

'The weather is like the game we play': Coping and adaptation strategies for extreme weather events among ethnic minority groups in upland northern Vietnam

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Abstract: *The Vietnamese government, along with country-based non-government organisations, are well aware of the vulnerability of Vietnam's coastal and low-lying areas to extreme weather events. Yet scant attention has been paid to extreme weather hazards affecting Vietnam's northern mountainous regions and the livelihoods of ethnic minority farmers residing there. Building on conceptual tools from vulnerability, food security and sustainable livelihoods literatures, we examine the impacts of extreme weather, namely drought and severe cold spells, in Vietnam's northern uplands. We explore the degree to which these events impact the livelihood portfolios and food security of ethnic minority farmers, and examine the coping strategies households initiate, based on their ecological knowledge as well as recent market integration initiatives. Drawing on ethnographic fieldwork with ethnic minority Hmong and Yao semi-subsistence households undertaken yearly from 2012 to 2014, we demonstrate that financial capital – now more central to households' livelihoods than ever before due to state-sponsored agricultural intensification – is an important means for farmers to cope with extreme weather events. Yet concurrently, longstanding culturally rooted social capital, networks and ties remain critical. Nonetheless, short- and long-term adaptation is not widespread, leading us to investigate possible explanations.*

Keywords: *coping strategies, ethnic minority, extreme weather, food security, livelihoods, Vietnam*

Introduction

There is a notable lack of research concerning the livelihood impacts of extreme weather events in Asia's montane regions, with the Himalayan region being an exception (see Xu *et al.*, 2009; McDowell *et al.*, 2013; Tiwari and Joshi, 2013; Kaul and Thornton, 2014; Klein *et al.*, 2014). The Southeast Asian Massif, a highland region over 500 m joining southwest China, Vietnam, Laos, Cambodia, Thailand and Burma, and home to over 80 million ethnic minorities (Michaud, 2006), has been virtually ignored in these debates. Moreover, Vietnam is one of the countries most vulnerable to the effects of climate change globally (Chaudhry and Ruyschaert, 2007; United Nations Vietnam, 2009). The Vietnamese state has spotlighted climate change mitigation and adaptation as national priorities, but with a clear focus on heavily populated coastal zones and deltas (SRV, 2011). Looking to

the northern uplands, a simple keyword search for cold spells, hailstorms, floods, droughts and intense wind from the online database of VietNam News revealed 54 such events between 2005 and 2014, or over five per year on average (Table 1). When we analysed available daily precipitation and temperature data (1965–2007) from two upland weather stations in Lào Cai Province, our data revealed only a slight decreasing trend in precipitation (about –1 day/20 years) and no significant variability in temperature. It is only when focusing directly on a daily resolution – much like the newspaper reports – that a very different picture emerges, with a number of extreme daily anomalies apparent. It is these local extreme events that upland farmers are particularly concerned about.

The handful of research and NGO studies on changing climate patterns in Vietnam's northern uplands (such as Mai Thanh Sơn *et al.*, 2011; Ho Ngoc Son, 2012; CARE, 2013) point to the

Table 1. Viet Nam News articles covering Extreme Weather Events (EWEs) in the northern provinces

Date	Article headline	Location	EWE
Jan 06 2005	'Cold weather brings visitors to mountains, threatens crops'	Lào Cai	cold spell
Apr 10 2006	'Hailstorm causes damage, death in Son La province'	Son La	hail
Aug 9 2006	'One missing in Yên Bái floods, fields destroyed'	Yên Bái, Lào Cai	heavy rainfall, landslides/ tropical storm
Aug 19 2006	'Landslides and floods claim 16 more victims'	Cao Bằng, Lào Cai	heavy rainfall, landslides
Dec 26 2006	'Cold spell leaves many sick, damage crops in Lào Cai'	Lào Cai	cold spell
Feb 05 2007	'Lào Cai sees rare snowfall'	Lào Cai	cold spell
Feb 23 2007	'Forest fires blamed on hot, dry weather in the northwest'	Son La, Lào Cai	forest fires, hot/dry weather
May 19 2007	'Flash flood kills 5-year-old-child'	Lào Cai	flash flood
Jan 03 2008	'Northern region bundles up awaiting more frosty weather'	Northern provinces	cold spell
Feb 11 2008	'Northern Lào Cai province sees longest cold spell for 40 years'	Lào Cai	cold spell
Mar 23 2008	'Tornadoes wreak havoc in north'	Bắc Kạn / Lai Châu	tornado
Apr 19 2008	'Floods cause traffic jam in Lào Cai'	Lào Cai	floods, landslides
Aug 14 2008	'Trains evacuate hundred from flood-ravaged areas'	Lào Cai	floods, landslides
Dec 03 2008	'North to see frost, as tropical pressure forms in East Sea'	Northern province	cold spell
Jan 16 2009	'More cold, endless drizzle, flood tides forecast for Tet'	Northern province	cold spell
Feb 12 2010	'Fire destroys 1,000 ha of primeval heritage forest'	Lào Cai	forest fires, hot/dry weather
Apr 09 2010	'Hail batters Yen Bai Province'	Yên Bái	hail
Dec 14 2010	'Warning as tropical low nears'	Lào Cai	heavy rainfall
Jan 06 2011	'Cold weather wreaks havoc in northern region'	Northern provinces incl. Lào Cai	cold spell
Jan 21 2011	'Cold front brings misery to north, central regions'	Lào Cai, Sơn La, Lai Châu, Cao Bằng	cold spell
Mar 17 2011	'Snow created winter wonderland in Sa Pa'	Lào Cai, Hà Giang, Cao Bằng	cold spell
May 14 2011	'Floods, landslides pummel Lào Cai, no deaths reported'	Lào Cai	flash floods, landslides
Dec 24 2011	'Tourists flock to Sa Pa for "White Christmas"'	Sa Pa, Lào Cai	cold spell
Jan 21 2012	'Cycle of unusual cold weather descends on Northern region'	Northern provinces	cold spell, unusual rainfall, flood
Apr 01 2012	'Northern provinces clean up after heavy rain, whirlwind'	Lào Cai	hail, whirlwind
Apr 28 2012	'600 households relocated in Lào Cai'	Lào Cai	flash flooding, landslides
May 03 2012	'Forest fires wreak havoc'	Lào Cai, Hà Giang	heat wave, forest fires
May 30 2012	'Heavy rainfall, floods turn deadly'	Yên Bái, Cao Bằng, Quảng Ninh, Sơn La	intense rainfall, floods
Jun 11 2012	'Frequent landslides threaten village'	Điện Biên	landslide
Jun 25 2012	'Flash flooding kills 1, injures 6 in Hà Giang'	Hà Giang	flash flooding
Sep 27 2012	'Households moved from path of impending flood'	Lào Cai	landslide, flood

(Continues)

Table 1. (Continued)

Date	Article headline	Location	EWE
Jan 03 2013	'Three-day cold snap expected to grip northern region today'	Sa Pa, Northern provinces	cold spell
Mar 27 2013	'Giant hailstones pummel Lào Cai'	Lào Cai	hailstorm
Mar 29 2013	'Drought kills 10 tonnes of fish'	Sa Pa, Lào Cai	drought
Mar 30 2013	'Hailstorms continue to hit the north'	Northern provinces	hailstorm
Apr 25 2013	'Whirlwind ravages northern mountainous provinces'	Lào Cai, Tuyên Quang	whirlwind, heavy rain, hailstorms
May 02 2013	'Northern provinces braced for floods, whirlwinds and landslides'	Lào Cai, Yên Bái	flash floods, hail, landslide, whirlwinds
May 07 2013	'Hailstorms destroy rubber trees in Lai Châu'	Lai Châu	hailstorm
Aug 19 2013	'Powerful weekend storms ravage north'	Cao Bằng	whirlwind, hailstorm, flood
Dec 16 2013	'Tourists flock to see rare sight of snow in Sa Pa'	Lào Cai	cold spell
Jan 14 2014	'Cold spell kills cattle in Lai Châu'	Lai Châu	cold spell
Feb 10 2014	'Cold spell hits north, fog covers south'	Northern provinces	cold spell
Feb 18 2014	'Livestock farmers suffer from prolonged cold spell'	Northern provinces	cold spell
Feb 22 2014	'Cold spell wreaks havoc in north'	Lào Cai, Hà Giang	cold spell
May 05 2014	'Northern provinces brace for cold weather'	Northern provinces	cold spell
Jun 06 2014	'Flash floods damage highway in Lai Châu'	Lai Châu	floods
Jul 21 2014	'Typhoon causes heavy floods in northern provinces'	Northern provinces	floods, heavy rainfall
Aug 14 2014	'Flash flood'	Lai Châu	flood
Aug 15 2014	'Flash floods leave 1 dead, another missing:'	Lai Châu, Yên Bái, Lào Cai, Hà Giang	floods
Aug 30 2014	'Heavy rains prompt emergency efforts'	Lai Châu	heavy rainfall
Sept 19 2014	'Typhoon Kalmaegi leaves two more dead'	Hà Giang	heavy rainfall
Sept 20 2014	'Child dies in Bao Yen flash floods'	Lào Cai	floods
Dec 17 2014	'Cold spell hits northern region'	Lạng Sơn, Bắc Kạn	cold spell

Source: Viet Nam News (<http://vietnamnews.vn/>)

broad environmental and structural factors, such as poverty and living in remote locations, that make ethnic minority groups vulnerable to extreme weather events. However, there is limited understanding of how these events impact montane livelihood systems, nor an in-depth appreciation of the intra-household and inter-household coping or adaptation strategies upland populations employ. This article begins to address this gap by focusing on the multifaceted vulnerabilities that these weather events bring for food security and local livelihoods, and the household-level, kinship-level and community-level coping mechanisms that ethnic minority populations undertake to secure

their livelihoods in Lào Cai province, northern Vietnam.

Vietnam's northern midlands and mountains (*Trung du và miền núi phía Bắc*) are home to over 11 million people or 18.8% of the country's population (GSO, 2010a). Of these upland dwellers, over 50% are ethnic minorities, creating a heterogeneous cultural landscape. In the most mountainous provinces, the proportions of ethnic minority populations rise considerably, including Lào Cai province (65% percent minorities), Hà Giang (87%) and Cao Bằng (94%) (GSO, 2010a). With much of the northern uplands ranging between 500 and 1000 m elevation, these populations are predominantly

small-scale subsistence farmers growing rice and/or maize as their staple crop. Indeed, agriculture engages 72% of these upland populations, compared with the national average of 50% (GSO, 2009). Official poverty rates are high, standing at an average of 25% in this upland region, compared with 13% countrywide (GSO, 2009). Adding to this complexity, government interventions over the past decades have created new upland livelihood exposures and sensitivities, as discussed shortly.

We next outline our methods, followed by the conceptual approaches that frame our investigation. We introduce the regional context where this study is situated, before providing an ethnographically rooted analysis of the impacts extreme weather events are having on upland ethnic minority Hmong and Yao semi-subsistence livelihoods. We examine the impacts that droughts are having on rice and maize production, as well as cold snaps that are particularly affecting livestock. We then focus on the strategies these populations are employing to cope with these shocks. While important social capital ties and networks, as well as new trade opportunities, have contributed the most to household resilience, we find that these are still short-term coping mechanisms, and little in the way of long-term adaptation has taken place to date.

This paper draws on fieldwork conducted from 2012 to 2014 in Sa Pa District (population 53,000), Lào Cai Province, on the Sino-Vietnamese border (Fig. 1). Located at 1650 m, Sa Pa town stands at the head of the Mường Hoa valley. Within this valley and watershed the first author completed 35 in-depth conversational interviews and observations in 2012 with Hmong and Yao participants. Follow-up interviews were completed with a third of these interviewees in 2013 and again in 2014, focusing on repeating impacts of interviewee-identified livelihood stressors. In 2013 and 2014, an additional 25 farmers were interviewed by the first (14) or second (11) author, bringing our total interviewees to 60.¹ Interviewees were members of semi-subsistence farmer households engaged primarily in paddy rice and maize cultivation. While purposefully sampled to cover these criteria, they were not selected due to any specific experiences of extreme weather events. Informed consent was gained from all participants and confidentiality was maintained

throughout the research. All names herein are pseudonyms. Forty-two participants were Hmong and 18 Yao, while 42 were women. Twenty-eight participants were between 18 and 30 years old, 12 between 31 and 50, and the remaining 20 over 51. Interviews examined livelihood activities, weather patterns, weather changes and impacts over the last 20 years, stressors and coping strategies. Observations of household activities and environmental conditions supplemented and acted as prompts for interviews. The research data was analysed using thematic coding with *a priori* and *a posteriori* codes used to categorise data and segregate themes (Cope, 2010; Saldana, 2013). The second author has completed fieldwork in the district yearly since 1999 focusing on local livelihood strategies, and we draw on this information too.

Conceptualising extreme weather impacts on rural livelihoods and food security

A sustainable livelihoods framework focuses on livelihood assets (financial, human, natural, physical and social) as well as transforming structures and processes that mediate livelihood opportunities. At the same time, it is important to take note of the vulnerability context (including shocks, trends and seasonality) that affect livelihood strategies and outcomes (including food security) (Chambers and Conway, 1992; DfID, 1999; Ellis, 2000). Livelihoods are dynamic and need to be understood in a framework of changing social and political contexts and emerging opportunities (de Haan and Zoomers, 2005). In Vietnam, for example, since the end of the French colonial period in 1954, government policies have influenced access to commercial livelihood opportunities for Hmong and Yao households in the northern highlands (Donovan *et al.*, 1997; Michaud, 2000; Tugault-Lafleur and Turner, 2009). A ban on independent tourism until 1993 meant that livelihood diversification related to this sector occurred relatively recently. Moreover, the non-timber forest product cardamom has been collected from under the shade of mature trees for decades, but only began to be actively cultivated by ethnic minority farmers in relation to increasing cash needs in the 1990s. Both these activities now

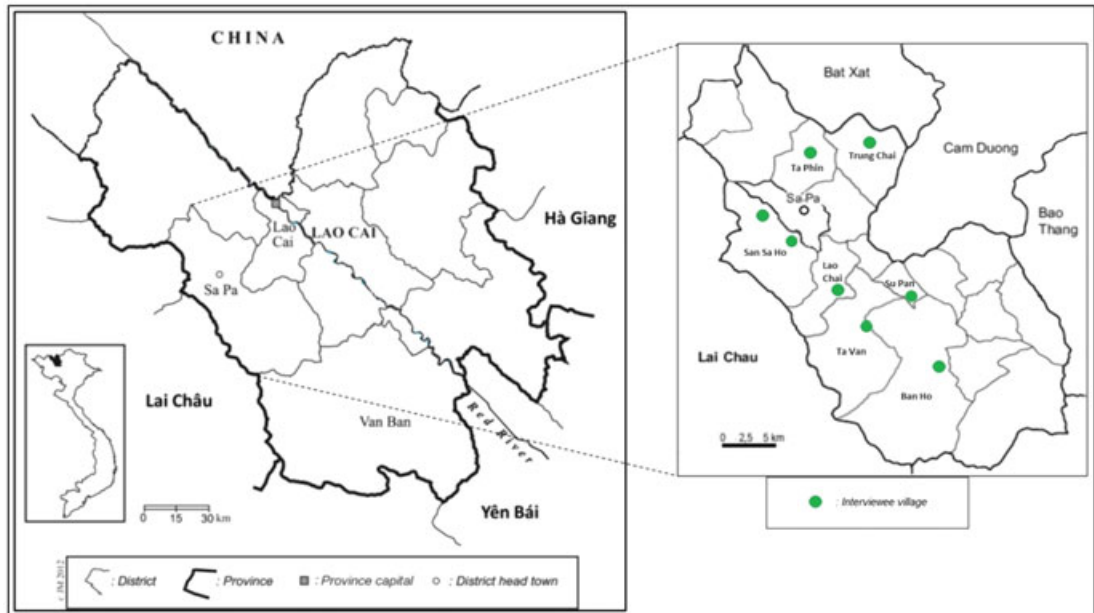


Figure 1. Case study location including interviewee villages

provide new income opportunities, and new vulnerabilities.

One shortcoming of a livelihoods framework is that an emphasis on livelihood assets and how one accesses these often results in an overly economic analysis of livelihoods (Scoones, 2009). Yet assets are far more than just resources that facilitate consumption. In this upland context, for example, water buffalo provide important labour for rice production. Buffalo are also symbols of wealth and status, are slaughtered for funerals and, because they can be readily sold in times of need, represent an important insurance commodity (Bonnin, 2011).

A specific part of livelihoods analysis that becomes crucial in this investigation is the role of social capital. Oftentimes categorised as having bonding, bridging and linking forms, bonding social capital denotes tight networks among similar individuals, such as extended kin. Bridging social capital refers to more open networks among members of different groups and communities, yet is still considered a horizontal form, with socio-economic and political status remaining fairly even. Linking social capital refers to vertical informal connections between individuals or groups of different social, political, or economic status, for instance

if a friendship develops between a farmer and an agricultural extension official (Putnam, 2000; Woolcock, 2002; Turner, 2007; Hawkins and Maurer, 2010).

Probing the concept of vulnerability further, Bohle and colleagues (1994: 39) identify vulnerability as 'a multi-layered and multidimensional social space defined by the determinate political, economic and institutional capabilities of people in specific places at specific times.' Viewing vulnerability as dynamic and highly contextual is echoed in more contemporary work on social vulnerability (Cutter *et al.*, 2003). Thus, vulnerability has a temporal element, and like food security, is a dynamic state (Cutter, 1996; Adger, 2006; Fussler, 2007). Thus, we examine not only *which* stresses affect Hmong and Yao livelihoods and food security but also *when* households are most vulnerable and *why*.

Within vulnerability research, the core aspect of adaptive capacity also informs our study (Luers, 2005; Adger, 2006). Examining the degree to which a system can adapt and evolve in light of changing conditions created by a stress, adaptive capacity is influenced by economic, political and social factors (Luers, 2005; Adger, 2006). While coping is a short-term response, adaptation is considered a long-

term process (Yohe and Tol, 2002; Brooks *et al.*, 2005). Both are a function of a system's underlying resilience, or ability to undergo change without affecting the functioning of a system (Yohe and Tol, 2002; Cannon and Muller-Mahn, 2010). We assess this ability to undergo change when examining the impacts of extreme weather on Hmong and Yao food systems.

Food security debates provide conceptual tools to examine food systems in terms of food availability, access, utilisation and stability (Maxwell and Smith, 1992; Carr, 2006; Webb *et al.*, 2006; Coates, 2013). Food security is often defined as 'the availability of sufficient quantities of food of appropriate quality, supplied through domestic production or imports' (FAO, 2006: 1). Yet such a definition can reduce the discussion to the supply of staple foods (Scanlan, 2003), while we argue that food preference is also an important factor. Food preference is culturally constructed, such that one's perception of food, rooted in a social and cultural context, must be considered when examining food security (Maxwell, 1996; Coates, 2013). For Hmong and Yao this preference is overwhelmingly for rice, even in areas where the predominant crop is maize (Kyeyune and Turner, 2016). We are also mindful of Schmidhuber and Tubiello's (2007) emphasis on examining the process of creating a food supply, not simply outputs (see also Scanlan, 2003). Examining the interplay between ecosystems, the natural inputs for food production, and the social systems underlying the way food is produced, highlights the multiple vulnerabilities and resiliencies of Hmong and Yao food systems and overall household livelihoods.²

Ethnic minority livelihoods in upland Vietnam

In addition to the majority Vietnamese or Kinh (*Việt*) ethnic group, the Socialist Republic of Vietnam identifies 53 ethnic minority groups (*các dân tộc thiểu số*), over 6 million of whom live in the northern uplands (GSO, 2010b). These uplands and their ethnic minority inhabitants have long been cognitively framed as backwards/traditional/minority in opposition to the lowlands, deemed modern by the majority Kinh, especially government officials.

This has resulted in these highlands being routinely socially, economically and politically marginalised (McElwee, 2004; Sowerwine, 2004; World Bank, 2009).

While Hmong and Yao are distinct ethnicities, their livelihood patterns in these uplands have many similarities, adapted to these high elevation conditions. As semi-subsistence farmers, their core agricultural focus is rice or maize production, depending on local ecological conditions. Rice is the primary staple food in Sa Pa District, our study site, while maize is primarily a livestock feed, unless there is a food supply crisis. Because of the cool montane climate, households only grow one annual crop of rice and/or maize. Households require access to arable land with a dependable water supply, either rain-fed or mountain-spring, hence placing a high importance on access to natural capital. In Sa Pa District most rice is grown in terraces, a traditional ecological knowledge said to have migrated with Hmong and Yao to the region over eight generations ago (Turner *et al.*, 2015). Farmers also maintain small gardens with vegetables and fruit, raise livestock, commonly one or two buffalo, as well as pigs and chickens, and gather non-timber forest products such as mushrooms, bamboo shoots and honey. Orchids are now also collected and cardamom cultivated in the forest for cash income. Water buffalo are a key natural capital as farmers rely on these animals to plough, and then till or harrow their agricultural land. As one Hmong interviewee, Mr Kao, noted, reflecting on the impact of recent buffalo deaths due to extremely cold weather: 'When a buffalo dies it's harder to work. The buffalo is important for the local people. It's the same as your car; you need that for work.'

Since the late 1990s, Hmong and Yao farmers have been encouraged by the state to plant hybrid rice and maize varieties (Bonnin and Turner, 2012). Before these varieties were introduced, 40 percent (24/60) of the interviewed households experienced food insecurity, characterised by annual rice shortages. After the introduction of hybrid seeds, only six interviewees reported experiencing yearly rice shortages. However, cash is now needed to purchase these seeds and new chemical inputs, especially fertiliser (Bonnin and Turner, 2012). The emergent importance of chemical fertiliser

is best exemplified by Mrs Sai, a 26-year old Yao mother from Tả Phìn village, who argued: 'Now, if we don't have the fertiliser, we can't grow anything.' For many households in Sa Pa District, financial capital for these agricultural inputs, as well as medical costs, and everyday necessities (e.g. salt, kerosene), is increasingly acquired through activities such as cardamom cultivation, selling handicrafts or guiding tourist treks to minority villages.

Hmong and Yao households must respond to a range of transforming structures and processes that influence their livelihood decision-making. State policies, such as those supporting hybrid seed adoption, cultural norms of land being divided among sons on marriage, increasing conflicts over land resources due to in-migration, tourism and state-supported dam building are all interwoven into livelihood outcomes (see Turner *et al.* 2015). While our focus is on the relationships among extreme weather events, the vulnerabilities these cause, coping and adaptive strategies and food security, we remain cognisant of these other transforming aspects.

Extreme weather impacts and household coping strategies

Weather variability is a factor that Hmong and Yao farmers respond to on an annual basis, but something new is afoot in these uplands. Mrs Cua, a Hmong woman from Giàng Tả Chải commune, explained that in recent years 'the weather is like the game we play.' Some years, good weather (appropriate rain and temperatures) means she grows enough rice to feed her household, while other years unfavourable weather results in an inadequate harvest. While each year brings an element of chance and uncertainty, interviewees noted that variability had become more extreme and more erratic since the year 2000, challenging householders' local ecological knowledge of weather patterns and growing calendars (also CARE, 2013). All but one of our 60 interviewees reported that extreme weather was affecting their livelihood activities, notably their food production systems. Winter cold spells, variable precipitation ranging from drought conditions to intense rainfall, and strong wind gusts, were the main stressors reported, with cold spells

and drought conditions having the most severe impacts. Interviewees explained that these events were straining local food production systems, limiting crop yields and reducing access to productive capital, such as arable land. While other, broader processes noted above, also play into food shortages, over half our interviewees singled out extreme weather events as the direct cause of their food shortages. We focus next on the impacts of two of these extreme events, namely drought and cold spells.

Livelihood impacts of drought

Close to 65% of all households reported that their most important livelihood activities, namely rice, maize and cardamom cultivation, had been adversely affected by drought, wherein insufficient rainfall and high temperatures wither plants and stunt crop growth. For terraced rice in these uplands, there is an optimal 2 to 4 week window at the end of April/beginning of May in which to transplant from nursery beds to larger fields, after which quality and output declines. In mid-May 2012, numerous interviewees voiced concerns over their rice harvest because of unseasonably dry conditions. As Yao farmer Mrs Man stated: 'If it doesn't rain, then next year we won't have anything to eat!' During the last weeks of May that year, many households were still waiting for rain in order to transplant seedlings. In June, most households reported – with relief – that they had received enough rain to plant a *portion* of their rice paddies, but not necessarily their usual acreage. Two householders estimated their expected losses at 500 and 1000 kg of rice, about 17 and 30% of their annual production, respectively. For six households, maize production also dropped that year, with plants becoming desiccated and stunted, or killed completely due to water shortages and above-average temperatures. Likewise, a lack of rainfall similarly delayed the summer growing season in 2014, again increasing stress regarding food supplies.

Drought conditions reduced cardamom production in 2010, 2011, 2012 and 2014. As the plants began to germinate, flowers dried from a lack of rainfall and high temperatures, and cardamom pods did not develop. Twelve households reported difficulties with their cardamom crop in 2012; eight experienced

drastically reduced harvests, while four dealt with the complete failure of their crop. Without adequate cardamom revenues, these households were unable to mobilise cash for sufficient fertiliser for their rice crops, having to turn to alternatives strategies, discussed shortly.

Livelihood impacts of cold spells

Because of its altitude, winter temperatures in the Mường Hoa valley can hover around freezing for short, intense cold spells. While these spells might only last a few days, they can have major impacts on livestock, especially water buffalo. Since 2008, colder-than-normal conditions have caused the deaths of thousands of buffalo in the northern upland provinces (LCPC and DARD, 2011). While cold snaps occasionally occurred prior to 2008, that year was a turning point for interviewees, after which they noted buffalo deaths have multiplied appreciably. Only two interviewees reported a buffalo death caused by cold weather *prior* to 2008, yet since then, 77% of interviewees (46/60) reported either losing a buffalo to extreme cold, having a severely ill buffalo, or having a close family member whose buffalo had been affected this way. Localised cold spells continue to affect buffalo on an annual basis, including intense cold and snow in December 2014 (dtinews, 2014).

Prolonged exposure to the cold decreases a water buffalo's core temperature resulting in lethargy, in turn reducing its physical capacity to care for itself. In these uplands, buffalo can ultimately freeze to death (as 62 were reported to have done in Sa Pa District alone in 2013; dtinews.vn 2014, online). Protracted cold periods also kill the grasses that buffalo graze on in winter months. With less feed, buffalo either lose body fat, increasing their sensitivity to the cold, or spend more time grazing for food, increasing their exposure. While thin or young buffalo are the most vulnerable, the loss of mature animals is considered a greater loss to a household because more time and feed has been expended to raise them and, when healthy, they can be sold for greater profit. Consequently, when a household loses a buffalo they lose an important asset for rice production (labour for ploughing), as well as the potential financial capital that can be accessed in times

of crisis (selling the animal), thus decreasing a household's coping capacity and increasing the household's sensitivity to future shocks. This potential insecurity was clearly exemplified by Mrs Thi, a Yao woman from Tả Phìn village, who stated that when she lost her buffalo it felt like she 'had nothing left.' Moreover, cold spells have greatly decreased the number of buffalo available locally, increasing their market price from \$600–750 USD for a mature buffalo in 2009, to around \$1000USD in 2012, and over \$1500USD in 2014. While positive for those able to raise, protect and sell their animals, this creates further demands on a household's financial capital for those needing to purchase a buffalo; in some cases buffalo are now well beyond a household's financial reach.

Extremely cold weather also reduces household financial capital by diminishing cardamom harvests. This livelihood stressor has been occurring since 2009, yet interviewees specifically noted snowfalls in 2010, 2011 and 2014 that killed important portions of their cardamom fields. For Mrs Ja from Tả Phìn, her average annual harvest fell from 300 kg of fresh cardamom to only 50 kg in 2010 due to snow, with a similar loss in 2011. In 2014, numerous households across the valley lost between half and three-quarters of their crops, due to unusually heavy snow in January that year.

Household coping strategies

How are farmers coping? Taking 2012–2013 as a snapshot, that year three of 35 interviewed households were food secure, with livelihood portfolios abundant enough to access rice, the preferred staple food, and agricultural inputs the year-round, despite extreme weather. Six households were chronically food insecure, unable to produce a sufficient yearly rice supply and lacking robust strategies to secure access through other means. The remaining 26 households experienced seasonal or transitory food insecurity, meaning short-term shortages of rice or occasional struggles to access needed inputs for food production, like chemical fertilisers. However, using available strategies based on different combinations of livelihood capitals, discussed below, they were able to maintain self-sufficiency and regain their food security.

When faced with drought conditions affecting rice crops, a common immediate response is to 'sit it out', hoping it will eventually rain. As Mr Kao stated: 'If it doesn't rain, we don't know what to do because it's the weather. We just hope it will rain in the next month.' Yet other householders were pro-active in carefully tending to their rice seedlings in small nurseries, supplying these with adequate water. Some also used bamboo and plastic pipes to irrigate where possible. Nonetheless, as noted earlier, late rains still resulted in decreased harvests.

When faced with rice shortages, Hmong and Yao households employ similar short-term coping strategies, with financial and social capital being central. Depending on available financial resources, householders buy rice from the market, or draw on social networks to borrow rice. Of the 26 households that reported food shortages in 2012, 85% purchased rice as part of their response portfolio. They also ate substitute foodstuffs such as maize or cassava, or foods foraged from the forest in extreme circumstances (cf. Tugault-Lafleur and Turner, 2009).

For those borrowing rice, immediate kin (parents or siblings) were the most common lenders, although sometimes friends and neighbours were called upon. Rice donated by relatives is generally regarded as a gift, while rice borrowed from friends and neighbours is usually treated as a loan. Yet for many households, borrowing rice is seen as a sub-optimum strategy because it requires asking others for help. The embarrassment of making this request is off-putting for some and they seek alternatives. One's social capital, and a community's resources, also have limits, so householders often combine borrowing with other strategies. As Mrs Tau from Sừ Pán commune explained: 'We can borrow rice but we can only get one [50-kilogramme] sack at a time so we need to stretch it. We need to try to get more food on our own before going and asking for more; so we eat corn meal with our rice, or find [paid] work to be able buy more rice.'

In the event of a community-wide extreme weather event, such as drought, the option of borrowing among friends and family is obviously constricted. When asked how her household would cope with a drought in the future, Yao farmer Mrs Man replied pragmatically, 'if I don't have rice, other people won't have rice,'

highlighting that household coping strategies are dependent on the scale of the stress. Community-wide extreme weather events disrupt proximal social networks, highlighting the risk inherent in coping strategies relying heavily on bonding social capital. Without bridging or linking social capital, households have difficulty accessing resources beyond their commune or familial networks in the event of widespread impacts (cf. Hawkins and Maurer, 2010).

Relying on one's social capital for borrowing is further restricted by one's reputation, or more precisely, the reputation of the male household head. Interviewees explained that a husband's drug or alcohol addiction, or reputation for being lazy, can restrict a household's ability to borrow, because these traits reduce the perceived ability of the household to repay the loan. Widows face similar difficulties accessing informal loans due to perceptions that they will not be able to make repayments. Unfortunately, this occurs regardless of whether the female householder and children are model labourers and community members.

When cold spells hit, household responses focus intensely on protecting water buffalo by keeping them sheltered from the elements and well fed. As Mrs Mo, a Yao mother from Giàng Tà Chải village in Ta Van commune, explained: 'In the wintertime, you need to have a beautiful place for your buffalo and you have to go to the forest to get it grass. If you leave the buffalo alone he cannot find anything to eat, so he'll get really cold and die.' Buffalo pens, the most common shelter, are made of bamboo or wood slates, sometimes also covered in plastic sheeting to aid insulation. However, lacking robust insulation, extreme cold and humidity easily permeates these pens. In response to the 2008 cold spells, government officials advised householders to dig a hole in the ground as a shelter for their buffalo. Yet after doing so, interviewees noted that they lost their buffalo anyway. As well as keeping buffalo well-sheltered, collecting buffalo feed – grasses or plants grown near the home or gathered in the forest – is a key coping strategy. Chải Gathering feed is a labour-intensive activity; it must be collected every day and can be difficult to find in winter, necessitating longer treks to find the requisite amount. A few households also reported feeding buffalo warm corn or

water, or covering them with blankets or empty fertiliser sacks, with mixed success. While household strategies are limited to the resources they have available, what works one year or for one household may not work for the next. In this variable context, even when household members do everything they can, buffalo can still succumb to the elements (see World Bank, 2010).

Upon the death of an animal, eating, smoking, sharing or selling the meat are the main strategies for reducing further food system losses. Smoking buffalo meat creates a sustained protein source for several months, while sharing meat through kinship and community networks helps other households in need and reinforces social capital ties.

Because of the dramatic rise in buffalo prices noted earlier, rarely do households purchase a new animal. A far more common strategy is to borrow this valuable asset from a family member or close friend, drawing on bonding social capital. Failing this approach, households can hire a buffalo from a household with one to spare. Mrs See, a Hmong woman from B^h village, estimated it cost 1.5 million VND (\$75 USD) to hire a buffalo for 10 days' labour from outside one's immediate social network. If a household does not have cash readily available, the borrower can pay the cost by working in the lender's fields. In recent years, gasoline-powered ploughs (9–12 million VND or \$450–600USD) have also appeared. Householders either purchase these outright, pool money with others to share a plough, or hire a plough from another family. However, while filling a need, these machines require ongoing expenditures for gasoline and are considered less suited to the mountainous terrain than buffalo.

Smaller animals (eg. chickens, pigs) lost through extreme cold events are often replaced through kin and neighbour donations, again highlighting the centrality of social capital to household safety nets and coping mechanisms. As Mrs Cua detailed: 'In the village, we often give each other things. So when I don't have something I can ask you, and when you don't have something you can ask me.'

For cardamom damaged or destroyed by drought or extreme cold, households were often at a loss as to how to cope. Cardamom plants take 4 to 5 years to mature, so those

who have lost crops must rely on the goodwill of family and close friends to donate them seedlings, or they divide some of their own surviving plants. Only one householder we interviewed reported that she would purchase new cardamom seedlings. Because of cardamom losses from the 2012 drought, households had turned to rely more heavily on other cash sources in 2013, such as income from tourism trekking and selling handicrafts, to meet a range of livelihood needs. However, interviewees also reported a downturn in tourist numbers in 2013, pointing to the complex vulnerabilities Hmong and Yao households must negotiate.

As a final alternative, when extreme weather events have resulted in insufficient household resources to meet immediate food or cash needs (such as a lack of cash from cardamom cultivation for hybrid seeds and fertiliser), householders may borrow money, either interest free within close social networks or, failing that, with interest from a bank. Yet as noted earlier, support via social networks can be fickle and households without cardamom or other reliable sources of future income, are seen as risks, even for kin and friends. To maintain the social linkages necessary for such loans, borrowers prioritise repayments; as Mrs Xuan stated: 'If I don't have money to pay back [my lender], then I need to borrow again from someone else to pay them back.'

As one of the few examples we found of linking social capital operating across ethnicity, four households borrowed fertiliser directly from Kinh-owned shops when their cardamom harvest had been compromised by extreme cold or drought conditions. Hmong and Yao farmers then pay a premium – ranging from an additional 20 000 VND to 35 000 VND (\$1 to \$1.75 USD) per 50 kg fertiliser sack (\$9 to \$25 USD depending on chemical composition) – when they can access funds. Trust and long-term relationships are essential for these arrangements. To repay loans, some households intensify income-generating activities (selling textiles, trekking, farm labour, off-farm manual labour) to make prompt payments, while others wait for the next cardamom harvest. Finally, when all other strategies fail to secure the needed cash for agricultural inputs, households reduce their fertiliser use, resulting in lower food supply yields.

Discussion: coping, but adapting?

Why do some households cope better with these extreme weather events than others? Households that are coping better tend to be those with more extensive social networks. In this case, this means those with larger extended families, because bonding social capital has been more important to date than bridging or linking. Clan exogamy means that family members are often living in different valleys (with different micro-climate impacts from cold snaps, or different water access from springs) and hence, through female relations (women move out of the clan village on marriage), social networks are important coping strategies. Those with more land are often able to cope better too, because they have a larger overall rice or maize harvest. However, as noted earlier, a patrilineal system that divides a household's land among sons on marriage, as well as land-hungry enterprises (such as large flower and vegetable farms) being established by lowland migrants, are creating a land squeeze in this district. As noted below, this demand for land has also created a coping strategy for some minority farmers.

Are extreme weather events causing disparities in wealth? To some degree yes, but it is important to note that Hmong and Yao tend to maintain a fairly stable socio-economic equilibrium within communities. Hence, while individuals may talk of 'richer' or 'poorer' households (based on the size of house, number of rice fields and number of buffalo), we argue that actual classes have yet to develop (see Michaud, 1997; Turner *et al.*, 2015).

In sum, vulnerability in Vietnam's northern uplands is multi-layered, dependent not only on extreme weather events themselves, but on social networks, financial capital flows, institutional leverage and state decision-making. Coping strategies are seldom straight-forward and access to livelihood capitals are closely intertwined. Strategies are highly contextual, depending on a range of assets and factors: is there land to rent? Chickens to sell? Kin from whom to borrow rice or maize? Households assess the opportunities available within their current capital portfolios and act accordingly, prioritising the most beneficial and least financially, socially and culturally detrimental

strategies available. For many households, financial capital is a key resource that facilitates food purchases, while bonding and bridging social capital facilitate borrowing, lending and giving, providing a crucial safety net.

Investigating the adaptive capacity of these households to extreme weather events and their knock-on impacts, we found four approaches being utilised. First, those with marketable skills have intensified income activities over the past 5 to 10 years, including cultivating cardamom (if cardamom fields are sheltered from the cold, lower in the valley), guiding tourist treks, sewing textiles and selling them to tourists and distilling home-made alcohol for sale (Turner *et al.* 2015). Second, those with access to maize fields for animal feed are increasingly raising small livestock such as pigs and chickens for sale (raising buffalo for sale is not a common adaptation in this valley because of the ongoing weather concerns). Third, renting out land that is chronically dry and inappropriate for traditional crops is a fairly recent strategy that some Hmong and Yao households are using to stabilise long-term food supply. Kinh-run agribusinesses growing cash crops such as artichokes and cabbages are now offering ethnic minority farmers up to 10 year contracts for their fields. As Mrs. Choi, a Yao woman explained, before she rented out her land, she frequently needed to borrow rice from her parents. In 2010, she agreed to a 10-year land rental contract and uses the rent to purchase 550 kg of rice per year, increasing her supply by one-third. Fourth, those without these options are sometimes offering their labour to others. As Mrs. Na, a Hmong mother from Bân Hồ explained, some richer households (defined earlier) hire workers to tend to their fields because they have diversified their livelihoods to include off-farm work, but have retained their farmland. For example, in Bân Hồ village many Tày households are now engaged in tourism as homestay operators and hire seasonal farm labourers of other ethnicities to tend their fields.

While such strategies can be seen as adaptation, or 'the process of deliberate change' based on local capacities and knowledge in response to external stressors, these are only available to a certain proportion of households due to the need for specific skills (cultivation skills, distilling knowledge, language ability) or land access.

Beyond these four approaches, most Hmong and Yao farmers are simply coping, managing the short-term impacts of food in security and livelihood stresses as best they can, often with stop-gap measures (Nelson *et al.*, 2007). Medium and long-term plans for protecting assets and minimising the impacts of weather-related stressors are far less nuanced and developed.

As Scoones (2009: 189) notes, 'bringing perspectives on livelihoods into climate change responses requires ... careful unpacking of the inter-relationships between vulnerability and resilience perspectives'. While unpacking these inter-relationships, we argue that Hmong and Yao farmers are more than able to *conceive* of potential, locally appropriate ways to help improve their resilience, but do not necessarily have the resources to carry these out. For instance, while interviewees reported few options for reducing drought impacts once a drought was underway, more than one interviewee suggested that to reduce drought impacts more trees should be planted to keep farming land cooler and aid with water supply. This could also increase the canopy cover needed to grow cardamom and mitigate the risk of these plants dying from drought. However, these communities, with minimal financial capital and limited political power, cannot implement large-scale schemes like this on their own. As both Mai Thanh Son *et al.* (2011) and CARE (2013) recommend, there needs to be recognition of the value of local knowledge and greater integration of local perspectives into state and NGO initiatives. More extensive state support to specifically reduce the impacts of extreme weather events in these uplands is not yet apparent but could obviously be beneficial, especially if a community-focused, participatory approach is employed.

Another concern this study raises is that interviewees were reporting important levels of emotional distress as a result of food insecurity and livelihood vulnerability. Even for those able to maintain a reasonably stable food supply, the presence of variables beyond their control was causing noteworthy distress. Once again, this highlights that food security is not simply a measure of food availability. During interviews, participants began to unravel the psychological impacts of extreme weather events, from emotional distress over losing buffalo, to feelings of

absolute helplessness about reducing their exposure. No householders reported strategies to cope with these impacts. Given the importance of human capital for upland livelihoods, these stressors could have debilitating and long lasting effects on individual and household capacities for coping with future events. While researchers are beginning to examine the interrelationships between extreme weather impacts and mental health vulnerabilities elsewhere (Berry *et al.*, 2011; Polain *et al.*, 2011; Cunsolo Willox *et al.*, 2012), more work is needed in the Global South.

Concluding thoughts

Vietnam's northern uplands are a multidimensional social space where ethnicity, cultural practices, gender and politics all influence social vulnerability, while local ecological knowledge remains a core strength (see Bohle *et al.*, 1994; Cutter *et al.*, 2003). Householders are aware of nuanced changes in ecological and climatic conditions, being far more sensitive to short-term changes in weather patterns than meteorological stations tend to record in average monthly or yearly data; in addition, these stations tend to be placed in local urban centres that can have a different micro-climate (see Klein *et al.*, 2014). Yet there is a clear need for more state support in these uplands for preparedness and mitigation approaches to extreme weather events and to underscore resilience strategies. While there has been little government research or assistance so far, we believe there are opportunities for better partnerships between communities and state officials. However, Hmong and Yao suspicions of government institutions, as well as the state's enduring perceptions of ethnic populations as backward, could easily hinder meaningful collaborations. By undermining potential linking social capital, this lack of trust may further challenge these communities' ability to collectively adapt to changing environmental conditions in the future (Pelling and High, 2005). As a starting point, more locally rooted ethnographic studies such as this are needed in these complex montane regions to access local knowledge and identify home-grown coping mechanisms and potential adaptation strategies to extreme weather. It is hoped that then policy directives

and non-government organisation interventions will be able to be genuinely beneficial to local livelihoods and food security.

Notes

- 1 Interviews were completed with interpreters of the same ethnic group as the interviewee, or by the authors alone.
- 2 While the food security literature continues to debate the appropriateness of the household as the unit of analysis, noting that household analysis conceals intra-household access dynamics (Maxwell and Smith, 1992), we will focus on the household here because it is the basic economic unit in Hmong and Yao communities (Cooper *et al.*, 1995; Corlin, 2004; Sowerwine, 2004). Yet we also highlight the interplay of household-level, kinship-level and community-level food systems.

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