Socio-ecological resilience and environmental sustainability: case of avocado from Mexico

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Abstract:

Natural science impact assessments of sustainability evidence more closely than social and business studies frameworks the interdependent planetary boundaries (PB) limits are being breached. This brings to attention environmental ecological assessments are better placed as the starting point to inform how human action or inaction as socio-economic behaviours can influence environmental management resilience, rather than the other way around. This study identifies food security as grand challenge. A socio-ecological cosmopolitan resilience framework is conceptualised and applied to the commodity case of the avocado from Michoacán, Mexico. Social, economic and policy issues are identified and captured as multi-level influences. These impact environmental management as biodiversity, land usage and fresh water sustainability at individual, firm and governmental levels. A variety of recommended simultaneous changes that may advance system-wide sustainability are considered as cultural, moral and governance dimensions for socio-ecological resilience. Our framework is important as natural science and social norms must inform business practice at all levels for environmental sustainability.

Keywords: Avocado; resilience; individual; firm; government; environment.

Running title: Socio-ecological resilience

1. Introduction

The concept of planetary boundaries (PBs) as an overarching assessment framework of the geophysical preconditions (i.e., collective '*limits or constraints*') for addressing sustainable human development is receiving increasing attention among Earth system and sustainability scientists (Ryberg et al., 2018; Dsouli et al., 2017; Folke et al., 2016). The priority for tackling environmental management holistically presses for a closer engagement between public policy makers and businesses. Leal Filho et al. (2019, pg. 179) highlight 'the focus will not only be on international co-operation, but also eliminating discrimination and inequalities within countries'. This is supported by growing transdisciplinary research (Antoni and Larringa 2017; Howard-Grenville et al., 2017; Dyllick and Hockerts, 2002) to accelerate mitigating the pressures of human activity on environment, for achieving the U.N. 17 SDGs[1] by 2030 (Leal Filho et al., 2019; Rockstrom et al., 2018; Holmberg et al., 1999).

The processual impacts pertain to the collective nine ecological biospheric constraints[2] (Rockstrom et al., 2009a), within which we live as asymmetrical societies[3]. Within these societies, the growth of corporate actors' power further increases asymmetry dispersion between individuals and corporate organisations, with power gradually moving from the former to the latter (Leal Filho et al., 2019).

Regardless, the overarching sustainability outcomes of natural and human activities intensify in a widening trend of interlocked and nonlinear Earth system extreme events e.g., hurricanes, flooding, droughts, wildfires, earthquakes, economic crises, conflicts, health epidemics, malnutrition and pandemics. The extending known risks pose as *grand challenges* (Emori et al., 2018; George et al., 2016). According to the WWF (2018) report our actions

[1] United Nations Sustainable Development Goals agreed in 2015, see https://sustainabledevelopment.un.org/?menu=1300
[2] The nine boundaries were developed based on geological scientific evidence. Three of these nine boundaries (Biodiversity loss, climate change, nitrogen cycle) have already been breached.
[3] Each society has local cultures, trades, skills, climates, resources. Different societies impact each other.

are degrading the natural world – the very basis on which our livelihood depends! Between 1970 and 2014 vertebrate population sizes have been reduced by 60%, with South and Central America suffering a decline of 89% (W.W.F., 2018).

Tackling a grand challenge calls upon 'mobilising multiple communities of actors whose interests overlap' (O'Mahony and Lakhani, 2011:7) so that the perceived, diverse, disparate interests may be better aligned and integrated in their implementations (Holmberg et al., 1999). The Anthropocene[4] as 'human impact on the planet' is critical to setting the enabling conditions for innovative projections such as: rediscovering local community skills and crafts; healthier food ingredients and sourcing; cleaner technologies for energy usage; and new materials for waste reduction; as business strategies to enhance self-sufficiency. Sustainability is then, context-sensitive (Dsouli et al., 2017) and requires re-orientation of its resilience trajectory (Smith et al., 2017; Cooke et al., 2016; Waters et al., 2016; Steffen et al., 2015; Rockstrom et al., 2009a; 2009b) as stewardship of the co-evolved, socio-ecological system (Folke, et al., 2016; Xu et al., 2015; Whiteman et al., 2013; Folke et al., 2004).

The precondition for any sustainable society is resilience or the system's capacity to cope with stress and local failures without collapsing (Walker and Salt, 2006). Given that any system is made up of several different interconnected elements, making them capable of adapting and lasting over time, even if one or more of their components were to break, so the whole should not collapse (Johansson et al., 2005). In the 21st century, promoting large scale production plants, greater corporate control, process oversimplification and standardization - results in reduced biological and socio-technological diversity, in consequence increasing overall fragility of the eco-system.

[4] Not yet fully evident as geological scientific evidence, but increasingly recognised as post 1950s impacts on the rate of transgressions.

A majority of the scholarly and scientific contributions are underpinned by simpler 'narrow standardised imposed solutions' from globalisation perspectives (Kakabadse and Khan, 2016). Communities and businesses are seeking a deeper involvement with policy makers in shaping how private sector contributes locally to effective sustainable development e.g., on land usage, employment rights, respecting the indigenous communities or wider scoping of competitive regulation. Scholars such as Whiteman et al., 2013; and Levy and Lichtenstein, 2011; Ceccon and Cetto, 2003 assert disconnects between impact assessments of global ecosystems and regional ecological processes, environment indicators, business development strategies and local practices of environmental management.

Our paper contributes to the research gap for addressing planetary boundaries limits from an integrative cosmopolitan perspective (Kakabadse and Khan, 2016). Cosmopolitanism has a long history as worldview (Diogenes, 404-423B.C.) that promotes achieving a common solution based on social connectedness, multi-level mutual diversity benefits and interactional stakeholder respect (Robbins and Horta, 2017). This paper develops a unique cosmopolitan socio-ecological resilience framework (Kakabadse and Khan, 2016; Alcarez et al., 2016) based on moral, cultural and governance characteristics, that are related and interlinked together engaging social axioms theory (Leung et al., 2002) to address planetary boundaries.

The principle of cosmopolitanism can be found in specific forms at every level of society (urban and rural). It can be practiced in every field of social and political action and is the paradoxical opposition to globalization (Beck and Sznaider, 2006). The articulation of cosmopolitan dispositions and practices is in local contexts as acceptable norms, values, interpretation of legal and regulatory frameworks, influencing organisational entities and their networks, transparency in practice, judgement and as accountable leadership traits. These attributes of individuals, urban and rural societies export to the global community.

In our framework social-axioms (Leung et al., 2002:289) are 'generalized beliefs about the world.' Social axioms theory allows comparative of dimensions, facilitates attainment of goals and is central to organising the belief system of people in their individual, social group, institutional and physical environment. This asserts a relationship between entities or concepts (Joshanloo et al., 2010; West et al. 2016, pg. 253, figure 1) that binds the characteristics and dimensions together e.g., as cause-effect or correlated, towards achieving the overarching sustainability goal (Leung et al., 2002: 288; Gari et al., 2009).

Cosmopolitanism is then an interconnected multi-level framework that is outward looking between localities, communities and global networks.

This paper is structured as follows. We first engage a literature review related to the research questions that includes considering agri-food resilience and cosmopolitanism. Then method and materials are outlined for the case of avocado in Mexico. The latter sections share findings, discussion and conclusion.

2. Literature review

Our research questions are *'why is it proving difficult to arrest the problems of resource depletion and climate change vulnerability?* and *'what are the obstacles to adaptive change necessary within the agri-food sector?*' (Marsden, 2012: 139). Our response addresses these questions pertaining to food security (Food and Agriculture Organisation, FAO, 2008) as this is the primary challenge (Marsden and Farioli, 2015). Agriculture contributes 24% to global greenhouse gas emissions (IPCC, 2014) and the ozone is adding to nexus of socio-economic factors affecting crop producers, soil erosion, farmer incomes, food prices, poverty and nutrition.

Xu et al., (2015) assert a deeper need to define localised contextual issues. As such, sustainability resilience frameworks need to combine ecological and human activities in their product and multi-stakeholder analysis, for more meaningful outcomes. Our study therefore focuses on a single product i.e., the avocado. The growing global appetite for avocados has been rapidly increasing (Agren, 2017). The adoption of Haas variety into the commercial market allowed mass production in 1990s, after a lifting of banned Mexican products. The Haas cultivar ripe slowly and its thick, bumpy skin allows longer shelf-life compared to other varieties. Hence, the selection of Michoacán State as a case-study.

Mexico is the world's largest producer of avocado that represents at least 45% of global supply (Modor intelligence report, 2018). Michoacán state in Mexico accounts for 92% of Hass avocado production and the state's sustainability issues of deforestation and cartels are related to this produce (Geo-Mexico, 2010). Bustos and Moors (2018) and Ibarolla-Rivas and Galicia (2017) justify the Mexican context for Food Security as a case-study based on production and consumption pathways. We also contribute to the call for further studies to map heterogeneity of Mexico along 1. evaluation of eco-system services related to agriculture 2. evaluation of environmental impact as a need for integrating stakeholders for a more resilient system (Ibarrola-Rivas and Galicia, 2017; Shamah-Levy et al., 2017).

Our study is an emergent, innovative contribution towards building theoretical frameworks (Kalfagianni, 2015; Vertovec and Cohen, 2003) and empirical evidence (Grinstein and Reifler, 2015) which link the fields of planetary boundaries, food security and cosmopolitanism (Whiteman et al., 2013). We identify and explain diverse and complex characteristics of economic, social and environmental policy towards improving sustainable entrepreneurial vitality, as local ecological needs in the context of international competitive pressures on government.

We proceed by introducing the agri-food sector and consider how human urbanisation, planetary resource use and global food system trade-offs are the anthropogenic critical responsibility concerns of socio-ecological resilience.

3. Agri-food sector resilience

Resilience is the capacity of an agri-food system to absorb shock (Bousquet et al., 2016) and the system's capability to prepare for, cope with, adapt and potentially transform (Smith et al, 2017; Schwarz et al., 2011). The resilience agenda is shared by those concerned with financial, political, conflict, disaster and climate threats to development.

The agri-food sector is unique as it is on the boundary between human and environmental systems and we ingest its produce (Marsden and Farioli, 2015). The regional effects include social e.g., public health, employment; and environmental e.g., energy, water; concerns as broader legitimate social justice and societal interests and impacts (Folke et al., 2016). At the 2009 inaugural Association of European Schools Planning (AESOP) Sustainable Food Planning group's conference in Almere, the term 'food equation' was considered in terms of urbanisation challenges. The dialogue linking business with social and environmental concerns included exploring the implications for food policy development with business practices; the need for food to be incorporated into public planning policies; and its oligopolistic political power dimensions (Lukes, 1974). More recently, the call has been to improve resilience as root cause (AESOP, 2017).

Meanwhile, in recent decades, the pace of global material consumption has continued to increase (Krausmann et al., 2009). Forty percent of land-usage is for agriculture (FAOSTAT, 2018; Hurtt et al., 2009) and crop production has risen by more than 47% since 1985 (Ramankutty et al., 2000). The pressure of international competition contributes to the

detrimental sustainability impact[5], with greenhouse gas emissions crossing 400ppm, and 75 percent of species are at risk of extinction (Living Planet Index, 2012). Regardless, the demand for food continues to intensify as density and rising living costs of mega-cities continue to increase (Davila, 2016).

From an international supply and demand perspective, recent Food and Agriculture Organisation (FAO) data suggest that one-third of food is never consumed (Gustavsson et al., 2011) while Lundqvist et al., (2008) stress that 50 percent of all food grown is not reaching the consumer and is therefore, discarded, with certain agri-food commodities exhibiting post-harvest losses of nearly 100% (Parfitt et al., 2010). The less developed nations experience over 40 percent losses of food during post-harvest or processing phases of production, mainly due to inefficient logistics and storage systems. Government policy support for local firm innovation varies depending on location and sector vis-a-vis Global Value Chain (GVC) upgrading (Martinez-Covarrubias, Lenihan and Hart, 2017). Meanwhile, developed countries may have addressed food losses at the early production stages, but food wastage reaches nearly 40 percent at the retail and/or consumption stage (Gustavsson et al., 2011). The internationalisation of the fresh fruit and vegetable industry has pushed third world producers, in the global south, towards economic globalisation, to meet an all-year demand by consumers in North America, Europe (Stanford, 2002) and more recently, demand from China[6].

This draws attention to the business entities of the agri-food sector as key change agents of environmental and sustainability wellbeing. Considering greenhouse gas emissions alone (Emori et al., 2018, Wright and Ryberg, 2017), multi-national corporations contribute 24-29% of the world total, significantly the most, among the different stakeholder emitters,

[5] further supporting evidence can be found in Millennium Ecosystem Assessment, 2005; Tilman et al., 2001

[6] Rise of 250% import of Avocado in 2017/18.

towards transgression (IPCC, 2014). Whilst there has been an increase in the quantified reporting on issues by leading firms[7], pressed by institutions and regulators (Oberthur, 2009; Biermann, 2009), the responsibility and 'collective yardstick' (Whiteman et al., 2013) by which sustainable performance is assessed, is not without ecological and social fallacies.

Both the problems and their solutions concerning food sustainability have often and for too long, been conceptualised as a top-down globalised view as 'one size fits all' (Foresight, 2011), which disregards local context and multi-level diversity. Agriculture is often narrowly perceived as parts i.e., farming, processing, distribution, supply, packaging, consumption, waste, where broader frameworks should integrate these as interdependent within a food system across human; cultural; ecological factors. Furthermore, agricultural and environmental policies often treat food as secular, rational and bio-economic whereas socio-ecological frameworks may offer more systemic moral, cultural and context-sensitive understanding (Xu et al., 2015; Kakabadse and Khan, 2016).

The principles of shared, albeit differentiated, responsibilities among polluting activities and joint mechanisms of custom control have been set forth as a well-aimed pathway. The polycentric systems of decision making and transnational/cross-sectoral initiatives and partnerships will prove to be vital in mitigation of quality losses and for holistically coordinating remedial actions (Ostrom, 2012). The Resilience Frontiers conference in Stockholm (2017) asserts resilience science (Cooke et al., 2016; Berkes, Colding and Folkes, 2008) as the key lens for biosphere-based sustainability, to which adopting socio-ecological systems approaches is vital.

The socio-ecological systems (SES) approach posits integration between humanity and nature within the biosphere, to which human adaptability is key for enhancing resilience

[7] e.g. Associated British Foods PLC; Danone; General Mills; Kellogg; Mars; Monsanto; and Syngenta;

in dealing with change as a malleable construct (Biggs et al., 2015; Levin et al., 2013). In this study, the socio-ecological system is understood from a Cosmopolitan perspective. Being local and social-context sensitive, adaptability refers to coordinated human actions towards innovative and improved pathways for better sustainability and economic wellbeing (Folke, et al., 2016; Whiteman et al., 2013).

The rest of this paper sets forth a unique, alternative, holistic, conceptual framework rooted in Cosmopolitanism comprising of moral, cultural and governance dimensions (Ghemewat, 2011). The theoretical framework is rooted and defined by a cosmopolitanism lens and the dimensions connected and related to each other through social axioms theory (Leung et al., 2002; Leung and Bond, 2004) asserting a relationship between concepts.

Our framework is a unique theoretical construct in combining cosmopolitanism and social axioms theories to address planetary boundaries in this way.

The framework is demonstrated through its application to the case of the avocado in Mexico. Whilst there are implications for all nine of the planetary boundaries, in this case study we draw attention to the major one at each level of our framework, as an environmental priority and high impact concern i.e., bio-diversity loss at the individual level; land usage at firm level; and fresh water at governmental level; towards promoting environmental conservation and better economic stewardship. In the last sections, implications for policy and business managerial practice as well as future research perspectives are considered.

4. Cosmopolitanism

Cosmopolitanism (Held, 1996, 2007; Woodward *et al.*, 2008) commonly grounded as *'I am a citizen of the world'* (Diogenes, 404-423B.C.) does not pre-suppose a political agenda, unlike globalisation (Kakabadse and Khan, 2016). We understand globalisation in this paper

as a rational perspective defined as a single, standardized, imposed, multi-culturalism (Kakabadse and Khan, 2016; Brown, 2008). This has dominated much of the twentieth century and supported the rise of the corporation (Khan and Kakabadse, 2013) as a neo-liberal competitive entity (Knyght et al., 2011a). Cosmopolitanism, in contrast, promotes common community (Lu, 2000) through a mutual respect for local diversity and differing beliefs, based on an awareness of interdependence and mutual benefit (Pieterse, 2006), which aligns better with enhancing transdisciplinary sustainable resilience and economic wellbeing within the planetary boundaries (Steffen et al., 2015; Rockstrom, 2009a).

Furthermore, cosmopolitanism overcomes the limitations of distance understandings of geographic boundaries such as nation-state (Selles, 2013; Jazeel, 2011) and addresses criticisms of 'sustainable development' (Hopwood, Mellor and O'Brien, 2005) as triple bottom line lacking systemic integration (Le Blanc, 2015). As such, our paper engages a normative logic to understanding cosmopolitanism.

Kakabadse and Khan's (2016) study of 450 C-Suite leaders identified the qualities of cosmopolitanism as a 'world view' consisting of certain moral, cultural and political characteristics and behaviours – as unique and different to that of globalisation. In practice, political characteristics can be understood better within broader governance (Banerjee, 2017; Bulkeley and Betsill, 2005). Hence, we introduce Figure 1 below, in which we illustrate our conceptualization of cosmopolitanism and its moral, cultural and governance characteristics. Moral promotes a *'sense of being the same as at home and in the world'*; cultural promotes '*an awareness and affinity to other diverse cultures*'; governance promotes a '*sense of wider community, tolerance and openness'* (Kakabadse and Khan, 2016). These triple helix[8]

[8] Etzkowitz, H. and Leydesdorff, L., 2000. The dynamics of innovation: from National Systems and "Mode 2" to a Triple Helix of university–industry–government relations. *Research policy*, *29*(2), pp.109-123.

characteristics can be linked to each other by engaging social-axioms theory (Leung et al., 2002) to investigate cosmopolitan resilience as multi-level and context sensitive (Hui and Hui, 2009) impacts on the planetary boundaries (Rockstrom, et al., 2009a) in our cosmopolitan socio-ecological conceptual framework. In this respect, social-axioms theory is the glue, or connects the parts of our conceptual framework with each other. Furthermore, '*social-axioms serve as guiding principles…. steering progress towards the attainment of goals....in a given situation*' (Hui and Hui, 2009: 18). The means to an end, being based on believed judgments and decision making for improving sustainability.

INSERT FIGURE 1 HERE

We proceed next, by outlining the qualitative approach engaged in this paper.

5. Material and methods

An over-reliance on quantitative analytical approaches prompts the call for more relevant and rigorous empirical research methods (Eisenhardt and Graebner, 2007).

Qualitative inductive case-study research (Langley, 1999; Yin, 1994) offers the capture of rich materials from real-world bounded settings, for the holistic investigation of the phenomena (Barratt, Choi and Li, 2011) towards building new theories and frameworks (Eisenhardt, 1989; Van de Ven, 1989). This is particularly beneficial in exploring and better understanding emergent context-sensitive research. Our justification for the inductive case-study approach notes a gap in existing theoretical frameworks that link cosmopolitanism to planetary boundaries, to explain multi-level sustainability impacts.

Our materials collection is from secondary published sources and we undertook qualitative thematic analysis. The study engaged archival sources i.e., documents, records,

reports, etc., to build a wider and deeper multi-level case-study (Bustos and Moors, 2018; Stagl, 2007; Eisenhardt, 1989). We allowed for traceability of the process and cross-checking with experienced expert colleagues to ensure validity and reliability (Sandelowski, 1986; 1993).

Our materials focus on the avocado grown in Michoacán, as unit of analysis (Mintzberg, 1979). Mexico is a world leader in the production, consumption and export of the avocado (Coronado, et al., 2015). A commodity case is described, offering emergent multi-level relationships and constructs (Stanford, 2002; Yin, 1994) that are theoretically connected (Leung et al., 2002) to improve system resilience (Smith et al, 2017).

Although the findings of our study are applicable only to a single product in one state of Mexico, the framework developed to analyse the case can be used for other products and regions.

We proceed by presenting a narrative (Eisenhardt and Graebner, 2007; Miles and Huberman, 1984) of the state of Michoacán in Mexico, where the avocado is grown.

6. Michoacán region in Mexico

Mexico is located along the Pacific 'Ring of Fire' (Degg, 1989) and borders America, the Pacific Ocean, Caribbean Sea, Guatemala, Belize and Gulf of Mexico. With a land mass of nearly 2 million km^2, its resources include petroleum and deposits of silver, salt, copper, and iron (Natural Resource Governance Institute, 2017). Whilst one fourth of the land is covered in forests, the country has low rainfall and a semiarid climate. Only 13 percent of the land is cultivated.

A population of 129m people and low average age of 27 make it the world's 10^{th} most populated country. Mexicans are governed as a Federal Republic, consisting of 31 States and

1 District (Mexico City). On the corruption perception index (CPI) it is rated 123 out of 176 countries by Transparency International (T.I., 2016).

Mexico has a very long and rich human history. The pre-classical period relates to the Maya civilisation (1800 B.C. – 250 A.D.). The post-classical to the Aztecs (1300-1521 A.D). Mexico was a Spanish colony (1521-1821)[9] before gaining its independence. Approximately 25 percent of the population lives in rural areas, which are primarily dependent on agricultural income. However, income from farming typically relates to only one third of the National average wage.

Michoacán, translation *'place of the fisherman'* is located in the south-west of Mexico (see map A). This region has been inhabited by humans for 10,000 years and was the home of the Purepecha Empire (1400 A.D.). Agriculture occupies over 1m hectares of land in Michoacán. Principal produce includes corn, limes and 92 percent of Mexico's Haas variety avocados (Henderson, 2017). Michoacán has mountainous areas and a 200km Pacific Ocean coastline. Sixty percent of the state is covered by forestation. It is well known that Monarch butterflies from all over the Americas come here for their annual migration. In this regard, a large park in Michoacán has been granted world heritage status (UNESCO, 2017).

Insert map A here

We proceed next with a narrative for the case of the avocado within Michoacán, Mexico.

6.1 Case of the Avocado

[9] First printing shop (1539) university (1551) and public library (1646) in Americas

Mexico produces more than one third of the world's avocados, which is classified in the plant family *Lauraceae* and has been grown since pre-7000 BCE (Silva and Ledesma, 2014). Avocados (*Persia americana Mill*) contain many vitamins and nutrients including Vitamin K, Folate, Potassium, Vitamin E and small amounts of Magnesium, Manganese, Copper, Iron, Zinc, Phosphorous, Vitamin A, B1 (Thiamine), B2 (Riboflavin) and B3 (Niacin), giving it high nutritional value and a super food status, often endorsed in Western media by celebrities. For example, in 2015, 5 million avocados were used by *Pret-A-Manger* stores, as 12 of its products now contain avocado. In the same year, around £150m of avocados were sold in the U.K., whilst in the U.S. 4 billion were consumed, resulting in an avocado deficit and higher prices (Henderson, 2017). Recently, this superfood is being banned by cafes and restaurants in the United Kingdom (Nair, 2018; Ridler, 2018, Reuters 2018).

Avocado trees prefer Mediterranean or tropical[10] climates. They like altitudes of 1500m above sea level and a particular soil containing ash - e.g., the legacy of 1952 volcanic eruption in Michoacán. Earthquakes are frequent due to Michoacán's proximity with the Pacific Rim (Degg, 1989). A recent large earthquake hit near to the highly populated Mexico City on 19th September 2017 with a magnitude of Mw 7.1 (Agren et al., 2017). In 1987, 80,000 hectares of land was being farmed by 37,000 labourers in Michoacán (Aguilera-Montanez and Salazar-Garcia, 1991) which has increased to 137,000 hectares[11] (340,000 acres) impacting as deforestation. Michoacán produces 92% of Mexican avocados, which represent 45% of the international market including the Hass variety e.g., in 2015-2016, 1

[10]Mediterranean or tropical climates offer mild summers and winters and include biodiversity hotspots in which the majority species and plants thrive (e.g. coral reef).

[11] 50,000 acres a year of land use conversion representing 30-40% deforestation.

million tonnes of avocado was exported from Mexico, including $1.5bn annual sales to U.S. alone.

The main pests that impact avocado production are red spider mites and thrips. Spiders themselves are recognised as being a key indicator of the impact on biodiversity (Kacar, 2016).

Land acquisition in Michoacán has been subject to ineffective regulation (Stanford, 2002), poor land-usage planning (Bravo-Espinosa et al., 2014) and is more likely through dubious means. In recent years, bloody clashes between rival drug cartels, savvy to the lucrative opportunity, represents the diversification of interest groups into the avocado trade (Henderson, 2017; *The Independent*, 2016). Illegal plantations, extortion, kidnapping, murders and unpermitted felling of forestation have been widely reported as common practices of the trade (Hootsen 2013). Between 2006 and 2015, more than 8000 murders were reported in the state of Michoacán (Flannery, 2017). It is interesting to note that in Tancitaro, the avocado production capital, citizens have taken to organizing armed patrols as vigilante protection against the cartels. The military and police are perceived to be ineffective. Rumours that some wealthy individuals may be partnering with the cartels have been reported (Flannery, 2017). Most recently the U.S. has issued travel warning for tourists advising them not to travel to five Mexico states, including Michocan (Sanchez, 2018). Meanwhile, experts warn that excessive chemicals used in mountain orchards may be running into lower-level ground water, streams, rivers and lakes and are a cause of illness to the human population (*The Independent,* 2016).

Unlike other crops, avocado trees take three years to grow into fruit-bearing trees and require higher quantities of water. This fruit has unique development characteristics including a longer flowering of up to 3 months and not ripening on the tree, rendering post-harvest timing and conditions critical (Hernandez et al., 2016).

In Mexico the small farmer struggles to compete with the larger cartels and corporations that, for example, have stronger buying power or a technological advantage such as expensive machines for greater access to deeper water sources (Blythman, 2016). With the intensification of production, the water table in the region is being impacted and farmers must find deeper sources of water (Gonzalez and Macias, 2017). Furthermore, the largest players often engage in expensive quality certification which gives them a competitive advantage. In actuality, this seems to be protectionist policy rather than one of equitable quality control (Friedmann and McNair, 2008).

In the next section, we present the emergent responsibility concerns as findings relating to the case of the avocado.

7. Findings

In the case of the avocado in Michoacán, the authors selected the secondary materials e.g., newspaper articles; research, practitioner, organizational reports; online articles; from reliable sources that were publically published. Each article's narrative was read and many themes developed. The materials were for the period 2014-2018. Our cosmopolitan understanding of moral, governance and cultural underpinned developing the themes in response to the research questions. The hundreds of emerging themes were categorized into dimensions: moral, governance and cultural and levels: individual, firm or government (see table 1 below) - for each of the nine planetary boundaries (Rockstrom et al., 2009a):

INSERT TABLE 1 HERE

The anthropogenic responsibility concerns are impacting all nine planetary boundaries. The nine emergent tables (one for each planetary boundary) were then collectively analyzed and evaluated together holistically - as an interlinked relational framework'. Importantly, we engaged social axioms theory (Leung et al., 2002) to conceptualise, explain and justify the cosmopolitan relationships between each of the planetary boundaries (our table 1,2,3…9) and at the different levels (individual, firm, government) establishing our framework. The themes were prioritized into issues that address the research questions with a focus on ameliorating negative sustainability and improving resilience. The analysis of each planetary boundary and of our overall framework was cross-checked independently by expert colleagues.

We highlight in table 2 below our main findings, that the major impact at different levels emerged as biodiversity loss, land-usage and freshwater (see table 2).

At the individual level there is major concern about human rights and freedom of the individual / small farmer, along with low pay and working conditions for the laborer. The historical *ejido* (communal land system) co-operatives have suffered since the neo-liberal, third–wave reforms from the 1990s and beyond (McDonald, 1999). Furthermore, the incurred and growing biodiversity losses e.g., fertilisers, pest control, access to and purification of water and yield per acre - make it more and more difficult for the small farmer to compete against the pressures of economies of scale and higher costs (Gates, 1998; 2009). This reflects power of individual farmer and laborer is eroded and there is a cosmopolitan contraction of mutual respect and diversity for the individual level (Pieterse, 2006). There is a reduction in quality of the product for the individual farmer (Stanford, 2002) as the larger oligopolistic players dominate resources and erode the small farmer's ability to make a living. Another issue is that individual farmers lack the ability to influence policy formation. Such phenomena may be likened to the impact of large grocery multiples in the U.K. responsible

for the erosion of the independent butcher, baker and town centre shopping areas (Reardon, Berdegue and Timmer, 2005; Burt and Sparks, 1994). The lack of formal voice and institutional representation contributes to dominant players pressing of informal geographic and formal cosmopolitan boundaries (Jazeel, 2011).

At the firm level there is a major concern about land-usage. Increasingly powerful firms (or cartels) have become the mechanism to dominate and control resources and provide returns to their wealthy investors (Martinez, et al., 2014). Related ethical concerns include illegal deforestation and change of land use to farming, which firms can afford to pay for, but are beyond the means of the small farmer (Aranda, 2014). Such pressures highlight a need to re-balance the distributive rights from large players back to small farmers. Furthermore, the regulatory concern points to a lack of control or more likely, corrupt public / private arrangements towards land allocation and its protection (Ravikumar et al., 2017). The irreversible consequences impact indigenous local rural communities as well as local plant and animal species as gap in practice and sustainability assessments (Whiteman et al., 2013; Levy and Lichtenstein, 2011). This has in turn impacted local communities, as big business has exerted power forcing the next generations to move into urban cities. The standards and certification towards regulating firms remains closed networked and unfair (Coronado et al., 2015; Sanchez, 2007).

At government level there is major concern about freshwater usage. The excessive illegal farming has lowered the water table, which makes it more expensive and larger machinery is required in order to reach deeper water sources. A lower water table in turn, impacts biodiversity and the soil quality (Gonzalez and Macias, 2017). Thus, there is a need for wider and longer-term research programmes that embed and enforce policies more stringently. The reality seems to be that the move from state-system to the adoption of a neo-

liberal approach has only benefited the advantaged, in a society where the majority are struggling to survive in rural communities.

The individual, firm and government levels have different issues at each level, that impact overarching sustainability, but to which collective multi-level resilience is interdependent (Smith et al.,2017; Stagl 2007; Leung. et. al., 2002).

INSERT TABLE 2 HERE

In table 2 above, the individual, firm and government cosmopolitan levels have a relational influence within and on each other, that emerges as cause-effect impacts or interdependent sustainability outcomes explained through concepts and dimensions influencing each other across our framework through social axioms theory (Leung et al., 2002, West et al., 2016 figure 1, pg 253). Thus, the effort is to reverse erosion and enhance resilience of sustainability as a systemic cosmopolitan response. In the recommendations section (next), building resilience against these concerns (Table 2) in relation to our research questions to address planetary boundaries is discussed – for improved cosmopolitan resilience.

8. Discussion and Recommendations

Since 1990, agriculture has been the main driver underpinning the loss of 92m hectares of forestation in the Latin America and Caribbean region, of which 88 percent is within South America (Willaarts et al., 2014). In Mexico, the State sought to promote rural development[12] (Rudel, 2007) with its government's policies e.g., NAFTA signed in 1994 or incentivising cheap land, placing infrastructure into remote areas and agricultural conversion.

[12] However rural communities and firms are being eroded as employment moves to mega-cities (e.g. Mexico city)and outside interests enter the market.

Such programmes, in the natural resource rich developing countries, have been endorsed by global bodies including the World Bank (WB) and International Monetary Fund (IMF), that favour trade neo-liberalisation agendas (Knyght et al., 2011b). This has been accelerated by foreign funded multi-nationals entering and competing in local markets (firm level). These globalisation effects alert to when competitiveness translates into local regional interference, erosion of indigenous culture and people skills (individual level), in-turn increasing government dependency (government level) on external bodies and colonial type pressures in the pull of capitalism and its call for resources.

In this regard, our cosmopolitan framework (Kakabadse and Khan, 2016) brings to attention that urgent transparent reforms and accountable innovations of institution and policy (Khan and Kakabadse, 2013) must first better serve the needs of individual citizen and local community, that should drive the purpose and practices of firm! Where firm interests are the priority of government as through a globalized lens (Kakabadse and Khan, 2016), the system is less sustainably resilient and more likely to collapse (Beck and Szaider, 2006). Our framework identifies that there are unique moral, governance and cultural dimensions to the avocado case in Mexico (table 2). Defining the lens and boundaries of a case-study becomes critical to the shaping of its outcomes (Eisenhardt, 1989). The dimensions have been and are currently impacting each other detrimentally for cosmopolitan sustainable resilience (table 3 as opportunities for improvement). Furthermore, the various issues and different priorities for each level are contributing as obstacles and perceived threats to socio-ecological systemic (SES) harmonization (Folke, et al., 2016; Xu et al., 2015).

The SES approach addresses the research questions whereby environmental, social and economic outcomes are equitable and in that order. This is in contrast to the globalization lens in which performance seems to follow more economic, social and environmental priorities (Kakabadse and Khan, 2016).

Costanza et al., (2014) highlight the fact that ecosystems must be considered to be inclusive of eco-services in promoting the benefits of wellbeing and sustainability (Millenium Ecosystem Assessment, 2005[13]; The Economics of Ecosystems and Biodiversity, 2011[14]). Within socio-ecological frameworks, nature and human society are interconnected through 'eco-services', supplying benefits from 'ecosystem' to human society, actions in turn that impact the eco-system. The cosmopolitanism framework draws attention to a greater need for multi-level and integrated relationships (Leung et al., 2002) which can enhance the broader sustainable resilience framework as firm engagement opportunities (Xu et al., 2015).

Figure 3 below presents the cosmopolitan resilience opportunities at individual, firm and government levels for enhancing the cultural, moral and governance characteristics in the case of the avocado within our socio-ecological framework. In this regard, the cosmopolitan approach prioritises the sustainability impact and mediates the narrower isolating economic effects of globalisation.

INSERT FIGURE 3 HERE

The avocado commodity case in Michoacán, Mexico has demonstrated application of our cosmopolitan framework by highlighting the need for improved multi-level communication and better coordinated bottom-up and top-down efforts for collaborative sustainability impact (Dsouli et al., 2017). Between government and firm level, there is a need for broader policy design and integrated environmental reporting by businesses. This must allow for some local discretionary capacity to enable stakeholders and communities in their bottom-up impact initiatives. Discretion relies on regulators and firm managers engaging higher order ethical values and sustainability skills. In our framework, the re-

[13] MEA – a UN 1300 scientist 4 year study for policy makers.
[14] TEEB – a UN project phase 1 report 2008; phase 2 report 2010.

orientation of government-firm relationship and firm incentives is critical (Leung et al., 2002). The policy effects and a broader purpose of firm will modify systemic resilience (Wright and Ryberg, 2017).

Between individual and firm level, the managerial implications are towards incentivising wellbeing actions for farming e.g., local working conditions, animal and human wellbeing, improving dialogues and relations and awareness of pesticides and fertilisers as drivers of longer-term economic wellbeing (Ibarolla-Rivas and Galicia, 2017).

Typically, individual and small farmers are many whilst larger firms are more dominant and few in local regions, which have developmental implications for local rents, land values, barriers to entry, access to knowledge and technology, quality and price of commodities.

At the same time, our framework points to the overarching issue that the institutional and regulatory governance structures of Mexico have not yet fully embraced the infra-structural, industry regulation, supply chain and labour force changes in the move from State control to market liberalisation as philosophical turn. This leads to power issues and opportunistic trade-offs as corrupt and illegal approaches remain norms and practices.

Our recommendation draws attention to current sustainability efforts requiring much more integrated assessments and future-state target setting with better accountabilities across all the levels. Further, the scientific global ecological limits are historical and need to translate into meaningful country level projected commitments (Selles, 2013). There remains opportunity for enabling co-directional application for dynamic responses within the framework.

9. Conclusion

To better address planetary boundaries (Rockstrom, 2009a), the commodity-case of the avocado illustrates that interdependent linkages and relationships (Leung et al., 2002) are critical to improving system-wide socio-ecological sustainability resilience. To date, the globalised lens has incentivised economic firm innovation, but struggled to mitigate its associated social and environmental problems, which remain misaligned and different at each level. Our conceptual cosmopolitan framework has engaged social-axioms theoretical lens to integrate a multi-level cosmopolitan resilience-framework as innovative and transdisciplinary contribution (Cooke et al., 2016; Xu et al., 2015).

Our framework extends cosmopolitan theoretical conceptualisation (Kakabadse et al., 2016) by adding to the dimensions a novel relational mechanism (Leung et al., 2002). Further, social axioms theory (Leung et al., 2002) is extended in its unique application to moral, governance and cultural cosmopolitan dimensions in our case-study (Yin, 1994). The conceptualization of cosmopolitanism with social-axioms has enabled theoretical construct of our unique socio-ecological framework to contribute to bridging planetary boundaries as scientific to social-scientific assessment (Rockstrom et. al., 2009a). In addressing our research questions, the study seeks to contribute to tackling the grand challenges (George et al. 2016) through systemic integrative frameworks and more meaningful resilient solutions.

To impact environment, social and in turn, economic wellbeing, our world-views, behaviours, aligned actions and institutional structures must innovate, with environmental impact as an equitable priority. The range of issues vary at each level, to which restoring resilience to the Holocene epoch (extinction) depends on Anthropogenic[15] (human) impacts across individual, firm and government levels as critical to socio-ecological sustainability. Resilience for sustainability calls for global planetary boundaries to be impacted through

[15] Growth of human agriculture in post-industrial revolution is affecting environment.

diverse cosmopolitan policy, government agendas and business entities more collaboratively. Ultimately, economic wellbeing is the financial outcome of environmental and social market innovations and their stabilities as longer-term sustainability.

This framework can be further refined and applied to other cases, at different levels and for considering other planetary boundaries. The framework's transferability to different industry sectors, across different modes of government and at the same time, having a relevance to local communities and citizens, is important. Our recommendations call for pro-active efforts rather than re-active responses.

In conclusion, at the deeper level, the current international and local entity structures themselves and their leadership approaches i.e., firm and government, need re-engineering to be fit for purpose to meet environmental and human goals for planetary boundary and international resilience more effectively. Ultimately the connection between policy formation and business management within industry must account for a variety of issues at different levels, for which bottom-up or more responsive environmental management linkage opportunities remain critical.

10. Limitations

This study is of a single product case of Mexico. The application to other countries will contribute to context case-building. Further the framework may be applied to other products from Mexico (e.g., vanilla; cocoa) to develop national and international supply demand perspective. A methodological limitation is that the case engaged secondary materials only. Alternative cases may consider primary materials e.g., interviews or observations as closer to current realities, but this would raise access to participant issues and may require support for the researcher or teams of researchers, particularly in sensitive case studies. Our study accumulates historical materials at one point in time, whereas other studies may consider

impact over time in understanding sustainable development. There remains opportunity for rigorous transdisciplinary quantitative assessments and reporting of environmental impact assessment, particularly in connecting and the reporting of integrated businesses and government environmental management.

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Figure 1: Socio-ecological resilience

Dimensions	Components
Cosmopolitanism	• Moral • Cultural • Governance (political and corporate)
Planetary boundaries	• Individual/Local • Firm • Government (institutional)

Anthropogenic duty of care responsibility towards natural resource

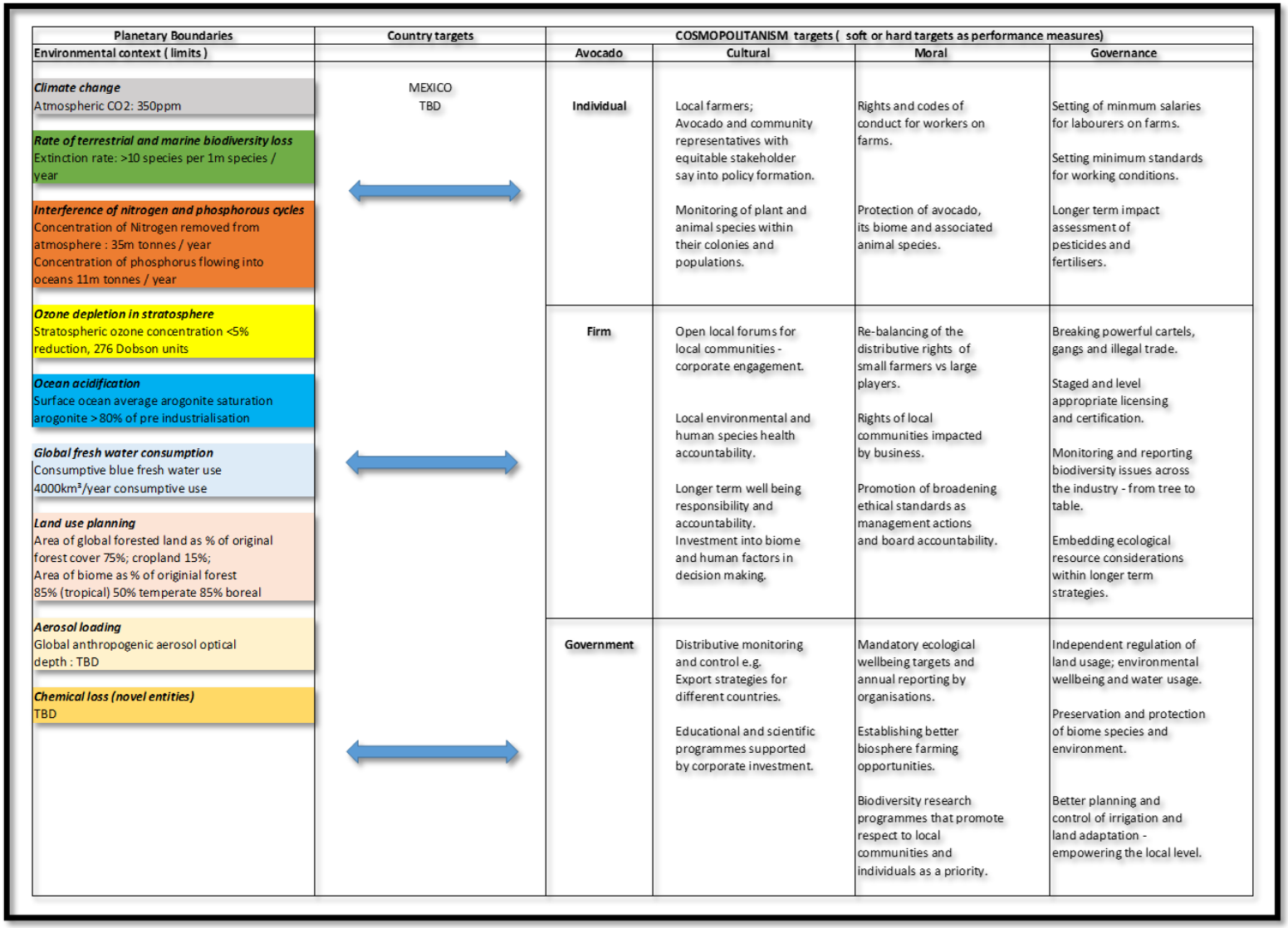
Table 1: Categorization of themes for each planetary boundary

Cosmopolitan dimensions for planetary boundary 1.	**Individual**	**Firm**	**Government**
Moral			
Governance			
Cultural			

Table 2: Findings as impact of avocado on planetary boundaries

PB level	Issue	Major impact
Individual	human rights and freedoms chemical and pest control product quality capacity to influence	**biodiversity loss**
Firm	dominance of resources illegal trade economies of scale species survival	**land-use planning**
Government	access to resources preservation of elements preservation of communities	**global fresh water**

Figure 3: Cosmopolitan resilience opportunities – case of avocado



Planetary Boundaries	Country targets	COSMOPOLITANISM targets (soft or hard targets as performance measures)			
Environmental context (limits)		Avocado	Cultural	Moral	Governance
Climate change Atmospheric CO2: 350ppm	MEXICO TBD	**Individual**	Local farmers; Avocado and community representatives with equitable stakeholder say into policy formation. Monitoring of plant and animal species within their colonies and populations.	Rights and codes of conduct for workers on farms. Protection of avocado, its biome and associated animal species.	Setting of minmum salaries for labourers on farms. Setting minimum standards for working conditions. Longer term impact assessment of pesticides and fertilisers.
Rate of terrestrial and marine biodiversity loss Extinction rate: >10 species per 1m species / year					
Interference of nitrogen and phosphorous cycles Concentration of Nitrogen removed from atmosphere : 35m tonnes / year Concentration of phosphorus flowing into oceans 11m tonnes / year					
Ozone depletion in stratosphere Stratospheric ozone concentration <5% reduction, 276 Dobson units		**Firm**	Open local forums for local communities - corporate engagement. Local environmental and human species health accountability. Longer term well being responsibility and accountability. Investment into biome and human factors in decision making.	Re-balancing of the distributive rights of small farmers vs large players. Rights of local communities impacted by business. Promotion of broadening ethical standards as management actions and board accountability.	Breaking powerful cartels, gangs and illegal trade. Staged and level appropriate licensing and certification. Monitoring and reporting biodiversity issues across the industry - from tree to table. Embedding ecological resource considerations within longer term strategies.
Ocean acidification Surface ocean average arogonite saturation arogonite > 80% of pre industrialisation					
Global fresh water consumption Consumptive blue fresh water use 4000km³/year consumptive use					
Land use planning Area of global forested land as % of original forest cover 75%; cropland 15%; Area of biome as % of originial forest 85% (tropical) 50% temperate 85% boreal					
Aerosol loading Global anthropogenic aerosol optical depth : TBD		**Government**	Distributive monitoring and control e.g. Export strategies for different countries. Educational and scientific programmes supported by corporate investment.	Mandatory ecological wellbeing targets and annual reporting by organisations. Establishing better biosphere farming opportunities. Biodiversity research programmes that promote respect to local communities and individuals as a priority.	Independent regulation of land usage; environmental wellbeing and water usage. Preservation and protection of biome species and environment. Better planning and control of irrigation and land adaptation - empowering the local level.
Chemical loss (novel entities) TBD					

Source: Developed by authors with reference to Leal-Filho et al. (2019); (2018), Kakabadse and Khan (2016) and Rockstrom et al., 2009a.

Map A: State of Michoacán (Yellow) in Mexico