s aquatic resources for domestic and social-cultural purposes and to meet its economic objectives. The declining water quality has had detrimental impacts on the livelihoods of fishermen and damaging consequences for the lake’s environment and its biodiversity, also impacting farmers that cultivate their crops on the banks of the lake. In combination with sudden environmental hazards such as landslides, the sustainability of the livelihoods of most of the population is under threat (Marzuki & Ali 2018).

The remainder of this article is divided into five sections. The next section elaborates on the theory-based concept of ‘resilient livelihood styles’ and provides the framework for what follows. Subsequently, we provide an overview of the region central to this study, followed by reporting on data collection and analysis. In the final sections, we present the research results and discuss our findings.

Towards a resilient livelihood style approach

To investigate the various ways in which livelihood styles in the Lake Maninjau area offer room for manoeuvre in dealing with environmental changes, we first delineate the key concepts we employ. The purpose of this section is not to provide detailed definitions but to lay out a set of broad but clear concepts that will serve as a framework for our analysis.

Livelihood resilience

The resilience perspective has been widely used for understanding human–nature dynamics. To thoroughly understand resilience in relation to social change and social-ecological trajectories beyond the system and the material (see, for example Alexander 2013; Berkes et al. 2003; Folke 2006; Garcia & Charles 2008; Walker et al. 2002; Walker & Salt 2006), we need a social conception of resilience on the individual and household levels (Armitage et al. 2012; Anderies et al. 2004; Crane, 2010). An initial attempt was made by Neil Adger (2000) who defined social resilience as ‘the ability of groups or communities to cope with external stresses and disturbances as a result of social, political, and environmental change’. This has since been widely used to understand a community’s ability to cope with, and actively and positively respond to, external changes in its social infrastructure (Giddens, 2009). However, strongly influenced by positivistic epistemology, this led to a focus on the use of ‘objective’ frameworks and methods that often depend on a range of observable socioeconomic variables that support people’s livelihoods, such as a household’s social capital, income and occupation (Jones & Tanner 2017; Miller et al. 2010). In this line of thinking, it is assumed that social

systems are in a stable equilibrium, but this overlooks the continuously changing and complex dynamics between human and nature systems that can be witnessed at the household level (Bahadur et al. 2013).

Endeavours to include the social dimension on a household level have seen the development of a livelihood perspective in resilience thinking. Synthesising these concepts strengthens and broadens the understanding of a community's resilience to climate change by creating a more detailed picture of the complexities of survival in response to environmental changes (e.g. Bebbington 1999; Block & Webb 2001; McSweeney & Coomes 2011; Scoones 2009). Such approaches generally describe the resources that people have and the strategies that they adopt to make a living. With the focus on monetary, material and social assets and activities, livelihoods constitute a comprehensive and widely applicable concept (Speranza et al. 2014). Livelihood approaches thus tend to address coping with and recovering from shocks, in which the diversification of systems, both as a within-sector approach as well as across geographical boundaries, is the major strategy for increasing resilience (e.g. Blaikie et al., 1998; Chambers & Conway 1992; Davies 1993; Ellis 1999; 2000; Gil et al. 2017; Moser 1998). Finally, a livelihoods approach can strengthen resilience theory by stressing that people's ability to adapt is shaped by their circumstances, cultures, values and perceptions (Enns & Bersaglio 2015).

Consequently, the range of indicators offered to objectively measure livelihood resilience has become vast (e.g. Keating et al. 2014; Lockwood et al. 2015; Speranza et al. 2014). However, relying on a largely quantitative approach still reduces the ability to explain the depth and breadth of social phenomena. Such approaches tend to envisage people as being occupied with achieving well-defined economic goals, such as enhancing their financial assets (Kaag et al. 2004), thereby overlooking the ways in which livelihoods create meaning in the world, as stressed, for example, by Bebbington (1999) and de Haan and Zoomers (2005).

Carr (2020, p.2) noted that understandings of resilience, given the prevalence of a sustainable livelihood approach that 'privileges persistence of and recovery to an initial state without deeply interrogating their sources in a world of increasing and intensifying change', add little to our understanding of social-ecological dynamics. In response, Tanner et al. (2014), Jones and Tanner (2015) and others have advocated re-evaluating the concept towards a more 'subjective' approach to livelihood resilience. They define livelihood resilience as 'the capacity of all people across generations to sustain and improve their livelihood opportunities and well-being despite environmental, economic, social, and political disturbances' (Tanner et al. 2014, p. 23). Rather than simply recovering from shocks, this approach emphasises how coping and adaptation strategies are related to different aspects

of social transformation. However, as in earlier livelihood resilience approaches, the main focus remains on one, or at best a few, livelihood dimensions.

Resilient livelihood styles

What is needed is a more differentiated and 'subjective' approach to resilience thinking to connect 'meaning to the material by embedding livelihood activities and decisions in social relations and their associated meanings' (Carr 2020, p. 2). As such, livelihoods become more locally specific outcomes of interactions between the social-culture, institutional and natural elements that constitute the landscape (Hebinck et al. 2018).

In doing so, it is important to address the duality of agency and structure, or rather, treat people as agents in the social world. Some scholars have argued, because of what they perceive as an overemphasis on people's agency in livelihood studies, that their ability to properly define opportunities and constraints, and understand the complexities of everyday life is severely limited (e.g. Scoones 2009; De Jong 2013; De Jong & Kuipers 2020). On the other hand, an overly narrow view on people's strategic choices runs the risk of neglecting the structural context (Kaag et al. 2004).

Therefore, we reconceptualise resilient livelihoods based on the ideas underpinning livelihood styles. Thus far, various authors have tried to integrate social-cultural components and move beyond the structure–agency divide (see Arce & Hebinck 2002; De Haan & Zoomers 2005; De Bruin et al. 2005) but many dimensions and concepts are still underexposed or lack a satisfactory elaboration (De Jong 2013). In response, De Jong (2013) and De Jong and Kuipers (2020) introduced a more encompassing approach to livelihood styles that addresses the duality of structure and agency, one that treats people as agents in the social world. They defined *livelihood styles* as:

A recognizable and coherent pattern of practices that results from an actor's conscious and unconscious objectives in establishing, maintaining, and enhancing a living in interaction (both in a cooperative and conflicting manner) with other actors over time, and within the framework of status systems, cultural ideals and geographical space and place(s).

The livelihood styles perspectives set itself apart by going beyond the conventional models of livelihood analysis. It not only examines the assets, capabilities and activities of agents, but also includes the consideration of people's perspectives and objectives in obtaining a living. In contrast to earlier models of livelihood strategies, such as those proposed by Ellis in 2000 and Scoones in 2009, the livelihood styles perspective acknowledges that outcomes are not solely determined by deliberate or rational choices. Instead, the use of

the term ‘style’ in the definition underscores that individuals do not opt for particular practices in a social vacuum; rather, their choices can be influenced by social and cultural factors, as well as the contexts that shape these factors. Because these influences can evolve over time, a single individual may employ various strategies at different points, some of which might be unintentional or driven by external dynamics. The livelihoods style perspective thus allows the dynamic nature of livelihoods to be understood since changes in styles are both embedded in the style itself and triggered by the context in which it is embedded (De Jong 2013).

The current study proposes an enriched perspective to address the multifaceted nature of the livelihoods of people living in Indonesia’s waterscapes and beyond. In doing so, we build on the ideas of Tanner et al. (2014) but adopt a more inclusive approach to livelihood resilience by including the notion of livelihood styles as developed by De Jong (2013) and De Jong and Kuipers (2020). This allows to look at the local communities through the lens of—overt and covert—socialised norms and tendencies that guide behaviour and thinking over time, rather than pre-existing defined categories.

We aim to enhance knowledge on the adaptability of the livelihood styles of lake communities by looking at the process of structural change and the capacity of people to adapt to future changes in response to external circumstances, and at the resilience of livelihood styles that are embedded in a wider social and cultural context. For the purpose of this study, a resilient livelihood style is defined in terms of the capacity of individuals or households to sustain or enhance a recognisable and coherent pattern of practices (and their key functions), that results both from their individual acts and from the social world in which they are embedded, in the wake of external stresses and disturbances that result from environmental changes. In this definition, sustaining or enhancing refers to an ability to adapt, or rather absorb, the impacts of disturbances without major deterioration in functioning (Speranza et al. 2014). A loss in this adaptive capacity, and as such in resilience, implies a loss of opportunities and constrained options during and after these periods of stresses and shocks (Nyamwanza 2012).

Site description: the Maninjau caldera

Our research was carried out among dwellers that live within the caldera of Maninjau in West Sumatra, Indonesia. The Maninjau caldera is a large cauldron-like hollow that formed around 52,000 years ago after a volcanic eruption. It comprises the lake, its natural surroundings with the rough hills of the crater and the social life in-between and is characterised by the intricate relationship between nature and people.

The villages around Lake Maninjau are populated by 35,309 people (BPS 2019) that nearly all belong to the

Minangkabau ethnic group. Although most Minangkabau are devoted Muslims, they adhere to an ideology of matrilineal descent and system of inheritance that has been largely sustained over time (De Josselin de Jong 1980; Ng 2006; Simon 2014; Thomas & Von Benda-Beckmann 1985). The Minangkabau are organised in localised matrilineal clans (*suku*) that have a single leader (*panghulu*) who holds the hereditary title of their lineage and their common material and immaterial property known as *pusako*.

Most of the land around Lake Maninjau is *pusako* land, meaning that it is inherited property belonging to either a household or a clan. The Minangkabau have traditionally been farmers and have largely settled in areas suitable for agriculture, where they have developed a diversified agriculture system that combines irrigated rice with perennial crops. As such, land plays a major role in their everyday lives and income. Decisions about transactions, internal group allocations and the inheritance of rights to *pusako* are taken through a process of shared deliberation involving all adult members of the lineage. For this reason, land generally cannot be easily sold or bought (Von Benda-Beckmann & Von Benda-Beckmann 2006; 2014) and excessive subdivision and fragmentation of productive land, or accumulation of ownership by rich people, has not occurred. According to Ridwansyah et al. (2018), land use in the watershed of Lake Maninjau changed little between 1991 and 2018. At the time of this research, the area of Maninjau primarily comprised smallholders (80%) cultivating rice and crops such as spices, coffee, fruit and vegetables for either commercial or subsistence purposes (Marzuki & Ali 2018).

Another feature that lies at the heart of the Minangkabau culture is *rantau* or out-migration. With their social customs and limited job opportunities, the Minangkabau encourage young people to leave their home village and travel to gain experience, knowledge and material wealth (Kato 1982). Since men in the matrilineal system have no right to inherit from their family, it is primarily young men who opt to migrate (David 2011), thereby reducing population pressure on land resources.

The communities in the Maninjau lake area face environmental threats on two fronts: land and water. Population growth and changing economic conditions have driven the expansion of agricultural land into forest areas, leading to deforestation. Earthquakes have resulted in several landslides between 2008 and 2013, taking numerous lives and destroying settlements and infrastructure (Istijono et al. 2016). A large part of the area is still considered a ‘red zone’ (Raden Ayu Ramanda et al. 2019). Environmental degradation has been further accelerated by the use of pesticides and fertilisers. The development and expansion of land-based livelihoods have become constrained due to the limited availability of land (Antomi et al. 2016).

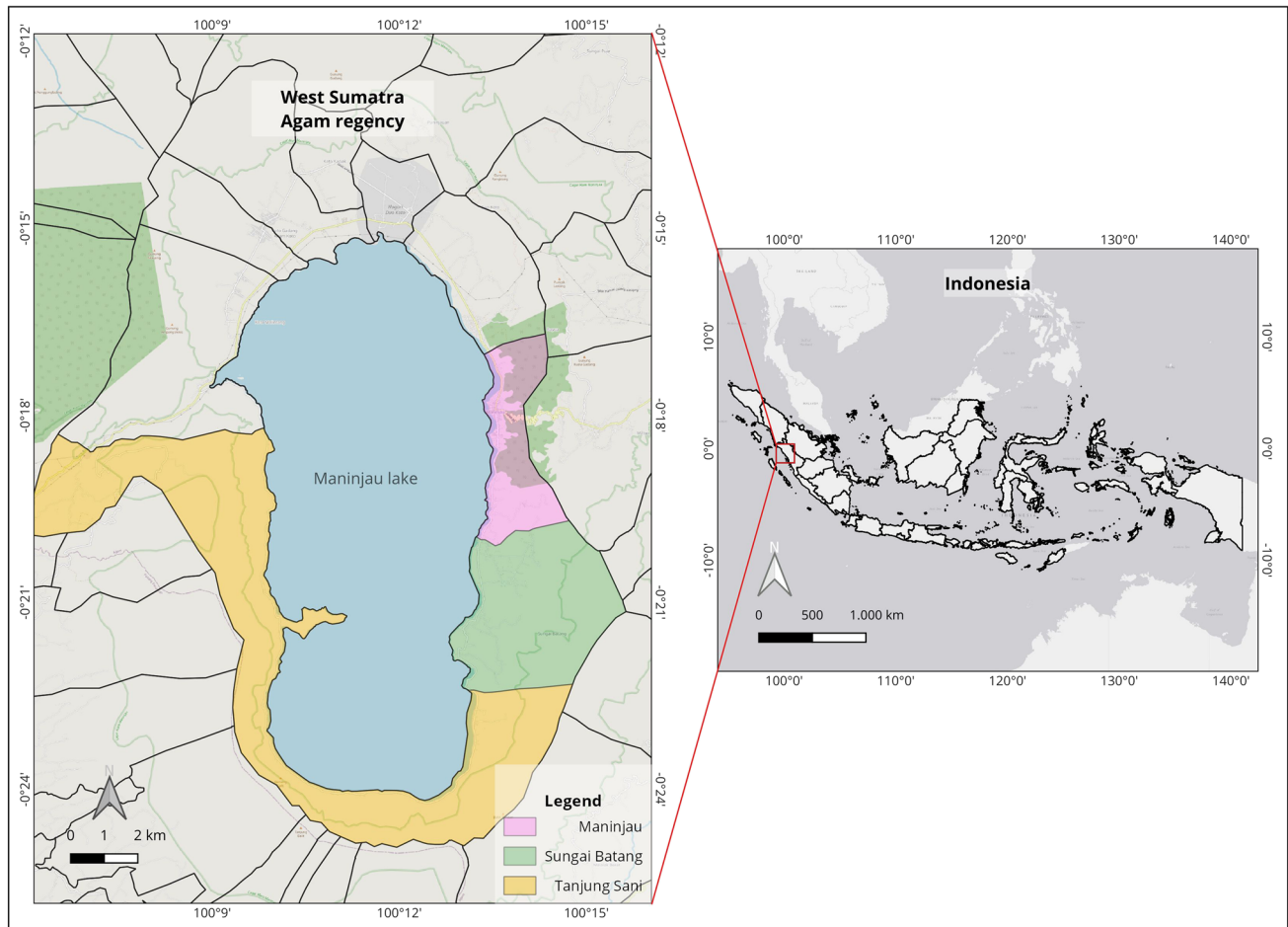


Fig. 1 Map of Lake Maninjau highlighting the research area. Adapted from ‘State of aquatic resources Maninjau Lake West Sumatra, Indonesia’ by Syandri et al. (2014)

As part of a broader government policy to support rural economic development in Indonesia, the cultivation of fish, using floating net cages (*keramba*), was introduced by the local government and National Science Agency in Lake Maninjau, starting with just 16 cages in 1992. As of 2020, this had increased to more than 20,000 cages (Makmur et al. 2020), far above the lake’s aquaculture-carrying capacity of 6000 cages (Jacobson 2016). Consequently, there are regular occurrences of massive and widespread fish deaths, locally known as *tubo*. Eutrophication and unsustainable aquacultural practices, because of overfeeding (50–70 tonnes per day) and fish faeces, have resulted in low oxygen levels and toxic sulphides at the bottom of the lake that rise to the surface under unfavourable weather conditions, leading to fish deaths (Henny & Nomosatryo 2016; Fukushima et al. 2017; Makmur et al. 2020). One of the larger *tubo*, in 2016, resulted in a loss of an estimated 3000 tonnes of fish and affected several villages around the lake. The losses were financially ruinous for many fish farmers (Jacobson 2016).

Methodology

Research was carried out on the south side of Lake Maninjau in the Maninjau, Sungai Batang and Tanjung Sani areas (Fig. 1).¹ Here, the space between the steep hillside and the lake is at its narrowest, resulting in the watershed and its surroundings playing a prominent role in the everyday practices of the land and fish farmers of the Minangkabau society. A mixed-methods approach was used to collect the data needed for exploring the patterns of practices of the communities around Lake Maninjau and to investigate the resilience of these practices. In total, through the different methods, we collected data from over 140 individuals and

¹ The sub-district Tanjung Sani covers an area of 75.03 km² and consists of 11 hamlets (or *Jorong* in the local language) inhabited by 7536 people. The sub-district Sungai Batang covers 5.6 km² with a population of 3582 divided over 7 *Jorong* and the Maninjau sub-district covers 25.60 km² and houses 3137 people living in 5 *Jorong* (BPS 2019). This amounts to a total population of 14,255 inhabitants in the research area.

households. While this is not statistically representative of the total population of the research area, we applied several strategies to achieve a balanced representation across several aspects, which will be explained below. Data were collected sequentially over three phases. Parallel to these three phases, participant observation, through participation in both daily life activities and ritual events, was conducted to gather in-depth information on habits and activities in order to compare and validate the results. The study utilises ‘thick comparisons’ between exemplary cases (see Niewöhner and Scheffer 2010) by taking an ex post approach to produce inside descriptions of similar specificities. This allows a portrayal of the everyday lives of people and creates a more comprehensive and contextual understanding.

Methods

During the first phase, the main concepts and themes were revealed and examined through daily interactions, and informal and topic-based interviews.² In the second phase, we conducted face-to-face questionnaires to gather information on and enable a comparison between different livelihood styles. Quota sampling techniques were employed to select participants, aiming at a balanced representation of households with farming and fishing activities. Hamlets and households were selected to represent the diversity within and among such activities, as well as locations within the waterscape and the variety of households that dwell in it in terms of social and economic position. In so doing, we gathered quantitative information on 85 households from 11 hamlets (*Jorong*) in the targeted area.³ These hamlets are dispersed along the southern shore of the lake. Although households were targeted, the survey included questions on both the household and the individuals. Questions addressed general information on household members, such as age, gender, religion and occupation (see Appendix 1), and on the household level, such as household size, household economy and availability and use of assets, as well as on the main livelihood activities and perceived changes over the past 5 and 10 years.

² Official permission to conduct research was obtained from the headmen of several villages. Our continuing presence in the village made us familiar with a large group of the population. Roughly 95% of the households approached by the research team agreed to participate in the research.

³ To increase the reliability of the responses to the questionnaires, six local students were trained as interviewers. Questionnaires were conducted face-to-face with at least one member of each household and two people from the research team (of which at least one was a native Indonesian speaker). Given the complicated nature of some of the questions and the inexperience of most people with this type of research, the questions were asked and the answers noted by a member of the research group. If a participant chose to elaborate on a question, the information was added to the data as supplementary material.

Subsequently, in the third phase, the results were reinforced through the collection of qualitative information. With the aim of using these follow-up data to elaborate and explain differences between livelihood styles and explore their resilience, we used semi-structured in-depth and oral history interviews.⁴ These interviews were focused on obtaining a thorough understanding of environmental changes and their impact on people’s livelihoods and their coping capacity through unravelling their life histories. From these thick descriptions of a person’s livelihood pathway, changes in the physical, social and material properties of their livelihood, and accompanying responses and perceptions over time, could be uncovered. Here, we used a quota sampling technique combined with snowball sampling. Criteria were similar to those outlined above but did not necessarily involve the same households. In total, 27 people were interviewed in 6 hamlets. All interviews were conducted in Indonesian by a native speaker. Participants’ ages ranged from 30 to 78. Half of the interviewees was farmers that owned fields on which they cultivated rice or other crops. A third were fishermen or fish farmers. Also among the interviewees were village heads, a district head and two *datuks* (clan heads).

Other qualitative data were gained through small talk and participatory observation. In addition to individual conversations, there were another 18 individuals and 10 families⁵ that provided contextual information throughout the research period. These included both male and female rice farmers, fishermen, fish cage owners, employees of fish-packing businesses, social workers, *toke ikan* (distributors of fish and fish-packing businesses), local government employees, students, teachers, owners of shops or restaurants, owners of tourist accommodation, a lawyer and a local tourist guide. Ages ranged from 18 to 64 years old, with the majority living in Maninjau or Sungai Batang.

Conceptualising livelihood styles

To uncover different livelihood styles and enable thick comparisons, various concepts of making a living were considered. These were derived from a combination of a literature review and empirical inquiry. As such, they are both the result of ex ante conceptualisation and ex post qualitative inquiry. Conceptually, we assume that resilience—the ways that people maintain or enhance a pattern of practices—is determined by the ways in which they shape their lives. Such livelihood styles consist of livelihood activities, a household’s dependence on the lake, their material assets and their savings (see Carr 2019; 2020; De Jong 2013; De Jong &

⁴ Eight Indonesian students were trained to conduct these interviews.

⁵ We refer here to families, rather than households, as not all individuals lived in the household for the full duration of the research period.

Kuipers 2020; Perret & Yuerlita 2014; Quandt 2018). Moreover, they are embedded in and highly dependent upon the physical, social, cultural and religious contexts that influence daily customs and habits.

Livelihood activities, the first factor, refer to the main occupations of the household, which, in this study, are farming and/or fishing practices. In the Lake Maninjau area, daily activities, practices and social life revolve around one's occupation. The second factor is related to the lake itself. The rapidly changing water quality of Lake Maninjau can have disastrous effects on people's livelihoods. Hence, it is important to take account of a household's dependency on the lake in their daily customs and habits.

Third, based on the assumption that greater wealth could indicate a larger capacity buffer (Speranza et al. 2014), an asset index was conceived to provide an indication of a household's material wealth (see also De Jong et al. 2012). Five indicators were taken into account in constructing this index: access to land, ownership of *keramba*, ownership of vehicles, the existence of an in-house bathroom and a house's connection to the electricity network (see Appendix 2 for a more elaborate explanation). We assume that a high score on this index enhances the opportunities and capabilities of households to become more resilient (Carr 2020).

Finally, we looked at monetary savings. Savings can be an indicator of a large buffer capacity. That is, households that have considerable savings have something to fall back on in the event of a natural disaster.

These elements of living both function within and depend on the wider context and were therefore also linked to social-cultural aspects of living that were derived through qualitative inquiry. This combination of analysing overt elements of life and the spaces between allows a broader understanding of resilient livelihood styles.

Analysis

Interviews were recorded and transcribed in Indonesian by Indonesian research assistants. Each interview resulted in a full transcription and a report with a narrative exploration of the contents of, and observations made, during the interview.⁶ Translation from Indonesian to English was carried out in collaboration with a native Indonesian speaker.

Qualitative data, including fieldnotes, photographs, interview data and interview reports, were analysed in ATLAS.ti using emergent category designation (Erlandson et al., 1993). The analysis consisted of two stages. In the first stage, all the material was read to obtain a thorough understanding of the

main topics and themes. In the second stage, the material was sorted into meaningful categories and labelled accordingly.

Data from the questionnaire were analysed using SPSS. First, descriptive information was gathered from the dataset to gain an overview of the research population. Cross-tabulation was used to draw inferences between the variables and create an understanding of the relative importance of some variables over others. Scales were constructed for concepts that were deemed important for the analysis (based on qualitative inquiry and quantitative analysis) such as lake dependency and the asset index. To compare the mean scores of the important variables for the various livelihood styles, independent samples *t*-tests and analyses of variance (ANOVA) were conducted.

Results

Livelihood styles in the Maninjau caldera

Three dominant livelihood styles were identified in the case study area: land-based *longue durée* farming practices, *avant* fishing practices (fishing and fish cultivation in cages) and a combination of the two, which we term *convergent* agri-fishing practices.⁷

The *longue durée* livelihood styles is primarily rooted in enduring farming practices, that have evolved over generations. Most farmers in the area possess *pusako* land that they have inherited from their family. The majority (89.1%) use it to cultivate rice. Most of these households have experienced a relatively stable (48.1%) or slight decrease (40.7%) in their quality of life (when considering aspects such as job availability, financial security, safety and security and housing) over recent years ($M = 2.30$, $SD = 0.669$).⁸ Despite this, respondents perceive there to be more pests in the past 5 years and, as a consequence, the majority of farming households has seen a decrease in harvest output. As one respondent noted:

The crops are not as good as they once were. There are more pests, such as *tikus* (rodents) and birds that eat the crops. There has always been *tikus*, but not like there are now. People have been attacking the rodents [with pesticides] but, once you kill them, they come back twice as bad (*mati satu, kembali seratus*).

⁶ During some of the interviews, the interviewee would show the researcher around their property or village. Observations and conversations during this time (that were not part of the interview itself) were described in the reports.

⁷ A complete overview of livelihood styles related to agricultural and fishing practices in the research area includes a fourth group of livelihood styles, characterised by non-farm activities. This livelihood style involves people who have no right to inherit land and no capital to invest in *keramba*. However, due to the limited number of households that could be allocated to this style and because there is no direct relationship between environmental pressures and these livelihoods, we have not included it in the analysis.

⁸ See Appendices 1, 3 and 4 for more information on the descriptive information and statistics.

Farmers see a significantly smaller positive change in their household quality ($t(63)$, $p \leq 0.05$) than do fish farmers ($M = 2.61$, $SD = 0.495$).

In search for additional financial income, many have turned to fish cultivation in *keramba* (cages), resulting in a second livelihood style: *avant*. This style is especially dominant in Tanjung Sani, where the short distance between the steep hill and the lake inhibits extensive land-based farming. Those within the *avant* livelihood style can be characterised by their forward-looking or pioneering nature.

Most fish farmers (*keramba* owners) do not own land and are therefore dependent on other sources of income. They tend to be more business-oriented and are willing to take financial and other risks that come with aquaculture cultivation. Most of them were previously successful in other occupations or were entrepreneurs in other domains. Notably, they have saved sufficient money to invest in *keramba*. Although their perception of their household's quality of living is significantly higher than that of farmers, the majority (60.5%) has seen it decrease over recent years (see Appendix 3). They also commented that fish diseases and other threats, including *tubo*, have decreased somewhat, but remains on their minds: 'we have not had a big *tubo* in the past few years, but people are still scared as they know it will happen again'. Moreover, due to the declining water quality, the volume of fish harvested has remained steady at best over the past decade, with many respondents having experienced a decrease. Moreover, as their dependency on the lake is significantly higher than that of farmers ($M = 1016.82$, $SD = 942.83$, $p = 0.000$), fish farmers are more prone, and therefore more vulnerable, to sudden environmental changes that result from declining water quality.

The *convergent* livelihood styles concern individuals who combine fishing and farming activities, who we term the agri-fishers. They took a chance by moving from farming to fish cultivation but have not yet managed to make enough money from their *keramba* to give up farming altogether, or have reduced their fishing practices due to the lingering threat of *tubo* and the accompanying loss of money. Generally, these people own only a few *keramba* cages, or fish from a small boat (*biduak*) using trawls or nets, and combine this with working a small plot of land that they have access to, either through ownership or from friends and family. There are no significant differences between this livelihood style and those that focus solely on either of the two activities in terms of the perceived threats to their farming or fishing practices (such as disease or pests), the volume of their harvests, and their perceived quality of life. In general, this livelihood style falls between farmers and fish farmers in terms of all the variables measured.

In terms of material and financial welfare, there is little distinction between the three livelihood styles and their

scores on the asset index show no significant differences ($F(2,82) = 1.057$, $p = 0.352$). However, several interviewees noted that accumulated money is often invested in assets, and therefore not available to make up for a drop in income. In Sungai Batang and Tanjung Sani, this investment mostly takes the form of physical assets or *tua* fields (fields with slow-growing crops or forestry for harvesting purposes), as was explained by an informant:

Surian trees are used to make traditional houses and *biduak* (small wooden boats). The wood lasts very well in water and can endure various weather conditions. It takes twenty years to grow *surian* trees but, because the wood is so expensive, it can make you very rich.

Other *tua* fields are used for crops such as cinnamon, areca nut and nutmeg. All are seen as long-term investments that have promising prospects for large profits in the future. However, they cannot be used to provide short-term income.

Moreover, it is common practice for people to be paid in goods that address their basic needs rather than in cash. This might take the form of giving a helping hand against a share of the harvest or being lent a plot of land to cultivate rice and getting both a share of the harvest and a percentage of the income.

The resilience of Maninjau's livelihood styles

The economic position of households in the Maninjau lake area has seen little progress in recent years and, in many cases, has even deteriorated. According to most respondents, national economic growth has resulted in increased prices for food and other products, but their income has not increased to match. According to respondents, funds to develop their practices are limited because they cannot borrow money from banks—mostly because they do not meet the lending criteria, and thus have to rely on personal or family funds. Expanding farming activities is difficult due to the limited availability of new land in the area. An unchanging productivity results in less profit than previously, meaning that most people refer to current daily life as 'a struggle' ('hidup susah').

Longue durée livelihood styles

Landslides between 2008 and 2013 have had a major impact on the communities on the south side of Lake Maninjau. Most residents were evacuated, and many households saw their houses, farming land and infrastructure destroyed. Nevertheless, most *longue durée* livelihoods have sustained. With the help of the local community, *pusako* land was cleaned and prepared for recultivation. Although the fertility of the affected lands decreased substantially, and many of the newly planted crops failed, people persisted and started planting a

wider range of crops to diversify their produce. While waiting for the new yields, they relied on family, or focused on other sources of income such as the lake (through fishing) or small businesses (such as food stalls or selling small household appliances), as a 78-year female respondent explained:

I stayed with my half-brother in Lampung [South Sumatra]. My mother died there three weeks later. When we got back, our house was completely destroyed and we had to rebuild it from leftover *surian* wood. The land was guarded by the community [because it is *pusako* land] and we started planting again what we had lost, while temporarily depending on the lake as well.

This is a typical example of the high level of adaptability that we found in those adopting *longue durée* livelihood styles. People were able to regain their land, clean it and start planting new crops almost immediately. In addition, through crop diversification they became more responsive to changes in their environment.

Impacts from other threats to farming, such as pests, have not been that detrimental to the majority of farming livelihoods in the area. Pests have been common for generations and farming livelihoods in Maninjau have anticipated and familiarised themselves with ways to adjust or adapt to plant diseases. Processes to learn about pests and diseases are also initiated by the farming community in collaboration with the local government. Small groups of farmers come together from time to time to discuss issues and developments surrounding farming practices. As part of such collaborations, a demonstration plot for the ‘healthy’ farming of banana plants (locally known as the *kebun pisang sehat*) was created in Sungai Batang by the government to demonstrate environmentally friendlier ways of cultivation—for example through less use of chemical fertilisers—and serves as an example for local farmers to implement on their own lands.

In many hamlets, it has become part of everyday life to help other community members and work together. Not only on a regular basis—people will work on others’ fields for a third of the yields—but also in the aftermath of disasters, creating for most at least a minimum form of non-governmental social security network for dealing with setbacks. With such strong community relations, constructed over generations, they are able to adapt to, or at least cope with, changes in their natural environment.

Since *pusako* land is allocated by right, which is protected by the community, long-term prospects are relatively promising, bringing a sense of comfort and safety that is not apparent in other livelihood practices. However, this inclusive social-cultural farming system offers little flexibility for embracing transformations, nor room for people to extend their activities. Nevertheless, provided people remain part of the farming community, as we will see with

the convergent group, there is the ability to develop farming practices through diversification or intercropping, to access material or emotional support and to share knowledge and skills. However, if they opt out of farming altogether, they run the risk of losing commonalities and, through that, their access to such privileges.

Avant livelihood styles

The situation for fish farmers is different than it is for farmers. Since its introduction, fish cultivation was seen as an investment that could yield large profits. Family members and friends, especially entrepreneurs and those looking for sources of income beyond the fields, were encouraged to invest in their own *keramba* because of the good economic prospects. As one respondent explains: ‘People used to say, “invest in *keramba*”. Every time you harvest, it will make you happy. You can send your children to school as you can make 15 to 70 million Rupiah (roughly 800 to 4000 euro) per harvest’. In the past, *keramba* owners earned enough to build new houses or to go on a pilgrimage to Mecca (*Hadj*). Nowadays, only a few *keramba* owners are able to maintain a stable and prosperous lifestyle from their fish practices. Maintaining a fish cultivation business requires capital that the majority do not have and comes with severe risks linked to the environmental changes. Moreover, the social-organisational system of support is far less prominent or profound than with *longue durée* livelihood styles. Although fish farmers are willing to help other *keramba* owners that they know with their daily tasks, respondents note that there is no social community to discuss issues or seek help on a wider scale. According to one respondent, most of the fishing communities want the government to initiate such socialisation processes, while the government seems to be looking to the communities to do that for themselves.

Moreover, due to the declining water quality and overfishing, the fishing community has had to deal with governmental restrictions, including limits on cage sizes and on the number of fish in one cage. Respondents stated that while they are aware of the destructive nature of overfeeding and the deteriorating water quality, they are financially dependent on their *keramba* and will continue with their current practices since they are already struggling to make ends meet. Nevertheless, their history of changing occupations and life paths offers them some flexibility to look beyond fish cultivation. This option is reinforced by the fact that fishing practices are largely based on potential economic gains rather than social embeddedness. A lack of an established social-professional structure means that they do not feel confined to the boundaries of their practices in the same way that farmers do. The insecurity linked to the threat of *tubo*, and the accompanying financial losses, results in unstable and vulnerable livelihoods. Nowadays, keeping *keramba*

is often referred to as ‘gambling’ and is seen as a short-term livelihood practice. One respondent explained the challenges associated with *keramba* as follows:

Between 1 and 1.2 million rupiah (62 to 75 euro) is needed to buy 10,000 baby fish. Not all of them survive. Half of the fish that we catch are dead. At most, 4,000 to 5,000 live. The current fish food price is Rp. 450,000 (~ 28 euro) and we need 15 bags of feed before we can harvest one 5 by 5 metre fish cage. Most of [the money] goes back into food and other things. The little that is left comes to us.

The majority of fish farmers is unaware of any possible and/or effective developments that could enhance their fishing practices. Despite the problems, the quantity of *keramba* is not declining. Currently, many people still invest, or are willing to invest, in floating net cages, believing that, even in the event of *tubo*, there is always the option of selling the cages. Their perspective has, however, undeniably changed and people have learnt from earlier mishaps. No longer do locals believe that owning *keramba* will make them rich. The majority of households are aware that the highs and lows are much more dramatic than with land-based farming and, although large sums of money can be made, the potential losses are also greater. Moreover, in the event of large-scale fish deaths or other disasters, starting over or continuing with *keramba* requires a large amount of capital, to which the majority do not have access.

Convergent livelihood styles

Many households that previously based their livelihoods solely on fishing practices have gone back to the fields in search of a more stable income. This phenomenon has developed over the past decade and mainly as a result of the huge fish deaths and the unpredictability of fishing practices. The majority of people within the convergent livelihood style group have a history in farming. They ‘left the fields’, where they mainly worked as labourers, because of the promising economic prospects of the fishing business. Their return was made easy because of the characterisation of farming in Minangkabau as being ever-present and accessible. Almost a quarter of the respondents now combine fishing practices with land-based farming, producing first for household sufficiency, and second for sale. There are several ways in which such a livelihood style comes into being. Members of households split their time between going to their *keramba* in the morning and late afternoon with working as labourers in the fields of others during the day. In other households, as *keramba* practices are usually fulfilled by men, they tend to their cages during the day, while women work in the fields of others, or on their own, often small, inherited plots. The combination of such practices allows them to meet their

economic needs and reduce the impact of a loss of harvest or sudden environmental hazards.

Discussion

By adopting an enriched perspective to livelihood resilience, we have offered a closer look at the ways communities adapt their livelihoods and seek resilience within and beyond their existing livelihood activities in the continuously changing landscape of the Lake Maninjau area. Rather than starting with an existing predefined measurement of livelihood resilience, we carefully investigated and tested local notions and priorities and identified what people in the communities around Lake Maninjau consider as important in relation to livelihood resilience. From this information, we have identified three predominant livelihood styles, distinguished by patterns of practices as well as social-cultural, economic and geographic aspects: *longue durée*, *avant* and *convergent* livelihood styles (see Table 1). These livelihood styles offer varying degrees of adaptability in terms of resilience.

Our results show that, although financial assets and material wealth enhance the likelihood of recovering and recommencing activities after natural disasters, these are not always decisive factors. Rather, social embeddedness and cultural characteristics play crucial roles in maintaining and enhancing future lives. Those with *longue durée* livelihood styles, rooted in longstanding farming practices, are deeply embedded in a social-organisational environment. This was particularly displayed in rebuilding efforts after a natural disaster, which avoided a need for substantial financial capital. That people in these livelihood styles had only limited financial wealth played only a small role in their adaptability, and their possession of land and ability to cultivate it provides a long-term and relatively stable source of income, even without modern technology. This finding is very much in line with the literature on agriculture, social security and livelihood studies that focuses on coping and stresses (e.g. Baird & Leslie, 2013; De Jong 2000; Garibaldi et al. 2017; Nooteboom, 2014; Von Benda-Beckmann & Von Benda-Beckmann 2014). A further insightful observation is their ability to manage and adapt to their changing environment as evidenced through the relatively recent decisions to diversify production or start intercropping and, together with other farmers, search for more sustainable ways to advance their practices. As such, it becomes far more than just a coping mechanism in response to current and/or past states and processes (Berkes & Seixas 2005): it is forward-looking. This farming livelihood style has resulted from a historically long pathway of cycles of shocks and stresses alternated with adaptation and anticipation measures. It has been challenged, adapted, tested, re-tested and revised again and again until a balance is restored, and as such, it is able to cushion the effects of more common changes. However, such a *longue durée* livelihood

Table 1 Overview of livelihood styles in Lake Maninjau area

	Longue Duree farming	Convergent agri-fishers	Avant fish farming
Basis of livelihood style	Based on long running farming practices	Based on farming and fish farming practices	Based on more recently adopted fish farming practices
Social and cultural embeddedness	Community collaboration Dependency on community involvement	Dependency on community involvement	Lack of social support
Financial dependency	Not dependent on financial resources	Dependency on financial assets	Dependency on financial assets
Change & diversification	High level of adaptability within existing structures	Stability, safety & flexibility	Forward-looking
	Stability & safety	Allows diversification opportunities across ecological systems	Flexibility & high risk
	Limited flexibility with major transformations		High flexibility with major transformations
	Resistance to interventions beyond farming		Forward-looking orientation

style, resulting from long running structures, also makes them less flexible. While many have additional sources of income from both on-farm and off-farm activities, in anticipating changes and adapting their livelihoods accordingly, they adhere to what they already know, i.e. farming. This makes them more resistant to interventions geared towards anything beyond farming as a dominant source of income.

For *avant* livelihood styles that base their practices on fishing, responding to environmental changes is much more onerous due to the unpredictability of external pressures such as large-scale fish deaths and the associated large financial losses. Although they live in the same social and cultural environment, obtaining assistance with their practices from others under changing environmental conditions is a challenge. The lingering threat of environmental changes and the continuously increasing price of fish food has resulted in decreasing profits. Options for change, such as diversification or introducing new methods, are extremely limited. Moreover, having adopted an *avant* livelihood style, they lack the structure and stability that is apparent in the *longue durée* livelihood style as they have not yet experienced numerous trial and error cycles that can create greater resilience. Conversely, the flexibility and forward-looking orientation that characterises the *avant* livelihood style, and the limited embeddedness within enduring social-cultural frames, allows fish farmers to anticipate changes more easily than farmers and adapt their livelihood style accordingly if they wish to do so.

Another notable finding is the development of a *convergent* livelihood style in which both farming and fishing practices are present. This traversing livelihood style enables households to spread the risks that accompany environmental changes by splitting activities across two ecological systems within the same geographical location and drawing upon both *avant* and *longue durée* practices. In this way, the impacts of environmental changes can be restricted or kept in check. By moving beyond the boundaries of a single sector, this livelihood style increases options for diversification and transformational opportunities, creating flexibility and resilience

where other styles fall short. If the farmed land cannot satisfy the financial needs of a household, or in the event of an unexpected natural change or hazard, they can fall back on their fish cages and vice versa. This highlights a way of diversification that is rarely emphasised in resilience research where resilience strategies more often focus on accumulating resources through within-sector diversification or off-farm and non-farm employment (e.g. Baird & Weslie 2013; Chambers & Conway 1992; Ellis 2000; Hussein & Nelson 1998).

Admittedly, the group that has effectively evolved their livelihood style into this convergent form is small. Moreover, one should acknowledge the part played by the Indonesian government's promotion of extensive aquaculture, with the sole objective of raising the incomes of those living alongside the numerous lakes dispersed across the archipelago of whom most were making a living out of agriculture. This led to short-term profits for some but more often to long-term natural disasters and the loss of livelihood resilience for most of the people, not just in Maninjau but around multiple waterbodies in the archipelago (see, for example De Jong et al., 2015; Piranti et al. 2019; The World Bank 2018).

This shows that an intervention that is not fully geared to existing livelihood styles, or is limited in focus to one or two dimensions (such as financial stability), has a much higher risk of failure. This can create non-resilient practices and endanger existing livelihood styles. Resonating with Stacey et al. (2021) and Octifanny & Norvyani (2021), we argue that, in terms of resilience, much could be gained by developing intervention measures that align with identified existing local livelihood styles, that, besides economic aspects, also take into account geographical and especially social-cultural dynamics of local communities.

Conclusions

This study contributes to knowledge-building on household livelihood resilience. We have demonstrated the importance of a more differentiated and 'subjective' conceptualisation of resilient livelihoods by adopting the idea of livelihood

styles. The findings provide a deeper understanding of the ways in which livelihood styles, based on social-cultural, economic and geographic aspects, show different levels of adaptability in terms of resilience. Understanding patterns of practices in this context is critical for policy purposes because human action today, whether constructive or destructive, may influence the future state of the environment. As De Jong and Kuipers (2020, p. 2) stressed: ‘The perceptions that humans have of their biophysical environment and their capacity to make choices that affect it (their agency) thus depend on both past interactions with the environment, and their experiences from these, and the social and cultural systems that they are part of’. As such, livelihood styles are the product of these social-cultural interactions and are therefore a key element that sets the stage for people’s sustainability, resilience and adaptability to change (Kofinas & Chapin 2009, pp. 55). Adopting the concept of livelihood styles, as lived habitus-forming entities, in resilience thinking, rather than the more frequently modelled categories (e.g. Speranza et al. 2014), offers a way to better understand how people continuously, and according to a certain pattern, interact to construe a living.

Further exploration of the social dimension should be encouraged as this offers a way to enhance knowledge on the importance of both social and cultural characteristics that affect people’s decision-making and opportunities in securing a sustainable living. A strong aspect of the livelihood styles approach is that it is flexible and adaptable and can thus be geared towards local specificities in different contexts, as done in, for example De Jong and Kuipers (2020). In this study, we have focused on livelihood styles based on occupational aspects. But livelihood styles can take on various forms in different contexts, and aspects other than those identified here may prove to be of greater value in other regions.

As such, this approach may lead to a far more differentiated representation of a local community’s ability to adapt to a changing environment and can aid in and strengthen the development and effectiveness of development interventions.

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