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Climate Smart Agri-Food Marketing: Conjugating Climate Smart Agriculture with Agri-Food Marketing in Bottom of the Pyramid-Subsistence Markets in Developing Economies

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ABSTRACT

The aim of the research was to attempt to appraise, ascertain and diagnose climate smart agri-food marketing in BOP-SM contexts in developing economies. Interestingly, the literature and sources of secondary data and information that directly addressed, in its own right, climate smart marketing were scant and more in specific to climate smart agri-food marketing were sparse, if not inexistant. However, in terms of climate smart marketing, in the literature and sources of secondary data and information, this emerged mostly indirectly, within the evolution of green and then sustainable marketing over recent years, where there has been, a greater focus on climate change matters. In terms of climate smart agri-food marketing, in specific, this has mostly emerged indirectly, within literature and sources of secondary data and information on climate smart food systems, agri-food value chains and agri-food supply chains. This all providing evidence that there is a lack, within literature and sources of secondary data and information, of directly and specifically addressing climate smart agri-food marketing. Hence and in this regard the research focused on attempting to delineate an agri-food marketing paradigm that specifically focused on climate change mitigation and adaptation. This also derived from the fact that climate smarting agricultural production outputs requires agri-food marketing to be climate smart. Indeed, if agri-food marketing is not made climate smart, it would partly off-set all the benefits that derived from climate smart agricultural production outputs and de facto agri-food marketing that is not climate smart contributes to climate change. As per the findings of the research, climate smart agri-food marketing finds it roots in the green, circular and low-emission economies, is within the realm of climate smart food systems, agri-food value chains and agri-food supply chains and derives from green marketing and sustainable marketing. In this regard, sustainable marketing covers the triple bottom line of people, profits and planet, and green marketing focuses on planet, and within planet, climate smart agri-food marketing focuses specifically on climate smart mitigation and adaptation. The research found that climate smart agri-food marketing in BOP-SMs needs to be localized, rural, urban, survival, system, service, relational, social, digital and entrepreneurial-oriented and consider the micro, meso and macromarketing levels. This all inherently implying that climate smart agri-food marketing needs to be adaptable, flexible, variable, versatile, agile and innovative. The process provided for climate smarting agri-food marketing is based primarily on learning from BOP-SMs in terms of locally-based innovations of technologies, activities, processes, systems, knowledge, know-how and behaviour that may be climate smart in terms of mitigation and adaptation. Such learning being locally based can be replicated within the same BOP-SM context, shared with other BOP-SM contexts as well as with other countries, both developing and developed to sustain the development of climate smart agri-food marketing. In turn such an approach does not exclude 'importing' innovations in terms of technologies, activities, processes, systems, knowledge, know-how and behaviour from other BOP-SM contexts within the same country and from other countries, both developing and developed, but not being locally generated, may require adaptations and modifications, for example, to be applied to make such innovations more locally palatable and thus implementable within agri-food marketing to make it climate smart.

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Introduction

There is ample scientific evidence on how human activity has affected globally the natural environment and how this will be observable for many millions of years to come (Lewis & Maslin, 2015). Indeed, climate change does not observe national borders (EIB & EBRD, 2022) and one of the most serious long terms risks for global development derives in fact from climate change, which has mainly derived from emissions of developed countries,[1] and in a very minor part from developing countries (World Bank, 2010), except for China, India, Indonesia and Brazil (UNEP, 2022).

Climate change can and has upset the global interconnectedness of economies, societies and human welfare (IMF, 2021). In terms of the externalities created by climate change, for example, the most perilous is global warming (Nordhaus, 2019). Global warming is perilous as per its impacts, for example, on weather patterns, extreme weather events, loss of human well-being and widespread economic damage (EIB & EBRD, 2022; OECD, 2025). Ripple *et al*., (2025) provide that over the past few years, record breaking increases in temperatures have been recorded in land[2] and oceans[3] and on ice. Further, human induced changes to climate have a large range of impacts from effects on natural processes that have changed some ecosystems on a global scale (Hoffman & Jennings, 2018) to the development of inorganic compounds, for example, and has led to 'the suggestion that we should refer to the present, not as within the Holocene Epoch (as it is currently formally referred to), but instead as within the Anthropocene Epoch' (Lewis & Maslin, 2015). The OECD (2025) provides that 'the planet may be approaching major climate tipping points, thresholds beyond which irreversible and abrupt changes in Earth systems could occur.'

Hoffman & Jennings (2018) refer to the Anthropocene as an 'era in which humans have a long-term, documentable impact, not only on the operation of the planet's terrestrial ecosystems, but also on its hydrosphere, cryosphere, biosphere, lithosphere and indeed, it's very geological strata.' The era is a dramatic change in planet physical realities as activities of humans have become highly impactful on the environment and its systems (Hoffman & Jennings, 2018). There has been, and is currently ongoing, increased population,[4] economic, trade and urbanization growth, for example, the crossing of planetary boundaries[5] and all this possibly leading to a collapse, which could be termed 'the sixth extinction' (Hoffman & Jennings, 2018). Indeed, WEF (2025) provides that there is 'strong scientific evidence that humanity is putting the stability of the entire Earth system at risk, jeopardizing global economic development.' However, and as provided by Steffen *et al*., (2011), seeing the amount of scientific evidence and related knowledge of how human activities are impacting the Earth system, humans are in the condition now to modify the relationship with the planet, taking 'responsible stewardship' that basically means 'emulating nature in terms of resource use and waste transformation and recycling, and the transformation of agricultural, energy and transport systems.'

[1] The OECD (2025) reports that 'emissions from OECD and OECD partner countries account for around 78 percent of total country-based emissions, underscoring their central role in global decarbonisation efforts.'

[2] The WMO (2025) provides for the period January to August 2025 that mean surface temperatures were 1.42 °C ± 0.12 °C above the pre-industrial average.

[3] The WMO (2025) reports that 'ocean heat content reached the highest level on record in 2024.'

[4] Ripple *et al*., (2025) provide that the global population is at an all-time high, including the livestock population destined for meat and other livestock products consumption.

[5] WEF (2025) reports that ' six of the nine boundaries are already breached, these being: climate change, novel entities, biogeochemical flows, freshwater change, land system change and biodiversity.' PBScience (2025) provides that 'seven out of nine planetary boundaries have been breached: climate change, change in biosphere integrity, land system change, freshwater change, modification of biogeochemical flows, introduction of novel entities, and ocean acidification.'

The Anthropocene, though needs to be seen not only at a global level, but also at the regional and local level. All are interconnected, and there should be consideration for the diversity of such, for example, the impacts of climate change on differing cultures, economic inequalities and consumption patterns (Biermann *et al*., 2016). As provided by Biermann *et al*., (2016), for example, in terms of consuming products and services, 20 percent of the global population, mainly located in developed economies, consume 77 percent of all products and services.

UNEP in 2022 reported that greenhouse gas emissions (GHGEs)[6] had slowed, but by 2023, still according to UNEP in 2024, GHGEs had set a new record and had risen by 1.3 percent compared to 2022 (UNEP, 2022; UNEP, 2024). The OECD (2025) also reports that in 2023 GHGEs reached and all time high and had increased from 2022 by 1.7 percent. Further, Schumer *et al*., (2025) provide that GHGEs continue to increase, thus intensifying impacts of climate change effects that are already widespread.

The major emitters that contribute to GHGEs by over 55 percent are China, the United States of America, the European Union, India, Indonesia, Brazil, and the Russian Federation (UNEP, 2022). However, most countries globally, face challenges in 'aligning their emissions with the reductions pledged in their 2030 Nationally Determined Contributions (NDCs) and reduction commitments of GHGEs remain inconsistent with the Paris Agreement temperature goals' (OECD, 2025).

At the global level GHGEs derive from industry (26 percent), production of electricity and heat (24 percent) , agriculture, forestry and other land use (21 percent), with agriculture contributing to half of such emissions, transport (14 percent), other energy (10 percent) and building (6 percent)' (Fazekas *et al*., 2022). [7] In terms of economic sectors, GHGEs derive from 'energy supply; industry; agriculture, forestry and other land-use change; transport; and direct energy use in buildings' (UNEP, 2022).

In terms of agriculture in specific, most emission derive from crop and livestock production which contribute 48 percent of the total (FAO, 2024). The emissions derived from livestock production, are mainly methane, coming from 'enteric fermentation (40 percent), manure left on pasture (16 percent), manure management (7 percent) and manure applied to soils (3 percent), that are estimated to have accounted for two-thirds of global agricultural emissions from 2001 to 2011' (IMF, 2021). Further and as provided by Batini (2021) how food is produced, how it gets to consumers (marketing) and how it is consumed has a large impact on the global environment. In fact, FAO (2024) points to pre- and post-production activities along the agri-food supply chain that contribute to 33 percent of the total emissions and since the year 2000 have grown by 52 percent. Tubiello *et al*., (2022) also further provide that between 1990 and 2019 pre- and post-production activities have doubled, these emissions deriving mostly from developed economies and a lot less from developing economies.

Indeed, as humans have progressed throughout history, the natural world has acquired far more value as natural assets, for example, like land, water and climate have become and are becoming scarcer and as such have ignited, as per increased values, conflicts (Collier, 2010). Clearly it is technology that transforms natural assets into value (Collier, 2010), for example, land via farming makes land have more value as also per its food outputs. As such, and as provided by the World Bank (2014), climate smart development is required. Indeed, development activities that can reduce GHGEs can provide to be beneficial and deliver benefits (World Bank, 2014). Indeed, mitigation and its related costs, are far lower than the costs of global climate related damages (Ripple *et al*., 2025). In agriculture, for example,

[6] The most relevant GHGEs 'are carbon dioxide (CO), methane (CH), and nitrous oxide (NO)' (Fazekas *et al*., 2022).
[7] It should be noted though that GHGE sources ' differ widely across countries, depending on factors such as the level of development, natural conditions, available resources, distance to markets, economic sectors, energy resources and land-use patterns (OECD, 2025).

climate smart agriculture[8] is one way of developing agriculture that attempts to reduce emissions and adapt to climate change (FAO, 2010). In line with this, agri-food marketing that is climate smart can be a great step forward in supporting climate smart development efforts as the role of marketing in economic development is important and in agri-food sector development becomes critical (Hilmi, 2025a).

Indeed, climate smart agricultural production provides agricultural products that have been produced taking as a priority the climate and the natural environment. However, climate smarting should also continue in the marketing of such agri-food products. Indeed, not considering the climate and the natural environment in marketing would create a climate and natural environment 'bottle neck.'[9] In fact, not taking into account the climate and natural environment in agri-food marketing activities and practices would seem to counteract all the efforts that have gone into climate smarting agricultural production. Hilmi (2022a), for example, in terms of tomato marketing in developing economies, found that tomato production practices have an impact on the natural environment and climate, but so do tomato marketing activities. The OECD (2025) also provides that GHGEs, are in fact, embedded in trade and FAO & UNDP (2025) suggest that enterprises must, in their distribution networks (marketing), reduce GHGEs. Further Reay (2019) provides that food is inherently intertwined with climate change and its impacts, with, for example, consumption, especially in developed economies, 'ramping up emissions and damaging the health of both humans and the planetary systems.' Moreover, still Reay (2019) points to the matter that food is 'testament to the global nature of what we consume and its global exposure to the impacts of climate change. '

Thus and following in this line of research, and considering the increase in marketing emissions as per evidence from FAO (2024) and Tubiello *et al*., (2022), and the call by Steffen *et al*., (2011) for responsible stewardship as well as, and more specifically the calls from, for example, Bocken *et al*., (2015), Hall (2018), Ardley & May (2020), Helm & Little (2022), Duku *et al*., (2022) and Hilmi (2025b) to research further climate smart marketing, the focus of this research is to appraise, ascertain and diagnose climate smart agri-food marketing in bottom of the pyramid-subsistence market (BOP-SM) contexts in developing economies.

Aim

The aim of the research is to attempt to appraise, ascertain and diagnose climate smart agri-food marketing in BOP-SM contexts in developing economies.

Methods

The research is in the same research streams of agri-food marketing and green food value chain development in BOP-SM contexts in developing economies as provided in previous researches by the author, for example, among the many see Hilmi(2025a) and Hilmi (2021a). This research is based on literature and sources of secondary data and information, and primary data and information found within, but is also based on the author's experience in terms of researching and working in developing economies on: agri-food marketing for over two decades, for example, among the many, see Hilmi (2025b); and developing green food value chains for circa 15 years, for example, among the many, see Hilmi (2018a).

The research is qualitative and abductive, and as provided by Sekaran & Bougie (2016), referred to the characteristics of: purposiveness, rigor, testability, replicability, precision, confidence, objectivity,

[8] Climate smart agriculture is 'a set of agricultural practices and technologies which simultaneously boost productivity, enhance resilience and reduce GHGEs' (World Bank, 2024).

[9] FAO (2025) provides that 'pre and post agricultural production emissions have risen by 33 percent between 2001 and 2023, accounting for 32 percent of agrifood systems emissions, comprising food manufacturing, retail, household consumption and food disposal.'

generalizability and parsimony. The research and review of literature and sources of secondary data and information was systematic, exploratory, historical and descriptive in nature.

An initial exploratory research and review of literature and sources of secondary data and information was provided to identify key search terms to be used in the research. Five online databases were used: AGRICOLA; AGRIS; CAB Abstracts; FAO Knowledge repository; and Springer Nature Link. The identified draft key search terms were open peer reviewed by a marketing academic and a final list of key search terms was drawn up. The identified key search terms were as follows: food systems; agri-food systems; climate smart food systems; climate smart agri-food systems; agri-food value chains; food value chains, climate smart agri-food value chains; climate smart food value chains; food supply chains; agri-food supply chains; climate smart food supply chains; climate smart agri-food supply chains; commodity chains; climate smart commodity chains; green marketing; environmental marketing; ecological marketing; eco-marketing; sustainable marketing; climate smart marketing; green agricultural marketing; green food marketing; green agri-food marketing; environmental agricultural marketing; environmental food marketing; environmental agri-food marketing; ecological agricultural marketing; ecological food marketing; ecological agri-food marketing; eco agricultural marketing; eco food marketing; eco agri-food marketing; sustainable agricultural marketing; sustainable food marketing; sustainable agri-food marketing; climate smart agricultural marketing; climate smart food marketing; climate smart agri-food marketing; marketing in the Anthropocene; agricultural marketing in the Anthropocene; food marketing in the Anthropocene; agri-food marketing in the Anthropocene.

The identified key search terms were used for an in-depth research and review of literature and sources of secondary data and information using 12 online databases: AGRICOLA; AGRIS; CAB Abstracts; Business Source Complete (EBSCO); FAO Knowledge repository; Google Scholar; JSTOR Business Collection; ProQuest One Business; ResearchGate; SAGE Journals Online; ScienceDirect; and Springer Nature Link. For each key search term, at least six references of literature and sources of secondary data and information were sought. However, this did not always result in finding at least six references, as in some cases less than six were found, in other cases more than six were found and in some minor cases, no references were found. The references for review were selected based on the following criteria: the direct and indirect relevance to the research aim and related subject matters; value (methodological rigour, quality of the reasoning or arguments, references, etc.,); research evidence in terms of either or both primary source-based (credibility; reliability; ecological validity)and secondary source –based information; derived from an identified and reliable source (author(s), scientific journal publisher, reputation of publisher, etc.,); date of publication (not older than 60 years); references used; and peer review conducted (Saunders *et al*., 2016; Adams *et al*., 2014; Fisher, 2010).

The findings from the literature and sources of secondary data were analysed using thematic analysis. As the results were coming in, they were analysed and this allowed for iteration and guidance in the research. To assess for research quality, reliability and validity were provided via a qualitative stance, hence trustworthiness (truth value, applicability, consistency, neutrality), authenticity (ontological, educative, catalytic, tactical authenticity, and fairness) and credibility (good research practice, peer review of findings) criteria were used (Bryman & Bell 2011).

The initial draft findings deriving from the research were shared for open peer review with two peer reviewers that were field practitioners: one in agri-food marketing and the other in food systems. The findings from the research as well as the feedback from the open peer review process were then used to provide for a first draft of the research. This first draft of the research article was then shared with the three peer reviewers who had provided for the previous three open peer reviews. The peer reviewers, as provide previously, were one marketing academic, one agri-food marketing field practitioner and one food systems field practitioner. The feedback from the three peer reviewers was compared and contrasted (triangulation). As a result of this, findings were deemed to be reliable and valid. The second

draft of the research was open peer reviewed by a marketing academic and the feedback from the last peer review process was considered in the finalization of the article.

Background

The green economy, the circular economy and low emissions economy

There is a need, which is urgent, that emissions need to drop to net zero by 2050 in attempts to avert worst scenario impacts on the planet (EIB & EBRD, 2022). This implies major transformations, and among the numerous matters, requires getting the economy right in terms of providing for economic development and growth that is climate and environmentally sensitive. In this regard the green economy, green growth, the circular economy and low emissions economy all play an important role in the overall 'umbrella' background to climate smarting agri-food marketing.

The green economy, defined by UNEP (2011) is ' one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities.' In other words, the economy should 'operate within the ecological limits of the earth's biosphere' (Healy, 2021). Further Allen (2012) provides that a green economy should be based on 11 principles, the main principles being that 'the green economy is a means for achieving sustainable development; it is resource and energy efficient; it respects planetary boundaries or ecological limits or scarcity; is equitable, fair and just – between and within countries and between generations; it protects biodiversity and ecosystems; and delivers poverty reduction, well-being, livelihoods, social protection and access to essential services.' The green economy builds on and invests in natural capital with the aim of progressing in a sustainable economic manner (UNEP, 2011) and considering to a full the need to provide for justice and equality, in other words, welfare (Cato, 2009). At the practical level, the green economy needs to mitigate emissions, be adaptable to climate change, increase energy efficiency and avert 'the loss of ecosystem services and biodiversity' (UN, 2011).

In fact, the green economy can foster economic growth, without trading-off the climate and natural environment (UNDESA *et al*., 2012). In this regard, green growth, according to OECD (2011), is developing and growing an economy via ensuring natural resources and natural assets continue to provide, over time, their vital services. It considers efficient and effective ways to provide for economic growth and development without crossing critical global, regional and local climate and environmental thresholds (Kanianska, 2017).

Inherent to the green economy and green growth is the circular economy and the low emissions economy. The circular economy is designed to be by its very nature restorative and regenerative (Tambovceva & Titko, 2020). Via designing industrial processes and products that minimise, if not void waste, resources are kept in a perpetual flow, and waste that may occur is recaptured and recycled (EIB, 2020). It is basically a 'closed material circulation system' (UN, 2021), and is basically comparable to a natural ecosystem where there is no waste (Tambovceva & Titko, 2020). The production and consumption circularity of the circular economy basically decouples 'economic growth from the extraction and consumption of materials' (EIB, 2020). The circular economy by keeping resources in perpetual use, eliminating waste and pollution, can extensively contribute to reducing GHGEs as well as cater for reducing biodiversity loss and water stress (Ellen MacArthur Foundation, 2021). The circular economy is based on designing out waste, building resilience via diversity, deriving energy from renewable sources, using a systems approach and that waste is 'food' (Ellen MacArthur Foundation, 2012). Overall, the circular economy is based on the notion that 'economic activity consumes less natural capital than it can regenerate' (Institut Montaigne, 2016) and that emissions be reduced if not brought to net-zero (McCauley *et al*., 2024).

In this line of net-zero emissions,[10] the low emissions economy seeks via reducing, if not eliminating emissions to provide for climate, natural environment, economic and social benefits (Godzisz, 2018). To achieve this there is a need for resource efficiency, producing low emissions products and services (Baranova, 2017), green investment plans, emission pricing, support for green research and development and measures to ensure social fairness (IMF, 2021). Basically, a low emissions economy requires thinking, behaving and operating that reduces emissions and at the same time facilitating and enabling the use of resources sustainably, while ensuring economic growth and well-being and well-fare (Baranova, 2017).

Findings

Climate smart agriculture (CSA)

In terms of agriculture, the 'business as usual model' will result in food insecurity and economic growth that is not sustainable and thus changing course is critical (FAO, 2018b). If planet boundaries were not breached, the food system could provide only for 3.4 billion people (Gerten *et al*., 2020). But if planetary boundaries are breached, these may put in peril food supplies, for feeding 9 billion people estimated to be the world population in 2050. However, a transition 'towards more-sustainable food production and consumption would enable food supply for 10 billion people (or somewhat more or less depending on target diet and ambition level of solutions) without compromising multiple planetary boundaries as is currently the case ' (Gerten *et al*., 2020).

Indeed, climate change has large and lasting impacts on agricultural production and small-scale farmers are being impacted the most (FAO, 2013) as climate change is 'increasingly affecting yields and rural livelihoods, while agriculture continues to emit GHGEs' (FAO, 2018b). However, most small-scale farmers lack the knowledge on how to possibly adapt to climate change and how to reduce GHGEs as they have limited knowledge on such, lack access to technology, finance and markets, and overall have limited assets (FAO, 2013). In this regard, FAO (2010) provides that agricultural production needs to change and transform so as to counteract such challenges.

Climate smart agriculture (CSA) is fundamentally based on three pillars: increasing productivity and incomes sustainably, building resilience and adapting to climate change, and decreasing and/or removing GHGEs (FAO, 2013). CSA is not a practice for agricultural production, but is an approach that considers local areas and assesses what may be the most viable agricultural production practices that are site specific and can contribute to mitigation of GHGEs and adapting to climate change and preserving the natural environment and its resources (FAO, 2013). The CSA approach considers also the economic, social and environmental context of specific local areas and sites, considers the needs and interactions between stakeholders, identifies challenges, energy needs, possible trade-offs that need to be considered and takes account of the complexities involved in the interconnected challenges of climate change, development and food security (FAO, 2013).

Climate smart food systems

Indeed, climate smarting agricultural production is important, but much the same climate smarting needs to be considered for food systems. Food systems consider all the functions, processes and stakeholders that are involved in moving food from farm to plate in terms of production, processing,

[10] It is important to emphasize that net zero means ' reducing emissions to levels consistent with the pathways that constrain global warming to 1.5C scenarios via offsetting GHGEs with an equivalent amount of mitigation or reducing efforts, typically across a broader spectrum of GHGs ' (Gangadhari *et al*., 2025). This is not the same as carbon neutrality as such requires 'offsetting ongoing emissions by absorbing an equivalent amount of GHGs from the atmosphere, through methods such as carbon capture and storage and buying carbon credits' (Gangadhari *et al*., 2025).

distribution, consumption and disposal (Nicolini & van der Vaart, 2020). Food systems have to feed growing numbers of people in urban settings with mainly small-scale agricultural production systems that are located in rural areas (Defries, 2021). Indeed, food systems contribute circa 30 percent of GHGEs thus affecting climate (Duku *et al*., 2022), and in turn climate impacts food systems (Nicolini & van der Vaart, 2020). All parts of the food system are impacted by climate change (Mirzabaev *et al*., 2021) and all parts of the food system can contribute to climate change and as such every part of the food system needs to adapt to climate change as well as mitigate GHGEs (World Bank, 2015a). However, pending on location, climate change will affect food systems in different ways, for example, in tropical and sub-tropical regions, climate change will face challenges, while in northern temperate regions some climate impacts may have short-term benefits (Mirzabaev *et al*., 2021). Some of these impacts are the intensity of extreme weather events, such as, for example, unpredictable rain falls, floods, and droughts, that can impact all parts of the food system (Mirzabaev *et al*., 2021). Such will have an impact on food affordability, accessibility, availability, safety and supply stability (Mirzabaev *et al*., 2021). However, in developing economies, and according to Duku *et al*., (2022), climate change impacts on food system in post-production activities are not well documented.

Ecological, green, environmental and sustainable marketing

The marketing element, within food systems, as is well known, has an important role in the interface between, for example, enterprises and its customers (business to customer marketing [B2C]) and between enterprises (business to business marketing [B2B]), in terms of providing value with products and services, but at the same time, needing to attend to natural environmental impacts and the impacts on human-well-being (Martin & Schouten, 2014). This implying for marketing taking a macromarketing approach, the impacts on society, alongside a micromarketing level approach, impacts on commercial exchanges between enterprises, and enterprises and customers. Indeed, Kotler (2011) provides that marketing, has for a very long time, assumed that natural resources and climate resources, are infinite and that the impact of marketing on the natural environment, including climate, is minimal.

In response to such matters, marketing adopted more ecological and green friendly approaches. This, as per Katrandjiev (2016), commenced in the late 1950s and budded in the 1970s with ecological marketing. Peattie (1995) defines ecological marketing as 'concerned with all marketing activities: (a) that have served to help cause environmental problems and (b) that may serve to provide a remedy for environmental problems.' Ecological marketing gave rise in the late 1980s to the early 2000s to green marketing that focused on wider negative externalities caused by marketing, its products and its services and on greener consumerism (Katrandjiev, 2016). Green marketing is defined as ' a holistic and responsible management process that identifies, anticipates, satisfies and fulfils stakeholder requirements, for a reasonable reward, that does not adversely affect human and natural environmental wellbeing' (Charter *et al*., 2002). Interestingly, Garg & Sharma (2017) define green marketing as ' comprising all activities designed to satisfy human needs or wants, such that the satisfaction of those wants occurs, with minimal detrimental impact on the natural environment with growing awareness about the implications of global warming, non-biodegradable solid waste, and harmful impact of pollutants.' This placing an accent on climate impacts of marketing and the need to avert such. Also, Dahlstrom (2011) further emphasises how green marketing can reduce the impacts of marketing on climate.

Nearly contemporarily to green marketing, environmental marketing emerged, and Peattie (1995), provides that environmental marketing is based on three main characteristics: taking a holistic approach; a sustainable approach; and a socially responsible approach. Polonsky (1994) provides for green or environmental marketing 'consisting of all activities designed to generate and facilitate any exchanges intended to satisfy human needs or wants, such that the satisfaction of these needs and wants occurs, with minimal detrimental impact on the natural environment.' Further, Kumar *et al*., (2025) refer to green marketing being composed of both ecological and environmental marketing.

Khan & Raft (2015) provide that green marketing and classic or traditional marketing share similarities, but there are distinctions: green marketing is holistic; green marketing integrates social and environmental concerns, with economic concerns; green marketing focuses on long term benefits, but also in natural environmental terms; green marketing considers the impact of production and marketing on the natural environment via eco-labelling of products and services, for example; and green marketing seeks to optimise natural resource utilisation. The benefits and advantages of green marketing, still according to Khan & Raft (2015) relate to: optimised use and reduced usage of resources; educates consumers in natural environmental matters in terms of consumption and not only; customer satisfaction that is within sustainable parameters concerning the natural environment; the provision of natural environmentally sensitive products and services; focuses on social outcomes of marketing, for example consumer health; and overall contributes to sustainable growth and development.

Thus, green marketing also has an important social marketing component to it. Lee & Kotler (2020) define social marketing as ' a process that uses marketing principles and techniques to change priority audience behaviours to benefit society as well as the individual.' In fact, social marketing concerns behavioural change and providing positive benefits to both individuals and society at large (Lee & Kotler, 2020). Hastings, & Domegan (2023) further emphasize that social marketing concerns 'all the different sorts of human behaviour.' Thus, social marketing attempts to influence behaviours that benefit society[11] (Kotler & Lee, 2009), for example, like reduced natural environmental and climate impacts. Indeed, McKenzie-Mohr *et al*., (2012) provide that behaviour change is the corner stone of sustainability.[12]

Within social marketing, in attempts to change behaviour, are inherent long term relationships with many and diverse societal stakeholders, for example. This, in turn, also implies relationship marketing. Gummesson (2008) considers relationship marketing as being 'interaction in networks of relationships' so as to foster long term relationships, and as per Buttle (1996), relationships that are 'healthy and characterized by concern, trust, and commitment.' These all being essential elements to attempt to foster behavioural change both at the individual level and at societal level. Egan (2011) implies cooperative marketing, where all parties concerned cooperate together for a common positive outcome. Clearly such social, relational and cooperative marketing also implies the highly relational nature of digital marketing (Palmatier & Steinhoff, 2019). Digital marketing is basically using digital technologies, both online and offline, to foster marketing (Charlesworth, 2021) and thus also attempt to create long term relationships. In fact, and for example, via social media, relationships can be enhanced and provides the possibility of interactivity not only between an individual sender and a receiver of a message, but among entire communities of people, both online and offline. This, in turn, reinforcing the cooperative nature of relationship and social marketing, but also of green marketing.

In fact, within green marketing, Kumar *et al*., (2025) refer to, for example, the four 'Rs' of reducing, recycling, reusing, and rebuying, including the digital side of green marketing, that implies by very nature of the four 'Rs,' cooperation and coordination, and thus relations. Jarin (2014) provides for the importance of, for example eco-advertising and eco-labelling to inform consumers with regard to the greenness of products as well as eco-packaging, where materials used are reduced and are also recyclable, this also with the intent of creating long term relations with customers. Interestingly, Grant (2007), within green marketing, considers the need for a cultural outcome, alongside commercial and environmental outcomes of such, as marketing can help and support ' new lifestyle ideas,' which are

[11] However, what needs to be considered and as provided by Eagle *et al*., (2013) is that ' behaviours that may benefit society do not always benefit the individual being asked to change their ways, and may not even benefit a social group, locality or generation.'

[12] Corner & Randall (2011), provide, however, that social marketing alone is not sufficient to build support for reducing impacts on climate change.

inherent to much needed individual, community and wider societal behavioural changes that are more in line with harmonious living with the natural environment and climate. In fact, Polonsky (2015) considers, within the realm of green marketing, the need to also focus on macromarketing, what Polonsky terms 'transformational green marketing.' Apaiwongse (2014) also considers the macromarketing level of ecological marketing. Indeed, the environmental system is an inter-connected whole, which includes micro-level aspects of marketing, but also macro-level and meso-level aspects of marketing, taking into due consideration all of this within green marketing. Hence, green marketing is not set only at the micromarketing level, but also at the macro and mesomarketing levels.

Most interestingly, Wymer & Polonsky (2015) provide that green marketing, even though having positive social outcomes , ' on its own is an insufficient solution to societal environmental problems in general and to humanity's existential threat from climate change in particular.' Thus, green and environmental marketing gave way to sustainable marketing from the late 1990s that considered marketing and its impacts on sustainable development, with regard to, for example, environmental justice, wider marketing impacts on society and health (Katrandjiev, 2016). In fact, in the evolution of ecological and green marketing, Charter *et al*., (2002) sees sustainable marketing as being the next natural step as green marketing focuses on environmental issues, while sustainable marketing focuses on 'achieving the 'triple bottom line' via creating, producing and delivering sustainable solutions with higher net sustainable value, while continuously satisfying customers and other stakeholders, in full recognition that sustainability recognises the inter-twining of environmental, social and economic progress and well-being.' In this regard, Martin & Schouten (2014) define sustainable marketing as the 'process of creating, communicating, and delivering value to customers in such a way that both natural and human capital are preserved or enhanced throughout.' This, putting sustainability at the forefront of marketing, via for example, not only addressing viable natural environmentally sound economic exchanges, but also considering social and cultural aspects of such exchanges and possible positive and negative outcome externalities that can derive from such. In fact, Murphy (2005), for example, points to the importance of focusing also on post-consumption behaviour, and not just on consumption behaviour, and how marketing should also be responsible for such. Sheth & Parvatiyar (2021) point also to the matter of, within sustainable marketing, meeting todays 'needs of the present without compromising future generations' ability to meet their own needs.' Indeed, White *et al*., (2024) point out that sustainable marketing has in its evolution expanded also to incorporate such matters as, for example, the circular economy, anti-consumption, regulatory frameworks, innovation, and carbon emissions. However, Peattie (2008), contends that 'integrating sustainability into marketing will require more than an emphasis on the development of new greener products and cleaner production processes. It will require a re-evaluation of some fundamental marketing assumptions and concepts.'

Climate smart marketing[13]

In terms of trade in general, and inherent exchanges within, the WTO (2022a) considers trade's contributions to GHGEs which can be disruptive and costly. But at the same time, trade can foster access to know-how and technologies, for example, more availability of solar panels and at a lower cost, and thus can enable how to adapt to and mitigate the impacts of climate change, this being especially the case for developing economies. Indeed, ' in the longer-run, open international markets

[13] From the research what emerged is that literature and sources of secondary data and information that specifically considered and focused on climate smart marketing were somewhat scarce. In terms of literature and sources of secondary data and information that specifically considered and focused on climate smart agri-food marketing were even more scant, if not inexistent. These findings though, clearly need to be considered within the boundaries of this research and hence considered within this realm. However, climate smart marketing is considered, indirectly, within other marketing paradigms of sustainable, green and social marketing, for example, but is not given an emphasis and central focus. Climate smart agri-food marketing is considered, though indirectly, in the literature and sources of secondary data and information on climate smart food systems, agri-food value chains and agri-food supply chains.

would help countries smooth necessary economic adjustment and resource reallocation, and more diversified sources of supply for key goods and services would translate into greater resilience against localized weather events ' (WTO, 2022a). Trade, and its further expansion globally, thus can contribute to a more low-emissions transition and towards a zero emissions economy.

More in particular, Duku *et al*., (2022) in terms of climate change impacts on food systems consider also post-production activities i.e. marketing. Increasing high and low temperatures both impact transport infrastructure, for example, implying not only climate smart building of such, but also in the maintenance of such. In the case of food processing, for example, climate change can impact on the stability and frequency of supply of agricultural products, their safety and quality as higher temperatures can foster increases in pests (Duku *et al*., 2022). FAO (2022), still with regard to food systems, and in particular to agri-food value chains, focuses on the risks and impacts at various stages of the agri-food value chain and the resulting economic losses of such. FAO (2022) considers also postproduction risks and impacts, i.e. in marketing operations and activities, and provides the need to identify hazards, exposures, and vulnerabilities at every stage, but based on local data and specific context assessments. In particular, the extent of impacts ' on the geographic area, the types of food commodities and social and economic assets and the degree of exposure and vulnerability of actors and infrastructure' (FAO, 2022). Some of the most commonly found hazards and their impacts also in post-production activities, marketing, can be seen in Table 1 here below.

As can be seen from Table 1, every marketing stage can have hazards as per climate change impacts. However, via 'identifying and assessing current and potential future risks of each stage, enables to prioritize different adaptation and/or mitigation options, determine the urgency of those options and identify the most appropriate investments accordingly as well as assessing climate risks and climate resilience' (FAO, 2022) of the entire marketing system, so as to support better management and coordination of required interventions and avert compartmentalizing as well as recognizing the interdependence of each stage. Tables 2 and 3 are two examples of possible measures to counter act climate change hazards in transport, food markets and consumption stages of marketing.

Still in terms of food value chains, Hilmi (2018a) provides for green food value chain development. The approach considers the need 'to provide value at each stage by proactively reducing the usage of the natural environment (natural resources, ecosystem services, and biodiversity), to diminish or mitigate adverse impacts, or even have positive impacts, while at the same time considering disposal and recycling patterns of generated waste, to recapture value at every stage of the food value chain and thus further reduce environmental impact' (Hilmi, 2018a). The approach is based on three main strategies: prevent, reduce and recapture (Hilmi, 2018a). Hilmi (2019b) in terms of green food value chain development, and in particular to greening and climate smarting of post-production functions and activities, marketing, can be done via learning from bottom of the pyramid (BOP) contexts in developing economies, for example. In terms of this, Hilmi (2019b) provides for examples of how such learning can green and climate smart post-production activities via innovations, which are termed grass-root or frugal innovations, but are not only about technologies, but are also about activities, processes, systems, knowledge, know-how and behaviour. Such are ascertained and diagnosed and then replicated within a local BOP-SM context as well as shared with other BOP-SM contexts. However, such an approach though does not exclude 'importing' into local BOP-SM contexts green and climate smart innovations that may derive from other BOP-SM settings as well as from other countries, both developing and developed. In this line, Hilmi (2019a) also considers recapturing value from waste, valorisation, and how this contributes to the reduction of food waste and consequently the emissions footprints of marketing activities. Still Hilmi (2016a), in terms of post-harvest operations on tomatoes, for example, finds that storing tomatoes for the brief period prior to marketing and selling, large green leaves were used in attempts to control temperature. Hilmi (2022a) still with regards to tomato marketing found that in transport, for example, in some cases bicycles were used often and loads per transport trip were high so as to avert multiple trips, thus also contributing to reducing GHGEs.

Table 1: Climate and weather-related hazards and impacts along the agri-food value chain

Weather-related hazards	Impacts at each step in the agrifood value chain				
	Production and harvest	Storage and refrigeration	Processing and packaging	Transportation	Markets and retail
Extreme heat	Reduced crop yields, food spoilage, rapid degradation, undermined food nutritional properties, decline in meat and milk quality, decrease in animal fertility, increase in animal mortality	Food spoilage, rapid degradation, undermined food nutritional properties, conditions for bacterial and fungal spread	Food spoilage, conditions for bacterial and fungal spread	Unfavourable driving conditions for food carriers, reduced food storage life	Food spoilage, impact on access to safe, healthy food, changes in consumer requirements
Extreme cold	Damage to crop growth and food spoilage; cold stress on livestock	Food spoilage	Food spoilage, increased energy demand	Frozen roads and food spoilage	Obstructed access to markets, changes in consumer consumption preferences
Agricultural, hydrological, socioeconomic drought	Reduced crop yields, food contamination, drought stress on animals, conditions for microbial growth	Reduced availability of rainfed and groundwater resources	Reduced access to rainfed and groundwater resources	Damage to road infrastructure	Changes to food prices and sales
Heavy rains and flooding	Rapid food deterioration, harvest delays, conditions for microbial growth and water-borne diseases, animal mortality, yield losses, coastal erosion	Damage to infrastructure, loss of food loads, water contamination, food spoilage, rapid degradation, contamination, conditions for bacterial and fungal spread	Damage to infrastructure and facilities, drying methods rendered ineffective, increased costs, food spoilage, rapid degradation, contamination, conditions for bacterial and fungal spread	Blocked roads, damage to infrastructure, risks for perishable food	Damage to infrastructure
Storms/winds	Damage to flowering and fruiting stages, soil and coastal erosion	Damage to infrastructure, loss of food loads	Damage to infrastructure and facilities	Unfavourable driving conditions	Obstructed access to markets

Weather-related hazards	Impacts at each step in the agrifood value chain				
	Production and harvest	Storage and refrigeration	Processing and packaging	Transportation	Markets and retail
Sea level rise, higher sea temperatures, salinization	Less suitable conditions for fisheries and agriculture near coasts, increased algal and marine biotoxin growth	Damage to infrastructure	Damage to infrastructure, reduced food quality	Erosion, deterioration of coastal infrastructure	Changes to food availability, prices and sales
Landslides	Reduced crop yields, delayed harvests	Damage to infrastructure	Damage to infrastructure	Damage to infrastructure and vehicles	Damage to infrastructure
Wildfires	Reduced crop yields, delayed harvests	Damage to infrastructure	Damage to infrastructure	Damage to infrastructure	Damage to infrastructure, food losses
Pests and diseases	Crop damage, loss of agrifood products	Food spoilage, food losses, compromised food safety	Food spoilage	Food spoilage and compromised food availability	Reduced food quality and safety
Fog/dust/snow	Decrease in productivity, reduced crop yields	Changes in energy consumption to maitain optimal temperatures	Changes in energy consumption to maitain optimal temperatures	Impeded road and infrastructure visibility	Obstructed access to markets
Relative humidity	Food contamination by mould and mycotoxins	Food damaged by mould, stem rot	Food contamination, drying methods rendered ineffective	Increased risk of food spoilage, reduced food storage life	Reduced food quality and safety
UV radiation	Enhanced oxidation processes, vitamin losses, damage to food flavour and quality	Enhanced oxidation processes, vitamin losses, damage to food flavour and quality	Enhanced oxidation processes, vitamin losses, damage to food flavour and quality	Enhanced oxidation processes, vitamin losses, damage to food flavour and quality	Reduced quality of food for consumption

(Source: FAO, 2022, pp. 19-20)

Table 2: Climate risks, services and resilience measures for food transportation

STAGE OF THE VALUE CHAIN	CLIMATE RISK	CLIMATE SERVICES	CLIMATE-RESILIENT MEASURES
TRANSPORTATION	Heavy precipitation	Extreme rainfall advisory	• Strengthen early warning systems to prevent impacts on road infrastructure and reduce food losses from heavy rainfall events. • Build resilient drainage systems and infrastructure. • Elevate roads and bridges above flood levels. • Ship products when external conditions are less critical. • Reduce transport speed and implement more efficient planning of transport routes. • Promote safe, efficient routes for transporting fresh, perishable food to reduce transport time, food losses and energy use. • Provide training and advice on food-storage manufacturing techniques to reduce losses during transportation.
	Thunderstorm	Thunderstorm advisory	• Strengthen early warning systems to prevent impacts on road infrastructure and reduce food losses from storms. • Conduct road-network vulnerability assessments tailored to specific means of transport. • Reduce transport speeds and implement more efficient planning of transport routes.
	Strong wind	Wind advisory	• Strengthen early warning systems to prevent impacts on roads and vehicles and to reduce food losses from strong winds. • Reduce road traffic when external driving conditions are critical. • Install embankment protection infrastructure.
	Dense fog, dust and snow	Fog, dust and snow advisories	• Use LED panels and appropriate lighting and planning to reduce road accidents.
	Extreme sea conditions	Coastal and offshore warnings	• Strengthen early warning systems to avoid shipments of products when external conditions are critical. • Promote the use of navigational equipment. • Use colour-coded warnings to inform on the best times to ship products.
	Extreme heat	Heat warnings	• Strengthen early warning systems to avoid shipments of produce when external driving conditions are critical. • Improve the insulation of refrigerated trucks while reducing the energy consumption of vehicles. • Promote safe, efficient routes for transporting fresh, perishable food, to reduce transport time, food losses and energy use.

(Source: FAO, 2022, p.50)

Table 3: Climate risks, services and resilience measures for food markets, trade and consumption

STAGE OF THE VALUE CHAIN	CLIMATE RISK	CLIMATE SERVICES	CLIMATE-RESILIENT MEASURES
MARKETS, TRADE AND CONSUMPTION	Extreme heat	Heat index values and warnings	• Enhance availability of water-rich food products and beverages.
	Pests and diseases, food contamination	Alert systems for food contamination	• Promote appropriate work hygiene and sanitation practices. • Provide warnings on identified risks to consumers' health at market level after complaints or illnesses linked to product-specific consumption. • Ensure immediate removal of the product from markets, stopping further distribution and inform all other actors along the value chain of its non-compliance with health and safety requirements
	Changes in temperature and rainfall patterns	Seasonal forecasts	• Provide seasonal advisory services for climate impacts on yields and changes in food availability in national and international production to enable value chain actors to set transparent and competitive food prices for both domestic markets and export.
	Heavy precipitation	Extreme rainfall advisory	• Develop efficient rainwater collection systems, such as rainwater tanks, pumps and purifiers. • Use ICTs to enhance communication and information sharing between actors along the value chain.
	Flooding	Flood advisory	• Strengthen early warning systems to enhance flood preparedness and reduce disaster risk. • Develop flood-proofing practices, such as storage on wood pallets, maintaining distance to walls and hygiene. • Build flood-proof infrastructure that meets sustainable structural requirements and standards (in appropriate locations with regard to floodplains, of suitable dimensions and type, with the right roof slope and ledge and solid building foundations). • Promote rainwater collection systems such as rainwater tanks, pumps and purifiers; use drying hangers and maintain storm drains.

(Source: FAO, 2022, p.70)

Gualandris *et al*., (2024) consider supply chains that are regenerative in social and ecological terms, as for example, such requires 'aligning organizational knowledge, decision-making, and activities by diverse supply chain members with the structures and dynamics of social–ecological systems in diverse geographies at multiple levels (local and global), and across time horizons (short term and long term).' There is a need, according to Gualandris *et al*., (2024), that supply chains and their operations should be regenerative for society, the natural environment and climate. Sosnowski & Cyplik (2022) consider closed-looped supply chains that keep on 'circulating' materials, for example, products, in numerous cycles, in attempts to avert not only waste, but GHGEs. Inherent to closed looped supply chains is the focus of not generating 'solid, liquid and gaseous wastes, minimize use of toxic and hazardous chemicals, and run only on renewable energy' (Sosnowski & Cyplik, 2022). FAO & UNDP (2025) consider how enterprises in their operations and along their supply chains, thus including marketing, can become more resilient, for example via reducing GHGEs in all their operations, and especially in their supply chain networks with their partners, thus fostering for coordination, cooperation and management and thus supporting the formation of partnerships.

Far more in specific to marketing, Asgharinajib *et al*., (2025) provide that marketing has a large role to play in reducing impacts on climate change, for example, in crafting and shaping enterprise marketing strategies and communications with consumers as well as, and importantly, in business to business markets. In other words, climate smart marketing also needs to consider the marketing in business to business markets, for example, between a food wholesaler and retailer, and not just in terms of enterprise-final consumer interfaces. Shaik *et al*., (2025) in terms of enterprise to consumer marketing, emphasise the importance of marketing communications as such can create awareness about climate change, and educate and demonstrate enterprise commitment to tackling climate change. Most interestingly, Shaik *et al*., (2025) provide for enviropreneurial marketing which identifies opportunities that have positive impacts on the natural environment and climate and create a value that is sustainable for consumers.

Gingerich (2015) considers the challenges faced in eco-labelling, for example, ranging from their efficacy in communicating to customers to their actual verifiability of claims to their implementation and to what eco-labels really mean to customers. QAssurance B.V. (2022) considers key sustainability certifications that revolve around climate action, regenerative agriculture, organic, fair trade, packaging and animal welfare, for example. Certifications play a key role in making agri-food systems, and hence also marketing, more responsible and transparent and provide a number of benefits in terms of: enhanced consumer trust; facilitate market access; improve practices; and build brand reputation[14] (QAssurance B.V., 2022). Fontein (2025) considers environmental, social, and governance certifications in terms of food products that are natural environmental and climate sustainable; socially applicable, via for example, fair treatment of labourers; and management that is ethical and transparent. Such certifications serve a 'trust brand' that enable, marketing, for example, to be perceived as being more credible and reliable and can, for example, build brand value, foster innovative sustainable food products and increase responsibility in both enterprises and consumers (Fontein, 2025).

FAO (2018b) considers managing consumer demand and educating, via raising awareness, for example on environmentally sustainable diets and discouraging food waste. Soule & Sekhon (2022) consider also how marketing can be climate sensitive via anti-consumption behaviours. This provides for reasons to not consume and related behaviours, in terms of, for example, attitudes, motives and practices of such, but such behaviour also includes 'reducing, repairing, and reusing existing products

[14]UNCC (2025) provides that there are many certification schemes, for example by the ISO, such as: ISO 14064, Greenhouse gases; ISO 14065, Greenhouse gases – Requirements for greenhouse gas validation and verification bodies for use in accreditation or other forms of recognition; and ISO 14080, Greenhouse gas management and related activities – Framework and principles for methodologies on climate actions. All this intended to make food systems, and thus also marketing within, provide for far lower emissions and attempting to neutralize negative impacts (UNCC, 2025).

so that the production of new material goods (and associated physical resource exploitation) can be minimized as well as reclaiming, restricting and avoidance' (Soule & Sekhon, 2022). Bocken *et al*., (2015) provide the need for marketing to introduce 'new regenerative ways of producing and consuming' that in products or services create positive impacts for the natural environment and climate, but are also socially viable and also ethical, thus all implying for far more sustainability in marketing. Emery (2012) within sustainable marketing considers the emissions provided by products, not only in terms of producing such products, but also in terms of the distribution of such products. In fact, FAO (2018b) considers the need for food prices to reflect not only the 'nutritional value of food, but also and importantly, the environmental costs, such as, for example, biodiversity loss, land degradation, water depletion, and GHGEs.'

Calvo-Porral (2019) considers sustainable marketing and actions that reduce climate impacts, in terms of, for example, shifting cultural values in consumption, via fostering various forms of consumption behaviours such as sustainable, responsible, and mindful consumption behaviours as well as anti-consumption behaviours. Ardley & May (2020) also foster for far more sustainability in marketing as found currently, that focus on encouraging and enhancing consumer behavioural change. Fransen (2024) also considers the role of sustainable marketing in environmental stewardship, in terms of, for example, physical marketing that, for example, provides for better designed packaging that is more easily recyclable and for more durable products. Fransen (2024) also considers the importance of digital marketing and how also this needs to become more natural environment and climate sensitive, for example, via reducing file sizes so as to reduce energy consumption. In this same line of digital marketing, Maksymova *et al*., (2024) consider digital technologies and how such can be used to enhance transitions to greener and climate sensitive behaviours, for example, by making information more readily available and more easily communicable in terms of marketing to consumers. Digital technologies can also have a strong influence on climate sensitivity and neutrality as per the ease of access of data and its analysis, in terms of, for example, emissions foot printing of products (Maksymova *et al*., 2024).

Alacevich *et al*., (2024) considers distribution and marketing infrastructure that is adaptable to climate change, but also mitigating: for example, in terms of waste infrastructure that can be both adaptable and mitigating and also infrastructure that is multi-purpose, and transport infrastructure combined with digital infrastructure. De Cara *et al*., (2017) consider local foods in terms of reduced GHGEs, for example, in comparison to imported foods, and interestingly find that distance and production location are not the only considerations for reduction in GHGEs as other factors come into play, such as for example, spatial matters related to inter and intraregional trade, and social welfare concerns that all need to be considered which effectively may not be related directly to natural environmental and climatic considerations.

Hodson (2019) considers how climate change and its complexities, requires 'an unprecedented level of behaviour and attitude change at all levels of society' that can make convincing individuals and society at large very challenging as per the implied challenges related to behavioural changes. In this regard, marketing requires ' new approaches which address multiple levels of human interaction' (Hodson, 2019) that should affect not only attitudes, but also perceptions and cognitions, for example, of consumers, and not only, that may result in behavioural changes in terms of lifestyles. Indeed, Hall (2018) provides that in marketing the focus on changing individual behaviours to foster more climate sensitivity is seemingly misplaced as social marketing may simply not be enough. Carvill *et al*., (2021) in this regard provide that multiple approaches are required that, for example, focus on the long term as a starting point, and use, for example, social marketing, but then branch out to, for example, actually informing and educating customers using marketing communications, branding, carbon labelling, etc. Amine & Benhallam (2021) provide that behavioural change, with regard to sustainable consumption, thus also in terms of climate change impacts, for example, is not 'a temporary enthusiasm, but rather a lasting change in the collective consciousness and the practices of individuals.' In this regard Amine &

Benhallam (2021) provide an example of organic products, which were once on the margin, but now are mainstream, the new normal, as per consumer and market uptake. In much this same line, Daniel-Chever *et al*., (2021) point to the growing trend of de-packaging, buying packaging free products, which is seemingly becoming mainstream. Elgaaied-Gambier & Bertrandias (2021) point to public sector intervention for changing behaviour that can be, for example, via public awareness raising campaigns, compulsory measures as well as per incentives. Indeed, Halbheer (2019) provides that concerns by consumers and governments can incentivize to provide products and services with low carbon footprints, but also with other footprints, for example, such as water and plastic footprints. Indeed, marketing plays a critical role in furnishing products and services with a low carbon footprint, however, with the success of such products and services, can increase demand and thus increase the carbon footprint for such products and services: a case where 'marketers become victim of their own success ' (Halbheer, 2019).

Thus, and in summary, as per the above findings from the review of literature and source of secondary data and information, climate smart agri-food marketing finds its roots in the green, circular and low emissions economy, is within the realm of food systems, agri-food value chains and agri-food supply chains and derives from green and sustainable marketing. This can be seen in Figure 1.

Fig. 1: Climate smart agri-food marketing roots and derivation

Discussion

From the above research and review of the literature and sources of secondary data and information on climate smart marketing and in specific to climate smart agri-food marketing not much has emerged from such directly. In terms of climate smart marketing, in general, this has emerged mostly indirectly within the evolution of green and then sustainable marketing, for example, over recent years, where there has been, a greater accent on climate change and how marketing can reduce impacts and thus mitigate, and how marketing can adapt to climate change. However, in terms of climate smart agri-food marketing, in specific, this has mostly, if not mainly, emerged indirectly, within literature and sources of secondary data and information on food systems, agri-food value chains and agri-food supply chains. This provides evidence that there is a lack, within literature and sources of secondary data and information, of directly and specifically addressing climate smart agri-food marketing.

This is interesting, as for example, there is plentiful literature and sources of secondary data and information on the green economy, green growth, and the circular economy, but also on the low emissions economy and net zero emissions economy. This providing that in fact focusing specifically on a low emissions economy is important for addressing climate change, even though the green economy and circular economy do address climate change and efforts for mitigation and adaptation and are both interwoven and related to a low emissions economy. Hence, much the same can be provided in marketing, where, for example, sustainable marketing and green marketing do cover climate change matters, but little is found directly in the literature and sources of secondary data and information that concerns specifically climate smart marketing. Thus, much like in a low emissions economy approach to climate change mitigation, for example, climate smart marketing has the same potential, within the realm of marketing, to specifically addresses climate change adaptation and mitigation, and in the case of this research, within the realm of the agri-food sector in BOP-SMs in developing economies. This means that climate smart agri-food marketing derives from and is related with sustainable and green marketing. Indeed, and in general, sustainable marketing addresses the triple bottom line of profit, people and planet, while green marketing focuses mainly on planet, but does not exclude people and profit, in other words the social and economic aspects of marketing. In this regard, climate smart agri-food marketing addresses planet, but specifically in the realm of planet, it focuses on climate change adaptation and mitigation of such, but does not exclude green marketing and sustainable marketing, as it has the potential to enhance both and seemingly has the potential to become in its own right an important area of marketing on its own, if not a new paradigm in itself.

However, in terms of climate smart agri-food marketing what needs to be considered is the context of BOP-SMs in developing economies, the inherent change and change management that such contexts imply and the nature itself of agri-food marketing in BOP-SMs.

BOP-SM contexts

Typically BOP-SM contexts are heterogeneous between and within and portray, as provided by Sinha & Oburai (2008): low incomes, cash flows and saving rates; reliance on remittances; varying social structures and there effects on purchasing; market fragmentation, shortages and informality; risks, uncertainties and shocks; lack of literacy and more in general consumer literacy; emigration to foreign countries and rural to urban migration; weak infrastructure; weak distribution systems; and underdeveloped legal frameworks. Indeed, such poverty settings place a 'cognitive burden on individuals that makes it especially difficult for them to think deliberatively, as for example, a great deal of mental energy every day goes just to ensure access to necessities such as food and clean water' (World Bank, 2015b). This in turn, usually and seemingly generates, a way of seeing oneself as being incompetent, unable to take advantage of opportunities and disrespected and thus having low aspirations (World Bank, 2015b). It also provides for a focus on the present and not on the future (World Bank, 2015b) as per the impinged needs for daily survival.

Consumers, for example, can be illiterate to semi-literate and have little if any understanding of what it means to be a consumer, are constantly under high degrees of uncertainty, deprivation and generally portray low self-esteem, but do have some idea of what value means, rely on empathy, orality and social and relational networks, do not routine buy and seek relations, preferably long term, with sellers as such can provide to be a life line in hard times, via for example, extending consumption credit (Viswanathan, 2020). This interrelationship between customer and seller fosters also high degrees of interdependence and customization and attempts to build trust (Viswanathan, 2020). In purchasing, consumers seek references from their social and relational networks, for example, family, friends and the wider community, and are thus influenced by the community in their purchase decisions, including the culture or differing cultures that may be found in such local communities (Viswanathan, 2020). However, consumers also in such contexts, tend to be what can be termed consumer-entrepreneurs: consumers can be sellers and sellers can be consumers (Viswanathan, 2020). Seeing the dire nature of

such BOP-SM contexts, consumers, for example, may trade some of their agri-food products bought with other consumers. Thus, consumers, usually, are by necessity entrepreneurial. Such micro-scale consumer- entrepreneur enterprises are usually also joined by family members in attempts to survive the daily struggle of hardship and poverty and thus are family-based micro-scale agri-food enterprises.

Change and change management in BOP-SM contexts

The BOP-SM contexts are dominated by volatility, uncertainties, risks and shocks, for example, as seen previously. These characteristics are much in line with what is provided by climate change and its impacts, and thus such contexts and people within, are seemingly more prone to also face up to the vagaries and unpredictable changes that climate change implies. Further this means that people that live and work in BOP-SM contexts are used to change and thus have learnt to manage change. Indeed, and to a degree, it may be 'impossible to anticipate the when, what, and where of change' (HBE, 2003), thus making change management a necessity that is inevitable and can be risky and mostly uncertain, but can also provide for opportunities that can enable survival. In other words, people in BOP-SMs are most often resilient: they have the capacities to deal with change, live with it, and make use of it. Indeed, in BOP-SM contexts, change, for example, can be related to shocks and crises, be incremental, but more often than not is continuous and there is thus an inherent set of capabilities of those within BOP-SM contexts to adapt to, attempt to mitigate and attempt to take advantage of such change.

Thus, and for example, learning from BOP-SM contexts can seemingly be a viable way to climate smart agri-food marketing. In fact, and on a daily basis, people living within BOP-SM contexts need to adapt and mitigate the unpredictability of poverty and navigate such in the quest for survival. As such in quests for survival, and the implied know-how and behaviours, for example, portrayed and demonstrated, may lay important lessons for climate change adaptation and mitigation that can be applied to agri-food marketing.[15] However, such is not only devoted to locally developed technologies, for example, that may mitigate climate change, but can also be related to activities, processes, systems, knowledge, and as provided previously, also know-how and behaviour that can all be conducive to climate smart mitigation and adaptation in agri-food marketing.

Agri-food marketing in BOP-SM contexts in developing economies

Commonly, consumers tend to by small quantities of agri-food products, frequently, as per their meagre circumstances. As per such dire demand found in BOP-SM contexts, and the consumer enterprise duality, enterprises that operate within such contexts tend to be micro-scale and informal (ILO, 2022). In this regard, and as per their size and meagre turn over, such enterprises in marketing, for example, agri-food products, tend to rely on entrepreneurial skills more than on anything else, providing an interface between marketing and entrepreneurship: entrepreneurial marketing. Entrepreneurial marketing 'entails the proactive identification and exploitation of opportunities for acquiring and retaining profitable customers through innovative approaches to risk management, resource leveraging and value creation' (Cacciolatti & Lee, 2015). In fact, and typically, 'entrepreneurial marketing, operates in an uncertain environment, where market conditions are discontinuous and the needs of the market are as yet unclear' (Hills & Hultman, 2013) as entrepreneurial marketing commonly is most apt for fluctuating and changing environments (Collinson & Shaw, 2001), like those found in BOP-SM contexts. Seeing though, the inherent interdependence with consumers, such enterprises also provide for relationship marketing and in their empathy towards consumers, for example, in extending consumption credit, provide also for social marketing. Indeed Hilmi (2025b) finds that agri-food marketing in BOP-SM contexts is entrepreneurial, relational and social, but also localized, service, system and survival oriented as well as being set on three levels, the

[15] There is an implied irony here. In developing economies, and within BOP-SM contexts, such provide far smaller amounts of GHGEs compared to developed economies, but can potentially provide for viable field-based solutions for climate change adaptation and mitigation for agri-food marketing.

micro, meso and macro-marketing levels. Hilmi (2022c) also finds that agri-food marketing needs to consider the rural and urban contexts of BOP-SM settings, thus agri-food rural marketing and agri-food urban marketing as well as the digital in agri-food marketing: digital agri-food marketing (Hilmi, 2021b).

Hilmi (2025b) provides that localization marketing is implied by the high heterogeneity of BOP-SM contexts and hence the need, for example, to focus on specific localities in terms of agri-food marketing and be embedded in such contexts so as to be able to better understand how the exchange of products and related services occur. This also includes in terms of localization considering rural, peri-urban and urban areas as agri-food marketing in such contexts does differ in its nature as found by Hilmi (2022c). Agri-food marketing within BOP-SM contexts is also survival marketing, for example, as per the implied necessities of creating social and relational networks so as to attempt to overcome the daily challenges implied by BOP-SM contexts via alliances and partnerships with others (Hilmi, 2025b). Agri-food marketing in such BOP-SM contexts is mainly, but not only, based on a systems approach, system marketing, implying, for example, a focus on the marketing process and the functions and activities provided at each marketing stage, so as to ensure, for example, agri-food product accessibility and availability (Hilmi, 2025b). Further agri-food marketing of products is also embedded with services marketing, as such furnishes added services to agri-food products, for example, ready to eat meals, food customization, credit on consumption, etc. Such service-oriented marketing as well as the BOP-SM context, implies relationship marketing as per the mutual needs and interactions between enterprises and customers for survival. Such in turn, implies, as per the interdependence for survival, for example, of both enterprises and customers, are also social, thus social marketing. This can involve, for example, the enterprise providing for credit on consumption.

The use of technologies within BOP-SMs, for example, mobile phones and digital media, implies also digital marketing. In fact, Hilmi (2021b) finds that agri-food marketing in BOP-SM contexts is also digital as such is conducive to agri-food marketing in such meagre BOP-SMs. Further, and seeing the nature of the BOP-SM, for example of being volatile and uncertain, the micro-size of enterprises commonly found within and thus the inability to plan marketing, makes all such marketing entrepreneurial, in other words entrepreneurial marketing. Moreover, even though the focus of most agri-food marketing in BOP-SM contexts is at the exchange level, between the micro-scale enterprise and the consumer, a micromarketing level perspective, the community and wider society influences on such cannot be ignored (Hilmi, 2022d). The community in BOP-SM contexts, for example, has an influence on individual consumption purchase decisions as well as in how agri-food products are consumed, thus making agri-food marketing rest also at the mesomarketing level(Hilmi, 2022d). In turn, the community marketing system, is influenced by much wider societal issues of, for example, marketing infrastructure such as roads and clean water supply, the well-being and quality of life of society, etc., the macromarketing level (Hilmi, 2022d). This all implying taking a three pronged approach to agri-food marketing. Thus, and overall, agri-food marketing in BOP-SM contexts in developing economies is localized, rural and urban, survival, system, service, relational, social, digital and entrepreneurial - oriented and considers the micro, meso and macromarketing levels(Hilmi, 2025b). This all inherently implying that agri-food marketing needs to be adaptable, flexible, variable, versatile, agile and innovative within BOP-SM contexts (Hilmi, 2025b).

Climate smart agri-food marketing

Climate smart agriculture (CSA) is fundamentally site specific and thus considers local areas, including economic, social and environmental contexts of such local areas (FAO, 2013). The CSA approach also considers the needs and interactions between stakeholders, identifies challenges, energy needs, possible trade-offs that need to be considered and takes account of the complexities involved in the interconnected challenges of climate change, development and food security. Thus, and in line with the CSA approach, also climate smart agri-food marketing should consider much the same

approach: localization and the impacts of climate change on such and what can be done in terms of adaptation and mitigation to counter act such. This, like CSA, taking into consideration , for example, the specific food commodities being marketed, local environmental and climate contexts in which agri-food marketing takes place, the interconnections with other local areas, economic, cultural, social and political aspects of localities, the stakeholders involved and their vulnerabilities, the challenges faced, and trade-offs that need to be considered. Indeed, in climate change impacts on agri-food value chains, for example, FAO (2022) also considers local areas in terms of 'the geographic area, the types of food commodities and social and economic assets, and the degree of exposure and vulnerability of actors and infrastructure.'

As seen previously, in fact agri-food marketing in BOP-SMs in developing economies needs to consider localization marketing, where the high heterogeneity of and between BOP-SMs is considered. This localization marketing considers such matters as, for example, local agri-food markets and marketing systems, including the business to business and business to customer agri-food markets; agri-food products being marketed; agri-food consumers; local cultures; local communities; local economy and political systems; rural, peri-urban and urban contexts; natural environmental resources; local climate, etc. It is basically an embedded marketing approach that can provide a good deal of information on the locality and a lot can be learned from such, including possible climate adaptation and mitigation measures that may have been already taken. Along with localization marketing and inherent to this is rural agri-food marketing and urban agri-food marketing. Indeed, climate smarting agri-food marketing also needs to consider the interconnections in local areas of climate change impacts. For example, agri-food marketing in rural areas and especially in urban areas and how such can impact on climate change mitigation and adaptation. Hilmi (2022c) identifies the rural and urban interface, and how agri-food marketing does not only connect rural food supply to urban areas, and peri-urban areas, but also to other rural areas, and how urban agri-food marketing not only operates in urban centres, but may also serve peri-urban and rural areas with agri-food products. As is well known, urban and peri-urban centres tend to be major 'emission hubs' and urban agri-food marketing may be no different. Also, rural agri-food marketing can provide for a considerable source of emissions, as for example, agri-food products need to be transported from distant rural areas to urban centres (Crossley *et al*., 2009).

Thus, localization marketing and inherent rural and urban marketing can be very fruitful in identifying, for example, agri-food marketing practices that may mitigate climate change and also be adapted to climate change. FAO (2022), for example, in terms of climate smart agri-food value chain provides that via 'identifying and assessing current and potential future risks of each stage (including the marketing stage of agri-food value chains), enables to prioritize different adaptation and/or mitigation options, determine the urgency of those options and identify the most appropriate investments accordingly as well as assessing climate risks and climate resilience.' Indeed, learning from local BOP-SMs, as provided by Hilmi (2019b), for example is a critical element for climate smarting agri-food marketing. However, such learning should not only focus on possible innovations found in terms of locally developed technologies, but also on activities, processes, systems, knowledge, know-how and behaviour that can be conducive to climate smart mitigation and adaptation. This learning will thus facilitate uptake as there will be more of a 'local affinity' to such climate smarting activities of agri-food marketing. As also mentioned previously such learning, for example, in terms of locally found know-how, is ascertained and diagnosed and can then be replicated within a local BOP-SM context as well as shared with other BOP-SM contexts. However, taking such an approach does not exclude 'importing' into local BOP-SM contexts green and climate smart innovations that may derive from other BOP-SM settings as well as from other countries, both developing and developed.

Consumers in BOP-SM contexts are aware of natural environment degradation (Viswanathan, 2020) as well as the impacts of climate change. Indeed poor communities are far more vulnerable to impacts of climate change, but as per the dire BOP-SMs and its impingements, tend to make people focus 'far

more on the present than with the future as survival commonly implies, for example, and indeed individuals' judgments about the climate are based on what they have perceived recently' (World Bank, 2015b). This, however, does not mean that people in BOP-SM contexts are helpless and cannot be resilient, far from it, just the daily survival in such contexts implies being, for example, entrepreneurial, change managers, and as such overall resilient, but on matters that are tangible, palpable and can give immediate release for meagre daily survival. Climate change is usually not immediately tangible as can be natural resource degradation, hence, even though being aware of natural environmental and climate degradation, for example, as per the felling of trees to provide wood for energy needed for food processing, such activities solve daily needs and provide immediate strategies on how to counter act the many challenges of poverty. In this regard, thus climate smart agri-food marketing needs to consider behavioural matters within local marketing systems that, for example, provide for immediate responses to alleviating poverty, but at the same time enable to mitigate and adapt to climate change. In other words, mitigation and adaptation should be tied into survival marketing.

Hilmi (2019b) in terms of developing green food value chains in BOP-SM contexts, provides that innovations that can be found are numerous, but should not only be considered in technology terms, as provided previously, but also as activities, processes, systems, knowledge, know-how and behaviour. For example, Hilmi (2016b) found that post-production (marketing) innovations found locally in BOP-SM contexts could be climate smart in terms of mitigation. In terms of technologies Hilmi (2016b) found that ' self-made water filters for water purification for washing table tomatoes, prior to marketing, were found in Dar es Salaam, Tanzania . The water filter was simply composed of two pieces of cloth, and sand was sandwiched and wrapped in the cloth and water was passed through the filter in attempts to purify the water for cleaning tomatoes.' Such a technology involved minimal emissions as no energy was used in the operation, and the only emissions implied were the original emissions that had been used to produce the cloths that were used for filtering. Thus this 'innovation' was locally developed, was emission mitigating, provided for tomatoes that were clean, and thus enabled better marketing, and hence enabled for survival to occur for the agri-food micro-enterprise that was attempting to market the clean tomatoes. This is in fact where localization marketing is interwoven with survival marketing as this facilitates and provides a 'survival incentive' to mitigate emissions, for example.

In many BOP-SMs, agri-food marketing enables survival as marketing fosters trade, exchange, and thus income generation. Those operating micro-scale agri-food enterprises, for example, be it farmers, traders, wholesalers and retailers are in business to generate income, but mainly so as to survive in such dire contexts. Thus, conjugating survival marketing with climate smart mitigation and adaptation makes such tangible for agri-food micro-scale enterprises. For example, in terms of know-how in tendering to climate mitigation and adaptation, in Accra, Ghana, it was found that some women street food vendors, group owned charcoal cookers that would be used in turn and when required, thus reducing cooking emissions (Hilmi, 2016b). It was later found that the self-made charcoal cookers were modified to be placed above the ground level, so as to adapt to the increase in rain fall intensity that would flood streets during the rainy season, for example. Such know-how enabled women street food vendors to survive by keeping their enterprise running even during weather adversity, and cut enterprise costs, by using shared cooking facilities. Thus, this being an example of how considering local survival know-how can enable and facilitate climate smart mitigation and adaptation to agri-food marketing.

Localization and survival marketing are interwoven with the system marketing approach taken by agri-food marketing in such contexts. Taking a marketing systems approach as per FAO (2022), for example, enables 'identifying and assessing current and potential future risks of each stage (including the marketing stage of agri-food value chains), enables to prioritize different adaptation and/or mitigation options, determine the urgency of those options and identify the most appropriate investments accordingly as well as assessing climate risks and climate resilience.' This considers not only each stage of agri-food marketing and the activities and functions carried out at each stage, but

also the entire process.[16] Thus, climate smart agri-food marketing needs to consider the business to business interface along the marketing system as well as the business to customer interface. Also here, learning from BOP-SM contexts can provide for mitigation and adaptation in such a systems approach to marketing. For example, in terms of mitigation, in the southern part of Tehran, Iran, food distribution systems had highly intensive geographical coverage, via street food sellers mainly, and thus small physical distances were needed for customers to access agri-food products, thus averting as well as reducing emissions (Hilmi, 2016b). Tied into such an approach, street food vendors also offered home delivery, which normally occurred mainly by bicycle and/or on foot delivery, thus averting emissions, this providing also for a service, service marketing approach in BOP-SMs, that was very competitive. As documented by Hilmi (2024), in fact, 'large supermarkets and their chains, represent only about 10 to 15 percent of consumer preference in where to buy food in Tehran.' Consumers 'prefer buying local agri-food products that are also organic, and like to focus on quality and also on nutritional value' (Hilmi, 2024), which street food enterprises can deliver in local areas, thus providing for localization, survival, system and services marketing that are intertwined with emissions mitigation, for example.

Clearly all such localized, survival and systems-based agri-food marketing approaches are relational in nature. This implying relationship marketing. For example, survival marketing, as per its very nature implies relationships, as agri-food micro-enterprises rely on customers for their survival and customers, in turn, rely on agri-food micro-enterprises. Relationship marketing in BOP-SM contexts builds on networks (systems), that can be based on, for example, family ties, friends and local communities, thus is also part of localization, survival and systems marketing. In terms of climate change adaptation and mitigation, relationship marketing can for example foster the reduction of food waste and thus mitigate emissions. For example, in Tunis, Tunisia and Cairo, Egypt, relational networks of street food vendors with other street food vendors would avert tomato waste: ' tomatoes that were not fit for fresh sales (bruised, grazed, starting to wilt, etc.), were sold on to close by small roadside street food restaurants. The processes adopted for such methods were found to be highly effective and efficient as commonly such reusage processes were short and in the vicinity of the small-scale street vendors' (Hilmi, 2016b).

Relationship marketing also implies social ties, for example, in BOP-SM contexts. These not only in terms of building trust, but also in terms of, for example, empathy with people in a community. This thus implying social marketing. For example, in Iraq, Hilmi (2021c), found that at the end of the trading day, agri-food micro-enterprises in markets, would gift unsold produce to the less fortunate, this making such enterprises also social enterprises. In terms of climate change mitigation, for example, such gifting averted food waste that could end up in landfills, and thus cause emissions, and also averted the agri-food micro-scale enterprise having to transport and store such produce again, this also contributing to reducing emissions.

Climate smarting agri-food marketing also needs to consider the high penetration of mobile and digital technologies in BOP-SM contexts. The penetration of ICTs, for example, has been well documented, and Hilmi (2021b), for example, found that there are a good deal of characteristic similarities between digital marketing and agri-food marketing in BOP-SMs. For example, digital marketing of agri-food products can facilitate a better understanding of what agri-food products are needed by which retailers, and thus making agri-food marketing more efficient and thus prone to less emissions (Hilmi, 2021b). Such, for example, can be achieved very simply, via mobile APP WhatsApp messaging, between a wholesaler and a number of retailers, that can not only ascertain needed

[16] Such a systems approach to marketing is most often non-linear and, for example, can include waste streams of agri-food by-products or sub products that derive from the agri-food marketing system which then may feedback into such a marketing system or be marketed elsewhere. Such agri-food marketing systems can be termed 'shadow' agri-food marketing systems as they rely, derive and operate as a result of main agri-food marketing systems by-products or sub-products, for example (Hilmi, 2019a).

quantities, but also make transport of agri-food products more targeted and thus more efficient and hence reduce emissions of the transport function of agri-food marketing.

As provided previously, agri-food marketing by micro-scale agri-food enterprises is fundamentally entrepreneurial marketing. Thus, entrepreneurial marketing is at the basis of, and interwoven with, localization, rural, urban, survival, system, service, relationship, social, and digital marketing. The size of agri-food enterprises being micro and the BOP-SM context and its volatility and uncertainties, for example, does not allow for planning and as such makes marketing entrepreneurial. In this regard, reducing and attempting to mitigate emissions was provided by, for example, entrepreneurial behaviours of street food vendors in Dar es Salaam, Tanzania, who would ' collect ash from their charcoal fires and store it in sacks and would then barter the ash with farmers who would use it in their fields. Further the same street food vendors would use charcoal very sparingly to cook food and the cookers were usually made out of recycled materials, such as large petroleum barrels that had been cut in half and wire handmade grills placed on top of them' (Hilmi, 2016b). In another example of entrepreneurial behaviour devoted to reducing and attempting to mitigate emissions was provided by street food vendors, still in Dar es Salaam, Tanzania, in terms of drying tomatoes, where 'recycled plastic paint buckets were used to cover tomatoes for drying. Tomatoes were washed, cut up into slices and pulped. They were then salted sparingly and placed in the sun on the lid of the recycled paint bucket and then the paint bucket was placed on top of the lid. The heat generated by the sun would dry the tomatoes in such sun-powered oven ' (Hilmi, 2016a).

Thus, entrepreneurial agri-food marketing, in BOP-SM contexts, implies that agri-food marketing needs to be, adaptable, flexible, variable, versatile, agile and innovative (Hilmi, 2025b). There have been plenty of examples of innovations, as shown previously, but not just innovation in locally found BOP-SM 'technologies,' but also in terms of activities, processes, systems, knowledge, know-how and behaviour. Also, such agri-food marketing by its very nature needs to be adaptable as per, for example, the volatility of BOP-SM markets and inherent uncertainties implied, and also be flexible, versatile, variable and especially agile so as also to cope with such uncertainties. These all make agri-food marketing prone and fertile for applying both climate change mitigation and adaptation activities, for example, which do require being adaptable, flexible, variable, versatile, agile and innovative. Further on this same matter, and considering Table 1 above and the post-production (marketing) climate change impacts that may occur, it is more than evident that agri-food marketing needs to be adaptable, flexible, variable, versatile, agile and innovative. Moreover, and as provided previously, even though the focus of most agri-food marketing in BOP-SM contexts is at the exchange level, in other words, between the agri-food micro-scale enterprise and the consumer, a micromarketing level perspective, the community and wider society influences on such cannot be ignored (Hilmi, 2022d). This also with regard to climate change and how it does not only affect local areas. The community in BOP-SM contexts, for example, has an influence on individual consumption purchase decisions as well as in how agri-food products are consumed, thus making agri-food marketing rest also at the community level, in other words the mesomarketing level(Hilmi, 2022d). This also implies community involvement in climate change adaptation and mitigation as per the inherent and implied agri-food community-based marketing systems that are found. In turn, the community agri-food marketing system, is influenced by much wider societal issues of, for example, marketing infrastructure such as roads and clean water supply, and the well-being and quality of life of society (Hilmi, 2022d). This, thus focusing on the macromarketing level of the wider society, for example, in a country. This also implying wider societal involvement, for example, in climate change adaptation and mitigation as per the inherent and implied agri-food country-based marketing system that is found.

Thus, and from the above, climate smart agri-food marketing in BOP-SM in terms of attempts to adapt too and mitigate climate change impacts needs to be localized, rural, urban, survival, system, service, relational, social, digital and entrepreneurial-oriented and consider the micro, meso and macromarketing levels. This all inherently implying that agri-food marketing needs to be also

adaptable, flexible, variable, versatile, agile and innovative within BOP-SM contexts (Hilmi, 2025b). Figure 2 shows the climate smarting agri-food marketing process.

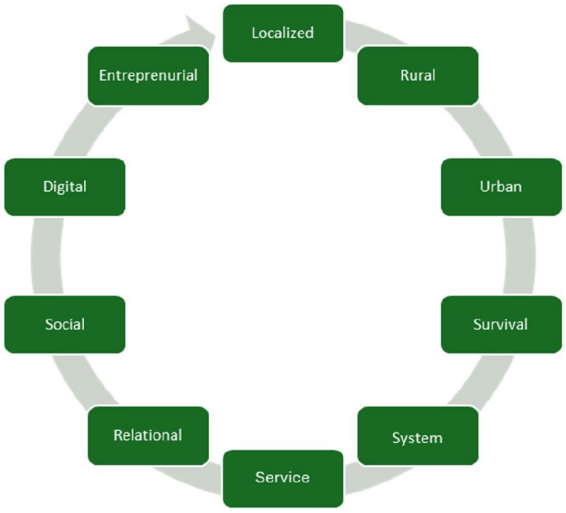

Fig. 2: Climate smarting agri-food marketing

However, there is a need to also consider other matters that may influence the climate smarting of agri-food marketing. As provided previously, climate smart agri-food marketing needs to be considered in terms of the agri-food marketing system and as such pertain to both business to business marketing and business to customer marketing.

The next matter to consider is trade-offs in climate smart mitigation and adaptation in agri-food marketing. For example, in agri-food waste valorisation, in other words the recycling of waste, Hilmi (2019a) found that such a process does consume energy and thus does provide for emissions. This being a trade-off. However, at the same time, the reintroduction of recycled materials into agri-food marketing systems are usually provided with a lower energy rate, thus reduced emissions, and this reintroduction of materials excludes the use of primary raw materials (GIZ, 2011) thus reducing, for example, the use of natural resources, their processing and related emissions.

Further, and still in terms of trade-offs, for example, cultural matters may need to be considered. For example, in terms of consumption behaviours, in Tunis, Tunisia, it was found that as per the culture of hospitality a lot of bread was bought for events and occasions and commonly resulted in bread being left-over. This providing for waste, and possible increased emissions in landfills. However, it was also found, that left over bread was not always wasted as it was gifted to the needy or feed to chickens in backyard poultry production systems as part of the feed mix (Hilmi, 2016b).

Moreover, trade-offs need to be considered in terms of, for example, employment in waste streams generated by agri-food marketing activities and processes. Such waste streams do provide employment and livelihoods for many people, for example, waste pickers, and thus, reducing such waste streams can jeopardize people's livelihoods. However, in such waste streams, 'any residual value left in waste is recaptured' (Hilmi, 2016b) and thus may be beneficial to climate smarting. Clearly, and as provided previously, waste streams and the recapture of value in waste do provide, for example, for emissions, but such matters do need to still consider people's livelihoods who operate in such waste streams. For example, in 'Iran it was found that in pistachio processing enterprises that provide for shell-less pistachio, the shells were used as an energy fuel for powering processing machinery' (Hilmi, 2016b).

Such an energy source does create emissions, but also provides for the collection and re-use of pistachio shells, thus employment for people working in pistachio processing enterprises.

Importantly, climate smart agri-food marketing also needs to consider how interconnected climate change is with other matters which are not only found at the local level. For example, national international and global agri-food trade, all have effects on local agri-food marketing not just in economic terms, but also in terms of the climate. Indeed, and as another example, long range transport of agri-food products in terms of exporting, may causes increasing GHGEs, and thus affect also local areas. Yet, another and further example, natural resource consumption in one area of the world, the cutting down of rain forests for agricultural land and timber, may have significant climate change impacts in other areas of the world. There may also, for example, be the case of migration to a local area, as a result of an extended brought in another area, and this creating a surge in demand for food, that may not be able to be fulfilled. This, in turn, creating social and political tensions that may upset local contexts in terms of over usage of natural resources, for example, and thus also upsetting agri-food marketing systems. Moreover, climate smarting one stage of agri-food marketing may have unexpected impacts on another stage or stages of agri-food marketing. For example, reducing waste at the food processing level, may inhibit waste valorisation to take place and thus the re-introduction of such valorised waste at the retail level.

Another matter to consider is that climate smart agri-food marketing requires long term strategies for climate change mitigation and adaptation. Usually, short term strategies are not viable as, for example, reducing emissions in transport, by transporting more agri-food products per journey, does contribute to mitigating emissions, but it does not solve the basic problem of emissions deriving from transport vehicles and how they are powered. However, in BOP-SM contexts, long term strategies and planning are not really viable as per the volatility of such contexts, and the uncertainties provided, thus making, for example, immediate survival the real concern. In fact, poverty usually makes people focus on the immediate daily needs and not so much on future needs.

The process provided for climate smarting agri-food marketing needs to be considered as a step by step process, but each step may occur simultaneously. For example, the localization marketing step commonly may occur along with the systems marketing step as learning from BOP-SMs for mitigation and adaptation needs to be identified at every stage of marketing system and at each stage survival marketing may be identified so as to create incentives for mitigation and adaptation. The process also needs to consider the change oriented nature that is common of BOP-SM contexts, as for example, per its volatility, and thus, in turn, the cyclical nature of climate smarting agri-food marketing as the process repeats itself over and over again over time.

Lastly, also what has to be considered is that climate smart agri-food marketing needs to be considered within the background of the green economy, the circular economy and the low emissions economy; in the post-production stages of climate smart food systems, climate smart agri-food value chains, climate smart agri-food supply chains and green food value chain development; and in and within the realm of green marketing and in turn in sustainable marketing, as provided also previously. Such considerations, for example, can potentially provide for a 'bigger picture' that can be conducive to climate smarting agri-food marketing.

Conclusions

Thus, and overall, and in summary, from the above research findings, what emerges is a process for climate smarting agri-food marketing in BOP-SM contexts in developing economies that focuses mainly on learning from BOP-SM contexts. This can provide for finding locally-based climate smarting technologies, activities, processes, systems, knowledge, know-how and behaviour. Such, if found, can be used successfully and replicated within agri-food marketing as uptake of such will be far more familiar to people involved in agri-food marketing. However, such an approach does not and should not

exclude climate smart agri-food marketing to also 'import' learning from other BOP-SMs as well as from other parts of a country and other countries in terms of climate smarting technologies, activities, processes, systems, knowledge, know-how and behaviour. But not being locally generated, may require adaptations and modifications, for example, to be applied to make them more locally palatable and thus implementable within agri-food marketing.

Importantly, and as per the findings, climate smart agri-food marketing needs to be localized, tied into survival marketing, that gives adaptation and mitigation efforts, for example, a good incentive to be implemented. Climate smarting agri-food marketing also needs to be system focused, provide for services, and be relational and social, as well as digital and all carried out entrepreneurially, and considering the micro, meso and macromarketing levels. This implying that climate smarting agri-food marketing be adaptable, flexible, variable, versatile, agile and innovative.

Thus, and in summary, the process of climate smarting agri-food marketing needs to learn from BOP-SM contexts and focus on:

- Localization marketing
- Rural marketing
- Urban marketing
- Survival marketing
- Systems marketing
- Services marketing
- Relationship marketing
- Social marketing
- Digital marketing
- Entrepreneurial marketing
- Micromarketing
- Mesomarketing
- Macromarketing

The above inherently implying that agri-food marketing needs to be adaptable, flexible, variable, versatile, agile and innovative within BOP-SM contexts. Also, and importantly, trade-offs need to be considered; how interconnected climate change is with other matters, for example, from local to regional, to national to international to global; long terms strategies and plans not being viable for agri-food marketing in BOP-SM contexts; climate smarting in one stage of agri-food marketing may have effects and impacts on other stages of the agri-food marketing system; how steps in climate smarting agri-food marketing may occur simultaneously; how the process is cyclical over time as per the change-oriented nature of BOP-SM contexts; and how also climate smart agri-food marketing needs to also consider inherently the green economy, the circular economy and the low emissions economy, the post-production stages of climate smart food systems, climate smart agri-food value chains, climate smart agri-food supply chains and green food value chain development and green marketing and sustainable marketing, so as to foster gaining a bigger picture.

Clearly the climate smart agri-food marketing process that emerges from this research is not 'the process,' but is, possibly, one among the many options to climate smarting agri-food marketing. It is a first step towards attempting to better understand and importantly define climate smart agri-food marketing as a new paradigm. As such a conclusion implies, and seeing the lack of literature and sources of secondary data and information on climate smart marketing and more specifically on climate smart agri-food marketing, further research is much required on the subject matter.

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