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Transforming exploitative land-based economy: The case of Borneo

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ABSTRACT

Large-scale land exploitation to jumpstart backward economies is often accompanied by massive environmental impacts. The broad concepts of productivity-oriented 'bio-economy' and conservation-oriented 'eco-economy' were proposed to transform exploitative land-based economies. Taking cases in Borneo as core examples, this paper explores 10 transformative strategies for sustainability: boosting upstream productivity of cash crops, activating under-utilised low carbon (ULC) land for production, upgrading and diversifying downstream activities, branding for more values (industrial), establishing new domestic demand for bio-resources, creating values for carbon and ecosystem services, enhancing agro-ecological resilience, establishing eco-based tertiary sectors, branding for more values (smallholders), and encouraging self-sufficient farming. Generally, utility-based development strategies with wealth creation as the centre of policy-making are inadequate to repair the previous environmental damage. Likewise, strategies that prioritise restoration have shown a limited contribution to economic growth as observed in the case of Borneo. The interconnected nature of economic productivity and conservation means that no single strategy is a perfect solution but a combination of them may produce a better outcome. While integrated landscape analysis that combines land-use models and economic analyses can facilitate understanding of the systems, in-depth area studies are necessary to capture the more subtle 'human factors' like socio-political dynamics. The existence of multiple stakeholders with different interests and values means that an 'optimal' combination would be a result of political negotiations rather than scientific investigations. To design and also effectively execute the strategies, communication, collaboration and co-production of knowledge between scientific communities and various stakeholders is imperative.

1. Introduction

Large-scale land exploitation has been regarded as a key to jumpstart backward agricultural economies with vast land resources. However, over-reliance on export-oriented resource exploitation for fiscal revenues will unavoidably lead to economic bottlenecks (Torvik, 2009). Due to uneven development, such economies are likely plagued by poor governance, corruption, ineffective law enforcement and limited growth in skilled labourers. They are exposed to periodic economic crisis due to fluctuations in commodity prices, largely preventing them from building their own secondary and tertiary industries in a steady manner. In many areas, low population density also encourages large-scale primary land-based activities and inhibits industrial advancement (Choy, 2005). This will lead to further unsustainable land exploitation, potentially causing serious environmental degradation and social conflicts (Torvik, 2009).

Typically, land exploitation is started with intensive timber extraction, followed by aggressive agricultural expansion, and

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accompanied by massive environmental impacts. While such exploitative activities have generated quick revenues for the economy, the livelihood of people has indeed been threatened in all aspects from immediate local health risk to long-term global climate change. Major agricultural and forestry commodities producers in the tropics, particularly Southeast Asia (palm oil and timber) and South America (soybean and beef), are typical examples of such exploitative land-based economies (Goh et al., 2016). For example, Borneo - the world third largest island (74 Mha) located in Southeast Asia - has been suffering from extensive environmental degradation after decades of rampant timber extraction, uncontrolled fire (mainly due to mismanagement of peatland) and rapid oil palm expansion. In terms of terrestrial carbon stock loss, the island contributed roughly 400–700 $TgCO_2$/year or about 10–17% of global land-use emission in 2000–2010 (Abood et al., 2015; Agus et al., 2013). The environmental issues are often accompanied by social conflicts, largely attributed to rapid (sometimes forceful) changes of local lifestyle and inequitable distribution of wealth created from resource exploitation (e.g. Potter, 2016; Scheidel et al., 2018). Exploring alternative development strategies for economic growth to prevent the exacerbation of environmental degradation is urgently needed.

In this context, the broad concept of 'bio-economy' has caught global imagination in producing more food and creating carbon-neutral substitutes for fossil materials while dealing with exacerbated environmental and developmental issues of conventional land-based economies (Bugge et al., 2016). This concept is mainly championed by 'productivist', i.e. advocates of productivity. Basically, it illustrates the transition of a fossil-based to a bio-based economy by using cutting-edge biological knowledge and technological innovation to utilize the potential of renewable biological resources, pressing the importance of increasing overall productivities instead of furthering unsustainable large-scale land exploitation. It seeks to offer a strategic means to reconcile socio-economic progress with environmental sustainability. The spectrum is wide to cover from upstream (increase primary production) to downstream (create more values for products) (Jordan et al., 2007; Shen et al., 2010; Batidzirai et al., 2012). Along these lines, rural development is also emphasized in terms of job creation, income generation and infrastructure construction (Johnson and Altman, 2014).

Meanwhile, an alternative economic concept with priorities over conservation, which may be broadly referred to as 'eco-economy', has also been proposed by conservationists. It stresses the multifunctionality of land-based activities, advocating the needs to observe the bio-capacity of the Earth system when optimizing the human use of nature (Marsden and Farioli, 2015). Unlike the bio-economic concept, it seeks to develop socio-economic orders in harmony with nature instead of emphasizing only economic productivity (Karsenty et al., 2014). Generally, it portrays a self-sufficient landscape with small-scale farming systems and some small-scale income-generation programmes, such as tree planting and restoration of agroforestry combined with banking on international carbon market mechanisms and other businesses like eco-tourism (Sills et al., 2014; Gómez-Baggethun et al., 2010; Das and Chatterjee, 2015).

These two broad concepts lead to a wide range of strategies that lead to different impacts, synergies, and trade-offs. At the time of writing, there is already a wealth of literature on assessment of existing or proposed strategies from a wide spectrum of disciplines including but not limited to agricultural science, forestry, ecology, economics, energy, engineering, eco-tourism, and land regulations. However, a cross-discipline systematic analysis of those in a sustainability framework is yet to be done. This paper aims not only to systematise this rich literature but also further analyse and discuss the complex underlying dynamics and interactions between the strategies. Borneo, the third largest islands in the world with a land mass of 74 Mha located in the tropics, with geographical and cultural continuity yet largely divided into two different countries, may provide a rich context with many ongoing transformative activities for such an assessment. The island was bestowed with huge stretches of rain forests and rich biodiversity. However, rapid land development in the past five decades has resulted in severe environmental degradation. It was estimated that about 19 Mha of old-growth forest were destroyed by rampant timber extraction, uncontrolled fire and extensive conversion to oil palm plantations (Gaveau et al., 2016). These rapid changes, together with transmigration linked to these, have triggered negative consequences to the society due to the disruption of existing lifestyles of indigenous communities who rely on forest resources and highly inequitable distribution of newly created wealth (Potter, 2016). More information on the island is provided in Section 1.1.

This paper is organised as the following. The conceptual framework used to systematise the analyse the strategies were described in Section 2. In Section 3, ten prominent strategies for transforming land-based activities were elaborated under the broad concepts of 'bio-economy' and 'eco-economy'. The Borneo island was used as the core example but also complemented with regional and global evidence. This is followed by a discussion in Section 4 and some final remarks in Section 5.

1.1. The study area

Despite the island-wide climate, agro-ecological and socio-economic continuities, Borneo is politically divided among Malaysia (26%), Indonesia (73%) and Brunei (1%) (Fig. 1) with about 20 million ethnically diverse inhabitants (DOSM, 2018b; BPS, 2018). After decades of massive timber extraction, the island is now widely cultivated with oil palm but also many areas are left abandoned after deforestation (Fig. 2). More unfortunate is the massive degradation of peatland, especially in Central Kalimantan and Sarawak, which has resulted in enormous carbon stock loss from the soil and exacerbated the risk of toxic haze and smoke detrimental to health (Miettinen et al., 2016). The development of the region displays vivid examples of exploitative land-based economies with varied progress across the island.

Broadly speaking, due to enormous pressure from various stakeholders especially the civil societies, the existing land-based economies on this island have been gradually undergoing a transformation. Located in the north, the two Malaysian states of Sabah and Sarawak are reaching a saturated level of agricultural expansion, especially oil palm, with limited land availability after decades of land exploitation. Both states are exploring transformation tracks for their agricultural and forestry sectors, with priorities given to economic development. Several actions and strategies were taken to upgrade the land-based industries, hoping to move higher up in

Fig. 1. Division of the Borneo Island and REDD + sites. Note: Numbers in red are REDD+ Sites: (1) Ketapang Community Carbon Pools (KCCP), (2) Rimba Raya Biodiversity Reserve Project, (3) Katingan Peatland Restoration and Conservation Project, (4) Kalimantan Forests and Climate Partnership (KFCP), (5) Berau Forest Carbon Program, (6) Sabah-EU REDD+ Project. Google map was used as the base map.

the value chain while slowing down the rate of environmental degradation (Borneo Post, 2016; 2017a; b; c). As both states enjoy a high degree of autonomy in land development, such policies are mostly designed with strong state perspectives.

In the south, the five provinces of Indonesia, collectively known as Kalimantan, are far less economically developed than their northern counterparts. Since the end of Suharto's regime in 1997, influences from international organisations have been growing stronger in this part of Borneo. Prompted by the exacerbation of environmental destruction, numerous initiatives aiming at recovering the ecosystems while generating income, such as payment for ecosystem services, agroforestry, ecotourism, community forestry, etc., have been created mainly by extra-local organisations (Carrasco et al., 2016; Rhama, 2017; Runting et al., 2015; Santika et al., 2019). Yet, large-scale oil palm expansions were still observed throughout the years.

This paper focuses on both the Malaysian and Indonesian parts of Borneo which rely heavily on land-based activities for economic growth and face large-scale land-use problems in the past decades. Meanwhile, Brunei that relies largely on fossil resources and retains most of its forests were not included in this paper.

2. Conceptual framework

A framework (Fig. 3) was first developed to illustrate the three domains of land-use strategies in the environmental and economic dimensions. Originally, the policy framework was proposed by Grubb et al. (2014) on the basis of greenhouse gas emission and energy. Here, it was modified to describe the transformation of a land-based economy, in which the emission dimension was replaced by a broader sense of cumulative environmental degradation and the energy dimension was replaced by annual economic output. The arrows represent the different driving forces that pull the development of land-based economies into different directions. For example, unwanted driving forces like uncontrolled fire will heavily damage both the environment and economy, while desired ones

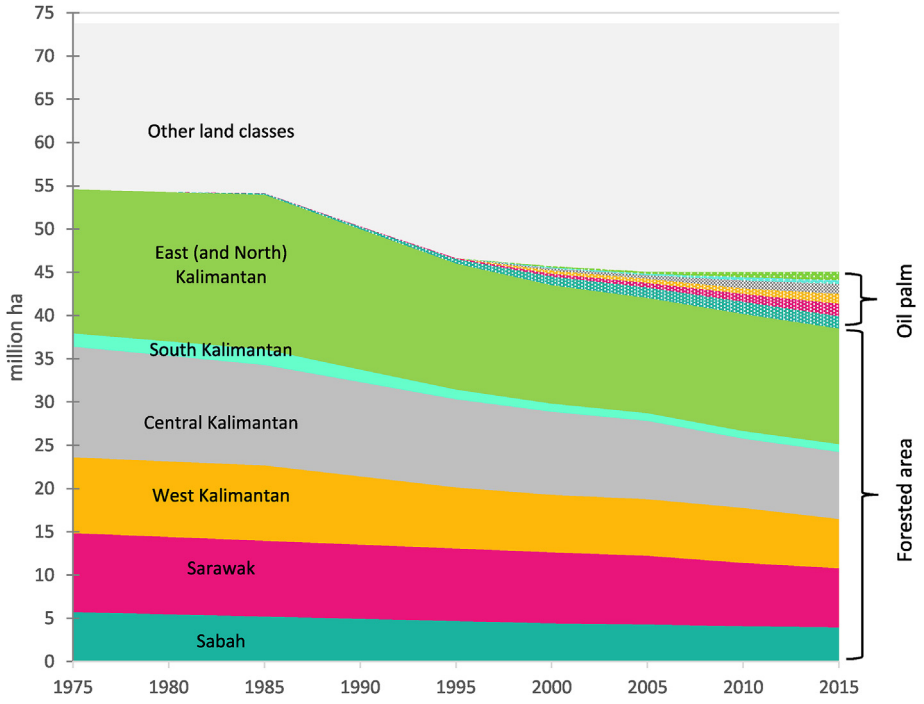


Fig. 2. Changes in the forested area and oil palm area in the territories of Borneo in 1970–2017 (estimated based on World Bank, 2001; BPS, 2007; DG Estate Crops Indonesia, 2012; 2013; 2014; 2015; 2016; MoE, 2016; 2017; Goh et al., 2017; Gaveau et al., 2016; MPOB, 2018).

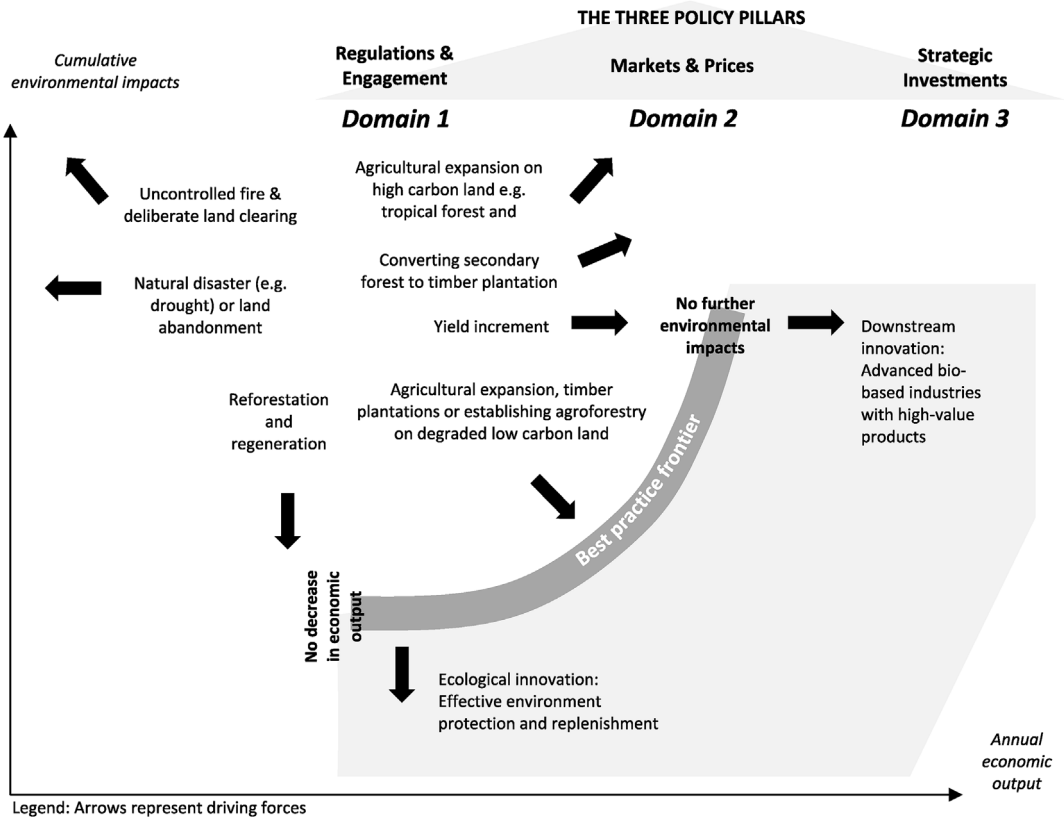


Fig. 3. A conceptual framework to identify transformative strategies for a land-based economy.

like yield breakthrough will lead to replenishment of the environment with economic growth.

The entire space is divided into three domains. *Domain 1* represents the infant stage of land-based economies. In this domain, there is substantial potential for improvements without trade-offs to productivity due to imperfect real-world practices, such as inefficient and improper land-use practices. The strategies usually consist of actions in the form of regulations and on ground engagement. *Domain 2*, represented by the fixed line of best practice frontier, consists of economic systems that limit the performance in two dimensions. Markets and prices are the key elements in which interventions can be made. *Domain 3* demonstrates the breakthrough of current best systems through technical and institutional innovation and growth which can be spurred by strategic investments. These will push the best practice frontier towards the direction of the innovation. Overall, strategies may be implemented simultaneously in all three domains, leading to multiple forces, whether complementing or counteracting each other, driving the equilibrium toward different directions.

Based on this framework, existing or proposed strategies were identified based on author's experience and discussions with various actors (governments, scientific communities, industries, international organisations, NGOs and local stakeholders) in the period of 2009–2018. Then, the draft was discussed, debated and verified through in-depth discussions with key informants. The snowball approach or chain-referral sampling technique was employed in the search for key informants to obtain information which is difficult for researchers to access. Most of these interactions and information obtained are informal, fragmented, non-specific (general conversations), and could be inconsistent (contradict opinion from time to time) and/or ambiguous (avoid revealing the real answer). Even though such an approach is subject to numerous biases depending on location, time and entry point (the first acquaintance), the inputs were useful as entry points for further research. The knowledge, claims or opinions were extensively compared, reviewed and analysed with multiple sources of published and unpublished information, both academic and non-academic, to ensure a more comprehensive perspective on the subject. Only published sources of information but not opinions were used as references in this paper.

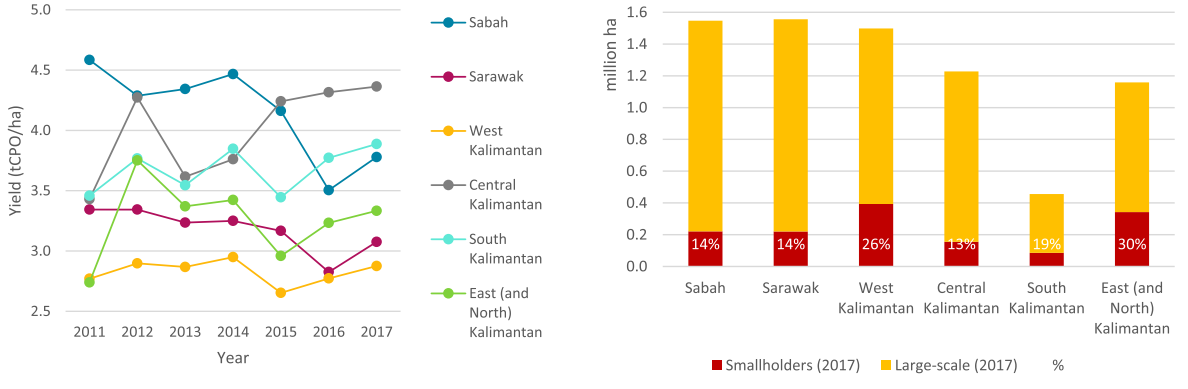
3. Transforming for sustainability: experience in borneo

Section 3.1–3.5 describe some 'bio-economy' strategies that refer to policies or policy proposals that put economic productivity as its core but with the precondition of no further exacerbation of environmental degradation. For the case of Borneo, oil palm still remains the 'thematic' cash crop as an equally lucrative new source of income is yet to be found, and thus has become the central subject for these strategies. Section 3.6–3.10 represent 'eco-economy' strategies that prioritise socio-environmental benefits with the economic components regarded as enablers to achieve the conservation targets. These strategies are generally smaller in operational scale and highly localized.

3.1. Boosting upstream productivity of cash crops

Pushing for higher production per unit of land has been deemed the most direct measure to reduce further unsustainable expansion (Garnett et al., 2013). The most widely cultivated crop as well as the major cash generator in Borneo, oil palm, has always been characterised as the most productive oil crop in terms of land area used. Large industrial players, especially those in Malaysia, together with public entities, have been investing in technology breakthroughs for boosting upstream productivity of oil palm, motivated by the limited land availability in the country for future expansion (*Domain 3*) (Corley and Tinker, 2015; Ali Nordin et al., 2017). With substantial financial inputs in upgrading crop breeding and genomics, as well as better agricultural management, the breakthrough in yield was reported from time to time in certain experimental plots – the most recent peak was reported at 12 tonne crude palm oil (CPO)/ha/year (Woittiez et al., 2017).

Yet, the historical data in Borneo shows that there was no substantial improvement in recent years as the CPO yields from matured



(a) (b)

Fig. 4. (a) Yield of matured oil palm plantations in Borneo (MPOB, 2018; DG Estate Crops Indonesia, 2012; 2013; 2014; 2015; 2016); (b) Percentage of oil palm plantation managed by all smallholders (Azman et al., 2018).

plantations fluctuate in the range of 2.5–4.5 t/ha/yr in 2011–2017 (Fig. 4a). It seems that the yield improvement is stuck within this range. Furthermore, the crop's performance can be quite uneven across the island. The agro-ecological characteristics like soil type and latitude, which vary from place to place, are the major constraints for yield breakthrough (Mulyani and Sarwani, 2013). For example, although the economic outcome of oil palm cultivation on marginal soils can be greatly improved from very poor to satisfying with intensive agro-inputs and proper mitigating practices, the yield can hardly grow further as compared to those planted on better soil (Goh et al., 2018). The other reducing factors like droughts, fires and diseases can also be critical to the overall productivity (Woittiez et al., 2017; Mohd Hassan et al., 2018). The lower points in Fig. 4a in 2015–2016 are indeed the results of the severe water deficit brought by *El Niño* in that period (Oettli et al., 2018). There is still no evidence on average yield improvement in the face of these agro-ecological and climatic constraints.

Another factor that has often been raised is the general underperformance of all types of smallholders (*Domain 1*). Currently, this group contributes to 19% of the total oil palm area in Borneo, ranging from 13 to 30% in different territories (Fig. 4b). Unlike the industrial players, the smallholders usually lack support in terms of agricultural inputs (fertilisers and pest control), machinery and knowledge about best management practices (Ali Nordin et al., 2017). Recognizing the improvement potential of these smaller players, the Malaysian governments have designed several schemes to technically support them through specific agricultural research agencies like the Malaysian Palm Oil Board (MPOB). In addition to direct financial assistance like seedling assistance schemes, measures like establishing small farmers' cooperatives were also introduced (Manaf et al., 2013; Azman and Nazirah, 2015). Such engagement has shown to be paramount in overcoming the constraints for productivity. The situation in Indonesian Kalimantan is less progressive as the governments generally lack capacity in implementing measures like these (Goh et al., 2018). The previous ‘plasma scheme’ designed to assist small farmers by attaching them to large companies in the early 2000s was proven to be quite unsuccessful with numerous cases of dispute between both parties reported (Potter, 2016; Goh et al., 2018). In general, the stage of development of oil palm plantations in Kalimantan is behind those in Sabah and Sarawak.

Labour shortage is yet another factor that drags down the overall performance (Murphy, 2014). Lack of labourers implies sub-optimal management of plantation with longer harvesting round (Sheil et al., 2009; Sayer et al., 2012). Most plantations in Borneo, including small and medium holdings in Sabah and Sarawak, relying heavily on foreign workers from other Indonesian islands for daily operation. With the availability of other opportunities at home due to the booming economic development across Indonesia, the plantation jobs in Borneo, especially moving to Sabah and Sarawak, have become less attractive (Selvadurai et al., 2018). Increasing wages and partly substituting with machines are some immediate measures, but this largely depends on the overall profitability, i.e. market price of CPO in the long run.

Considering these tough challenges from both natural and human aspects, monocultural intensification on the upstream to maximize economic productivity does not show high potential as expected from the experimental breakthrough in yield. Rather, it seems to be more about combating the multiple emerging problems to prevent yield declining in the future (Rasmussen et al., 2018).

3.2. Activating under-utilised low carbon (ULC) land for production

Shifting future production away from high carbon and biodiversity land is another direct way to keep pace with demand growth yet not adding pressure on the environment (*Domain 2*). Land resources with the following criteria, or so called under-utilised low carbon (ULC) land, may potentially be used: (i) the current economic productivity of the land is insignificant or low compared to its optimal potential and (ii) the level of carbon stock is low so that land utilisation is unlikely to incur additional carbon stock loss and negative ecological impacts (e.g. forest and wetland must be excluded) (Goh et al., 2017). In this direction, possible scenarios of further oil palm expansion on ULC land has been extensively investigated by various studies (Austin et al., 2015; Mosnier et al., 2017; Sumarga and Hein, 2016; WRI, 2012). Fig. 5 illustrates the extent of low carbon land areas that do not belong to the high carbon or functional land classes. By 2015, the Kalimantan provinces have significant areas of low carbon land, amounted to roughly 18 Mha. Meanwhile, Sarawak and especially Sabah has only a very small area of that.

At first sight, it seems that the island still has massive areas of ULC land that might be potentially used for production if the only land cover and carbon stock are put into consideration. However, as revealed by Goh et al. (2017), such physical area estimations need to be further evaluated from various perspectives, such as land suitability and land-use intensity. This can considerably reduce the actual area of land that can be practically turned into productive land. Currently, accurate spatial data of agro-ecological characteristics is still largely missing (Goh et al., 2017). Furthermore, the mobilisation of ULC land resources is not that straightforward. Underlying socio-economic dynamics, such as labour availability, can impose a great limitation to the actual use (Goh et al., 2018). These are further intertwined with subtle institutional and cultural elements, such as fragmentation and uncertainties of land ownership that can inhibit productive use of land (Sklenicka, 2016). A proposal about swapping such ULC land with high carbon land in oil palm concession was made but it has not been successful due to immense legal complexity in Indonesia (Rosenbarger et al., 2013).

It is questionable for the further expansion of monoculture to max out productivity considering the aforementioned constraints. Generally, oil palm cultivation has been regarded as the best economic opportunity with no comparable competitor and thus is still strongly promoted by many local governments (Goh et al., 2018). This is, however, shadowed by the past experience of improper planning throughout Borneo - large tracts of ‘idle’ land (which may still be covered by forests) to private companies which could involve seizure of land from native people under the name of development (Cramb, 2016; Majid Cooke, 2002). Forest encroachment may also happen in the absence of effective forest governance, as some of these ULC areas are located just next to the remaining forests. Also, the fragmented ULC areas may actually contribute significantly to the connectivity of forest patches and thus intensive use may cause impacts on important ecosystem services (Evan et al., 2017).

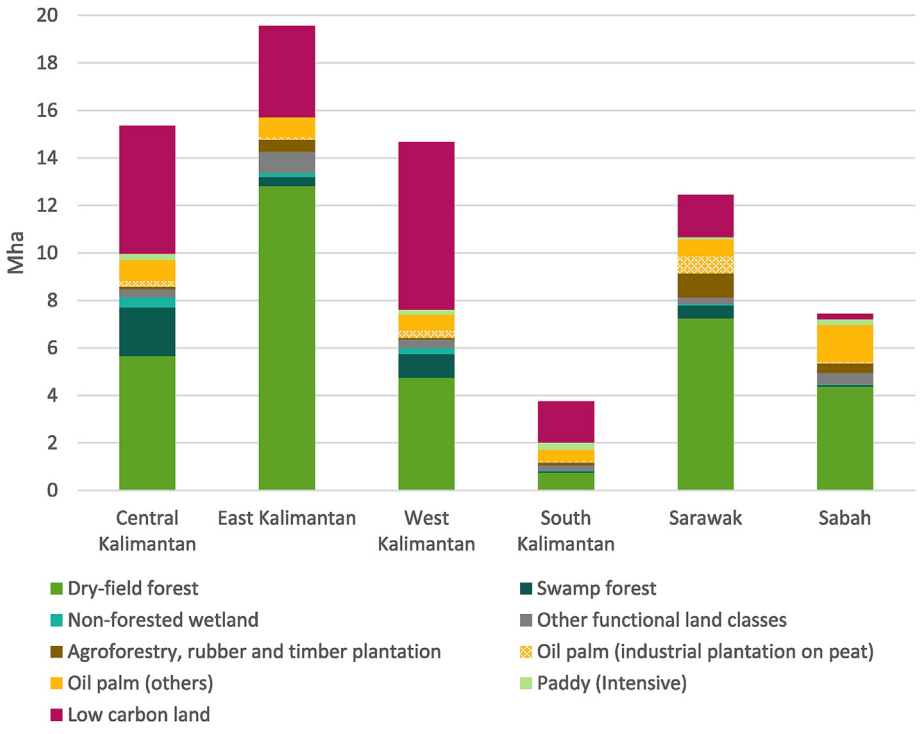


Fig. 5. Extend of low carbon land in Borneo by territories in 2015. Note: 1. Oil palm data were adapted from DG Estate Crops Indonesia, 2016 and MPOB, 2018, 2. Wetland and peatland data were adapted from Miettinen et al., 2016, 3. Dry-field forest data were adapted from MoE, 2016, NRE, 2015, 4. Other functional land classes were adapted from Gunarso et al., 2013 and Goh et al. (2017), assuming insignificant changes in the area from 2010 to 2015.

Despite the multiple risks and tough challenges, activating ULC land for production is still a better option than converting forest or other high carbon lands for production especially in face of the growing demand for food and materials. In addition, proper management of these land may help to avoid further land degradation and replenish lost carbon stock. Reviving abandoned timber plantation for both production and restoration is a good example. However, there is currently no specific incentives for activating ULC land resources in sustainable manners.

3.3. Upgrading and diversifying downstream activities

In addition to boosting physical quantity, creating and keeping added-values in the territories is deemed an essential strategic move to secure long-term economic interests. This requires moving the local industries up in the commodity value chain with more advanced bio-processing and production, spanning from base oleo like fatty acids to end products like polymer and cosmetic products (*Domain 2 & 3*) (Salimon et al., 2012). Currently, in Borneo, most economies still rely heavily on primary production, except Sarawak that has gradually undergone structural change with more than half of the state's GDP comes from secondary and tertiary industries in 2015 (Fig. 6). The contribution from manufacturing has doubled to 27% compared to 1990 (SPU, 2015; Drabble, 2000). It is not known how much of this can be related to value-adding of agricultural and forestry products (such data is only publicly available at national level), but a large portion likely comes from the oil and gas sector (also contributed as mining and quarrying) as well as aluminum smelting which relies on the state's cheap hydropower. The other territory that relies heavily on mining and quarrying, i.e. East (& North) Kalimantan, has a smaller manufacturing sector but a higher share of primary materials (mainly oil and gases).

For Malaysia as a country, to counter the vulnerability of over-relying on commodities, the national government has introduced various incentives to stimulate the growth of high-value-added agro-based industries. In the 1960s and 1970s, Malaysia has fought through the pressure from foreign capitals to put own palm oil refineries on ground through a series of industrial policies like high export duties on raw materials, tax benefits, credit financing and other financial supports, such as the implementations of New Key Economic Areas (NKEA) for palm oil that aims to triple gross national income (GNI) from the sector by 2020 (Jomo and Rock, 1998; PEMANDU, 2010). Today, it has gone further with the oleochemical industry growing steadily in Peninsular Malaysia (Tong, 2017).

Despite being the two largest oil palm producers in Malaysia, both Sabah and Sarawak have no oleochemical plant yet compared to the total national capacity which has grown up to 2.7 Mt by 2018 (MPOB, 2018). Although Sarawak responded to the national biodiesel policy promulgated in 2006 with a biodiesel plant constructed in Bintulu (the major seaport), the policy was proven to be unsuccessful and the plant did not create meaningful strategic values to the industry due to the fluctuated CPO prices (Goh and Lee, 2010). The risk from the absence of high added-value processing components was exemplified alongside the booms and busts of

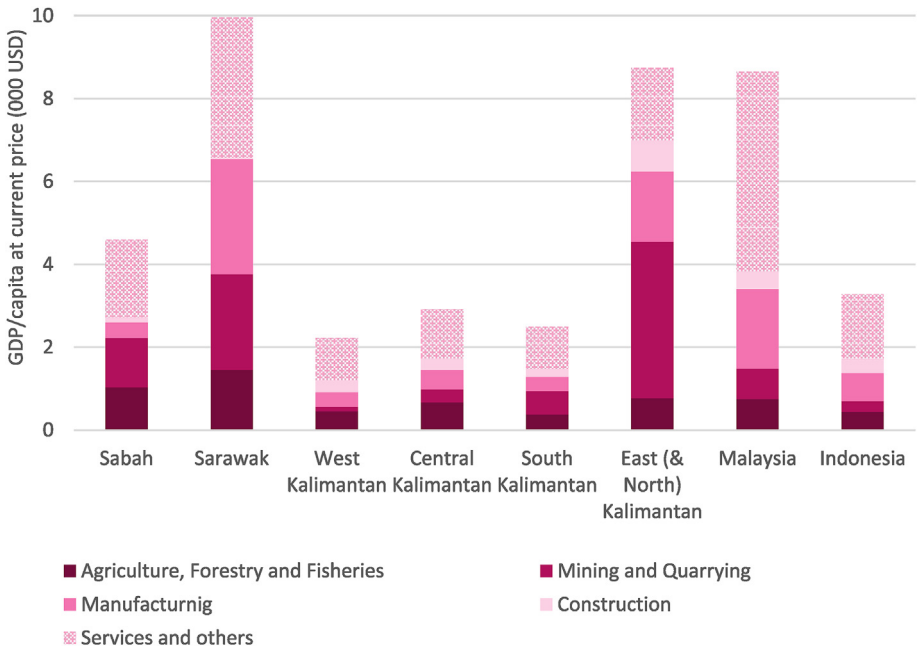


Fig. 6. GDP per capita in 2015 of Bornean territories, Malaysia and Indonesia (DOSM, 2018a; BPS, 2018; BPS Kalbar 2018; BPS Kalsel 2018; BPS Kaltara 2018; BPS Kalteng 2018; BPS Kaltim 2018).* Import value of EU minus that of Asia.

commodity prices throughout the past two decades, making the growth highly unstable (DOSM, 2018a).

In addition to vegetable oil, the substantial amount of agricultural and forestry residues like empty fruit bunches (EFB) and palm kernel shell (PKS), so-called biomass, were also deemed as potential income sources. State-specific strategies for Sabah and Sarawak were rolled out in 2016 to valorise the residues in combination with other waste streams like palm oil mill effluents (POME) and municipal solid waste (MSW). The ambition is to develop high value-added biochemical industries with energy production (i.e. biogas and energy pellets) as the first step (AIM, 2013; Garcia-Nunez et al., 2016; Borneo Post, 2016). Currently, some of the residues were burnt locally for power or exported to Japan and South Korea as pellet fuels as motivated by the Feed-in-Tariff schemes for bioenergy in both Malaysia and overseas markets. The other unused oil palm residues are currently largely returned to the soil to replenish carbon and nutrients through mulching (Tao et al., 2017). It is not entirely clear the actual impacts of diverting these biomasses for other purposes. Together with other economic constraints like logistic costs and market uncertainties, the mobilisation of oil palm residues has only been partially realised in the past few years.

It is no doubt climbing up the commodity value chains is critical for land-based economies in breaking the bottleneck of economic growth. While the Malaysian states have attempted to implement some promotional strategies, the Kalimantan provinces are far from venturing into the high-value markets. Overall for Borneo, there is still a large room for improvement in the oleochemical space compared to pioneers like Peninsular Malaysia, not to mention advanced biorefining businesses that further valorise various types of biomass (Sadhukhan et al., 2018). Yet, realising these requires a substantial amount of strategic investments especially in infrastructure. Sarawak and Sabah were way forward partly due to their more established transportation especially the ports. For example, the Bintulu Port in Sarawak and Palm Oil Industry Cluster (POIC) in Sabah are well-equipped with facilities like purpose-fit storage and handling facilities to serve the refineries (Pang and Lee, 2013; Soon and Lam, 2013). This strategy is a very crucial step for 'bio-economy' as transforming into a more advanced industrial economy can be deemed a turning point to relief the island from further timber extraction and agricultural expansion.

3.4. Branding for more values (industrial)

One potential strategy to increase economic outputs is the branding of large-scale bio-production for gaining access to high value markets especially in developed countries (*Domain 2*). A prominent example is palm oil. This major cash-generating product from Borneo has faced multiple challenges in entering high-value markets in the EU due to a bad reputation from its historical links to severe deforestation. Fig. 7 illustrates the differences in value per tonne of palm oil imported by the EU and Asia. On average, the value differed by 49 USD/tCPO in 2001–2016, remarkably boosted compared to 1995–2000.

It was hoped that well-known certification systems like Roundtable for Sustainable Palm Oil (RSPO) can engender confidence in the cash crop supply and thus add premiums to the products (RSPO, 2018). Such mechanism urges the companies to shift away from unsustainable agricultural expansion and contribute to socio-environmental improvements. By 2017, about 1.7 and 0.9 Mha of plantations in Malaysia and Indonesia were RSPO-certified, respectively (RSPO, 2018). These numbers are still small compared to the total plantation area of > 18 Mha in both countries (7.2 Mha on Borneo) and will probably still be limited by the demand in the

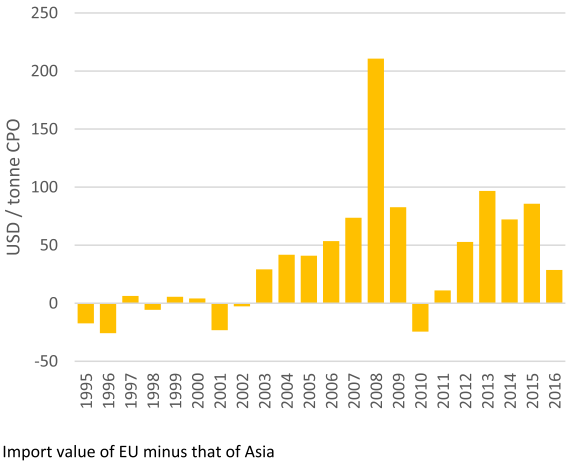


Fig. 7. Differences in import value per tonne of palm oil between EU and Asia in 1995–2016 (FAOSTAT, 2018).

European market (about 9 million tonnes in 2016) in the near future (FAOSTAT, 2018). While the environmental performance of RSPO certified concessions in Borneo were reported to perform much better than those non-certified in some cases, some other showed that RSPO certification has minimal impact on the environment (Meijaard et al., 2017; Morgan et al., 2018; Carlson et al., 2018).

Furthermore, certification was reported to have inherited weaknesses. Taking palm oil as an example, the premium of RSPO is reportedly insufficient to cover the transaction cost (e.g. auditing) and foregone economic opportunity cost (i.e. cost to conserve forests) (Ruysschaert and Salles, 2014). As a result, financially less capable smallholders (which are suppliers to large industrial conglomerates) are practically excluded and only large producers who rely on large European buyers remain in the scheme to seek market penetration (Saadun et al., 2018). It also seems to favour large-scale intensive monoculture which can be more easily monitored at lower costs (Azhar et al., 2015). The Malaysian and Indonesian governments have then started to make their own certification schemes to overcome the cost issue, namely MSPO and ISPO (Pacheco et al., 2017). These schemes set a lower-than-optimum level to expand the coverage on weaker players, especially the smallholders. They are, however, deeply troubled by their reliability to convince the high-value markets in Europe (Hidayat et al., 2018). These government-driven schemes inherit enormous governance challenge to handle the complex issues of smallholders despite their ambitions. These different 'brands' are largely disconnected between producer-consumer with great disagreement in terms of sustainability standards (Pacheco et al., 2017).

Overall, the challenges to regain access to the high-value markets through the rebranding of palm oil are tremendous, especially for smallholders on a weaker side, in face of the complex interactions between the different actors including their fierce competitors (e.g. rapeseed and soybean producers) across the world. Some have advocated alternative ways out beyond certification, such as value and trust building (Poynton, 2015). For example, a group of major oil palm conglomerates has declared 'No Deforestation, No Peat, No Exploitation' policies. On the government side, Indonesia has taken a bold move to decree a moratorium on over 69 Mha of concessions to improve governance of primary natural forest and peatland (Murdiyarso et al., 2011). Albeit a few years late, Sarawak has also stopped issuing timber licenses and provisional leases for new plantations (Borneo Post, 2015). However, these efforts have yet to sufficiently convince consumers. It will still be a continuous long battle to repair the reputation of palm oil.

3.5. Establishing new domestic demand for bio-resources

For regions bestowed with vast bio-resources, it is beneficial to promote the local use of bio-resources to replace fossil materials, such as liquid fuel for transportation, solid fuel for power generation, packaging materials as well as drop-in and novel chemicals (Sheldon, 2014). In addition to exporting to established markets in developed regions like Europe, creating a domestic and regional market for bio-based products could be a practical strategy to contribute to a self-sufficient circular economic ecosystem with local bio-resources (*Domain 2*). A healthy domestic market also acts as an effective buffer to uncertainties in commodities' prices and the international market.

To do so, policy directives and incentives to boost local demand would be necessary. In the past two decades, liquid biofuels and biomass for energy are the two key subjects in this matter. For liquid biofuels, the blending of biodiesel is mandatory with a gradual increment target of the percentage year by year under the National Biofuel Policy of Malaysia established and Presidential Instruction on Biofuel Supply and Utilisation of Indonesia, both kickstarted in 2006 (MPIC, 2006; Wibowo, 2014). These policies also carry the objective of reducing reliance on fossil diesel and boosting energy security. The amount of palm oil domestically consumed as a transportation fuel has reached 350 million litres and 3 billion litres both by 2017 in Malaysia and Indonesia, respectively, despite the huge decline in exported volume (USDA Gain 2017a; b). Numerous challenges have been encountered since the early days, especially the fluctuating CPO prices and the food-fuel debates (Goh and Lee, 2010; Johari et al., 2015; Laborde, 2011). In a way, it is viewed more as a buffer for excessive stock in certain years to back-up the oil palm industry with government subsidies rather than a long-

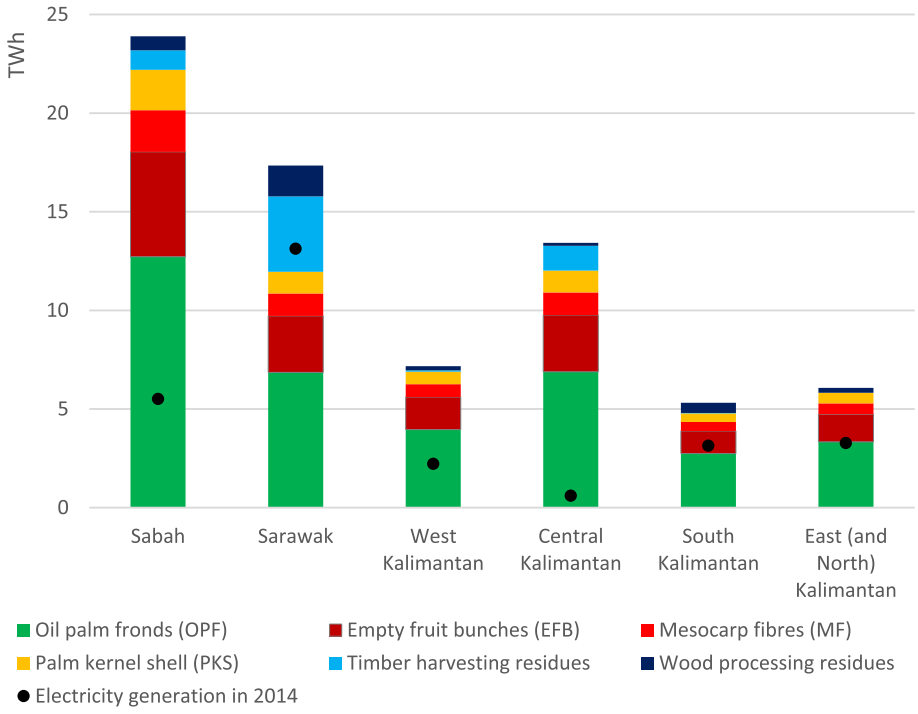


Fig. 8. Theoretical potential of biomass for electricity generation (assuming conversion efficiency at 30%) in 2013 and electricity generation in Borneo in 2014 (Own calculation based on Goh et al., 2010; Simangunsong et al., 2017; BPS, 2018; personal communication with government officials). Note: Oil palm trunks are not included here due to the dependency of its availability on replanting decisions with aging plantations. A general trend is that tens of millions of trunks are generated from replanting every year. However, most plantations in Kalimantan and Sarawak may require replanting in the 2030s as the majority of the trees will become > 25-year-old. This may lead to the generation of > 50 million trunks a year (own calculation).

term business.

For electricity generated with bioresources, incentives are given in the form of Feed-in-Tariffs (FITs) with prices fixed by the government since 2011 and 2014 in Malaysia and Indonesia, respectively (Wong et al., 2015; Hasudungan and Sabaruddin, 2018). The use of local bio-resources for energy purposes can be a way to ease the stress of energy security in low population density areas due to high fuel cost and limited accessibility (see e.g. Brewer et al., 2018). It is also deemed an opportunity to create new jobs and income for the rural population (Pang and Lee, 2013). By 2014, total electricity generation from bioresources, mainly on-site at palm oil and paper mills, has reached 0.9 and 4.6 TW h (TWh) in Malaysia and Indonesia (mainly in Sumatra), respectively (IRENA, 2016). Note that in Indonesia biomass is still largely used traditionally as cooking fuels – about 1.6 EJ was consumed (IRENA, 2016). There are 9 bioenergy plants in operation on the east coast of Sabah with a total capacity of about 100 MW. Most of these plants are small with capacity < 10 MW but contributing to about 4% of the total electricity generation of the state (ST, 2014; personal communication with government officials). However, in Sarawak, only a small amount of biomass is used (mainly internally by palm oil mills) as the state is already largely powered by cheap hydroelectricity (SPU, 2015). In West Kalimantan, the first biomass power plant (15 MW) by the state-owned power company started operating in 2018, aiming to consume about 100 ktonne of agricultural residues (Jakarta Post, 2018). Theoretically, the availability of biomass is enormous as shown in Fig. 8. However, the progress to date is still slow as challenges remain considerable with the high mobilising cost for biomass in remote areas and less attractive economic return. In places with poorer soil quality like Central Kalimantan, agricultural residues are largely used for mulching, i.e. returned to the soil as fertiliser. Such competition may further reduce the actual amount available.

Globally, biofuel and bioenergy have proved their successes in several countries and become key components of the energy mix in e.g. Brazil (sugarcane ethanol) and Sweden (woody biomass for heat and power). These especially rely on soundly designed financial support schemes (Abdmouleh et al., 2015). However, the two countries on Borneo are facing financial challenges to further invest in expanding the local biofuel and bioenergy markets. It is unlikely that the market shares of palm-based biodiesel and biomass power will increase significantly in the near future.

3.6. Creating values for carbon and ecosystem services

The concept of capitalising ecosystem services (ES) is not new but exists for decades already. It advocates incorporating ecosystem services with the contemporary market economy through creating values for 'nature' that are compatible with economic accounting practices (*Domain 2*) (Missemer, 2018). The basis is to link 'natural capital' to human benefits in terms of provisioning, regulating,

supporting and cultural services (Millennium Ecosystem Assessment, 2005). Quantification of ES is deemed crucial for this strategy as it provides manageable attributes of natural capital stocks for interventions to take place (Maseyk et al., 2017). However, it has been very challenging especially for the last two categories (Gunton et al., 2017).

The concept experimented since the early 2000s in Borneo with carbon stock which is among the most conceivable and measurable components and can be banked on carbon trading. Reducing Emissions from Deforestation and Forest Degradation (REDD+) is the major programme widely promoted in Kalimantan (see Fig. 1 for the locations of the sites) (Sills et al., 2014). It aims to raise billions of US dollars from international donors to compensate the stakeholders who avoid degradation and deforestation for the opportunity costs of converting these lands for agricultural production. The Kalimantan Forests and Climate Partnership (KFCP) that covers 120,000 ha of intervention area in Central Kalimantan was regarded the most established REDD + programme among the others in the country (Atmadja et al., 2014). The programme was designed to reduce ongoing GHG emissions from peatland degradation using various measures (Aldhous, 2004). The programme also includes the four other projects throughout Kalimantan: Katingan Peatland Restoration and Conservation Project, Rimba Raya Biodiversity Reserve Project, Ketapang Community Carbon Pools (KCCP) and the Berau Forest Carbon Program (Anandi et al., 2014; Indriatmoko et al., 2014a; b; Intarini et al., 2014). On the Malaysian side, the Sabah-EU REDD + project was also launched in Sabah since 2014 (Sabah Forestry Department, 2018).

These projects suffer from many challenges. First, there have been stiff competitions between productive-use and conservation of land which were demonstrated by the polarized views between villagers and villages and the inconsistencies in government policies as seen in the case of Ketapang and Berau (Anandi et al., 2014; Intarini et al., 2014). The immediately following question would be who has the right to benefit from the 'sales' of 'ecosystem services' (in this case carbon credits)? The Rimba Raya case that was dominated by a foreign company based in Hong Kong raises concerns about the real implications of such schemes for local people (Indriatmoko et al., 2014b). Even for the other programmes, the actual implementations were troubled by the uneven distribution of benefits among the local people (Joshi et al., 2010; Howson and Kindon, 2015). Third, tenure uncertainties are another long-standing issue to be solved. The Indonesian government itself has a lot of concerns in giving out the license of managing a large area of land for such projects due to legal uncertainties and extreme difficulties in managing potential land conflicts, not to mentioned the underlying political complexity (Indriatmoko et al., 2014a). Last but not least, monitoring of carbon stock would be a difficult technical challenge. In addition to various arguments about verification methods (e.g. carbon leakage issue), difficulties in understanding the system also cause hesitance of officials to get involved (Thompson, 2018).

With these multiple challenges, creating values for carbon and ES may not truly benefit the livelihoods of local people at least in the short term (Suyanto et al., 2009). Either top-down prescriptions or bottom-up approaches have received objections from local stakeholders. Furthermore, it is also unclear how to sustain large-scale payment in the long term once the local communities begin to rely heavily on this for their livelihoods – can developed countries continue to pay 'sufficiently' for the ES in Borneo for several decades to come? Naturally, long-term economic development cannot rely solely on voluntary payment from other countries.

3.7. Enhancing agro-ecological resilience

Disasters like climate change will inflict enormous damage to the environment, economy and society. Just taking the example of transboundary haze caused by uncontrolled land fire in Borneo and Sumatera in 2015 - the amount of CO_2 released into the atmosphere in just one month is equivalent to the annual emission of Germany and the direct economic loss is estimated to be USD 16 billion for Indonesia alone (not yet included are losses for Malaysia and Singapore as well as health damages due to transboundary haze) (World Bank, 2015). These unwanted consequences, with fire and drought as the main themes for Borneo, are likely to become more pervasive threats due to drastic alteration of the earth system. In recent years, resilience to these disturbances has been proposed to be an important economic indicator in addition to productivity due to the numerous pieces of evidence of impacts from harmful disasters on an existing production system (Walker et al., 2010).

A landscape that can supply a broad range of products and ecosystem services (with rich biodiversity) is deemed less vulnerable to external shocks. It was proven that the decline of biodiversity as a result of excessive land exploitation in the past decades has substantially crippled agro-ecological resilience (Newbold et al., 2016). More holistic landscape management, i.e. forging synergies between different land-use and services throughout the landscape, may avoid unwanted environmental impacts and also create opportunities for restoration (*Domain 3*) (Sayer et al., 2013). Practically for Borneo, this can include for example re-activation of abandoned monoculture timber plantations by introducing new species in combination with natural forest regeneration depending on the suitability (Brockerhoff et al., 2008; Crouzeilles et al., 2017). Having said that, it is not entirely clear how such a landscape approach can be applied to meet different needs optimally. Past experience shows that its effectiveness is difficult to be monitored and measured (Sayer et al., 2017).

Some had advocated that reforming of the current system with decentralisation and empowering of indigenous and rural communities may significantly help to anchor resilience (Marshall, 2009). Important to recognise is that different stakeholders hold different views on land-use that can vary widely even within a smaller administrative territory like districts and villages (Goh et al., 2018). While value judgement is unavoidable, a 'balanced' configuration that satisfies the majority may just not be truly resilient. In certain occasions, it can be more effective with a stronger move from the higher-level governments, such as the strict enforcement of 'no burning' policies to prevent the use of fire for land clearing in Kalimantan. This is of vital importance to avoid the exacerbation of extreme drought events like El Niño. A decline in fire activities was observed after 2015 with efforts from multiple parties, although it is not entirely clear how much of this was linked to human efforts or absence of El Niño (Lambin et al., 2018; Noojipady et al., 2017).

The more crucial consideration would be the capability of local actors and their understanding of the diverse mechanisms in establishing resilient agro-ecological systems. In many occasions, the stakeholders simply do not have enough financial means to

equip themselves with proper tools in countering unforeseen changes (*Domain 1*). For example, key infrastructure like irrigation and firefighting system are still largely missing throughout Kalimantan (Goh et al., 2018). In addition, leveraging available resources and local strengths is also necessary. Local communities may also possess traditional ecological knowledge which they learned from decades of human-environmental interactions (van Oudenhoven et al., 2011). Incorporating these can further enrich the 'knowledge bank' or 'toolbox' to improve agro-ecological resilience.

To make this strategy works, innovative ways of managing landscape are needed. While investments in both people capacity and key infrastructure are necessary, effective governance would be the key to steer the transformation as it involves cross-sectorial and cross-scale coordination. Despite the emergence of multitudinous theoretical and conceptual frameworks, on-ground implementation remains an arduous challenge for Borneo, especially in Kalimantan. Evidence from many parts of the world shows that implementing such strategies heavily depends on external funding if not other forms of strong interventions (Ortiz et al., 2018).

3.8. Establishing eco-based tertiary sectors

In addition to primary production activities, multiple environmental-related economic opportunities in tertiary sectors related can be featured alongside land use and management. Expanding the service sectors and creating more 'green jobs' in this space, especially targeting small and medium players, would be a strategy to steer development onto a more sustainable pathway (*Domain 2*) (Cecere and Mazzanti, 2017). The spectrum spans from eco-tourism to agro-environmental services, with income opportunities grow upon healthy landscape management (Bakre and Dorasamy, 2017). As displayed in Fig. 6, the service sectors contribute the highest percentage to the regional GDP in Bornean territories (except East Kalimantan). While Sarawak is leading far in the front, the actual values remain low in the others. It is, however, not clear about how much of these can be associated with eco-economy although eco-tourism is likely to be a major contributor.

For communities engage directly with land, establishing more diversified rural livelihoods with off-farm activities, or also called 'de-agrarianisation', has been a trend in many developed countries and some developing countries (Hebinck, 2018). In the context of 'eco-economy', eco-tourism has been developed vigorously across Borneo in the form of eco-tours and cultural experiences, sometimes attached as side events to conferences and other activities. In addition to famous scenic spots like Mount Kinabalu (Sabah) and Sebangau National Park (Central Kalimantan), homestay in rural areas for city-dwellers to enjoy some quiet days has also emerged as a new form of business (Pengiran Bagul, 2009). It can also be combined with local agri-food products like in the case of Kelabit Highlands which became a famous tourist spot through the branding of *Bario* rice, a very fine rice variety (Tarawe and Harris, 2009). Ecotourism can also be transboundary – the Kelabit Highlands is also connected with the Kerayan Highlands within the 'Heart of Borneo' (HoB) initiative (Hitchner et al., 2009). The HoB initiative is a trinational collaboration between the three countries that occupy the Borneo island that aims to tap on 'green' economic activities which are low risk to the environment. All these could in a way help to nurture and strengthen the appreciation of nature and culture among both the tourists and the local people, especially when they are combined with educational touches (Force et al., 2018).

To retain economic values within the territories through tertiary sectors, a necessary precondition is equipping the local people with sufficient knowledge and skills to carry out the environmental-related services instead of outsourcing to external players. These include not only basic technical services like fertilizing but also high-end jobs like water engineering (e.g. treatment of palm oil mill effluents) and other environmental consultancies. In this sense, well-established, affordable and strategically designed (such as emphasizing environmental related knowledge) secondary and tertiary educations are the basis (Lee and van der Heijden, 2019). Furthermore, governments need to forge a lively environment for local businesses in the tertiary sector to grow and thrive, such as facilitating technology transfers through a partnership with extra-local companies. Keeping the competitiveness of small and medium players may potentially trigger more eco-innovation (de Jesus Pacheco et al., 2018).

The practical implementation of this strategy relies heavily on rural-urban linkages, i.e. transportation and communication (Abdullah, 2016). First, better connectivity in physical transportation enhances the mobility of people in providing and reaching services in both urban and rural areas. The availability of digital networks may allow virtual skill training and knowledge transfer at much lower costs. Combination of both channels allows effective marketing for these services in both directions. In these terms, Sabah and Sarawak fare better than their counterparts due to higher investment in infrastructure in the past decades. This strategy may become less realistic when increasing numbers of people migrate from villages to cities permanently but could be feasible with strengthened urban-rural connectivity, both physically and digitally, that allows greater exchange at much lower costs.

3.9. Branding for more values (smallholders)

This strategy is different from the large-scale certifications which largely focus on the big players, as it prioritises the enhancement of economic opportunities for small farmers, with the ultimate goal to lift them from persistent poverty. Similar to large-scale players, smallholders also seek to add values for their products through branding in the presence of market differentiation for more sustainability, quality or health concerns (*Domain 2*). The key difference is that it seeks to connect the buyers more directly with the efforts of small farmers to improve their livelihoods through sustainable engagement with nature, as well as the flavours of 'authenticity' from such production systems.

Globally, the market share of sustainably certified products, including those characterised by the small-scale production system, is growing rapidly (Lernoud et al., 2017). The presence of market differentiation for such products offers opportunities to small farmers to capture a better share of the selling price. The numerous success branding stories, especially for tea, coffee and cotton certification, have reflected the potential of such a strategy to be taken in Borneo (Lernoud et al., 2017). In this regard, a few agro-products in

Borneo well-known for quality and authenticity (albeit not sustainability), such as Sarawak pepper, Sabah tea and Tenom coffee, are among the potential candidates.

A few ways may be taken to reach this end. First, such branding efforts can be done by gathering small farmers, manufacturers and traders in groups, possibly with the support from governments, to collectively improve their businesses following better management practices tailored in a local context (which are different from universal standards used in branding large-scale monocultures). The benefits include optimisation of farm management with scale (e.g. lower cost for fertilisers), more opportunities for training and mutual learning as well as stronger voices in price negotiation in face of commodity price fluxes (Blackmore et al., 2012). This has actually been carried out by some oil palm smallholders with the help of larger players along the supply chain (RSPO, 2016).

Then, collective geographical branding, instead of types of crop or timber, can also be a suitable strategy to encourage more diversified agricultural and forestry landscape. There are also multiple synergies with the branding of bioproducts by attaching cultural and traditional 'flavours' like music and arts to food and other bio-products. For example, Kelabit Highland in Sarawak is famous for its culture and the fine rice of *Bario*, making the place itself as a brand identity for both tourism and food (Harris, 2009). Another interesting example of promoting policy would be the Sarawak Biodiversity Regulations in 2004 (SBC, 2018). The state government has invested in exploring the potential use of biological resources for high-value products based on the traditional knowledge of indigenous communities and find ways to commercialise them.

Additionally, boosting the regional market for local bio-products, such as 'buy local eat local' kind of promotion, can be an effective way to realise this strategy. This is not rare in developed countries like Japan where local bio-products by small and medium farms in rural areas are deemed among the highest quality with large premiums. With increasing purchasing power from the urban population like Kuala Lumpur, Jakarta or Singapore, products with traditional 'flavours' may have great market potential.

However, this strategy can only be realised with a proper distribution network. As smallholdings are naturally constrained by the economies of scale, new business models to connect small sellers with buyers, such as virtual trade platform, are highly desired. The Sarawak government has displayed vision in promoting the application of digital technologies in agriculture to boost productivities (Borneo Post, 2017a; b; c). To realise such a vision, strategic investment in laying out the basic infrastructure and skill building is needed.

In reality, gaps remain between the wishes of consumers and the actual uptake of sustainable branded products due to the higher prices (Smith, 2007). This is particularly true for small farmers' products which were imposed higher premiums compared to those come from large farms due to economies of scale. Also, there have been substantial competitions between brands within the market niche (Janssen and Hamm, 2012). While the farmers may earn additional income from the premiums, the overall sales and hence the total income may drop (Mendez et al., 2010). For such a market-based tool, ways to boost both the final price premium and the sales volume are needed to continuously incentivise farmers to adopt sustainable practices (Glasbergen, 2018).

3.10. Encouraging self-sufficient farming

The concept of 'self-sufficient farming' was proposed to get rid of the productivity-oriented mindset by replacing it with an alternative definition of development. It encourages self-sufficiency by creating a diversified agro-ecological and socio-economic landscape, which can sometimes be termed as 'neo-productivism' (Almstedt et al., 2014). Importantly, this strategy advocates for the appreciation of the 'traditional' way of living that emphasized the human-environmental relationship (Dressler et al., 2016). This is not unusual in developing world where farming is treated as an integral part of social life instead of prioritising economic productivity (Hisano et al., 2018). Also, it is believed that the preservation of native agro-ecological and socio-cultural settings can greatly enhance conservation efforts (*Domain 1*) (Altieri, 2004). In a way, it shares the same tunes with the Global National Happiness (GNH) index that challenges the use of economic metrics especially GDP to measure development (Sears et al., 2017).

It is imperative to clarify that a small-scale and self-sufficient farming landscape is not necessarily 'traditional' for a particular place. For example, new agroforestry systems may replace existing slash-and-burn practices when local biophysical and socio-economic conditions permit (Rahman et al., 2017). Migration and resettlement may also bring new farming practices that alter the landscape, such as wet-field paddy cultivation and livestock husbandry of Javanese migrants in Kalimantan (Goh et al., 2018; Martojo, 2012). Furthermore, this concept may not be oriented to fully embrace conservation when taking the view from local communities. For example, small-scale clearing of forest for agriculture may be tolerated for farmers' own interests (Meijaard et al., 2013). Some observations in Sarawak also display that subsistence farming can still exist with adaptation to changes in the environment such as the establishment of industrial plantations in neighbourhood and expansion of road networks (Kato, 2016). The perception of 'living in harmony with nature' through 'sustainable agriculture' by the local people may be quite different from the general understanding of conservationists (Hazard et al., 2018).

In Borneo, the agrarian transition is highly complex with multiple forces driving the process. While the entry of external and emergence of local large corporations have greatly impacted the existing systems, it was also revealed that many local farmers, albeit with a diverse background (such as ethnicity and wealth), have taken the initiatives to transform themselves into cash-crop-based farmers (De Koninck et al., 2011). Widely reported is that oil palm generates more money for small farmers, but also exposes them to market volatility when they over-rely on the crop for livelihoods (Dib et al., 2018). The small farmers may not be able to withstand the financial loss during the economic crisis and may face great risks of livelihood (Potter, 2010). This has again observed by the first author in the recent visit (2018) to West Kalimantan, where farmers who initially rejected oil palm in the 2000s but converted their farms into oil palm in the 2010s, have been facing household economic crisis due to the great fall of oil palm prices (until the time of writing the price remained low). Not to mention is the fact that a large group of people (especially the indigenous *Dayak*) have been marginalized in such a monocultural economic setting (Semedi, 2014). It is thus arguable that ensuring self-sufficiency to reduce the

dependency on cash crops, such as diversifying their farms with rice cultivation and agroforestry can better secure food security and well-being (Dewi et al., 2005). This is not a new idea as agroforestry and rice farm projects that emphasize self-sufficiency was not less promoted in Kalimantan since the 1990s. Several studies on agro-ecological suitability and benefits have been conducted (see e.g. ICRAF, 2018; Wulan et al., 2008; Peno and Mahabharata, 1996). Unfortunately, these initiatives have been largely outcompeted by cash crop cultivation in the past decades in Borneo.

The gradual integration with the other parts of the country, or in other words the larger society and economy, is further accelerated with improved communication and transportation. Many parts in Borneo are now highly specialised with cash crops especially oil palm. It is unlikely to have this trend reversed on a macro-scale. To examine the practicality of promoting this concept in particular places, precise understandings of the local human-environment relationships beyond agro-ecological suitability are needed as development is usually hybridised. Having said that, this 'strategy' in its current progress is more of a form of ideology than well-defined actions on-the-ground.

4. Discussion

The conventional exploitative land-based economies are facing a predicament: how to maintain economic growth not only without causing further environmental impacts but also repairing the damage done in the past. The broad concepts of 'bio-economy' and 'eco-economy' have been regarded by productivitists and conservationists, respectively, as sustainable pathways to address these lines of inquiries, albeit to different extents. This paper identified and discussed 10 transformative strategies with an elaboration of the experience in Borneo as well as the associated opportunities and challenges.

While there is no strict dichotomisation between the two concepts as the development processes are mostly hybridised, general differences do exist – the two Malaysian states with greater autonomy from the federal government tend to prioritise economic development with multiple 'bio-economy' policies taken (Section 3.1–3.5), while the more under-developed Kalimantan provinces are highly influenced by international efforts in conservation with various 'eco-economy' initiatives (Section 3.6–3.10). It is, however, important for policymakers to realise that skewing heavily onto one side will potentially lead to the collapse of another side. Generally, utility-based development strategies with wealth creation as the centre of policymaking may prevent further degradation but are inadequate to repair the previous environmental damage. Similarly, strategies that emphasize restoration have shown a limited contribution to economic growth as observed in the case of Borneo. The interconnected nature of economic productivity and conservation means that no single strategy is a perfect solution, although some can be more practical and effective than the others in different periods of time, or more or less acceptable by different stakeholders.

These inadequacies demand optimally combining the different strategies to reach both ends, but this would be a daunting task considering the variation by places and timing of implementations. On the positive side, these strategies may create synergies between each other. For example, limiting the unsustainable expansion of the major oil palm companies with alternative incentives (Section 3.4) can be viewed as a big synergy to the REDD + programme (Section 3.6). Some brief examples of the potential synergies and trade-offs between strategies are presented in Table 1. It can be seen that many strategies under 'eco-economy' are not necessarily incompatible to those under 'bio-economy' with no direct trade-offs. However, due to the fundamental differences in nature, it is difficult to define 'optimal' combinations as not all outcome can be easily measured and linked to the policy actions for analytical evaluation. For example, the strategy '*boosting productivity of cash crop on upstream*' (Section 3.1) has straightforward actions and measurable outcomes, while '*encouraging self-sufficient farming*' (Section 3.10) is subtler and more difficult to evaluate. In this sense, the choice of strategies may rely more on value judgement.

It is necessary to recognise the differences in values that deeply rooted in the mindsets of the people, as well as the dynamic socio-economic changes. There are always attempts to superimpose interests and values from one group onto another - in a general manner, between 'productivitists' and 'conservationists'. One common phenomenon observed is that pressures from 'conservationists' are more often countered by 'productivitists' in the period of economic downturns, and in reverse when (local) environmental degradation has reached a point that raised immediate concerns especially those related to health like the haze problem. This can be reflected in, for example, the case of the biodiesel policies in Indonesia and Malaysia. When the palm oil price is low and the stock is high, there is more pressure to create domestic demand like biodiesel as a buffer for the industry (Section 3.5). In such a competitive environment, some strategies may have been overrated, leading to unrealistic expectations. The productivity boosting strategy (Section 3.1) is one example - it is indeed not entirely clear whether substantial breakthrough in yield can be achieved in the near future as shown in the past.

The existence of multiple stakeholders with different interests, values and education level means that the 'optimal' set of strategies would more likely be a result of political negotiations that can be practically implemented. One vivid example has been the proposal to divert agricultural expansion onto ULC land (Section 3.2). Exploiting ULC land for productivity may seem acceptable purely from an environmental point of view, especially when the governments are under strong economic pressure. However, it may significantly alter local socio-cultural dynamics through e.g. lifestyle changes and migration, and potentially victimised certain groups of people. For example, a large part of local communities may be left out from the discussion about large-scale investments in converting ULC land to productive plantations as shown in some cases in the past. Some can be very eager to integrate into market economies, but some may opt to go for traditional self-sufficient farming (Section 3.10). Crucially, people change their minds from time to time on livelihoods with the changes in elements like access to different types of resources, biophysical circumstances and other factors (Scoones, 1998). For example, the author's recent visit to West Kalimantan revealed that some villagers who were strongly against oil palm a decade ago are now planting oil palm themselves, while some former oil palm smallholders who failed in planting have either switched to other crops or went for off-farm jobs. This is not new as similar stories have been observed throughout the modern

Table 1
Potential synergies and trade-offs between strategies.

Synergies – non-italics; Trade-offs – *italics*	Boosting upstream productivity of cash crops	Activating under-utilised low carbon (ULC) land for production	Upgrading and diversifying downstream activities	Branding for more values (industrial)	Establishing new domestic demand for bio-resources	Creating values for carbon and ecosystem services	Enhancing agro-ecological resilience	Establishing eco-based tertiary sectors	Branding for more values (smallholders)	Encouraging self-sufficient farming
Boosting upstream productivity of cash crops		Improvement in production technology may help to replenish degraded land	Continuity in technology development and product quality improvement	Increase production without using more land can help branding	New demand may spur productivity improvement	Reduce demand for forested land while generating income from forest	A more resilient landscape may boost productivity	No direct synergies	Better practices for branding may boost productivity	Improvement in technologies may facilitate self-sufficient farming
Activating under-utilised low carbon (ULC) land for production	*Space for expansion may demotivate productivity improvement*		New demand may spur the use of ULC land	Proper use and recovery of degraded land can help branding	New demand may spur the use of ULC land	Additional incentives for replenishing degraded land	A more resilient landscape may replenish degraded land	No direct synergies	No direct synergies	No direct synergies
Upgrading and diversifying downstream activities	*Require enormous resources to develop both upstream and downstream at the same time*	*May trigger more export of raw materials rather than develop own downstream*		No direct synergies	New demand may spur the development of downstream	No direct synergies	No direct synergies	No direct synergies	No direct synergies	New job opportunities at downstream may attract small farmers to switch away from cash crop farming
Branding for more values (industrial)	*No direct trade-offs*	*The use of more land may trigger some debates on sustainability*	*May trigger more export of raw materials rather than develop own downstream*		New demand, if coupled with sustainability requirement, is complementary to branding	Additional incentives for maintaining a healthy landscape	Additional incentives for maintaining a healthy landscape	Create 'green' jobs for communities may help the branding	Can be complementary or packaged together	No direct synergies
Establishing new domestic demand for bio-resources	*No direct trade-offs*	*No direct trade-offs*	*If new demand is only for simple products, it may inhibit further downstream development*	*New demand without sustainability requirement may undermine branding work*		No direct synergies	No direct synergies	No direct synergies	New demand, if coupled with sustainability requirement, is complementary to branding	Additional incentives (e.g. for using own producing bio-energy instead of fossil fuels) to remain subsistence
Creating values for carbon and ecosystem services	*No direct trade-offs*	*Potential competition for land – production or conservation*	*No direct trade-offs*	*No direct trade-offs*	*No direct trade-offs*		Additional incentives for maintaining a healthy landscape	Highly complementary	Highly complementary	Additional incentives to remain subsistence
Enhancing agro-ecological resilience	*Additional use of fertilisers may undermine agro-ecological resilience*	*Overuse of ULC land for production may undermine agro-ecological resilience*	*No direct trade-offs*	*No direct trade-offs*	*No direct trade-offs*	*No direct trade-offs*		No direct synergies	Additional incentives for maintaining a healthy landscape	Highly complementary
	No direct trade-offs	*No direct trade-offs*	*No direct trade-offs*	*No direct trade-offs*	*No direct trade-offs*	*No direct trade-offs*	*No direct trade-offs*		Can be packaged together	Additional incentives (off-farm

(*continued on next page*)

Table 1 (*continued*)

Synergies – non-italics; Trade-offs – *italics*	Boosting upstream productivity of cash crops	Activating under-utilised low carbon (ULC) land for production	Upgrading and diversifying downstream activities	Branding for more values (industrial)	Establishing new domestic demand for bio-resources	Creating values for carbon and ecosystem services	Enhancing agro-ecological resilience	Establishing eco-based tertiary sectors	Branding for more values (smallholders)	Encouraging self-sufficient farming
Establishing eco-based tertiary sectors										income) to remain subsistence
Branding for more values (smallholders)	*May discourage growth in production volume*	*No direct trade-offs*	*No direct trade-offs*	*No direct trade-offs*	*No direct trade-offs*	*New demand without sustainability requirement may undermine branding work*	*No direct trade-offs*	*No direct trade-offs*		No direct synergies
Encouraging self-sufficient farming	*May discourage growth in production volume*	*If external labourers (migrants) will be introduced, unwanted social consequences may be triggered*	*No direct trade-offs*	*No direct trade-offs*	*Contradictory*	*Some traditional practices* e.g. *slash-and-burn may be ruled out*	*No direct trade-offs*	*No direct trade-offs*	*May be competing concepts – market integration vs subsistence*	

Bornean land-use history (Kaur, 1998).

It is thus vital to recognise that there are no straightforward solutions considering these profound differences in both spatial and temporal dimensions. High-level discussions and theoretical or conceptual proposals without due regard to on-the-ground reality are likely unable to offer practical solutions. The strategy '*creating values for carbon and ecosystem services*' (Section 3.6), with the REDD + programme as the prominent example, has been deeply troubled with lengthy political and scientific debates from local to national and international level, despite it shows many synergetic effects with other strategies. This has become even more complicated with the fact that it relies heavily on funding from other countries. There are also significant risks of failures or undesired outcome due to under-representation of certain stakeholders in the planning and negotiation processes. It seems that while synergetic policy-mixes can be potent on paper, the 'human' challenges can also be enormous in reality.

5. Final remarks

While this paper has opened up a space for further exploration of the possibilities and realities of reconciling economic development and conservation, many questions remain to be answered. This requires serious thinking of the suitability of various strategies in a wider canvas of reality – the perspectives, attitude, capability and influencing power of the various actors, the financial and infrastructural readiness, as well as the greater socio-economic processes. Integrated landscape approach which has recently become a popular concept is an attempt to promote in-depth studies that encapsulate as much as possible these elements to facilitate our understanding of how the systems work (Reed et al., 2016; Erbaugh and Agrawal, 2017). It helps to outline the big blueprints of landscape management by integrating various spatially explicit land-use models as well as complex economic analyses. However, it is inherently challenging to capture more subtle territorial-specific conditions and on-the-ground realities, like the system of government, extra-local influences, socio-cultural characteristics and rural-urban linkages, as well as historical background of these into the models. These 'human factors' require an in-depth understanding of a particular territory beyond just physical and monetary analyses when one intends to understand how the transformation of land-based economies was driven. While generalized knowledge can help to lay out the framework, area studies would play a much larger role when it comes to the actual implementation and execution of transformative strategies.

Following this line of inquiry, transforming land-based economies would require a more holistic development thinking beyond just 'land' but the entire territory. The adoption of the Sustainable Development Goals (SDG) framework by the countries may mark a big departure from sectorial-based but an overarching vision for improving people's lives, prosperity and wellbeing. The transformation process will likely be a result of a (potentially uneasy) compromise between the various actors with the co-exist of synergies and trade-offs. Only innovative land-use strategies and business models that fit better in specific local contexts will work effectively. What imperative is not only communicating and discussing scientific findings between scientific communities and various stakeholders on the ground but also co-producing and tailoring knowledge together to effectively design, execute and manage the strategies considering synergies and trade-offs in different areas and contexts.

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