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Linking climate change strategies and land conflicts in Cambodia: Evidence from the Greater Aural region

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ABSTRACT

This paper investigates how climate change strategies and resource conflicts are shaping each other in the Greater Aural region of western Cambodia. Agro-industrial projects linked to climate change goals are reshaping both social and ecological dynamics, by altering patterns of access to land and water resources as well as the nature of the resources themselves. Using a landscape perspective, we investigate these social and ecological changes occurring across space and time. Drawing on data from community researchers, field visits, interviews and secondary sources, we examine two kinds of connections between climate change responses and resource conflicts in the Greater Aural: 1) demand for biofuels as a driver of flex crop expansion; and 2) the construction of irrigation infrastructure as a climate change adaptation strategy. Findings include that some impacts of flex crop expansion and irrigation systems are local and immediate, for example when villagers lose land, plantation workers are not paid, and cassava processing pollutes local water supplies. Other impacts are transferred to different locations or deferred to the future, for example when changes in water quality and quantity affect those living downstream, or when soil degraded by cassava production becomes unproductive for future generations. We conclude that climate change strategies are now deeply entangled with resource conflicts in the Greater Aural region. Adopting a landscape perspective and working directly with community researchers opens new pathways for identifying not only site-specific, but also cumulative and shifting impacts of climate change strategies and their relationship to resource conflicts.

1. Introduction

Land use change and resource extraction to promote economic growth have been provoking social unrest in Cambodia since the Paris Peace accords of 1991 (CCHR, 2013; LICADHO, 2009; Tucker, 2015). Recently, concerns over climate change add a new layer of issues to contested forestry, agriculture and land use decisions in the country (Milne & Adams, 2012; Poffenberger, 2009). While the links between conflict and elite resource capture are well established worldwide (Hall, Hirsch, & Li, 2012; Peluso & Lund, 2011; White, Borras, Hall, Scoones, & Wolford, 2012), and security concerns linked to the impacts of climate change are receiving increasing attention (Barnett & Adger, 2007; Verhoeven, 2011), interest in a new set of relationships between conflict, economic development and *responses to climate change*[1] is still emerging. In this paper we examine resource conflicts in the Greater Aural region of Cambodia linked to two climate change strategies: biofuel production promoted as climate change mitigation, and irrigation projects promoted as climate change adaptation. We seek to understand how these initiatives may be involved in sparking or perpetuating conflicts, particularly by altering access to contested resources in landscapes already affected by land concessions for agro-industrial use. To capture these interactions we look beyond project-specific impacts to consider how the influences of climate change responses are felt locally and over a wider landscape; presently and over time.

[1] We consider 'climate change responses' to be any actions taken to mitigate or adapt to climate change. In this study we focus on rural, land-based activities including the production of biofuel crops (a mitigation strategy) and the expansion of irrigation infrastructure to support agriculture under drier conditions (an adaptation strategy). Land management schemes aimed at storing carbon would also fit this category but are not considered here.

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A rich body of scholarship investigates links between climate change, insecurity and conflict (Devlin & Hendrix, 2014; Fetzek & Mazo, 2014; Homer-Dixon, 2010; Smith, 2011). A central question in this work – whether environmental change produces 'environmental conflicts' – is not the focus of our study. We question whether the land-based climate change responses cause conflict. The idea of environmental conflicts gained considerable traction; however, research portraying the biophysical effects of climate change as a direct security threat is critiqued for lack of verifiable results (Klomp & Bulte, 2013; Selby, 2014), for obscuring the influence of historical social and political processes (Verhoeven, 2011), and for advocating technological fixes (Käkönen et al., 2013). While environmental change can increase insecurity "by reducing access to, and the quality of, natural resources that are important to sustain livelihoods" (Barnett & Adger, 2007, p. 609), this relationship is widely recognized to be mediated by social factors including poverty, economic opportunities, social cohesion, and procedural justice (Barnett & Adger, 2007; Hartmann, 2014). This literature highlights the risks of being too deterministic about the relationship between environmental change and conflict, and emphasizes the importance of foregrounding social, political and historical processes.

Critical scholarship asks whether actions taken to address climate change create as many problems as they seek to avoid. For example, the rights violations and livelihood impacts associated with land grabs are increasingly connected with responses to climate change Montefrio & Dressler, 2016; Uson, 2017). Scholars working on 'green grabs' – land grabs conducted in the name of environmental goals (Dunlap & Fairhead, 2014; Fairhead, Leach, & Scoones, 2012; Holmes, 2014) – make important contributions in this regard, as do agrarian and Indigenous social movements working to promote climate justice (Claeys & Delgado Pugley, 2016). Meanwhile, parts of the climate change research and activist community are making similar connections. Social and equity issues remain under-reported in research on climate change mitigation and adaptation generally (Corbera, Calvet-Mir, Hughes, & Paterson, 2015; Ribot, 2014). Nonetheless, climate justice activists increasingly advocate against land grabbing and market-based measures that commodify stored carbon (Friends of the Earth International, 2015) and the livelihood impacts of biofuel production have come under particular scrutiny (Blaber-Wegg, Hodbod, & Tomei, 2015; German & Schoneveld, 2012; Hunsberger, Bolwig, Corbera, & Creutzig, 2014; Selfa et al., 2015).

These trends show that scholars and activists are increasingly articulating the overlap between climate change responses, land rights, and questions of justice. We seek to extend this work in two ways. Empirically, we investigate local perspectives on whether and how specific climate change response strategies affect conflicts on the ground. Conceptually, we draw on Baird and Barney's (2017) efforts to capture cumulative and 'cascading' interactions between overlapping land- and water-based projects and local livelihoods by adopting the landscape as our unit of analysis. Using this approach, we investigate aggregate, shifting and delayed impacts of climate change initiatives as they interact with existing economic concessions and past conflicts – and reflect on the merits and challenges of this strategy. Further, we explore the role of elite cooperation across multiple projects as well as cooperation between grassroots activist communities. Our cases suggest that these varied forms of cooperation can have the simultaneous effect of entrenching conflicts (by widening power differences) and strengthening local people's ability to negotiate compensation (by drawing on knowledge, skills and alliances formed during past conflicts).

Cambodia provides a good setting to explore these dynamics because of its history of resource conflicts, its high concentration of large-scale land deals, and its recent experience with climate change initiatives. We focus on two processes occurring in the Greater Aural region: flex crop expansion linked to demand for low-carbon biofuels; and irrigation infrastructure expansion as a climate change adaptation strategy. Drawing on data from community researchers, field visits, interviews and secondary sources, we examine how each of these climate-related processes is entangled with social and environmental roots of conflict. We hope that insights from this work can ultimately inform efforts to manage or avoid conflicts through actions that respect local interpretations of justice.

The paper proceeds as follows. The next sections introduce our key terms, the study area and methods used. We then present empirical data on climate change responses in the Greater Aural, focusing on two flex crops and two irrigation projects. Finally, we reflect on the findings and their implications for research and practice.

2. Defining our terms: conflict, cooperation and landscape

2.1. Conflict and cooperation

In much research on climate change and conflict, conflict refers to violent confrontation – typically between armed groups, and sometimes meeting additional criteria such as involving at least one government, having a particular duration or inflicting a minimum number of casualties (Scheffran, Brzoska, Kominek, Link, & Schilling, 2012). While some of the conflicts we refer to in the Greater Aural involve the Royal Cambodian Armed Forces, we also include non-violent protests at the local level, refusal to participate in climate change interventions (Mingorría, Gamboa, Martín-López, & Corbera, 2014), and the violence to persons and landscapes that forest conversion entails Peluso & Watts, 2001). We recognize that conflict can stem from competing values over resource access and use as well as from structural injustices (Montefrio, 2013). The conflicts we encounter in the Greater Aural involve the loss of homes, farmlands, and forest resources, soil degradation, water pollution, and changes in water access. These factors have combined to produce conflicts across the region since the first attempts to convert it for plantation agriculture in 2001.

Resources are deeply tied to conflict and elite power in Cambodia (Milne, 2015). Logging revenues helped prolong war in the country by funding insurgents near the Thai border in the 1980s and supporting remnants of the Khmer Rouge into the 1990s (Le Billon, 2012). Once the conflict stopped, legal forms of resource extraction began, especially focused on Cambodia's abundant and profitable forests (World Bank & FAO, 1996), which gave way to economic land concessions (ELCs) for agro-industrial use (Fig. 1). Over 2 million ha, more than half the country's arable land, were awarded as ELC, which sparked numerous protests and their sometimes-violent suppression (LICADHO, 2012; Neef, Touch, & Chiengthong, 2013). Each wave of resource use, from illegal timber extraction, to legal concessions for timber harvesting and agro-industrial use, to flex-crop plantations and irrigation schemes, has increased tension between local people and the Cambodian government and elites.

Our discussion of conflict also considers how cooperation – between companies, government bodies, and donors who are enacting climate strategies, and between community members and allies who are defending local rights – interacts with resource conflicts. Particular forms of cooperation have increased between the government and emerging national elites, as well as international financiers and development institutions (see also Knuth, 2015; Rocheleau, 2015; Wolford, Borras, Hall, Scoones, & White, 2013). This is not the kind of cooperation that donors envision when they call for "conflict sensitive" responses to climate change

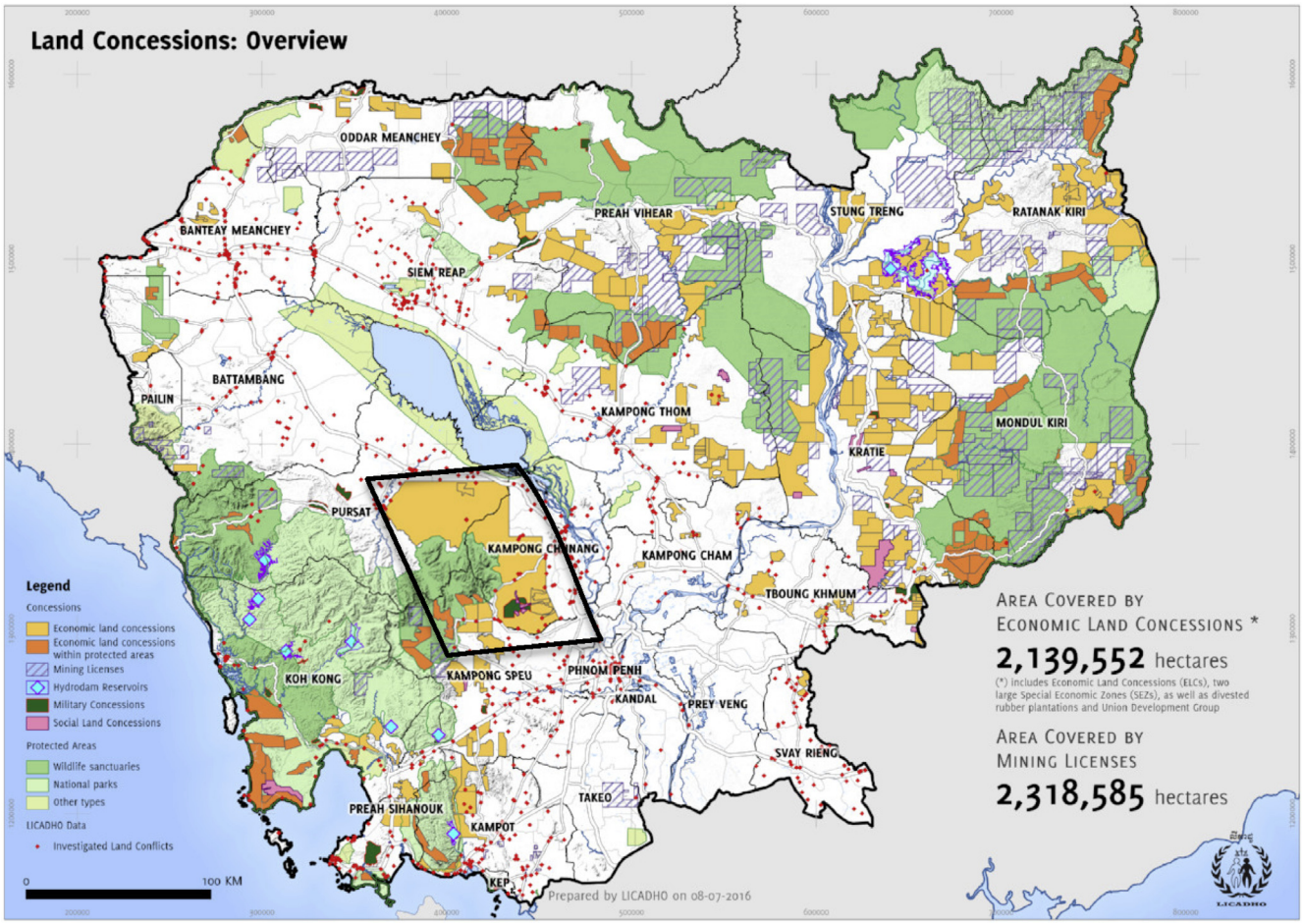

Fig. 1. Map of economic land concessions and investigated land conflicts in Cambodia. Black rectangle is the analytical landscape for this paper. Source: LICADHO (2016).

that foster collaboration (Käkönen, Lebel, Karhunmaa, Dany, & Try, 2014). This is cooperation in which development donors, investment banks, and trade agreements turn a blind eye when projects threaten eviction, bulldoze villages (Borras et al., 2016; Martiniello, 2015) or degrade livelihoods (Work & Thuon, 2017). Attention to elite cooperation is increasing as greater proportions of common lands are enclosed (Geisler, 2015), including through climate-related resource grabs (Fairhead et al., 2012).

This is not to say that the only cooperating actors are at the top. Local resistance in Cambodia has given rise to grassroots activist networks that work across village and provincial boundaries (Parnell, 2015). These collaborations between marginalized people are reshaping physical and legal spaces for resistance. Our case studies identify some of the links between cooperating actors in resource-related conflicts in the Aural landscape. We also explore mechanisms through which affected communities use conflicts to make credible demands for more equitable social and environmental resource use.

2.2. Landscape

Many studies of conflicts over land focus on specific, geographically bounded locations (often linked to a single project or case) where land rights are acquired by investors and local people are displaced or dispossessed (Borras & Franco, 2012; Cotula, 2012; Pedersen & Buur, 2016). Such an approach fails to capture social and ecological dynamics that can play out over a larger area containing multiple sites of conflict. Recent approaches address such limitations by starting with the idea of "multiple resource-based livelihoods" leading to cross-sectoral views that merge, for example, land- and water-focussed assessments (Baird & Barney, 2017). Through such approaches landscapes emerge as a relevant aspect of case study analysis. With this study we aim to go one step further by making the landscape part of our analytical starting point.

Our specific interest in climate change responses and conflict framed within a particular landscape draws on the analytical power of connecting activities across sectors with local livelihoods. Our analysis, while similarly examining the cumulative impacts of multiple projects and 'cascading effects' over time, also attends to those impacts that are spatially displaced or temporally deferred. This element is important for analyses of the impacts of climate change responses.

A look at a map of Cambodia shows the logic of this approach. The country is peppered with large-scale concessions for agriculture, resource extraction and industry (Fig. 1). In some areas the number, size and concentration of land concessions suggests they will inevitably produce cumulative and shifting impacts, both on social dynamics and available resources. Thus, climate change strategies enter already impacted landscapes and legitimise further changes in land use and control. In light of these cumulative effects, this paper uses the landscape rather than the project scale to investigate links between climate change responses, land use, and conflict.

Applying a landscape perspective has a long history in the natural sciences, where watersheds or other ecological regimes are considered with attention to the effects of time (Leyshon & Geoghegan, 2013). Because administrative boundaries do not

coincide with ecological systems, in the contemporary era this concept has been taken up by policy planners (Castella et al., 2013; Ros-Tonen, Derkyi, & Insaidoo, 2014; Selby, 2014) in search of an "integrated landscape" that can incorporate multiple land uses into a single management process (Nielsen, 2016). Some contest this use of the landscape concept because of its focus on top-down management, which can subjugate the land-use claims of many resource users to the will of those few at the top (McCall, 2016; Nielsen, 2016).

Our interpretation of landscape is more akin to the earlier use by natural scientists: A landscape is an area in which social and ecological processes combine to produce conditions that are fluid and dynamic, yet also spatially specific and localized (Antrop, 2005; Batterbury & Bebbington, 1999). Using this definition, we investigate interactions between multiple projects, actors, land uses, and resources across an area not limited by project boundaries or arbitrary political designations. Our aim is not to manage, but to monitor interactions between local and broader processes, as well as social and ecological effects that may 'spill over' in the larger landscape. Such interactions can be obscured by focusing on smaller, more narrowly defined areas (Hunsberger et al., 2017).

The importance of attending to coupled processes across spatial boundaries is increasingly being picked up by scholars in the critical social sciences, with productive insights. Landscapes can be produced by interactions between local and global actors working within them, each engaged in individual or collective agendas toward functionality (Mitchell, 2008), in turn creating complex and rooted networks (Rocheleau, 2015). On one hand these networks can form transnational alliances that hit the ground in multiple locations, potentially exacerbating existing legal pluralities (Franco, Monsalve, & Borras, 2015) and ignoring linked ecological and social processes (Radjawali & Pye, 2017; Wolford et al., 2013). On the other hand, socio-ecological networks can connect local people with surrounding fields, forests, lakes, and streams. The diverse livelihoods that engage with landscapes to achieve functional subsistence are rooted in the knowledge of inhabitants as well as the habits of water, fish, buffalo, and trees (Baird & Barney, 2017; Roberts, 2015). Such intimacy and contingency is vital for community resilience in the face of environmental instability (Diepart, 2015).

3. Study area: Greater Aural

The Greater Aural region is not an administratively defined area nor does it have fixed boundaries, but is roughly centred around the country's tallest peak, the Phnom Aural (1813 meters). The region includes parts of Kampong Speu, Koh Kong, Kampong Chhnang and Pursat Provinces. Greater Aural includes the Cardamom Mountains along with lowlands in the northeastern, eastern and southeastern parts of the region (Fig. 1). We selected this region because it contains multiple land-based projects related to climate change and economic land concessions, coupled with a history of resource conflicts, and an active social activist network.[2]

One large and many minor tributaries to the Tonle Sap River flow down from the mountains, across the flatlands populated by lowland rice farmers and into the rivers populated with fishers. Livelihood strategies in this region have for centuries centered on rice production, fishing, palm sugar, and harvesting or cultivating greens, mushrooms, fruits, and medicines from forested areas. Highland villagers, also rice growers, have long histories in the Cardamom mountains, and the Colonial era brought new settlements along the base of those mountains. During the post-Khmer Rouge civil war, 1979–99, the area near the mountains housed many Khmer Rouge strongholds. In these areas, rural resettlement was scattered until around the year 2000 when fighting fully stopped. Highland villagers were less displaced, and these areas along with the towns along the colonial era railroad remained populated throughout the war years. After 2000, the same year that ELC began in earnest. Those villages began to spread into the second growth forest and new residents came from around the country to populate the area. Across the region and over time, this Aural Landscape has emptied and filled with people engaging in multiple practices to make their livings from the forests, fields, and streams.

Today, local farmers share the land with new economic land concessions for sugarcane and cassava flex-crops; ongoing and planned dam and irrigation projects; a recently designated protected area connecting the Phnom Aural Wildlife Sanctuary and the Central Cardamom Protected Forest; and an awarded, but not yet implemented, REDD+ project in the Cardamom Mountains. The least active of these are forest-based climate change mitigation initiatives, which will not be treated in this paper. The most transformative is the continued expansion of agro-industrial concessions for the production of crops that can be used to make biofuels. Also important are two new irrigation systems, one connected to high-yield resilient rice production and the other of inscrutable utility, discussed further below.

These new projects enter into a deep history of local land use and informal governance. The analytical boundary we draw for this paper (Fig. 1) is large enough to encompass the climate change projects currently most active as well as their interactions with existing social and ecological processes of the area – including fraught economic land concessions. Just as the spatial boundary of the landscape expands our view beyond the project scale, we also extend our time horizon beyond the immediate by attending to historical processes as well as the potential for long-term or delayed future effects.

4. Methods

This study is part of a broader research project[3] that examines interactions between climate change mitigation and adaptation initiatives, land grabs, and conflict in Cambodia and Myanmar. Co-producing knowledge between researchers, advocacy organizations, and affected communities is a key part of the methodological approach.

Co-production of knowledge emerges through three main activities: training, research, and information sharing. First, local activists are trained in research methods, land laws, and negotiation skills by the project's academic/advocacy team. Second, collective research is conducted on project objectives. Local activist networks also conduct research according to their needs, for example researching community forest encroachment by local officials, elite capture of irrigation water, or the construction of a new SEZ. Data and insights from these two research streams are shared and discussed by phone, in person, or through social media. Third, the local networks share data with the academic/advocacy partners about new land encroachments, chemical dumps into the river, and rumors or meetings about development initiatives. In turn, academics share information gained through desk and urban research as well as interviews with donors, NGOs, or companies. Advocacy partners provide further support, for example by

[2] These parameters came from a research framework developed collaboratively by academic and civil society partners for a larger project that also includes another landscape in Cambodia (Prey Lang forest) and two in Myanmar. Our decision about where to draw the landscape boundaries was driven more by analytical questions than by biophysical or administrative features.

[3] The broader project is called "Mosaic: Climate change mitigation policies, land grabbing and conflict in fragile states: understanding intersections, exploring transformations in Myanmar and Cambodia." Its research agenda is outlined in (Hunsberger et al., 2017).

translating and explaining new policy and land use initiatives that may affect communities. We use local experiences with conflicts as our guide for continued research, and work toward advocacy that engages national and international political actors, investors, and development donors.

Research began in June of 2014 and is ongoing at the time of writing. In this paper, we present data collected from group discussions and individual interviews with affected community members as well as representatives of local and provincial governments, companies involved with flex crops, and the Asian Development Bank and JICA. We primarily worked in teams with at least one representative from academia, advocacy, and activist organizations and conducted interviews and focus groups together. At times we conducted focus groups and interviews independently, sharing data and discussing the outcomes. Participant observation activities including training sessions and seminars with local activists, researchers, and advocacy organisations provide important context about activities and trends in Cambodia and the Mekong region. We also consulted secondary sources including: government documents articulating Cambodia's land use and climate change strategies; agricultural production and trade statistics from the Food and Agriculture Organisation of the United Nations; company websites describing ongoing and planned activities; newspaper articles reporting on conflicts in the study area; and websites and databases of the advocacy organizations Environmental Justice Network and Open Development Cambodia (now Open Development Mekong).

Analysis of the primary data was guided by the following questions: 1) What were local experiences with climate change-related projects? 2) What kinds of conflicts were linked to these projects and how were they handled? 3) What links did residents and others see between climate change projects and other projects, processes or events across the region and over time (including historically)? Transcripts and field notes were scrutinised in relation to these themes and compared for consistency across participants. Secondary sources were used to triangulate the data (for example, checking local accounts of cassava expansion against national-level FAO statistics), to gather data from original concession agreements (for example, to compare with actual concession activities and to establish explicit links to climate change policies), and to fill gaps (for example, consulting the websites of sugar companies we were not able to interview, or gathering historical conflict data from the region).

When discussing the data and implications academic partners drew connections to other studies on climate change, resource conflicts and land use, while activist partners drew links to regional dynamics, partnerships, and community responses. This approach allowed us to situate our data about climate change projects in the broader field of land struggles and the intimate work of contemporary processes in this region.

We now examine the two types of climate change responses active in the Greater Aural: biofuel production and irrigation projects. Our aim is not to directly connect these cases to each other; they provide examples of different climate change mitigation and adaptation strategies entangled with conflicts across the same landscape. We consider their interactions with past, present and potential future conflicts by analysing linked ecological and social processes at a landscape level, and consider the role that cooperation between actors plays both in perpetuating and addressing these conflicts.

5. Flex crops and the demand for biofuels

A worldwide surge in demand for biofuels, largely driven by policy mandates, has contributed to the expansion of crops that can be turned into ethanol or biodiesel (Bailis & Baka, 2011; Lane, 2016). The most common feedstocks – corn, sugar cane, cassava, oil palm and soy – are 'flex crops' that can be used for food, feed and fuel production (Borras, Franco, Isakson, Levidow, & Vervest, 2015). In Cambodia sugarcane and cassava are the most common flex crops. Here we explore interactions between flex crop expansion, biofuel production and conflicts in the Greater Aural.

5.1. Sugarcane

The government of Cambodia awarded economic land concessions of an estimated 100,000 hectares for sugarcane production (McKay, Sauer, Richardson, & Herre, 2015), with 28,900 ha actively cultivated in 2014 (FAO, 2016). Sugarcane grown in Cambodia has a clear history of conflict. While in-country production of ethanol from sugarcane is still nascent, Cambodia is nevertheless part of the global "industrial sugarcane-ethanol complex" (Oliveira, McKay, & Plank, 2017) driving the expansion of sugarcane production worldwide.

5.2. Sugarcane and conflict

The earliest sugarcane activities in the Greater Aural occurred in northern Kampong Speu, encroaching into the Phnom Aural Wildlife Sanctuary. In February 2010 the Cambodian government approved side-by-side ELCs in Thpong and Aural districts, each around 9000 ha, for the Phnom Penh Sugar (PPS) and Kampong Speu Sugar (KSS) companies – owned by the Cambodian tycoon Ly Yong Phat and his wife. In March 2011 Prime Minister Hun Sen signed a sub-decree allowing land in the Aural Protected Area to be reclassified and the concession expanded by 4700 ha. Today the consolidated twin concession totals over 23,000 ha (EC & IDI, 2013).

PPS and KSS encroached on more than 2000 ha of farmland belonging to approximately 1100 families (affecting 6000 people) in fifteen villages in Amlaing commune in Thpong District, and Trapaing Chor commune in Aural District (EC & IDI, 2013). This establishment of sugarcane plantations entailed lost access to land, water and forests for local people (Herre & Feodoroff, 2014). This was ancestral land for most of the affected people, repopulated and continuously habituated after the elections in 1993 (Group discussion, Thpong District, September 8 2014).

Early evictions involved subterfuge, in which illiterate villagers signed documents they believed authorized new roads or land titles. These documents actually awarded their land to the sugar company. Later, villagers report that military police and bulldozers arrived without warning and began clearing farms, homes, and forests, backed up by army battalions. Villagers considered the compensation inadequate and there were violent confrontations between villagers and security forces (EC & IDI, 2013; Herre & Feodoroff, 2014).

In June 2016, hundreds of displaced families were pressured into accepting what they saw as a very low compensation offer for their land. 157 accepted the offer. Most families received $500 on condition they agreed to drop all outstanding claims against Phnom Penh Sugar (Phone interview, Aural commune, 6 June 2016). Letting go of these claims is significant in the context of a 2014 EU resolution on Cambodian sugar that links human rights abuses in the sugar industry to the Everything but Arms (EBA) trade agreement. The company may be eager to settle land disputes for this reason; exports of Cambodian sugar to the EU fell by almost 95% between 2013 and 2015 (Jackson, 2016).

The government of Cambodia plans to expand the country's industrial and agricultural production (RGC, 2015), with sugarcane positioned to play a major role. Satellite pictures complemented

with local information indicate that since 2013, ELCs near the west and south of the PPS concession shifted to sugarcane production. Furthermore, an estimated 8000 ha of the southern part of the Pheapimex concession, lying east of the PPS factory, grows sugarcane under the name of the Takeo Company, which trucks raw cane to the PPS factory for processing (Group discussion, Takeo sugar workers, June 8, 2016).

5.3. Sugarcane and biofuels

So far sugarcane does not appear to directly support ethanol production in Cambodia, but efforts are underway to advance that goal. Kamadhenu Ventures (KVCL), Adalidda Bio-Energy Corporation, and Rui Feng (Cambodia) International Co. Ltd. all have stated plans to start producing ethanol from sugarcane in Cambodia (Personal communication, July 10, 2016, Sor, 2016). While a direct relationship between sugarcane production in Cambodia and growing ethanol markets remains uncertain, there are realistic links. One is that the ambition of sugar processing companies in Cambodia to start producing ethanol reflects 'anticipated flexing' (Borras et al., 2015), where demand for sugarcane grows in response to expectations that new market opportunities will soon arise. Further, increased sugar production in Cambodia may be offsetting ethanol production in other countries. For instance, reduced white sugar production in Thailand and China to accommodate expanding ethanol production in those countries can increase sugar imports from Cambodia. Indeed, the value of sugar exports from Cambodia to Thailand increased from just $129,000 in 2009 to over $5 million in 2014, while sugar exports from Cambodia to China grew from zero to over $1 million over the same period (UNCTAD, 2017). Transnational corporations from Thailand and China that are already involved with ethanol and energy production at home are playing a leading role in the sugarcane sector in Cambodia (McKay et al., 2015).

5.4. Ecological impacts of sugarcane

Large-scale sugarcane production impacts forests and water resources – both fundamental to local livelihoods. Massive deforestation occurred in the Greater Aural between 2010 and 2014 as sugarcane plantations were established (Global Forest Watch, 2017). Villagers from different places around the concession who engaged in small-scale logging said they had been forced to move deeper into the forest (Personal Communication 2012, 2014).

Others stated that strong-smelling wastewater from the sugar factory was periodically released, flooding and destroying rice fields and fruit orchards (Personal Interview 2014), and that the company washed their sugar equipment with acid that flowed into the local water source (Personal Interview, 5 June 2016). In Kampong Speu and Kampong Chhnang, villagers reported that plantation wastewater killed rice and livestock, turned well water brown and caused skin rashes (Group discussion 4 June 2016).

In the final instance, villagers close to the mountain explained that the erection of a dam and subsequent small reservoirs – used to irrigate the sugarcane plantation – produced longer and more complete drying of reliable local streams vital for their livelihood, which limited rice harvests (Personal Interview 2014).

5.5. Cassava

Cambodia's cassava production rose sharply since 2005, and more than doubled between 2009 and 2014 (Fig. 2). Cassava is a flex-crop and it is difficult to determine exactly how much of the cassava grown in Cambodia is turned into biofuel, demand for ethanol is clearly a driver of the crop's recent expansion in the country. Moreover, cassava grown in the Greater Aural is linked

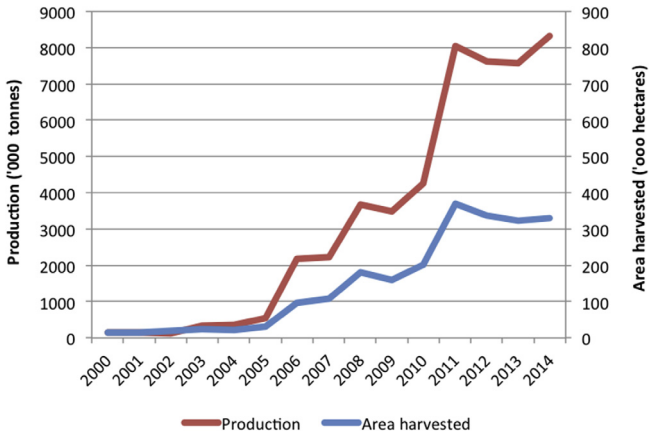

Fig. 2. Cassava production and area harvested in Cambodia, 2000–2014. Data source: FAOSTAT (2017).

to at least two kinds of conflicts. First, violent and prolonged land disputes characterize the Pheapimex concession, where large swaths of secondary forest were converted to plantations. Second, cassava production pollutes water and degrades soil in ways that shift and accumulate over space and time.

5.6. Cassava and biofuels

Cambodia's National Strategic Development Plan (RGC, 2014b) expresses a desire to increase renewable energy production, identifying cassava as a "bio-energy crop" (126). The government has not yet created incentives to encourage biofuel production or use within Cambodia, only the MH factory near Phnom Penh taps this market with intermittent production. Nonetheless, there is clear demand in other countries for biofuels made from Cambodian cassava.

China is one such country. After a 2010 Memorandum of Understanding opened up trade between the two countries, cassava exports from Cambodia to China increased quickly – coinciding with the rapid growth of cassava production shown in Fig. 3. Between 2012 and 2013 alone, the quantity of cassava chips exported from Cambodia to China tripled from around 18,000 to 55,000 metric tonnes (RGC, 2014a).

China has high quotas for ethanol consumption; in 2013/14 it produced 2 million tons of non-grain ethanol, primarily from cassava (Kang, 2014), and was projected to import 90 million litres in 2016 (USDA Foreign Agricultural Service, 2015). Tianguan Global Processing Company – one of four nationally appointed ethanol producers in China (Styllis & Sony, 2015) – operates a cassava drying factory on the Pheapimex concession. A representative confirmed that the company produces ethanol after acquiring cassava from several Cambodian provinces (personal communication, 17 June 2015). Advanced Glory Logistics (AGL), a Cambodian company that arranges export shipments, confirmed they export cassava to China on behalf of a major ethanol producer, citing China's air pollution and desire to mix ethanol with petroleum as drivers of this demand (personal communication, 19 June, 2015). Cassava is also exported from Cambodia to Thailand and Vietnam; so far we cannot confirm if this trade supports biofuel production.

5.7. Cassava and conflict

The Pheapimex concession – originally awarded at 315,028 ha and reduced by over 90,000 ha in 2014 – remains by far the largest ELC in Cambodia. Large portions of it were converted for cassava production even though the concession was initially conceived to

Fig. 3. Sinohydro canal under construction. Photo: C. Work, June 5 2016.

be a tree plantation on "depleted forest" (Kingdom of Cambodia, 1997). This framing, which local villagers reject, is a source of conflict (Bou, 2001).

The Pheapimex concession caused profound and multiple land conflicts in the well-watered forests between the Aural Mountains and the Tonle Sap River. These conflicts spanned two provinces and affected over 8000 families since the concession's inception in 2000 (CCHR, 2013). The company's efforts to develop the concession failed amid local protests in 2001 and again in 2004. When they returned in 2009; displacement and dispossession followed (Beban & Work, 2014). The company bulldozed homes, fields, and forests, often under the protection of military police as communities protested, blocked roads, and faced arrest (Khuan, 2012). Land titling schemes did not provide an effective defence, as titled land was also consumed (Titthara, 2012).

The concession was granted to plant eucalyptus trees for pulp and paper, though these plans did not materialise beyond establishing tree nurseries on some hundred hectares. Wuzhishan LS, a Cambodian subsidiary of Chinese Wuzhishan Group, was an early investor in the Pheapimex concession. Sy Kong Triv, co-director of Wuzhishan LS, is also a partner at British American Tobacco (BAT) Cambodia and owner of the KT Pacific Group, BAT's product distributor. Between 1998 and 2002 BAT donated 3.3 million eucalyptus and acacia saplings for "reforestation" in Cambodia, allegedly to compensate for deforestation caused by firewood consumption for tobacco kilns. Community researchers report that the company ripped up acacia saplings and started planting cassava in 2005 (Group Discussion, Pursat, March 2016).

Through 2015 cassava was cultivated on approximately 50,000 ha and processed in the Tianguan factory inside the concession boundaries to prepare it for ethanol production in China (personal communication, Tianguan representative July 12, 2016). According to field workers, the company stopped paying them in November 2015 (Personal communication, January 2016). They were told the company had no money to pay them or to plant new crops. In June 2016 with much of their wages still in arrears, workers confronted the company and detained two bulldozers, forcing local authorities to negotiate payment of the salary owed. At the time of writing, most of the land formerly used for cassava is reportedly fallow. The plantation company is bankrupt and the factory is silent (personal communication, Tianguan representative, June 4, 2016; Sept. 27, 2017).

5.8. Ecological impacts of cassava

Villagers in Pech Changvar state that the cassava factory in their area releases dirty water into the river and produces a bad smell (Personal communication, 15 June 2015). Cassava processing produces wastewater high in organic compounds; if left untreated, this wastewater encourages bacterial growth and reduces oxygen supplies, impacting aquatic life and producing foul odours (FAO, 2001). Research in Nigeria found that water bodies receiving untreated wastewater from cassava processing had higher than acceptable levels of cyanide, solids, iron, magnesium, and biological oxygen demand (Okunade & Adekalu, 2013).

A representative from Advanced Glory Logistics (AGL) supports villagers' observations that wastewater is released untreated. He explained that Cambodian companies have trouble competing with processors in Vietnam and Thailand that use cassava fibre and wastewater to make fertilizer, the sale of which subsidizes their main product, starch (Personal communication, June 19 2015). AGL's observations suggest that dumping untreated wastewater not only impacts local ecologies, but is bad for business. Water pollution from cassava processing represents an ecological spillover – a case where biophysical pressure alters a resource (in this case, water quality) which then shifts in space, affecting people outside the immediate area where the pressure occurred.

Cassava production can also contribute to soil degradation and erosion. The plant extracts nutrients from the soil, especially potassium (Howeler, 1991), and is planted in widely spaced, raised rows that increase erosion (FAO & IFAD., 2001). Erosion was visibly evident on a field visit to cassava plantations in Pursat province (June 14 2015), where water gullies partially collapsed rows of cassava. AGL confirmed that cassava yields in Cambodia decrease after the first few years if farmers do not rotate their crops (Personal communication, June 19 2015).

If actions are not taken to replenish soil nutrients and prevent erosion, cassava plantations could degrade a resource – farmland – and make it unavailable in the future. Even with the current fallow period, depleted and eroded soils could make future farming

more difficult. This would represent an ecological effect of plantation farming that 'spills over' in time rather than space.

6. Irrigation as climate change adaptation

Crop irrigation is portrayed as a climate change adaptation strategy that helps farmers grow crops under increasingly dry conditions; it can be seen to promote food security or agricultural export goals in the face of climate change. Cambodia's Climate Change Strategic Plan (RGC, 2013) identifies irrigation as a means of achieving food, water and energy security. It states that investment in irrigation is necessary for Cambodia to "meet the target of agricultural export by 2030 under conditions of climate change (drought)" (9) and pledging to "rehabilitate and build water infrastructures including small-, medium- and large-scale irrigation schemes" (13). The Asian Development Bank also includes irrigation as part of its climate change adaptation agenda (Asian Development Bank, 2016).

6.1. Irrigation projects in the Greater Aural

Two irrigation systems are under construction in the Aural landscape. The first, spanning three districts in Kampong Chhnang, is part of the West Tonle Sap Irrigation and Drainage Rehabilitation and Improvement Project funded by a development loan from JICA and administered through an inter-ministerial group.[4,5] The second is the Achang Irrigation Project, built by Sinohydro and its subsidiary, Power China, in Boribo District, Kampong Chhnang. Both projects reshape access to land and water, lacked consultation meeting the standards of free, prior and informed consent, and pressured communities to accept unfair compensation.

Local people first became aware of the JICA project in 2008 when they saw surveyors taking measurements and fixing stakes into the ground (Interview, 4 June 2016; Interview, 13 July 2016). They thought this was the work of Pheapimex and questioned the surveyors, demanding to know the nature of the project. When they were told it was a JICA sponsored irrigation project that would rehabilitate Khmer Rouge-era channels and expand the system for increased rice production, residents were not satisfied. They supported rebuilding the old dam and channels, but were against expansion (ibid).

In 2010, the Agricultural Productivity Promotion Project in West Tonle Sap was instigated, which is connected to the irrigation project currently affecting villagers. Project documents describe the initiative's purpose as "the improvement of the productivity and income of farmers who participate" (JICA, 2014). It aimed to introduce new farming methods and enhanced seeds for high, drought-resistant yields. The irrigation rehabilitation project was funded in 2011, de-mining and scoping activities began in 2012, and the project was announced to the community in 2014. Compensation negotiations stalled the project until 2016. Through the collaboration of grassroots activists, NGO advocates, and academic researchers, local people pressured JICA to ensure the government abided by the conditions of the loan. Not everyone has received compensation at the time of writing, and what they agreed to is still below market value, but they are satisfied. Land that has not yet been paid for is not being developed (FN July 13, 2016). The Sinohydro project (Figs. 3 and 4) is connected in local people's minds with plantations in the Pheapimex concession. The owners of Pheapimex are third party governors in Sinohydro (Pye, 2014) and the irrigation project is located inside the concession boundaries. Residents report that project workers first appeared between November 2014 and January 2015, saying they were involved in anti-mining to make way for the Sinohydro project. Villagers protested and went with 100 people to ask the commune chief for information. They were told this was an irrigation project to increase rice production and benefit the community (Personal communication, June 4, 2016).

In April 2015, a first meeting was held with commune authorities, members of the community and company representatives. Villagers were asked to thumbprint a document to transfer their land to the company, for which they would be compensated \$0.50/m^2. Villagers report that in the meeting, people did not agree to this offer. Over the next three months, officials and company representatives visited affected families in their homes and threatened that if they did not accept this compensation deal their land would be taken anyway and they would get nothing (Group discussion June 15, 2015, Boribo district, Kampong Chhnang).

Following this intimidation, approximately 70% of affected households agreed to the compensation. In June 2015, bulldozers, in preparation to dig canals, had flattened land right to the edge of properties where residents resisted the compensation offer, and started flattening again on the other side. After further negotiations, the remaining 30% of affected households agreed the company would pay \$55 per sugar palm tree, \$1/m^2 of rice land, \$3/m^2 of house land, and \$48 per mango tree that would be lost to make way for irrigation infrastructure (Field notes Boribor District KCH April 23, 2016).

6.2. Irrigation, conflict and cooperation

Community cohesion and experienced activists in the area where these irrigation projects are located represent a spillover effect from past confrontations over the Pheapimex concession. From 2004–9 farmers in Kampong Chhnang had violent and bloody conflicts with Pheapimex companies and the government forces that supported them. Residents succeeded in keeping their rice fields (Personal communication, June 18 2015), but now their fields and homes are in the way of planned irrigation schemes, igniting new conflicts and hardships (Group discussion, Kampong Chhnang, June 2015). The history of conflict with other development interventions plays an important role in negotiating compensation for affected residents.

The new conflicts are characterized by increasing cooperation between the private sector, government ministries, and international donors to execute 'sustainable' programs that supposedly protect against the effects of climate change. In the case described here, past conflicts with the company and local authorities created solidarity across communities. They came together over a common cause and have since been able to make a stand with the irrigation projects – negotiating better compensation for their losses.

It remains unclear how these two irrigation systems will affect the river system and surrounding landscape. The depth of the Sinohydro channels is a concern for residents. Already villagers report well water and rice field water going into the 6–7 meter-deep channels (Personal communication, July 13–15, 2016 Kampong Chhnang). Residents are concerned that when this deep channel reaches the Tonle Sap River, it will drain water from the river back into the Pheapimex plantation area, potentially lowering water levels in the Tonle Sap Lake – a vital resource for fish and floodplains (Personal communication, KHC June 4, 2016). The JICA project is not as deep, but it will cover a large land area with many channels. Residents are not convinced that the configuration of the channels will improve water management. In both sites, residents expressed concern over possible fees for water use, which today they receive for free. The effects of these two projects on

[4] The inter-ministerial group is comprised of the Ministry of Water Resources and Meteorology (MOWRM), Ministry of Health (MoH), Cadastral authority, and the Ministry of Agriculture, Forestry and Fisheries (MAFF).

[5] This project was implemented in Battambang, Pursat, and Kampong Chhnang. We attend only to the current conflicts in Kampong Chhnang.

Fig. 4. Sinohydro dam under construction. Drone photo: V. Rong, June 5 2016.

downstream water access are as yet unconfirmed because the dams remain open. Whether increased irrigation for some will come at the expense of water access for others remains an open question.

7. Discussion: landscape effects now and over time

The four projects we discuss in this paper – two flex crop plantations and two irrigation schemes – are all situated in the flatlands at the base of a major mountain system. The waters from this mountain flow across the flatlands and into the vital Tonle Sap flood-pulse ecosystem in which the annual cycle of influx and outflow of water is an integral part of system health and biodiversity (Bayley & Sparks, 1989). The effects of soil degradation, polluted water, and deforestation to clear land for agro-industry are already felt by small-scale farmers and fishers, while irrigation projects are poised to change hydrology and water access in the Tonle Sap basin. The long-term effects of these changes are as yet unknown. What is vitally important is that they are not being investigated or considered in Cambodia's climate change and development planning.

Every interview or focus group discussion we had involved accounts of abundant access to resources and vibrant livelihoods before company interventions (see also Jiao, Smith-Hall, & Theilade, 2015). The landscape that encompassed the mountains, rivers, forests, and cultivated areas was filled with wild fruits, fish and aquatic plants, wild game and rice, which were negotiated through local and national level resource management techniques including rice and palm sugar production, sale of wild fruits and medicines, and timber. All participants reported a high reliance on "environmental income" (Angelsen et al., 2014), the lack of which has dramatically affected their livelihoods – despite the roads, plantations, dams, and irrigation systems established through development. In this region, the impacts of multiple projects and dramatic land transformations over a short time period have palpable and cumulative impacts on local livelihoods (see also Baird & Barney, 2017). For example, villagers receiving irrigation infrastructure are suffering the effects of a water cycle altered by the deforestation of tens of thousands of hectares, and the depth of the Sinohydro irrigation system threatens to draw water from their wells and rice fields, exacerbating the precarity of their position.

Table 1 summarizes specific ways in which flex crop production and irrigation projects alter environments and social relations in the Greater Aural, setting the stage for conflicts to begin, escalate or spread.

Some of the impacts in Table 1 can trigger or worsen conflicts 'here and now.' When villagers lose land to make way for flex crop plantations or irrigation infrastructure, when the surrounding forest also falls to plantations, when plantation workers are not paid on time, and when cassava and sugar processing pollutes the water in the immediate vicinity, the effects are felt locally and in the present.

In other instances, localized impacts may be deferred into the future. Large-scale cassava production can cause soil degradation and erosion, possibly compromising the future agricultural potential of land. Deforestation for plantation agriculture affects an ecosystem for many generations after the land conversion, while irrigation canals draw surface water into them throughout their life, which can change the distribution of water at the landscape level and over time.

Still other effects of climate change responses occur in the short term but move geographically beyond where a project occurs. Examples of immediate but spatially shifting impacts include drought effects from deforestation, villagers' concerns over water pollution from factories that process cassava, and irrigation systems changing access to water downstream or groundwater.

Finally, we see potential for conflict linked to climate initiatives to shift over both time and space. The water diverted for irrigation could be reduced even further for downstream users if climate change leads to drier conditions in the future – a reasonable possibility given that expected future droughts were used to justify the irrigation system.

These are only a few examples of the immediate and potential justice implications and unintended consequences of land-based climate change strategies, which signals the need for further investigation – some possibilities for which are discussed below.

Table 1
Impacts of climate change mitigation and adaptation strategies that have potential to increase conflict, categorized by the extent of their geographic and temporal reach.

	Local	Beyond local
Present	– Villagers displaced for flex crop plantations – Villagers lose land to irrigation infrastructure – Pollution from flex crop processing – Flex crop plantation workers not paid – Deforestation for flex crop plantations	– Changes in water access downstream from irrigation dam – Water pollution downstream from flex crop processing – Increased pressure on/competition for resources in areas surrounding displacement?
Future	– Further deforestation for flex crop plantations – Degraded soils on flex crop plantations – Water diverted into irrigation channels	– Water access downstream from dam further restricted by future drying?

8. Conclusions

Our analysis leads us to three conclusions. First, actions taken in response to climate change are indeed affecting insecurity and conflicts in the Greater Aural region. Second, a landscape perspective reveals that these effects are not limited to the project site or the time in which projects are initiated – they can be displaced or delayed. Third, being attentive to cooperation in various forms helps explain conflict dynamics. This section elaborates on these findings and suggests avenues for further work.

This research shows that in the study area, land-based responses to climate change do reshape patterns of resource control, in turn igniting conflicts. They do so through two linked processes: 1) ecological effects that alter the nature or quantity of available resources; and 2) social effects that impose or reproduce patterns of exclusion, social inequality or discrimination. How this plays out, in specific local entanglements that cascade across landscapes and over time, must be carefully understood in order to anticipate and address such conflicts. Interestingly, in the Greater Aural climate change responses appear to be triggering some of the same kinds of problems expected from the biophysical impacts of climate change itself – both ecologically and socially (Fetzek & Mazo, 2014). We thus affirm that insights from critical literature on climate change and conflict, such as the need to understand historical, social and political dynamics and not focus too much on environmental change as an explanatory factor (Barnett & Adger, 2007; Verhoeven, 2011), remain relevant to analyses of climate change responses.

Our second conclusion is that the landscape perspective reveals layered, displaced and delayed impacts that receive scant attention in planning and implementing climate change responses. Given that climate change initiatives – on-the-ground projects like those investigated here (biofuels, irrigation) as well as higher-level policy objectives (reducing emissions, storing carbon, adapting agriculture to changing conditions) – tend to be undertaken with a narrow spatial and thematic scope, and implicitly reinforce the dominant economic paradigm (Dunlap & Fairhead, 2014), the fact that interactions between climate projects and other processes across the landscape and over time largely escape scrutiny is a crucial oversight.

Using the landscape as our unit of analysis has posed analytical challenges by increasing the complexity of the research, complicating boundary definitions, and sacrificing the depth of a focused analysis for the insights of the broader perspective. While we continue to refine our theoretical and practical engagement with the landscape, working at this scale causes reflection on processes that would otherwise be less visible. Identifying how access to contested resources changes over broad spatial areas, with deferred or cumulative effects over time, can help anticipate conflict dynamics.

The landscape perspective also provides both complications and opportunities for addressing conflicts. Complications include that no single authority has the jurisdiction to resolve issues spanning multiple districts and provinces or to manage their short- and long-term effects: the unit of analysis does not match existing units of intervention. However, the opportunity to track patterns of resource use and conflict in a way that cuts across administrative boundaries widens the range of available governance instruments – as well as cooperative networks of local and international actors – that might be leveraged to pursue just and sustainable conflict resolutions (Franco, Park, & Herre, 2017).

Our third key finding concerns the role of cooperation as an element of resource conflicts. While our insights remain preliminary, we see two kinds of interaction between conflict and cooperation at work in the Greater Aural. First, coordination between government organizations, national and international investors, banks and development donors has made possible the climate change programs that intensify disputes over access to resources (see also Work & Thuon, 2017). To the extent that land-based climate change mitigation and adaptation activities safeguard elite interests and entrench existing power relations, the constellations of actors promoting and enabling these activities deserves careful scrutiny.

More positively, we see evidence of cooperation within and between affected communities and through broader alliances being used to challenge patterns of dominance and exclusion. The case of residents confronting companies and local authorities over the terms of irrigation projects shows solidarity within and between local communities. It is possible that dealing with past resource conflicts, for example over land rights in the Pheapimex concession, has improved their ability to navigate new conflicts in the future. We also see community activists united across different project sites, cooperating with national and international advocacy organizations, and collaborating with academic researchers to find pathways toward social and environmental justice. We hope that further research will continue to develop this theme.

To conclude, our evidence shows that climate responses are shaping conflicts in demonstrable ways: by degrading available resources and contributing to social exclusions and rights violations. Ironically, these ecological and social effects can mimic the predicted impacts of climate change that mitigation and adaptation strategies are supposed to address. This raises a challenging question: are conflicts predicted to occur due to the impacts of climate change in some ways being anticipated – even hastened – by globally legitimized responses to climate change? In pursuing this line of thinking, we suggest that key processes can be made visible through attention to landscape and to the interactions between conflict and cooperation.

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Conflict of interest statement

The authors declare no conflicts of interest.

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