A New Sustainability Model for Measuring Changes in Power and Access in Global Commodity Chains

Abstract

High-value agricultural commodities face substantial economic, environmental and social sustainability challenges. As a result, commodity industries are adopting sustainable supply- and value-chain models to make production more efficient, traceable and risk-averse. These top-down models often focus on giving higher prices to smallholder producers. While an important component of sustainability, this focus on farm-gate prices have shown mixed results in part because they are less effective in highlighting the asymmetrical power relationships and the socio-economic and ecological complexity in high-value commodity production. We use a novel method to measure and visualise changes in smallholder power in Madagascar's northeast 'vanilla triangle' – home to about 80 per cent of the world's high quality vanilla. Our results reveal the paradox that during the recent price surge an overall increase in smallholders' multi-dimensional power to access economic benefits was accompanied by a decrease in many other equally important measures of sustainability. This illustrates how effective models for understanding global sustainable commodity chains should take a smallholder view that emphasises power, complexity and change across both high and low price points.

Measuring and visualising changes to smallholder power

Social, economic and environmental sustainability standards are increasingly mainstream in the production of high-value agricultural commodities such as coffee[1], cacao[2], acai[3], palm oil[4] and vanilla[5]. However, there is a growing recognition that mainstream sustainability models often struggle to achieve their objectives[6 7]. This may include widespread failings for the millions of smallholder producers who are often purported to be the beneficiaries of sustainability initiatives[8].

These failings are frequently attributed to less-recognised asymmetrical power relations along the commodity chain, from smallholder producers to multinational suppliers[9]. Power issues – including structural inequalities and social relations between market actors – are a recurrent and key conceptual dimension for understanding sustainability outcomes in commodity studies[10]. However, power is often treated as a 'black box': generic, under-described and certainly unmeasured, particularly as power changes at the smallholder level.

In this study, we propose a novel way of exploring how smallholders experience commodity production and the various dimensions of sustainability – environmental, social and economic. In particular, we make power an explicit and visible part of our analysis, mapping smallholders' ability to access the monetary and non-monetary benefits from high-value commodities under dynamic environmental, social and economic conditions. We draw on

Ribot and Peluso's 'access mapping' approach to tracing benefits in high-value commodities[11]. Similarly, we adopt an actor-orientated approach to power, which recognizes an individual's agency in accessing certain benefits and resources. We situate this agency within historically, culturally, and politically produced social structures (Foucault 1990; Peluso and Ribot 2003; Watts 1993; Weber 1978 – see section below for more on our approach to power).

Our focus, however, moves beyond conceptualising power, providing a unique applied model that both measures and visualises changes to smallholder power as a lens for assessing sustainability. This approach is attractive for its analytic ability, which begins with smallholder perspectives on various multi-dimensional factors (e.g. new technologies, security, and customary land tenure) that affect sustainability in diverse ways. We make these variables explicit and highly adaptable to other commodities so that future sustainability initiatives can do more to recognise their role and dynamism.

Vanilla production provides an excellent example to study the relationship between commodities, sustainability and smallholder power. Similar to many high-value global commodities, such as palm oil and cacao, it primarily relies on poor, smallholder farmers for production. Moreover, it has also been the focus of both sustainability initiatives[12] and price spikes; in April 2017, a kilogram of high a quality *Vanilla planifolia* reached approximately $600, representing a 14-fold price increase since 2013[13]. The paradox is that prices are frequently promoted in mainstream sustainably initiatives. While price increases may present income opportunities for upstream market actors in the commodity chain, they also pose complex challenges for the vanilla market and smallholders' economic, social and environmental sustainability. The focus on price comes at the cost of ignoring power in these contexts, thereby reducing our ability to capture a comprehensive understanding of smallholders' experiences, particularly in periods of rapid price fluctuations, and socio-economic and environmental change.

For instance, the recent high vanilla prices in Madagascar have driven increases in early harvests of unripe 'green' pods, thereby diminishing product quality.
Smallholders are also foregoing vital food crops desperately needed to make it through the 'hunger season' – the lean period when food is scarce before the rice harvest[14] – further fuelling speculation and the clearing of some of the world's most biodiverse rainforests to tap into surging demand[15]. The effects of the price spike have been particularly egregious for

smallholders, with sharp increases in vanilla-related theft and violence[16]. Further, the current high prices and declining overall quality of Madagascar vanilla have caused many larger operators to drop their Fairtrade and organic certification programmes. These operators remark that the increase in smallholder 'power' both to command high prices and to sell early have made sustainability programmes less effective and economically unviable[17].

Our results reveal that there has indeed been an overall increase in smallholders' power during the recent price spike in vanilla. Yet, this increase in power has not necessarily translated into an unmitigated increase in sustainability across the three dimensions − environmental, social and economic. Rather, we see an inverse relationship in some respects, as economic gains made from the price spike dramatically decrease vanilla crop quality and village-level security. While vanilla presents a unique opportunity to examine the often less-measured relationship between power and sustainability for commodity-led development, similar challenges remain with many other important global commodities. In our conclusion, we discuss the novelty, limitations and broader applications of access mapping, not only for vanilla, but also for sustainability efforts in associated high-value agricultural commodities.

Crossing disciplinary boundaries to address global challenges

The purpose of this article is to expand disciplinary boundaries and communicate integrated elements of the social sciences and humanities to wider audiences in order to address global challenges and make social change.[18] Drawing on the strengths of design, the work illustrates diversity and plurality in how market actors, and beyond, understand and measure changes in power and access in global commodity chains.[19] This addresses recent calls highlighting the importance of interdisciplinary sciences to address growing global challenges.[20] Such needed dialogue, Castree et al., suggest, is vital to 'engender plural representations of Earth's present and future that are reflective of divergent human values and aspirations'.[21]

For instance, our access mapping model uses integrated design visuals to demonstrate how power changes from over different periods of low and high price points and how smallholders experience this change. We build the commodity chain from smallholder's perspective. An approach that is vastly different from current firm-led sustainability models that rely principally on two 'top-down' approaches: sustainable supply chain management (SSCM) and global value-chains (GVC).[22] SSCM is a model used to streamline production through new information and communications technology, while building resiliency and

decreasing risk by securitization of productive assets, including vital raw materials and human capital. GVC goes a step further to analyse potential opportunities for source countries to 'capture the gains' of commodity production through technological upgrading at the national or regional scale.[23] These two sustainability models are ideal for lead firms to exercise control and influence market-relationships, yet are much less effective in highlighting asymmetrical power relations that exist between actors and socio-economic and ecological complexity and change (Gibbon and Ponte 2005). This absence is particularly astute in periods of price volatility when smallholders find themselves having to cope with rapid price fluctuations and crisis.[24]

Our approach to visualizing smallholder commodity relationships builds from 'counter-mapping' and 'participatory mapping' traditions within social sciences that adopt a bottom-up rather than a top-down approach to creating visual maps.[25] Social scientists have called for integrating multiple mapping methodologies to better "understand the spatial organization of local resource use and management as produced through social relations and contingent on changing social, political, economic and environmental processes.'[26] Following this, our access-mapping methods and visualizations of commodity relationships account for dynamic social, economic, ecological, and political relationships, taken across space and time. Our visualisations of ethnographic data bring legibility, comprehension, and provide a metaphoric, visible form through which to make sense of complex and dynamic sustainability models.[27] For us, this is not merely a case of illustrating text. Rather, the visualisation enhances the legibility of the text.[28] Communicating the model visually enables its assimilation into existing practices and knowledge sets, open up novel reflection through prototypical iterations, and deepen our own understanding of the model in both text and image.[29] [30]

Study design

We conducted semi-structured interviews and socio-economic surveys with smallholder farmers in Madagascar in 2017 (during the 'boom' vanilla market) in the areas of Antalaha (*n*=295) and Mananara Nord (*n*=185). Surveys and interviews were held in multiple village sites and included a range of sustainability-related questions concerning crop security, production and trade. Questions were asked to smallholders specifically in relation to the current vanilla price spike (measured in 2017) and in comparison to the 'bust' period just ten years previously (measured in 2007).

We then coded the survey and interview data using a grounded-theory inductive process allowing for smallholders' responses to guide the analysis. Through the coded text, we identified 50 distinct 'factors' which directly affect vanilla smallholder sustainability (see Table 1).

The factors placed into eight categories or 'access mechanisms', which Ribot and Peluso (2003) define as the 'means, process and relations' which facilitate the capture of benefits from resource commercialisation[31]. These eight mechanisms are technology, capital, markets, labour, knowledge, authority, identities, and resources. Collectively, they clarify the complex relationship between power – one's *ability* to access benefits – and the dimensions of environmental, social and economic sustainability (Figure 1). Not all mechanisms contained an equal number of factors, reflecting the different weights of the mechanisms and their contribution to an aggregated measure of change in power. We, therefore, do not add numeric values to our models in order to avoid cross comparisons of changes in power by mechanisms.

We see the different dimensions of sustainability not as standalone or static, but relational and dynamic. We therefore gave each of the 50 factors six ratings based on its relative effects on smallholder sustainability, including smallholders' power to capture benefits (see Table 1 in supplementary information for definitions). The ratings ranged from a high of 4 (very positive effect for benefit capture) to a low of 0 (very negative effect for benefit capture) and were divided up, with two for each of the three dimensions of sustainability – environmental (a. *external* and b. *internal*), social (c. *status* and d. *control*) and economic (d. *options* and e. *income*), respectively. We call this measure the 'Sustainability effect' (Se). Critically, however, not all smallholders have access to all factors, so we applied a second 'Access' rating (Ax), on a numeric scale from 0.2 (no access) to 1 (very accessible), which discounts the sustainability rating above according to smallholders' ability to access the factor. This second measure of changes in power we term 'Actualised power' (Ap). This provides us with an understanding not only of how complex factors affect sustainability, but also of smallholders' power to access the benefits that derive from each factor. We used linear weighted Cohen's Kappa (Kw) analysis to verify differences between the ratings. Visualised changes across low and high price points for both Se and Ap were populated into polar grids

by mechanism, sub-total and by each individual factor (Figures 3–5, respectively; see supplementary information for further details).

A note on power

Our working definition of power closely follows Ribot and Peluso's (2003) original conceptualisation of power in their seminal publication, 'theories of access.' Ribot and Peluso's define power in very close relation to 'access' or what they see as one's '*ability* to benefit from things' (2003, 155, emphasis added). Taking overlapping perspectives from Weberian, Marxist and Foucauldian interpretations, they define power as:

> …first, the capacity of some actors to affect practices and ideas of others (Weber 1978, 52; Lukes 1986, 3) and second, we see power as emergent from, but not always attached to, people. Power is inherent in certain kinds of relationships and can emerge from or flow through the intended and unintended consequences or effects of social relationships. Disciplining institutions and practices can cause people to act in certain ways without any apparent coercion (Foucault 1978a, 1979).[1]

We also focus our 'attention to a wider range of social relationships', which are mobilised in both discursive and material forms that 'can constrain or enable people to benefit from resources' (Ribot and Peluso 2003, 154). In our study, we demonstrate that there are multiple and overlapping access 'factors' which may affect, or be affected by, ones' *ability* to benefit from the rise in vanilla prices (c.f. Sen 1995). In our model, we place these access factors within larger mechanisms (e.g., knowledge and/or labor) through which one obtains access to benefits. We measure how through the gaining or losing of access to particular things (e.g., new varieties or vacuum sealing), power is generated or lost, and we consider how this change in power mediates one's subsequent ability to navigate the material realities of vanilla production (e.g., vanilla needs to mature on the vine and therefore is vulnerable to theft). We are careful to position access within broader structural constraints, including the historical, political, and economic dimensions of market volatility, smallholder marginality, and cultural identity, to name a few (Sen 2017; West 2012).

We do appreciate that there are significant differences in the way power is conceptualised, and thereby analysed, and by no means do we have the space to review them all here (for some reviews on power and resource governance see: Svarstad et al. 2018; Ahlborg and

[1] For an excellent recent review of Ribot and Peluso's and others approach to 'power in political ecology', see, Svarstad et al. 2018.

Nightingale 2018; Cavanagh 2018; Fletcher 2010; West 2006; Lukes 2005). However, it is extremely important to identify how and where power is applied, source(s) of that power, and the consequences. We understand that social relationships are multiple, ranging across scale, from the global to the local (Wisner 2015; Neumann 2003; Rangan and Kull 2009). Power emanates from state (Harris 2006; Meehan 2015; Sikor and Lund 2009) and non-state institutions (Asiyanbi 2018; Büscher 2010). Power is manifested through disciplinary power of institutions (Fletcher 2010; Cavanaugh 2018) in the form of discourse (Escobar 1994), over policy (Goldman 2015), knowledge production (Goldman et al 2011) and science (Neimark and Wilson 2016; Robbins 2004; Forsyth 2003). Materiality and social relations, such as, characteristics of the commodity itself (Bakker and Bridge 2006), mediate power. Many through class differences (Watts and Peet 2004), gender (Nightingale 2006; Schroeder 2000; Rocheleau et al. 1996), race (Pulido 2015), sexuality (Gandy 2012), identity (Sundberg 2004; Ojeda 2012; Butler 1997; Spivak 1998) and violence perpetrated by regional elites (Peluso 2003) also observe power.

Yet, we also cognisant that defining power through a structural lens may be seen as 'rigid' and reifying top-down 'hierarchies of power' (Svarstad et al. 2018, 355), and thereby, may be better conceptualised as 'networks' (Robbins 2004; Rocheleau 2008), 'webs' or 'bundles' (Ribot and Peluso 2003) or 'assemblages' (Li 1999; Goldman et al 2011). These different perspectives of conceptualising power is very important in resources governance scholarship and beyond. We recognise that this overly structural lens also dominates discussions of power leaving out other post-structuralist ways that some may see, and define power, mainly through more constructivist elements of 'cultural hegemony' (Gramsci 1982), some which are non-class based (Laclau and Mouffe 1985). We encourage those who apply this access map to measure and visualise power to explore such diverse conceptions and builds off others who are forging vital links between humanities, design and social sciences (Escobar 2018). We feel such conceptualisations will only help in deepening understandings of the multiple, layered and dynamic complexities of power particularly from a smallholder perspective.

Results: visualising smallholders' power

Our results show that smallholders held more overall power to access benefits during the recent price spike. This increase is reflected across seven of the eight different mechanisms that we measured (Figures 3–5). As illustrated by Figure 3, not all mechanisms had an equal

relational influence on this overall increase in smallholder power. Such differences suggest that 'power' is not a homogenous variable for farmers who participate in commodity systems, but rather represents complex relationships that vary with changing economic conditions.

The category of ***labour*** showed a significant relational change for farmer power, meaning that the ability to access labour had a relatively greater effect on overall farmer power during the boom market. We attribute much of this effect to the added labour needed for security in homes and vanilla fields, as well as the relative advantage of hiring wage-labourers for household and other agricultural tasks, freeing up farmers to invest more time in the lucrative vanilla market.

As with labour, the category of ***authority*** exhibited a marked influence on increasing smallholders' power during the boom market. With increased security risks, people's ability to access courts, police and local authorities became an increasingly important form of protection against theft and fraud. In comparison, the authority of farmers to gain and maintain their formal and customary land tenure remained important in both low and high price points. This is not surprising, as during periods of volatility and insecurity land tenure acts as an environmental, social and economic 'security blanket'[32].

For ***technology***, access to low-input vacuum-pack sealers and industrial quick-curing machines also notably increased smallholder power. Once promoted during the low price points by development agencies, vacuum-packed vanilla is now prevalent in the vanilla market. By vacuum-sealing vanilla beans for long-term storage, farmers gain the ability to 'play the market' and increase their selling power – in terms of both when to sell and negotiating a better price since theoretically they can store it away and not sell to the first buyer. However, many farmers and collectors are sealing their vanilla before it is properly dried and cured, resulting in a large impact on vanilla quality. Consequently, smallholder adoption of vacuum packs has been one of the biggest points of contention with exporters, as the resultant decrease in quality translates into an overall loss in the value of vanilla beans on the international market[33].

Although the results for ***knowledge*** did not markedly change over the period from 2007 to 2017, this category remains important in terms of its relationship to smallholders' power in both bust and boom markets. It includes smallholders' knowledge of official harvest dates, of

hand pollination and farming/curing practices, and of price differentials at various nodes in the commodity chain. Some factors saw a decrease in relational importance during the boom market up to 2017, including smallholder knowledge of certification projects.

Similar to knowledge, the category of ***capital*** remained important for maintaining smallholder power in both bust and boom markets. Yet, the advantages for farmers with access to greater capital resources through loans and cash in hand were significantly higher during the price spike, when farmers had higher capital requirements for security, wage-labour, and small-scale vanilla purchasing needs. A very significant *negative* factor on smallholder power in both boom and bust markets is the practice of predatory lending, which often leads households into further debt – a harmful economic cycle also seen with other commodity relationships, including cotton[34] and coffee[35].

For ***resources***, having access to curing supplies to process raw vanilla beans remained correlated with increased farmer power in both high and low markets. Cured beans command a higher price on the market, and can be stored for longer than raw beans, giving farmers more power in timing their vanilla sales. As security becomes a concern in the boom market, farmer resources including weapons for protection, blankets for sleeping in the fields, and materials to build guard posts become vitally important.

The category of ***identity*** had a relationally positive impact on smallholder power in 2017, especially for those individuals considered trustworthy and skilled farmers. In the heightened tensions of the boom market, collectors and traders increasingly look to work with farmers with an established 'track record'. The importance of trust and social reciprocity speaks more broadly to the diffuse nature of power and value in commodity production, which connects to individual relationships between farmers and between farmers and collectors[36].

Finally, the category of ***markets*** was the only mechanism for which farmers' power decreased between the two periods, indicating that the advantages of having market connections become less of a 'power' factor for smallholders when vanilla prices are highest. High prices coupled with low supply mean farmers do not need to seek out buyers, as buyers are motivated to track down farmers with vanilla to sell. The overall decrease for the market category can also be attributed to the collapse of both organic and Fairtrade certification programmes. This category also illustrates that many smallholders are not diversifying their

agricultural and economic efforts during the boom market, as the majority of their labour is devoted to growing and securing vanilla. Hence, commodity sustainability efforts, which focus exclusively on price, are problematic, as when commodity prices drop, farmers may be left without diversified agricultural and economic resources[37].

The eight categories and their constituent factors had differing influences on the three pillars of ***vanilla sustainability***, as illustrated in Figures 4 and 5. Our results show the multiple factors that determine the uneven and variable sustainability outcomes within the vanilla market from a smallholder perspective. As with smallholder power relationships, depending on the case, factors could have either complementary or contradictory sustainability outcomes.

For example, the case of vacuum-sealing technology illustrates how one factor can have competing sustainability implications: while vacuum-sealing beans increases the *economic* sustainability of smallholder farmers in the current market, it also decreases their *environmental* sustainability in relation to overall vanilla quality (Figures 3–4). Further, the decreased quality of Madagascar vanilla is causing some buyers to look for other sources; such a shift to other countries would pose an economic sustainability challenge for smallholder farmers in coming years. As another example of competing sustainability effects, the increased practice of smallholders pollinating all of their vanilla flowers during the boom market increased household economic autonomy but decreased the environmental health of vanilla vines.

Discussion: linking power and access

Our results illustrate that the boom market in vanilla has led to an overall increase in smallholder power across environmental, social and economic realms. Power in this sense encompasses both material and social realms, including the ability to influence interpersonal relationships and dynamics in informal, everyday contexts[38]. Yet this moment of empowerment, while welcomed by farmers in the short term, may be leading to practices that will raise new sustainability challenges to vanilla farmers' livelihoods in the future.
For example, those in the vanilla industry with the necessary capital, power, mobility and connections are once again looking to other countries and other products to replace Madagascar vanilla, which has reached price points and quality markers unsustainable from the industry's perspective[39]. Further, the current dynamics seem poised to set up another

vanilla ‘bust’ market. If realised, both of these developments would have negative implications for Malagasy vanilla farmers, many of whom are already on the margins of household food security.

One implication of our results is that sustainability initiatives working with producers should not simply focus on high prices, but rather take into account the complex, relational effects of power, change and uncertainty within local communities. In the case of vanilla, the current high prices should not prompt firms to abandon their commitments to community sustainability programmes as no longer relevant, but rather to shift their programmes to address the unique concerns brought about by the boom market (such as vanilla security and quality) that will support the sustained success of Madagascar’s vanilla producers and forest environments over the long term.

In order to understand the unique challenges of both boom and bust markets, sustainability models need to account for the complex relationships between power, access and markets across the entire supply chain, including at the smallholder level. Yet, firms involved in high-value commodity markets are increasingly integrating sustainability models into their business operations that largely adopt static, equilibrium-based representations of commodity relations. These models assume baseline ‘generalised’ socio-economic and environmental conditions within sites of production. Because of these assumptions, such models have proven less successful at achieving sustainability objectives in times of acute change and uncertainty.

Yet, smallholder farmers who produce high-value commodities for international markets continuously face a high degree of economic, social and environmental change and uncertainty. For example, for vanilla farmers in Madagascar, price points are rarely, if ever, at an ‘average’ level and instead fluctuate between extreme market highs and prolonged times of market depression. Environmental conditions in tropical ecosystems are seldom stable, with frequent cyclones, drought, pests and fungal diseases, and other challenges related to climate change[40]. Social and political structures that govern vanilla production and trade are also highly unpredictable and liable to sudden shifts[41]. In the face of such uncertainty, smallholder farmers have developed complex, dynamic approaches to vanilla production and trade that regard change and uncertainty as intrinsic to commodity systems[42].

Taking a cue from the smallholders themselves, we have proposed a model that takes a farmer-based approach to commodity relationships, and that regards change and uncertainty as constitutive of – and not external to – linked historical, economic, social and environmental systems[43]. This model additionally unpacks the 'black box' of smallholder power within commodity-chain relationships. For example, it notes the complex array of variables that influence farmers' ability to access the advantages of the vanilla trade and to avoid the disadvantages of the market, across both high and low price points. Understanding the diverse mechanisms of smallholder power across material, economic, social and cultural contexts is necessary to develop a more realistic understanding of how these village-level dynamics affect – and are affected by – firm-led sustainability programmes.

Looking ahead: applications for sustainability

We argue that mainstream models for sustainable commodity production flatten the complex, recursive relationships of power, access, uncertainty and change at all points of supply-chain relationships. These simplified models lead to top-down approaches to commodity-chain management. They often support interventions that prove to be counter-productive, by narrowing the options along the chain instead of opening them up to adapt to shifting environmental and economic conditions, and to support the social agency and strategic positioning of actors along the commodity network. Further, sustainable initiatives often identify high price points as a key driver of sustainability. Yet, while high prices to farmers are indeed an important component of sustainable commodity chains, they are not sufficient to foster social, economic and environmental sustainability[44].

Increasingly, researchers are using complex socio-economic systems approaches and models to address pressing environmental challenges, such as the effects of climate change[45], biodiversity conservation[46] and deforestation[47]. However, these forms of ecological and social complexity have been applied less to the development of tools for envisioning sustainable commodity chains, mainly because of the drive to 'clean-up' exogenous factors and bring about efficient production. We illustrate that a smallholder access model to commodity chains can account for a wider range of relational economic, social, cultural and environmental factors linked in historically shifting commodity relationships. The resulting complexity defies simple relationships of causation between various aspects of the supply chain, but situates them within the 'messier' realities of networked, relational, and non-equilibrium systems[48].

From an applied perspective, working from access-based models opens up sustainability interventions for government agencies, civil society and industry across new realms of smallholder outreach. These go beyond income-generation initiatives, including complex variables which range from security to transparent land governance. Our results support the design of sustainability approaches to commodity relationships that increase the power, access and options for smallholder farmers[49]. These are deliberately flexible and adaptive to change and uncertainty at both high and low price-points[50].

We do recognise, however, that like most models there are limitations to the access mapping approach we put forward. First, while certain factors foster smallholder empowerment, these factors are not universally accessible to all members of a community[51]. We recognise that smallholders vary widely, participating in market relations according to their different social and structural histories; they have unequal access to resources and benefits[52]. In this vein, we understand that this is just a snapshot over two price points and that accessibility to resources including capital, land, improved growing material, market advances and transportation differ in high and low markets, and indeed even within differing months in any one given season. Finally, we recognise the complexities of considering power as an analytical category, as individuals exercise power across a range of material and cultural forms.

A second limitation is that our presentation only shows the access map of one, albeit important, node of the commodity chain – the smallholder. Further studies could expand the access map by looking both at horizontal inequalities that exist within smallholder groupings through gender, race, class, and other structural formulations[53] and at smallholders as compared to other nodes such as collectors or exporters[54].

Overall, this approach will foster flexibility to work with, instead of against, existing social and cultural relationships connected with high-value commodity chains[55]. It acknowledges that for vanilla – like many high-value crops cultivated by smallholders throughout the globe – there is no ‘normal’ market. Further, many of these crops, including coffee, palm oil and cocoa, have also experienced unprecedented price spikes in recent years. The significance of such models is increasingly pressing, with many forest-based and high-value commodities facing similar dynamics of compounded social, economic and environmental uncertainty and change across the globe.

Data Availability Statement:
The full qualitative datasets generated during and/or analysed during the current study are not publicly available at this time due to the ongoing and sensitive nature of the ethnographic material, but are available from the corresponding author on reasonable request. The quantitative data table generated is fully available at: 10.17635/lancaster/researchdata/229

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