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Cardamom Casualties: Extreme Weather Events and Ethnic Minority Livelihood Vulnerability in the Sino-Vietnamese Borderlands

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Abstract: In the wake of important economic reforms and an ongoing agrarian transition, non-timber forest products, most notably black cardamom, have emerged as significant trade options for ethnic minority farmers in the mountainous Sino-Vietnamese borderlands. Yet, after a series of harsh winters had already crippled cardamom harvests in the 2000s, extreme weather in 2016 decimated the cardamom plantations of hundreds of farming households. Drawing from sustainable livelihoods, livelihood diversification, and vulnerability literatures, we investigate the multiple factors shaping how these harvest failures have affected ethnic minority cultivator livelihoods. Focusing on four case study villages, two in Yunnan, and two in northern Vietnam, we analyse the coping and adaptation strategies Hmong, Yao, Hani, and Yi minority farmers have adopted. We find that farmers' decisions and strategies have been rooted in a complex ensemble of factors including their degree of market access, other livelihood opportunities available to them, cultural traditions and expectations, and state development strategies. Moreover, we find that in recent years the Chinese and Vietnamese states have stood-by as affected cultivators have struggled to reorganize their livelihoods, suggesting that the impacts of extreme weather events might even serve state projects to further agrarian transitions in these borderlands.

Keywords: extreme weather events; vulnerability; livelihoods; ethnic minorities; cardamom; Sino-Vietnamese borderlands

1. Introduction

The Southeast Asian Massif—a broad expanse of mountainous uplands extending southeast from the Himalayas and shared among 10 countries—is home to more than 110 million people from diverse ethnicities [1]. Eighty million of these individuals live in southwest China and northern Vietnam where they have customarily resided in isolated rural communities while maintaining semi-subsistence livelihoods. These livelihoods, traditionally centred on staple crops of rice, maize, or cassava, as well as limited livestock, home gardens, and small-scale trade, are now being rapidly altered as a result of ongoing agrarian transitions. These transitions involve growing market integration, pluriactivity, and industrialisation, in addition to commercial intensification, and new infrastructure and communications technologies. In turn, these transitions are resulting in ethnic minority farmers increasingly needing cash for the procurement of industrial farm inputs, food, rising education and healthcare costs, and the hiring of farm labour.

Such an intensification of capitalist market relations is creating new opportunities as well as challenges for local minority populations in the borderlands of southwest China and northern Vietnam who have traditionally focused on maintaining semi-subsistence livelihoods [2]. Among the recently expanding opportunities are new markets for non-timber forest products (NTFPs). While the cultivation and trade of NTFPs such as bamboo shoots, honey, mushrooms, and black cardamom (*Amomum tsaoko*) have always been part of upland livelihoods, since the mid-1980s black cardamom has gained significant traction as a highly lucrative and comparatively low-risk NTFP option. Cardamom prices have risen relatively steadily over the past three decades, with cultivators benefiting from the fact that dry pods can be stored when trade prices dip, and that cultivation requires comparatively little labour or chemical inputs. As such, at the turn of the millennium, it looked like cardamom might be emerging as the 'new opium', bringing relative wealth to these borderlands and acting as an important cash source for farmers progressively in need of cash for chemical inputs and hybrid seeds for agriculture. Yet, the picture has since turned increasingly volatile. A series of extreme weather events occurred in these uplands from 2008 onwards, the most disastrous to date being in January 2016 which brought heavy snow, freezing rain, and hail. These events have revealed important differences in the coping and adaptation capacities of cardamom cultivators, and exposed a lack of interest by the Chinese and Vietnamese states to become involved in supporting such borderland residents.

This paper draws on interviews completed with ethnic minority cardamom cultivators before, during, and after the disastrous January 2016 winter on both sides of the Sino-Vietnamese border. Our aim is to understand how these cultivators are being affected by and responding to increasingly frequent and intense extreme weather events, focusing on the 2016 events due to their magnitude, but also taking other recent extreme weather events into account. In order to achieve our aim, we compare four case study villages chosen for their altitude (influencing the impacts of extreme weather events on crops), relative location to local market places (influencing livelihood alternatives), ethnicity (potentially impacting cultural norms regarding coping mechanisms), and political context, in two bordering countries. We examine how different households and village communities are attempting to cope with and/or adapt to external shocks, and reveal the possible reasons behind the similarities and differences in approaches. After briefly outlining our methods, we turn to conceptually situate this study within literatures concerning sustainable livelihoods, livelihood diversification, and vulnerability. We then introduce the ethnic minority cardamom cultivators at the centre of this analysis and detail their core livelihood approaches. We investigate these actors' perceptions of recent extreme weather events, before focusing our analysis on how increasing failures of cardamom harvests are impacting their livelihoods, and what their responses have been to date. Our analysis also uncovers what state actors are doing—or not—to help alleviate farmer concerns.

Utilising a multi-sited ethnographic approach, the first and third authors completed semi-structured and conversational interviews in Honghe Prefecture, Yunnan Province, China, with more than 30 Hani, Yi, and Hmong ethnic minority cardamom cultivators, as well as with 18 Han (Chinese majority) traders and state officials. Across the border in Lào Cai Province, northern Vietnam, the second author completed semi-structured and conversational interviews with more than 40 ethnic minority Hmong and Yao cardamom cultivators, eight minority Tày and Kinh (Vietnamese majority lowlanders) trade intermediaries, and five Kinh cross-border wholesalers. Interviews in Yunnan were completed in Mandarin or with a local Hani research assistant, while those in Vietnam were conducted with research assistants of the corresponding ethnicity of the person being interviewed, or alone. The core interviews for this project were completed from 2015 to 2018, before, during, and after the extreme weather events of 2016. Emphasising an inductive research design, our interviews focused on a series of themes that we agreed upon prior to fieldwork spanning: cardamom growing and cultivation techniques; knowledge acquisition and sharing; trade routes, traders and market interactions; cardamom transportation, storage and usage; details of the impacts of extreme weather events, coping and adaptation strategies; and commentaries regarding state support. We processed our data as a team using thematic coding and segment our results below following the core thematic clusters that emerged. The quotes we use in this

article are representative of how our interviewees responded to specific themes. This research is further supported by observations and interview data gained from completing fieldwork on ethnic minority livelihoods in these uplands since 1999.

2. Conceptualising Livelihoods, Their Diversification, and Vulnerability in the Sino-Vietnamese Borderlands

Drawing on livelihood studies allows us to probe how individuals and households in these borderlands mobilise complex bundles of assets in order to benefit from new opportunities or cope when they lose access to earlier options [3,4]. Conceptual approaches to livelihoods emerged in the early 1990s as an alternative to earlier impact assessment models centered on tangible and measurable variables such as financial income and employment [5]. Livelihood scholars seek to highlight the complexity and diversity of livelihood asset portfolios, and how these combine both tangible and intangible components. Livelihood portfolios are often conceptualized in the form of an asset pentagon comprising natural, social, financial, physical, and human capitals [6]. However, this pentagon approach has been critiqued for making livelihood complexity 'manageable' for the development community, through a largely economic approach [7]. Since the mid-2000s, livelihood scholars have, therefore, worked to address critiques that livelihood approaches have overlooked important contextual elements such as culture, local belief systems, and ethnicity [8,9].

As part of this work, livelihood scholars have provided original insights into how people are affected by environmental change, how they react to it, and why. This focus has been helped by the framework's attention to the vulnerability context, including shocks (e.g., extreme weather events), trends (e.g., economic and resource shifts), and seasonality (e.g., seasonal employment opportunities or price fluctuations) that affect livelihood strategies and outcomes [6]. Individuals or households attempt to mitigate their vulnerability to such events through diverse responses, the most immediate of which are coping strategies [10]. Such coping strategies are often involuntary, short-term responses to a sudden crisis [6]. In turn, adaptive strategies are "the process of deliberate change" in response to an external stress, focusing on the ability of an individual, household, or village to respond over the long-term [11] (p. 395). Factors such as ethnicity or exposure to market integration can play key roles here, as differences in access to power and resources contribute to how people respond to adverse livelihood impacts [12,13].

Ellis [14] (p. 4) suggests that livelihood diversification is "the process by which rural families construct a diverse portfolio of activities and social support capabilities in their struggle for survival and in order to improve their standards of living". Livelihood diversification is, therefore, often categorized as a risk spreading or wealth accumulation strategy [15]. Diversification might be achieved by engaging in new income opportunities, such as undertaking a mixture of agricultural, livestock, and off-farm activities [3,16].

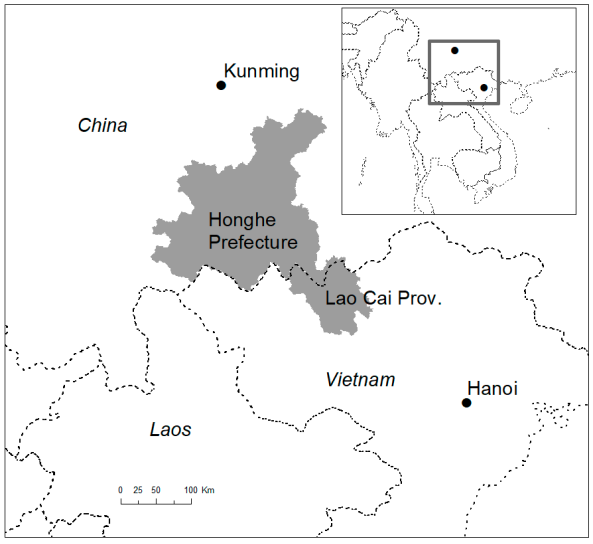
Livelihood diversification is a common focus of vulnerability scholarship which centers on the human impacts from climate stimuli such as extreme weather events. While a number of understandings of vulnerability exist, the Inter-governmental Panel on Climate Change (IPCC) framework is widely used and stipulates that vulnerability brings together exposure, sensitivity, and coping and adaptive capacities [12,17–20]. Exposure encompasses "the nature and degree to which a system is exposed to significant climatic variation" [19] (p. 987), while sensitivity is "the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli" [19] (p. 993). Similar to livelihood scholarship, vulnerability literature conveys the idea that coping strategies are short-term, immediate responses, while adaptation encompasses long-term, planned impact alleviation strategies [20,21].

Furthermore, vulnerability is determined to be socially differentiated, being mediated by a wide spectrum of sociocultural criteria including race, ethnicity, gender, age, household size, and so on [12,21]. Households with greater livelihood asset pools can mobilize these resources to enhance their coping and adaptive capacities [17,18]. With this in mind, we combine conceptual ideas from the sustainable livelihood, diversification, and vulnerability literatures to examine the impacts of extreme weather events on ethnic minority cardamom cultivators in the Sino-Vietnamese borderlands.

3. Contextualising Cardamom Livelihoods in the Sino-Vietnamese Borderlands

Black cardamom is a perennial crop indigenous to the highland regions of Yunnan, Laos, and northern Vietnam, where it grows under the forest canopy and requires fairly precise humidity conditions to achieve optimal yields (cf. [22]). Black cardamom plants start yielding four to five years after they are sown and require no chemical fertilizers, with cardamom plots only needing to be weeded once or twice a year to ensure springtime ground-level flower blooming. Cardamom pods are harvested in the fall, and are commonly fire-dried in situ, with dried pods then being far lighter to transport and storable for years. Cardamom cultivators include Hani (Akha), Yi, Hmong (Miao), and Yao (Dao) ethnic minorities (the most important ethnic groups by demography in these borderlands) who usually grow cardamom in their customary forest domains. They have historically used cardamom as a medicine for respiratory and stomach infections, also feeding it to buffalo during cold weather to prevent illnesses. However, these days the bulk of cardamom grown in these borderlands is transported to central and eastern China where it is processed and sold as a cooking spice or for traditional medicines. This route sometimes involves cardamom traders crossing the Sino-Vietnamese border with Vietnam-grown cardamom and entering China through a chosen border crossing depending on criteria such as volume, place of origin, destination, and whether the traders are local ethnic minorities cultivators, Han, or Kinh. These crossings range from large, formal and highly controlled border stations, such as that found at Lào Cai-Hekou, to far less formal posts, that only local residents can utilize [23].

To compare cardamom cultivator responses to extreme weather events in these uplands we draw on four case studies (using pseudonyms for the sake of protecting informants) (Figure 1). The first two are located at relatively lower altitudes, and are well connected to markets for trade, namely Cash Cropping Cun (Ch: Cun = village) in Yunnan, and Tourist Bản (Vn: Bản = upland village) in Vietnam. These are compared with two villages located at comparatively higher altitudes, which are remote from important marketplace trade locales, Remote Border Cun in Yunnan, and Remote Bản in Vietnam.



Village characteristics: / *Village:*	**Lower altitude, well connected to markets for trade**	**Higher altitude, distant from markets for trade**
Honghe Prefecture, Yunnan, China	Cash Cropping Cun (Yi and Hani)	Remote Border Cun (Hmong)
Lào Cai Province, Vietnam	Tourist Bản (Hmong and Yao)	Remote Bản (Hmong)

Figure 1. Locations and main characteristics of our four case-study locations.

4. Upland Livelihoods and Diversification Approaches Prior to Recent Extreme Weather Events

4.1. Market Expansion Waves: Honghe Prefecture, Yunnan

In Yunnan, Cash Cropping Cun and Remote Border Cun are located in Honghe Prefecture, and more specifically, within the Township of Caoguo ('Townships' in China are not necessarily urban; they denote the fourth-level of political administrative units). Honghe Prefecture is home to about 1 million (23%) Yi, 790,000 (18%) Hani, and 330,000 (7%) Hmong ethnic minorities (Hmong are subsumed within the official 'minority nationality' category 'Miao' in China), as well as about 1.9 million (43%) Han Chinese, with a total population of about 4.3 million [24]. Honghe is one of China's cardamom production hubs, as a local state official proudly claimed:

> When people think about cardamom, they think about Yunnan [province]; when they think about Yunnan's cardamom, they think about Honghe [prefecture]; when they think about Honghe's cardamom, they think about Jinping [county]; and when they think about Jinping's cardamom they think about Caoguo [township] (4 November 2016).

4.1.1. Cash Cropping Cun: A Lower Altitude Settlement Integrated into the Market Economy

The ethnic minorities living in Cash Cropping Cun (altitude 1250 m.) are Hani and Yi. Hani traditionally live in midland settings (altitude between 750 and 1500 m.) where they tend to grow maize and rice as staple crops in impressive terraced fields, customarily ploughed with buffalo. Ducks, chickens, and pigs are also commonly raised, usually within household courtyards. Nonetheless, the relative importance of subsistence agriculture within Hani livelihoods is receding fast, with cash cropping (especially bananas and tobacco), work migration, and village-based tourism and retail activities having all grown in importance since the new millennium.

Yi are settled in comparable locales and their livelihoods have likewise customarily been centered on maize and rice farming and extensive animal rearing. Like for the Hani, economic reforms, together with shifting forest regimes, have modified Yi access to forest resources and have driven extensive diversification patterns over the last few decades. As a consequence, Yi livelihoods are increasingly market oriented while traditional forest knowledge, once a core human capital asset, has decreased in importance [25].

The vast majority of cardamom cultivators in Cash Cropping Cun harvest between 20 and 100 kg of dry cardamom pods from forest patches which are a quarter of a hectare on average, located near their houses (obtaining one kg of dry pods requires about four to five kg of fresh seeds). These small-scale cultivators switched to cardamom in the mid-2000s, when prices started to boom. In contrast, a small number of cardamom cultivators were actively involved in a state plan to expand cardamom in a nearby protected forest in the early 1980s. These farmers now oversee plots of five hectares or larger, yielding anywhere between 500 kg and a few tonnes of dried cardamom during a normal year's harvest. They have managed to accumulate important levels of natural capital, including dry cardamom pods that they store to take advantage of price fluctuations (in years without an extreme weather event, prices decline in the summer as the harvest approaches, and then climb again in the winter, a few months post-harvest). Yet maintaining large scale plantations requires hiring wage workers during the weeding and harvest seasons and, as one Hani farmer explained, "Growing cardamom on a large scale requires lots of money. It cannot be done in a random way" (interview, October 2016).

4.1.2. Remote Border Cun: A Higher Altitude Settlement Remote from Markets

Hmong households in Remote Border Cun (alt. 1550 m) tend to maintain semi-subsistence livelihoods based on a core staple of maize and rice. Small household gardens provide vegetables, fruit, and herbs, while the forest provides NTFPs. Livestock such as pigs, chickens, and goats are also raised, as well as prized buffalo for ploughing rice fields and specific ceremonies. Due to fairly limited cash crop options, all Remote Border Cun households have managed to secure cardamom

plots averaging about two hectares where they harvest about 160 kg per household (interviews, 2015). Local growers seldom hire wage workers to help, with work pooling arrangements being the norm instead. Non-cardamom related opportunities are far less numerous than in Cash Cropping Cun. For instance, the only trade intermediaries to make the journey on the paved road (since 2003) that links Caoguo Township and Remote Border Cun are cardamom traders who arrive to buy dry pods when quantities and price justify it. Villagers have thus accumulated less financial assets on average than in midland villages like Cash Cropping Cun. Moreover, apart from a few manual work migration opportunities, further livelihood diversification opportunities have been limited.

4.2. Market Expansion Waves: Lào Cai Province, Vietnam

In Vietnam, Lào Cai Province is home to about 146,000 Hmong (24%), 88,000 Yao (14%), and 215,000 (35%) Kinh (lowland majority), with a total population of about 615,000 [26]. In Lào Cai Province, when people think of Sapa District, they tend to think of tourism, not cardamom. The District head town, Sapa town, has become a well-known tourist destination for lowland Vietnamese (Kinh) wanting to visit Mount Fansipan, Vietnam's tallest mountain, via a newly installed cable car, or to escape the lowland summer heat.

4.2.1. Tourist Bản: A Lower Altitude Settlement Integrated into the Market Economy

Tourist Bản (altitude 1100 m) lies in a valley five kilometers from Sapa town, with fertile rice fields and steep forested mountains on either side that house scattered cardamom plots. Oral histories with Hmong and Yao residents reveal that the first inhabitants arrived here from China about eight to nine generations ago and brought terraced rice farming knowledge with them. Yao have fairly similar livelihood portfolios as Hmong households (introduced above), also living at high altitudes on either side of the borderline. Most Hmong and Yao farmers maintain fairly small cardamom plots due to the area having been settled for over a century, with the best forested areas for cardamom cultivation already divided among numerous households and then between sons upon marriage. Farmers harvest between 50–200 kg of dried cardamom a year, which provides 'security funds' for emergencies such as a hospital visit or funeral costs. Some households also partake in the small-scale trade of other NTFPs, such as orchids and song birds. The vast majority of households in this village also have at least one member, predominantly female, involved directly or indirectly with tourism. These individuals are either leading tourist treks in the valley, or producing and selling textiles for sale along tourist trekking trails or in Sapa town (see [27]).

4.2.2. Remote Bản: A Higher Altitude Settlement Remote from Markets

Remote Bản (altitude 1900 m) is located about 22 km from Sapa town on a very winding, steep mountainous trail, only completed for motorbike and four-wheel drive access in 2007. Here, Hmong villagers have historically been far more self-reliant than those in Tourist Bản, as access to Sapa marketplace, or to smaller village marketplaces in the valley, was eight to 10 h on foot until the road was completed. Cardamom cultivation has become big business since the 2000s, with farmers cultivating between 300–400 kg a year at high elevations. Very few alternatives exist for Remote Bản households to gain access to cash except illegal wood extraction. Given that the whole village is within a National Park where timber extraction (except dead branches for fuelwood) is forbidden, this is a risky occupation, usually only undertaken by young men at night. Yet, the removal of any NTFPs, including cardamom, is also illegal–in theory.

5. Cardamom Crisis: Extreme Weather Events Hit the Borderlands

All of the 70 ethnic minority cardamom cultivators we interviewed across these four villages confirmed that weather patterns in these borderlands have been changing in important ways since 2008. They are increasingly concerned about shifting rainfall patterns during the summer months, with rains now often delayed and then more intense than in the past. This results in cardamom flowers

either not blooming, or drying out and yielding fewer fruit. Yet, of greatest concern are changes in winter weather patterns. Winters have become far harsher since 2008 and extreme weather events including heavy snow, hail, and freezing rain have become more frequent and intense, leading to cardamom plants freezing and/or breaking under the weight of freezing rain, hail, or snow.

Cardamom cultivators in both Honghe Prefecture, Yunnan, and Lào Cai Province, Vietnam, remember specific cold spells with freezing rain or hail in 2008, 2010, and 2013, while 2014 is remembered for heavy snowfall episodes. Farmers on both sides of the border also noted that in 2015 growers harvested less than half the pods they would normally obtain in October due to hail and snow earlier that year. Yet, none of the cultivators we spoke to had decided to pursue any significant adaptation strategies at that stage; a bad harvest was still considered an outcome of the vagaries of nature. But then came January 2016, with heavy snow, haze and unusually cold conditions, when the cardamom harvest was "*miejue*" [extinguished], as Chinese-speaking informants explained. A large-scale Hani cardamom cultivator in his sixties from Cash Cropping Cun noted that this was "the worst winter since I was born" (interview, October 2016), while another Hani grower from the same village added: "I usually harvest a few tonnes of dry seeds a year. In 2015, we got 750 kg, which was bad already. This year [2016], we won't get more than 50 kilograms" (interview, November 2016). Vietnam-based growers were also seriously impacted, including a Hmong cultivator in Remote Bản who lamented "all my cardamom plants are dead. It's all yellow and we will have to find another way to get cash. I don't know how, maybe sell some animals?" (interview, February 2016).

6. Cardamom Cultivator Coping and Adapting Capacities

6.1. Coping Strategies in Yunnan

After the harsh winter of January 2016, a common coping strategy among Hani and Yi farmers in Cash Cropping Cun, and one seldom discussed in vulnerability studies, related directly to local belief systems. Hani and Yi are predominantly animists, believing that entities in the natural environment, including trees and mountains, possess a soul or spirit. All the Cash Cropping Cun villagers we interviewed firmly believed that local gods were directly involved in the formation of the extreme weather events they had endured, and that these gods held the solutions as well. As one Yi grower explained: "It's the gods who decide whether there'll be cardamom or not. The gods decided that there would be lots of snow and no cardamom harvest this year" (interview, October 2016). A culturally rooted coping mechanism that Yi and Hani informants alike therefore undertook during local festivals that followed the 2016 extreme weather events was to focus prayers on weather concerns. As one Hani farmer explained: "We ask the gods for good weather. We'll keep doing so even if the weather keeps being bad. We really don't have a choice" (interview, November 2016).

In comparison, Hmong cultivators in Remote Border Cun primarily resorted to selling their stock of dry cardamom pods, frequently at a lower price than they had been hoping for. Extreme weather events have exposed these cultivators to unusual price fluctuations, while their distance from trading centres creates further price-related insecurities. For instance, after the 2016 harvest, one young Hmong household-head from Remote Border Cun explained that he travelled to Caoguo township to sell his pods on a specific date as a relative had informed him that prices had risen to 97 yuan [USD14] a kilogram. Upon arrival in the town, local traders only offered him 90 yuan [USD13.15]. He argued: "This couldn't happen in normal years; when traders come to collect the pods in Remote Border Cun we have more leverage over prices" (interview, November 2016). An additional coping mechanism farmers noted was eating less meat so as to cut down on food expenses.

In both locales, no state supported coping mechanisms were received after the 2016 winter crop failure. Although the state had distributed some free cardamom seedlings after the less catastrophic 2015 harvest, this measure was received with great suspicion at the time in both Cash Cropping Cun and Remote Border Cun. Fearing they would later be taxed heavily if they accepted the seedlings, nearly all farmers refused the authorities' offer. By November 2016, the state had made no attempt to re-introduce such alleviation measures or devise alternative support approaches to help growers after that year's worse harvest failure.

6.2. Adaptation Strategies in Yunnan

In Cash Cropping Cun, eleven months after the disastrous winter events, the small group of farmers who had large cardamom plots—those originally supported by the state—had decided to maintain the status quo as their long term strategy; retaining their cardamom plots despite the poor prospects. These farmers argued that they could not afford to lose the possible income from their cardamom plots *if* a normal harvest were to reoccur. One middle-aged Hani farmer explained: "It'll cost me about $1000 to have my plantation weeded next spring, and if there's another bad winter, it'll all be wasted again. But it can't be as bad as this year!" (interview, November 2016).

In contrast, in both Cash Cropping Cun and Remote Border Cun, cultivators with smaller cardamom plots had begun reorganizing their livelihoods away from cardamom as a safeguard against future extreme weather events. For example, one Hani grower who had previously harvested a modest 25–30 kg/year of dry pods had begun replacing his cardamom plots with *lingxiangcao* (Latin: *Lysimachia foenumgraecum*), another NTFP used in traditional Chinese medicine. He explained that he held few expectations for his withering cardamom plants: "Given the bad weather, it's been three years since I could replace my older plants properly. If I plant new seedlings now and they ever manage to survive, it would take another few years before they start yielding. I'd rather try something new" (interview, November 2016). Asked why he chose *lingxiangcao*, he explained that his brother trades NTFPs nearby and recommended he gave *lingxiangcao* a try, suggesting that social networks play a key role in adaptation routes.

Still in Cash Cropping Cun, another Hani household that had previously harvested about 50 kg of cardamom each year decided to diversify via local migration and wage-labour: "My husband will work outside the village more often, while I'll take care of someone else's land. Many young villagers are leaving and the elderly who stay can't grow all the land. I need to stay home to take care of my parents-in-law, but I can take care of someone else's land too. I'll grow bananas to sell, and rice to eat and to pay the landowners [in-kind payment]" (interview, November 2016).

Similarly confronted with declining harvests, another Hani grower from Cash Cropping Cun had decided to diversify into alcohol distillation. He had saved some cash from previously harvesting 200–300 kg of dried cardamom annually and felt the time had come to utilize his financial assets to reorient his cash-generating activities. He explained: "These last few years, cardamom was less and less lucrative, so I started to distill alcohol. I now have less and less time to allocate to my cardamom plantations" (interview, November 2016).

In contrast, in Remote Border Cun, restricted market access together with a shorter growing season made most of the above adaptation and livelihood diversification strategies impossible. Weighing up the consequences of the 2016 harvest failure upon cultivators and the local economy, one government official in this Cun explained:

"Cardamom is virtually the only source of income here. In normal years, we sell some 120 tonnes of dry pods. This year, the villagers have harvested 250 kg altogether. People have no choice but to go work elsewhere to pay for living expenses. We can only grow rice and maize here otherwise. You can't make money from these crops" (interview, November 2016).

This same informant anticipated that work migration will make it impossible for many households to manage their plantations properly in the future, and that yields will decline sharply.

The diverse strategies that residents in Cash Cropping Cun and Remote Border Cun put into play when faced with harvest failure highlight how culture, access to natural and financial capital, and social networks shape cardamom growers' vulnerability, their coping and adaptation options, and their livelihood diversification choices (see Table 1). The range of crops one can grow in specific agro-ecological settings, together with market access opportunities, as well as specific belief systems, stood out as key variables in these equations.

6.3. Coping Strategies in Lào Cai Province, Vietnam

Over the border in Vietnam, coping strategies in the upland commune of Remote Bản following the harsh January 2016 winter were limited by a lack of access to a marketplace large enough for any significant trade. Upon the devastation of their cardamom plots, cultivators explained that they borrowed cash and goods from kin and friends, especially from those in different communes. These social contacts either relied on cardamom far less, or their crops were not as badly damaged as those in Remote Bản, due to being at lower altitudes. As one young Hmong woman whose sizable cardamom plots were destroyed explained: "My sisters all live in different villages [following clanic exogamy] and we have family with cardamom in different parts of the forest, so we asked them for help, for cash for medicine for example" (interview, February 2016). Others sold chickens and pigs to gain cash for immediate needs, while a few had made the rather arduous journey to Sapa town to sell textiles. A Hmong woman with a small shop selling textiles in the town corroborated this tactic: "Two women came last week to sell me embroidered belts. They were from far away, and they needed cash because their cardamom was ruined. They had no idea as to the prices they should ask for" (interview February 2016).

Down in the valley in Tourist Bản, cardamom cultivators were in a similar situation to those in Cash Cropping Cun over the border, with more diverse livelihood portfolios before the 2016 extreme weather events. These cultivators were generally able to find cash through other trade activities they were already regularly involved in, to cope with their cardamom crop failures. This included women household members sewing more textiles and trading them in nearby Sapa town, or households selling small livestock. A Kinh resident of Sapa town noted that it was clear when a bad cardamom harvest had occurred: "This year the Hmong and Yao cardamom all died. It's obvious because when the harvest fails the street vendor numbers in Sapa explode. There are so many this year trying to sell!" (interview December 2016). While Hmong and Yao are also commonly animist, with households providing offerings to spirits before important crops are grown and for forest protection [28,29], those who had implemented extreme weather event coping strategies appeared more focused on hands-on approaches, rather than offering specific prayers.

With regards to official compensation or aid, in 2017 an international non-governmental organization (NGO) worker noted that the local government was going to supply financial aid to those who had lost important harvests of cardamom in remote areas, such as Remote Bản. While a few locals confirmed that they had also heard this, other cultivators in different villages had no idea of this program. This leaves one wondering whether the government was attempting to keep this support quiet, so that other cultivators would not ask for similar compensation.

6.4. Adaptation Strategies in Lào Cai Province, Vietnam

Approximately one-third of interviewees in both Tourist Bản and Remote Bản did not have any adaptation strategies in place when we met them in December 2016 or afterwards. These individuals tended to shrug their shoulders and exclaim "what can we do?" They explained that the weather was changing in worrying and very unpredictable ways and they did not know the best way to react or adapt. However, the other two-thirds of Hmong and Yao interviewees had started to devise adaptation strategies that were slowly being put into operation.

In Remote Bản, one of the most striking adaptation strategies we heard of (in hushed tones) was the return of opium as a cash crop. Banned since 1993 but never quite eradicated in the district as farmers have always relied on its medicinal properties for human and buffalo pain relief, opium appears to

be making a subtle comeback in very remote, hidden pockets of the National Park. This is being considered as a possible replacement crop for cardamom and, being an annual crop, harsh winters do not affect the poppy's growth (interviews, December 2016; May 2018).

In Tourist Bản, as well as continuing to have a diversity of cash options through links to tourism, there were three other notable adaptation strategies being put into place. First, a number of farmers are trying their luck at growing orchids, prized by lowlands Kinh tourists as souvenirs. Nonetheless, competition is stiff, with Kinh residents of Sapa town with greater financial assets and easier access to Kinh traders and customers also becoming involved in this trade. Second, some young Hmong men are turning to wage labour; with Sapa town becoming increasingly popular as a tourist destination, unskilled labour on building sites for hotels and restaurants is an increasing option.

Third, and perhaps most drastic, some Yao and Hmong have been selling their land. The recent tourism boom in Sapa District has seen land appropriated by the state for private resort developments. Observing that Kinh can have their land taken with compensation that is widely considered inadequate, Tourist Bản ethnic minority residents are becoming extremely uneasy that this might happen to them too. Thus some minority households have decided—spurred on by losses of cardamom income—to sell their land privately to Kinh speculators. Yet, there was a lot of concern among interviewees about the long-term consequences of such actions. As one male Yao interviewee noted: "I don't understand why they do this. Sure, they get cash now, but then they just buy something fast. What about needing to eat next year and the year after?" (interview December 2016).

Similar to cardamom cultivators in Yunnan, coping strategies in Vietnam also varied by altitude and degree of integration into the market economy, with social networks and family ties being important coping mechanisms (see Table 1). It is interesting to note that on both sides of the border, no cultivators whom we interviewed suggested coping or adaptation methods with regards to the crop itself. Possible strategies could have included shielding plants from snow using sacking, clearing the snow from plants after important snowfalls, or searching for more resistant cardamom breeds.

Table 1. Livelihood approaches in the four case study sites prior to extreme weather events (EWE) and cardamom-linked coping and adaptive strategies after EWE.

	Livelihood Approaches Prior to Extreme Weather Events	**Coping Strategies after EWE**	**Adaptive Strategies, including Livelihood Diversification after EWE**
Remote Border Cun, Yunnan	Diverse on-farm livelihoods with a semi-subsistence core; only major cash income via cardamom.	Selling cardamom stocks; cutting food expenses.	Migration for wage work.
Cash Cropping Cun, Yunnan	*Large scale cultivators*: specialised rural livelihoods focused on cardamom cultivation. *Small scale cultivators:* fairly diversified on-farm livelihoods and integrated into market economy.	Praying to local gods.	*Large scale cultivators:* wary to give up on cardamom. Little diversification. *Small scale cultivators:* further diversifying portfolios with additional cash activities, such as new crop species.
Remote Ban, Vietnam	Diverse on-farm livelihoods with a semi-subsistence core; only major cash income via cardamom.	Borrowing cash & goods from kin & friends; selling livestock and textiles.	Limited diversification: some switching to opium; others relying on social networks for support.
Tourist Ban, Vietnam	Fairly diversified livelihoods, including integration into market economy via tourism.	Selling more textiles; selling some livestock.	Further diversifying portfolios with additional cash income activities such as selling more textiles, and orchid growing. Also selling land.

7. Complex Relationships: Extreme Weather Events, Livelihood Diversification, and Vulnerability in the Sino-Vietnamese Borderlands

All of the 70 ethnic minority cardamom cultivators we interviewed have been exposed to cardamom failure. Yet, their levels of sensitivity, their coping and adaptive strategies, and their capacities vary; accordingly so does their livelihood vulnerability. The importance that cardamom played within cultivator livelihoods *before* the January 2016 extreme weather events partly explains this livelihood vulnerability, intersecting with their degree of on-farm and off-farm diversification, their different asset levels, market access/remoteness, and the altitude of their village.

The livelihood diversification patterns emerging among the four case study villages appear to follow an 'inverted U' pattern (Figure 2), similar to what Alobo Loison [30] documented in her review of rural livelihood diversification in sub-Saharan Africa. Alobo Loison [30] argued that the inverted U pattern appears when households with higher and lower incomes maintain more farm-centered livelihoods than households with intermediate income levels. As she puts it: "the middle-income households have a higher share of nonfarm income compared to the relatively poor and the relatively rich households with a lower share of nonfarm income" [30] (p. 1133) (see also [15,31]).

One explanation to justify this inverted U pattern is that households with more access to financial capital/assets tend to specialise in lucrative farm activities, while households with less access to financial capital struggle to overcome the entry costs associated with initiating diversification strategies. Similarly, Sanders and McKay [32] (p. 29) suggested that agricultural success made villagers from the richer Nepalese settlements they surveyed "risk averse", as they faced fewer incentives to diversify their activities in comparison to farmers from poorer locations. Our data suggest a similar pattern, with perhaps slightly more complicated causes.

First, in the face of extreme weather events, the decision of large-scale cardamom cultivators in Cash Cropping Cun, Yunnan, to keep investing resources in their cardamom plantations was risky. One cultivator (cited above) acknowledged this, explaining that there was a high likelihood that the investments he had made to maintain his plants after the January 2016 harsh winter could be wasted if extreme weather events were to occur again in the future. Yet, these actors had previously accumulated enough financial capital to accommodate further shocks, with the eventual hope of long-term profits (cf. [33]). Second, we found that cardamom cultivators with low financial capital had initiated only a few diversification strategies (migration in Remote Border Cun in Yunnan, and limited on-farm diversification to opium or selling livestock in Remote Ban in Vietnam; see Table 1). In these cases, the limited nature of this diversification was due to altitude (limited crop choices) and distance from markets (limited trade options).

In contrast, villagers with a medium degree of financial capital, namely small-scale growers from Cash Cropping Cun, in Yunnan, and those from Tourist Ban, in Vietnam, showed the highest degree of diversification. Again, this was not only related to financial capital, but also to physical capital and proximity to marketplace trade opportunities. For instance, on-farm diversification opportunities were more available in midland settings compared to highland villages due to lower chances of frost during regular years, and slightly warmer temperatures year round. These midland villages were also far closer to important marketplace trade networks, and could more easily get alternative trade goods to markets.

Interviews in the four case study villages likewise revealed that higher levels of financial capital were not commensurate with lower vulnerability to climate stimuli, in contrast to an assertion often made in the vulnerability scholarship [17,34–36]. Indeed, although their sensitivity and adaptive capacity manifested differently, we found that households with both the lowest and highest income levels were the most vulnerable to cardamom failures driven by extreme weather events (Figure 2). These households derived important proportions of their financial capital from their specialised natural capital base, namely cardamom crops. In contrast, mid-level households were less vulnerable since their livelihood strategies were more diversified.

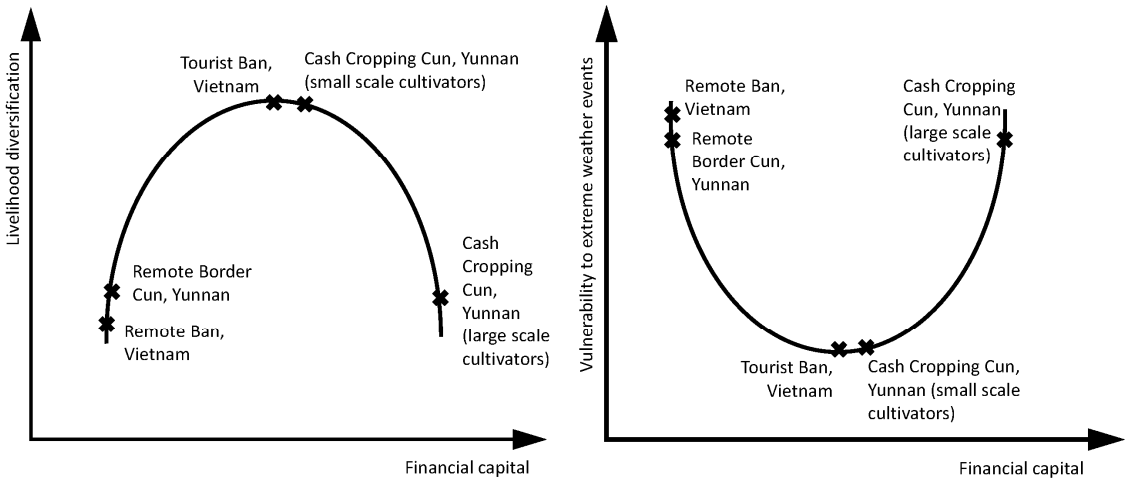


Figure 2. The four case study villages created an inverted U pattern with regards to livelihood diversification and financial capital and a U pattern when comparing vulnerability to extreme weather events and financial capital (axes show relative degrees of importance).

8. Concluding Thoughts: The Agrarian Transition and Vulnerability Dynamics in the Sino-Vietnamese Borderlands

From a vulnerability lens, lower vulnerability to extreme weather events is seen as a positive outcome and testifies to appropriate adaptation strategies having been implemented (see [37]). Yet, by applying a livelihood framework approach to vulnerability (see [10]) we reach somewhat different conclusions, summarised below. That is, by broadening the picture to focus on livelihoods as a whole, and thus considering extreme weather events as one among a number of shocks, trends, and seasonal effects within the vulnerability context, the picture becomes far more complex for farmer decision making. This is complicated further again by examining current day policies, processes, and institutions [10].

As noted earlier, on both sides of the border, agrarian transitions are well under way, fuelled by new agriculture and forest policies, industrialisation, and increasing market integration (cf. [38,39]). Yet, these transitions are occurring at different paces. In Yunnan, China, in the wake of the 'Reform and Opening' (*gaike kaifang*) economic reforms from 1978 onwards, even fairly remote villages are now integrated into circuits of financial capital, due to the need for cash for education, medical expenses, and agricultural equipment and inputs. As a result, ethnic minority farmers are becoming full-fledged participants within the market economy. In Vietnam, 'Economic Renovation' (*Đổi Mới*) economic reforms commenced in 1986 and the cash requirements for individual households in remote regions are not quite to the same level as for Yunnan—yet. In upland Vietnam, while minority farmers increasingly need cash for hybrid seeds and chemical fertilisers, they often still maintain some semi-subsistence approaches such as small, rotating swidden fields [39].

Such differences in the speed and intensity of these agrarian transitions partially explain why the diversification pathways and options we observed on both sides of the border are slightly different, as detailed above. For example, we have highlighted the greater need for farmers in Yunnan to be able to access cash, while those in Vietnam, especially in Remote Ban, still rely on more subsistence options. However, given rapid changes occurring in the Vietnam uplands, this difference may not remain notable for long.

Also important to note is that the range of coping and adaptation strategies we document (see Table 1) is somewhat narrow. Reviewing 92 climate change adaptation projects implemented worldwide, Biagini et al. document dozens of adaptation tactics and rank these under 10 categories [40]. In contrast, as listed in Table 1, we only found a handful of such strategies, all of which would relate to one of the categories that Biagini et al. introduce ('Management and Planning'). One factor explaining this is that while the state has typically been a central actor in designing and implementing

adaptation strategies elsewhere [39], this was not the not the case after extreme weather events hit these Sino-Vietnamese borderlands.

Yet, in the early 2010s, when extreme weather events struck other areas in Yunnan's borderlands, farmers whose banana, pineapple or tobacco cash crop plantations were decimated did receive government support. Such relief measures included rice, seeds, or cash handouts [41]. This has not been the case for cardamom harvest failures in Yunnan and, to our knowledge, has only occurred on a minimal scale in Vietnam. For example, in Bát Xát District, neighbouring Sa Pa District, the state has provided some households that experienced large-scale cardamom crop failures with pear trees as a substitution crop. While this seems to suggest a recognition of the importance of cardamom for upland minority livelihoods, it is the only project underway that we have heard of. This project also mirrors earlier attempts to convince Hmong farmers to grow plum trees to advance their entry into the cash economy. Yet this project has failed to support local livelihoods convincingly as no appropriate marketing strategies had been established [39]. Perhaps more appropriate state support and policy options for affected cultivators could encompass training on best adaptation practices, promoting the development of more robust cardamom cultivars, sharing information on earlier harvest failures, introducing early warnings prior to extreme weather events, and offering financial support to affected cultivators (see [40]). It is not clear why the states on both sides of the border have been so reluctant to support cardamom livelihoods. Is it because cardamom is relatively 'hidden' in forests (and in Vietnam often grows illegally in National Parks)? Do officials remain unaware of the important cash inflows from this crop to date? Or have state authorities on both sides of the border purposely turned a blind eye to the challenges that many cardamom growers are facing, because cardamom is not considered a 'modern' or 'high value' crop (unlike field-based crops or fruit tree crop plantations), to be promoted and supported?

Nonetheless, this research has shown that cardamom is too lucrative for the majority of cultivators to simply abandon, and it will likely remain a major cash crop in these borderlands if weather conditions permit. Whether current coping strategies and emerging long term adaptation strategies will then lead to reduced livelihood vulnerability remains to be seen. Praying to the gods might be culturally appropriate, but does not easily reduce vulnerability. The fact that some households have switched to an illegal crop (opium) or traded core natural capital (land) for cash, also suggests that reduced livelihood vulnerability may not systematically be likely. Of great concern is that some of these adaptation tactics might turn out to be 'maladapted' trial and error strategies providing short-term reduced vulnerability to extreme weather events, but ultimately driving socio-environmental changes or strategies that will imperil future livelihood options [41–44]. These communities have been remarkably resourceful and skilled in the past to adapting to changes in market opportunities and different state policies [27,29,39], but unpredictable natural events that wipe out an important crop for four to five years are an entirely new ballgame. How resilient these communities will be in the long term, in the face of extreme weather events, the likes of which they have never experienced before, remains to be seen.

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References

1. Michaud, J.; Swain, M.B.; Barkataki-Ruscheweyh, M. *Historical Dictionary of the Peoples of the Southeast Asian Massif*; Rowman & Littlefield: Lanham, MD, USA, 2016; ISBN 978-08-1085-466-6.
2. Borras, S.M. Agrarian change and peasant studies: Changes, continuities and challenges—An introduction. *J. Peasant Stud.* **2009**, *36*, 5–31. [CrossRef]
3. Chambers, R.; Conway, G. *Sustainable Rural Livelihoods: Practical Concepts for the 21st Century*; Institute of Development Studies: Brighton, UK, 1991; ISBN 978-09-0371-558-4.
4. Ribot, J.C.; Peluso, N.L. A theory of access. *Rural Sociol.* **2003**, *68*, 153–181. [CrossRef]
5. Whitehead, A. Tracking livelihood change: Theoretical, methodological and empirical perspectives from North-East Ghana. *J. S. Afr. Stud.* **2002**, *28*, 575–598. [CrossRef]
6. Ellis, F. *Rural Livelihoods and Diversity in Developing Countries*; Oxford University Press: Oxford, UK, 2000; ISBN 978-01-9829-696-6.
7. Scoones, I. Livelihoods perspectives and rural development. *J. Peasant Stud.* **2009**, *36*, 171–196. [CrossRef]
8. de Haan, L.; Zoomers, A. Exploring the frontier of livelihoods research. *Dev. Chang.* **2005**, *36*, 27–47. [CrossRef]
9. Thulstrup, A.W. Livelihood resilience and adaptive capacity: Tracing changes in household access to capital in central Vietnam. *World Dev.* **2015**, *74*, 352–362. [CrossRef]
10. Department for International Development. *Sustainable Livelihoods Guidance Sheets*; Department for International Development: London, UK, 1999; Sections 2.1–2.6.
11. Nelson, D.R.; Adger, W.N.; Brown, K. Adaptation to environmental change: Contributions of a resilience framework. *Annu. Rev. Environ. Resour.* **2007**, *32*, 395–419. [CrossRef]
12. Adger, N.W. Vulnerability. *Glob. Environ. Chang.* **2006**, *16*, 268–281. [CrossRef]
13. Adger, N.W.; Barnett, J.; Brown, K.; Marshall, N.; O'Brien, K. Cultural dimensions of climate change impacts and adaptation. *Nat. Clim. Chang.* **2012**, *3*, 112–117. [CrossRef]
14. Ellis, F. Household strategies and rural livelihood diversification. *J. Dev. Stud.* **1998**, *35*, 1–38. [CrossRef]
15. Martin, S.M.; Lorenzen, K. Livelihood diversification in rural Laos. *World Dev.* **2016**, *83*, 231–243. [CrossRef]
16. Rigg, J. Land, farming, livelihoods, and poverty: Rethinking the links in the rural south. *World Dev.* **2006**, *34*, 180–202. [CrossRef]
17. Adger, N.W. Social vulnerability to climate change and extremes in coastal Vietnam. *World Dev.* **1999**, *27*, 249–269. [CrossRef]
18. Hahn, M.B.; Riederer, A.M.; Foster, S.O. The livelihood vulnerability index: A pragmatic approach to assessing risks from climate variability and change—A case study in Mozambique. *Glob. Environ. Chang.* **2009**, *19*, 74–88. [CrossRef]
19. Intergovernmental Panel on Climate Change. *Climate Change 2001: Impacts, Adaptation, and Vulnerability*; Cambridge University Press: Cambridge, UK, 2001; ISBN 978-05-2101-500-4.
20. Intergovernmental Panel on Climate Change. *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*; Cambridge University Press: Cambridge, UK, 2012; ISBN 978-11-0702-506-6.
21. Afriyie, K.; Ganle, J.K.; Santos, E. 'The floods came and we lost everything': Weather extremes and households' asset vulnerability and adaptation in rural Ghana. *Clim. Dev.* **2017**, *10*, 259–274. [CrossRef]
22. Aubertin, C. Cardamom (*amomum* spp.) in Laos PDR: The hazardous future of an agroforest system product. In *Forest Products, Livelihoods, and Conservation: Case Studies of Non-Timber Forest Products Systems*; Kusters, K., Belcher, B., Eds.; CIFOR: Bogor, Indonesia, 2004; pp. 43–60, ISBN 978-97-9336-124-6.
23. Turner, S. Borderlands and border narratives: A longitudinal study of challenges and opportunities for local traders shaped by the Sino-Vietnamese border. *J. Glob. Hist.* **2010**, *5*, 265–287. [CrossRef]
24. Honghe Government. Main Results from the Sixth National Survey in Honghe Prefecture. 2010. Available online: http://www.hh.cn/communist/communist_document/201105/t20110517_353174.html (accessed on 8 November 2018).
25. Liu, J.; Zhang, R.; Zhang, Q. Traditional forest knowledge of the Yi people confronting policy reform and social changes in Yunnan province of China. *For. Policy Econ.* **2012**, *22*, 9–17. [CrossRef]
26. Socialist Republic of Vietnam. *The 2009 Vietnam Population and Housing Census: Completed Results*; Central Population and Housing Census Steering Committee: Hanoi, Vietnam, 2010.

27. Turner, S.; Oswin, N. Itinerant livelihoods: Street vending-scapes and the politics of mobility in upland socialist Vietnam. *Singap. J. Trop. Geogr.* **2015**, *36*, 394–410. [CrossRef]
28. Corlin, C. Hmong and the land question in Vietnam: National policy and local concepts of the environment. In *Hmong/Miao in Asia*; Tapp, N., Michaud, J., Culas, C., Lee, G.Y., Eds.; Silkworm: Chiang Mai, Thailand, 2004; pp. 295–320, ISBN 978-97-4957-501-7.
29. Sowerwine, J.C. The Political Ecology of Yao (Dzao) Landscape Transformations: Territory, Gender and Livelihood Politics in Highland Vietnam. Doctoral Dissertation, University of California, Berkeley, CA, USA, 2004.
30. Alobo Loison, S. Rural livelihood diversification in Sub-Saharan Africa: A literature review. *J. Dev. Stud.* **2015**, *51*, 1125–1138. [CrossRef]
31. Rickards, L.; Howden, S.M. Transformational adaptation: Agriculture and climate change. *Crop Pasture Sci.* **2012**, *63*, 240–250. [CrossRef]
32. Sanders, C.; McKay, K. Where have all the young men gone? Social fragmentation during rapid neoliberal development in Nepal's Himalayas. *Hum. Organ.* **2014**, *73*, 25–37. [CrossRef]
33. Gautam, Y.; Andersen, P. Rural livelihood diversification and household well-being: Insights from Humla, Nepal. *J. Rural Stud.* **2016**, *44*, 239–249. [CrossRef]
34. Goulden, M.C.; Adger, W.N.; Allison, E.H.; Conway, D. Limits to resilience from livelihood diversification and social capital in lake social–ecological systems. *Ann. Assoc. Am. Geogr.* **2013**, *103*, 906–924. [CrossRef]
35. Islam, M.; Sallu, S.; Hubacek, K.; Paavola, J. Vulnerability of fishery-based livelihoods to the impacts of climate variability and change: Insights from coastal Bangladesh. *Reg. Environ. Chang.* **2014**, *14*, 281–294. [CrossRef]
36. Lemos, M.C.; Lo, Y.J.; Nelson, D.R.; Eakin, H.; Bedran-Martins, A.M. Linking development to climate adaptation: Leveraging generic and specific capacities to reduce vulnerability to drought in NE Brazil. *Glob. Environ. Chang.* **2016**, *39*, 170–179. [CrossRef]
37. Tian, Q.; Lemos, M.C. Household livelihood differentiation and vulnerability to climate hazards in rural China. *World Dev.* **2018**, *108*, 321–331. [CrossRef]
38. Scott, J.C. *The Art of Not Being Governed: An Anarchist History of Upland Southeast Asia*; Yale University Press: Lanham, MD, USA, 2009; ISBN 978-81-2503-921-1.
39. Turner, S.; Bonnin, C.; Michaud, J. *Frontier Livelihoods: Hmong in the Sino-Vietnamese Borderlands*; University of Washington Press: Seattle, WA, USA, 2015; ISBN 978-02-9574-173-4.
40. Biagini, B.; Bierbaum, R.; Stults, M.; Dobardzic, S.; McNeeley, S.M. A typology of adaptation actions: A global look at climate adaptation actions financed through the Global Environment Facility. *Glob. Environ. Chang.* **2014**, *25*, 97–108. [CrossRef]
41. Champalle, C. Cash Crops and Climate Shocks: Flexible Livelihoods in Southeast Yunnan, China. Unpublished Master's Thesis, McGill University, Montreal, QC, Canada, 2012.
42. Barnett, J.; O'Neill, S. Maladaptation. *Glob. Environ. Chang.* **2010**, *20*, 211–213. [CrossRef]
43. Magnan, A.K.; Schipper, E.L.F.; Burkett, M.; Bharwani, S.; Burton, I.; Eriksen, S.; Gemenne, F.; Schaar, J.; Ziervogel, G. Addressing the risk of maladaptation to climate change. *Wiley Interdiscip. Rev. Clim. Chang.* **2016**, *7*, 646–665. [CrossRef]
44. Smithers, J.; Smit, B. Human adaptation to climatic variability and change. *Glob. Environ. Chang.* **1997**, *7*, 129–146. [CrossRef]