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Article

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Inclusive operations at the base of the pyramid: sustainable value creation for mitigating social exclusion

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ABSTRACT

Literature on inclusive production, logistics and sustainable supply chain models and good practices for BOP markets is sparse. This paper reports results of a cross-case study on supply chains in base-of-the-pyramid (BOP) societies. Inclusive procurement, production and distribution activities are identified as central elements to achieve sustainability, poverty alleviation and to avoid social exclusion in BOP markets. By combining BOP research and social exclusion theory, this work aims to provide structured insights into the design of inclusive operations and their sustainability contributions in developing countries by the cross-case comparison of four case studies of frugal products produced and mostly sold in Ghana and India. The explorative research shows that inclusion can be realized in all parts of the supply chain: Inclusive supply chains show a funnel-shape with an increasing number of involved local actors from product development, to procurement, production and distribution. Our findings also reveal that while external financing is key for viability in BOP settings, inclusive operations are required to avoid exploitation risks and enable sustainable local value creation.

KEYWORDS: Supply Chain Management · Sustainability · Developing Countries · Co-Creation · Inclusion · Multiple Case Study

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1. INTRODUCTION

Social, economic and technical developments change living and working conditions globally. Even the so-called Bottom of the Pyramid (BOP) – a term frequently applied to gather approximately 2.7 to 4.3 Billion people worldwide that live on a daily income of less than 1.25 \$ and thus represent the lowest level of the global income pyramid [1, 2] – is heavily affected by the changing conditions, due to the loss of biodiversity, climate change and the globalization of trade and production. Increasingly, the BOP is perceived as a highly attractive market for multinational corporations [3]. The development of this market is perceived as one main approach to fight poverty and to increase the wellbeing of those people at the BOP [4]. For this reason, Multi-National Corporations (MNCs), -local and global governments as well as NGOs are interested in the sustainable development of BOP markets and in the social inclusion of the actors of the BOP society [4, 5]. Several literature streams and empirical findings suggest that a targeted design of operations and supply chains can have powerful outcomes for sustainable development of BOP societies [6-8] and can even mitigate social exclusion. In order to emphasize the contributions of social inclusion, several insights from social exclusion theory are adopted. Therefore, operations must be adapted towards inclusion and participation of local actors to achieve sustainability [4]. Value-adding processes of production, logistics and services were identified as core elements to realize this inclusion.

However, so far, no specific research was conducted to systematically describe the required process design [9]. Although there are several success stories of companies serving the BOP markets while alleviating poverty, expansion into the BOP markets poses several challenges, especially related to global supply chain (SC) design, local production, logistics and service provision [10]. Yet, the literature is sparse on inclusive production, logistics and operations models and good practices for BOP markets. Existing literature explores

issues related to partnerships [11], marketing [12], product development [13], business models [6, 14-15], and distribution [16, 17]. The guiding research question is: How are inclusive operations designed in local BOP markets in order to achieve economic viability, sustainable poverty alleviation and mitigation of social exclusion?

Combining BOP research and social exclusion theory, this work aims to provide structured insights into the design of sustainable and inclusive operations in developing countries by the cross-case comparison of four case studies of sustainable frugal products (see [14]) produced and mostly sold in Ghana and India.

2. STATE OF THE ART

Several research streams indicate the importance of and provide impulses for the research on the inclusion of local actors in sustainable SC activities in developing countries.

2.1. Social Exclusion Theory

Social exclusion is an approach to poverty developed in industrialized countries to describe the process of marginalization or exclusion, which happens also within industrialized countries. The EU defines social exclusion as a “*process through which individuals or groups are wholly or partially excluded from full participation in the society in which they live*” ([18], p. 129). The term in general is associated with several difficulties from various characters, some of which relate to labour market marginalization, poverty and social isolation. They are “*mutually reinforcing, generating a vicious circle that leads to a progressive deterioration in people's social situation*” ([19], p. 3).

Adato et al. (2006) state that exclusion has both economic and social dimensions [20]. The former is related to the fact that excluded individuals are denied “*opportunities to earn income*” through the exclusion from “*the labour market and access to assets*”. Gallie et al. (2003) elaborate on the negative consequences resulting from social isolation due to unemployment with a focus on the fact that all aspects of life are affected. Socially excluded people are more likely to have problems within their family as well as with their previous social circles leading to psychological stress and continuous pessimism [19]. Therefore, social exclusion is of relational nature and a dynamic concept, since it has the ability to affect other deprivations and also promotes falling into poverty [21]. Empirical findings in social exclusion studies suggest that the main mechanisms causing social exclusion are rooted in poverty and resource constraints [19].

BOP population has been excluded and denied access to resources, capabilities and opportunities [22]. The same authors provide a nuanced view of inclusiveness

(they call it *ladder of inclusive innovation*), where at the most basic level, by not addressing the needs or problems of certain groups, traditional innovation models have excluded individuals at the BOP. Moreover, Shivarajan and Srinivasan (2013) explore the lack of access to global knowledge networks in BOP markets as a severe form of social exclusion. They argue that in today's interconnected world, not being able to participate, contribute and benefit from the global knowledge may lead to multiple severe deprivations [23].

Social exclusion is combated by plans and strategies for inclusion, mainly taking part in society and empowering to participate in employment, communication, community and infrastructure, etc. [24]. This also includes the access to resources, products and services, rights, etc. As “*the private sector is a major driver of exclusionary processes*” ([25], p. 157) it is of crucial interest how inclusive sustainability SC strategies can contribute to a mitigation of social exclusion [25].

2.2. BOP Markets and Inclusive Supply Chains

BOP markets have been proposed by scholars as the next untapped realm of opportunities where global and local companies can create significant economic returns while contributing to local human development [3, 26]. The initial idea was that MNCs can contribute to eradicate poverty by offering products and services to BOP markets [2]. Due to criticism of this approach [23], BOP scholars advanced the discourse to BOP 2.0 where the low income consumers are also involved in the value creation processes [15]. In this understanding, the individuals at the BOP are perceived as active economic actors and this has significant implications for the way MNCs design their global SCs.

Several authors argue that business models adapted to local framework conditions (e.g., infrastructure, education, resources) with participative elements aimed at involving the poor into global SCs are needed [9; 14; 27]. Gold et al. (2013) argue that MNCs should involve the poor through the participative design of production, logistics and service processes while simultaneously ensuring economic value creation and prevention of ecological damage [9]. These *inclusive SCs* differ from socially responsible SC. Social aspects in SCs focus largely on employees' wellbeing and education, safety and health practices, community compliance and public relations [28; 29]. Inclusive SCs go beyond the issues which directly affect the firm's bottom line and integrate in their effective management issues related to societal development in the long run. This idea of social issues related to poverty alleviation has been largely neglected in sustainable SC research [30].

However, although it seems logical to include local actors into value adding activities along the SC, in particular, MNCs face several challenges. First, BOP markets present informal market characteristics, power and knowledge asymmetries, low education levels

and socio-cultural barriers. Second, MNC often have to comply with international standards for product development, labor issues and compliance with such standards in these markets is challenging. Third, these markets face severe affordability constraints and therefore prices must be very low while investment costs are very high. Additionally, returns tend to occur after many years. These are also the main reasons why BOP markets have been the domain of development aid and NGOs for a long time. However, the inclusion of BOP actors can help MNC overcome these difficulties and while at creating social and economic value.

2.3. Sustainable Supply Chains and Supply Chain Strategies

Gold et al. (2013) found that BOP projects follow often a double bottom line focused on social and economic performance objectives and tend to neglect ecological considerations [9]. Yet, the inclusion of ecological aspects in the BOP discourse is crucial, because eradicating poverty from developing countries can create significant ecological damage [31]. Rosca et al. (2016) found that sustainability is not an inherent feature of products and services targeting low income markets and only specific SC configurations allow sustainable value creation [14].

Therefore, Hall and Matos (2010, p. 128) highlight the social dimension as a pivotal challenge in SCs as a multitude of stakeholders is integrated “*within and beyond the supply chain*”. They argue that the sustainable SC discourse stresses the need for “*systemic approaches to sustainability concerns*” [32]. Firm internal and inter-organisational analyses of SC components in light of the *triple bottom line* approach are necessary to measure financial performance and social and ecological impact of the whole SC equally (see table 1). Multiple studies are available that analyse the sustainability aspects of SCs in different facets and regions, such as presented by [33-39].

Table 1: Sustainability dimensions adapted from [40].

Dimension	... refers to ...
<i>Ecologic impact</i>	improvements concerning eco-design and eco-efficiency as reducing energy, land, resource intensity, and emissions and waste, etc. per unit of production and/or during the use phase
<i>Social impact</i>	the quality of human life, the quality of health care and services as well as the individual wealth, etc. are improved
<i>Economic impact</i>	self-sufficiency and economic value creation

In order to systematically access the sustainability impact of a SC, both the SC strategy and the operationalization in form of the procurement, production and distribution concept need to be accessed. Based on the work of Fisher (1997) [41], Christopher et al. (2006) present a taxonomy of global SC strategies to derive a suitable SC strategy based on the demand and supply characteristics for a certain product [42]. If demand is stable, and thus predictable, and lead times are short, a lean strategy with a focus on continuous replenishment is suggested. If lead times are long a lean strategy but with a focus on planning and optimisation is proposed. If demand is unpredictable and lead times are short, an agile SC strategy is recommended. If demand is unpredictable and lead times are rather long, the authors suggested a hybrid *leagile* SC strategy based on decoupling of a lean and an agile part of the SC through postponement.

SC managers have to make several decisions about how to operationalize a SC strategy. They have to decide whether to design processes, structures and management as cost-efficient or responsiveness-oriented in order to implement features that enable rather *lean* or rather *agile* characteristics. Hofmann (2010) suggests the implementation of the SC strategy in the three functional areas of procurement, production and distribution [43]. This structure serves as the basis for the structured analysis of BOP SCs (see table 2). Moreover, we include the Research and Development (R&D) concept in our consideration because in the R&D phase already determines logistics and production characteristics and thus the opportunities of inclusion of local actors in the downstream SC processes [44, 45].

Table 2: Description of SC concepts adopted for this study.

Supply Chain Structure	Description ... determines/ ... refers to ...
<i>Supply chain strategy</i>	... the nature of procurement of raw materials, transportation of materials to and from the company, manufacture of the product or operation to provide the service, and distribution of the product to the customer, along with any follow-up service.
<i>R&D concept</i>	... processes of product and process development.
<i>Procurement concept</i>	... activities related to raw materials acquisition, thus supplier searching, sourcing and goods receipt.
<i>Production concept</i>	... activities and approaches on conversion of raw materials into final products and services.
<i>Distribution concept</i>	... activities related to bridging the gap between production and final customer, therefore, sales, warehousing and transportation.

2.4. Research Gap and Objectives

The analysis of the different research streams shows that in BOP research, so far there is a focus on social and economic and less on ecological aspects. Moreover, while various scholars argue that inclusion in local and global operations is needed to achieve sustainable poverty alleviation and mitigate social exclusion and exploitation of the poor, little is known yet on this. Current literature presents scattered examples of operations and supply chain inclusion where local BOP act as producers, suppliers, service providers and distributors of products and services. Nevertheless, these efforts seem to be undertaken by few companies mainly because of the lack of knowledge on how to engage in local inclusion in a financially sound manner while supporting sustainability objectives. In this sense, the integration of theoretical insights from the sustainable supply chains at the BOP and social exclusion discourses can lead to important contributions with high managerial relevance. Therefore, the main objective of this study is to explore successful cases of companies which have developed inclusive operations in BOP markets in order to understand the design of their procurement, production and distribution practices. Moreover, the aim is to unravel how these designs can lead to sustainable poverty alleviation efforts and the mitigation of social exclusion.

3. METHODOLOGY

3.1. Research Strategy

This study employs an exploratory multiple case study approach [48, 49] to discover how inclusive operations can create sustainable impact for the local BOP societies. Four cases of companies with inclusive operations at the BOP in India and Ghana were investigated. The sample of four exemplifying cases serves as a good basis for the derivation of first propositions, hypotheses and analytical generalizations for a broader category as well as the examination of key processes or items

[48]. Due to the infant stages of the current research in inclusive and BOP SCs, explicit and testable hypotheses on how different levels and approaches of inclusiveness can create economic, social and ecological value in low income markets should be developed. The formulated hypotheses based on the theoretical approaches above give a first orientation for exploring the cases and validating further research [48]. In particular, the case study approach is applicable for research questions involving ‘why’ and ‘how’ aiming at the identification of key variables and the associated relationships [49].

3.2. Case selection

Data collection, analysis and interpretation were done from June 2015 until March 2016. In a first step, a large database of products and services often mentioned in the frugal products and BOP innovation literature was created. A good overview of products and services is provided by Rosca et al. (2016) who also investigated the sustainability and business model patterns of 59 BOP cases [14]. A small sample of four cases has been selected for this study based on the following criteria. First, aligned with the research focus on inclusion, cases which presented clear elements of inclusive operations have been short-listed. Second, in order to explore relationships with sustainable poverty alleviation, cases providing sustainability outcome in all three dimensions (economic, ecologic and social) were selected. Third, all four products in the cases are introduced to the market already and thus entail a functioning business model for a certain time. Cases were selected that aim for business models (and therefore SCs) that scaled in a period of more than eight years and showed a significant growth without significantly changing in their basic functioning. Moreover, in order to increase validation and reliability the cases belong to comparable regions and life-cycle. In particular, the cases have a comparable foundation period (2001 – 2007) and region (India and Ghana, see table 3).

Table 3: Case studies for in-depth analysis of inclusive sustainable SCs in BOP markets.

	<i>Toyola Stove</i>	<i>Bamboo Bike</i>	<i>Oorja Stove</i>	<i>Mitticool Fridge</i>
Founding year	2002	2007	2006	2005
Founded in	Ghana	Ghana	India	India
Existence	Still existing	Still existing	Still existing	Still existing
Products	Stove	Bicycles made of natural sources	Stove	Fridge without using electricity
Sector	White goods	Mobility	White goods	White goods
References	[14, 49-51]	[14, 52-56]	[14, 57-60]	[14, 61-66]

The *Toyola Stove* is a stove for cooking and heating for domestic and commercial users. It reduces fuel consumption by more than 50% in comparison with traditional ovens and therefore, has a positive impact on the health situation of women spending significant parts of the day with cooking. The *Bamboo Bike* aims at low income, domestic users as well as medical staff. It is a cheap, but very resistant in transporting heavy goods. Starting from the domestic market in Ghana, sales volumes have constantly grown also in other African as well as European countries. The *Oorja Stove* aims mainly at commercial users, such as restaurants, caterers and canteens, but also domestic users in rural areas. It is a portable, light-weight and efficient stove for cooking with a third of the fuel consumption compared to traditional kerosene stoves. The *Mitticool Fridge* is made from clay and works without electricity based on the evaporation principle. It is mostly sold in India to low income and domestic users in rural areas, however, increasingly customers from Europe and other African countries are served.

3.3. Data Collection, Analysis and Interpretation

In order to collect data for the analysis of the four cases, extensive secondary data research was performed [48]. This was caused by the following reasons: a comprehensive interview study with all company and SC members of all four cases was not possible

or there was no reply. In addition, an on-site research was not possible due to lack of resources. In this sense, different types of sources including academic articles, books, company websites, NGOs reports, public reports, accessible interviews and new media data were used for each case to include different perspectives. Primary data was used where given. Based on the classification of SC concepts presented in section 2.3, we created keywords for data collection. Iterative steps were then taken to further refine these keywords using BOP literature (see table 4). Many keywords that are important in BOP literature but do not correspond to the traditional SC literature were added to the keyword list (e.g. “awareness campaign” for the distribution category).

A database with a protocol was created during the data collection phase in order to comply with external validity and reliability aspects [67]. The database includes the main information, the corresponding sources, coding schemes and data analysis. The data collection and analysis processes had iterative character and tended to be inductive as data emerged and themes and patterns derived [48]. We use the business model, the SC and the sustainability frameworks to structure the results. Business models are analysed on the basis of *target customer*, *value proposition* (environmental, social in addition to economic value), *revenue model* (appropriate distribution of economic costs and benefits, see table 4). Sustainability patterns were analysed by the triple bottom line approach of sustainability, ecological,

Table 4: Keywords for case research and iterative adjustments.

SC concepts	Keywords	Keywords added during iterative literature coding
R&D concept	Customer requirements, resource availability, knowledge, knowhow, innovation, idea generation	Frugal innovation, raw materials, decentralized R&D, training, education, co-development, co-design, cost reduction, maintenance cost, affordability
Sourcing concept	Resources availability, rough-cut capacity, order, schedule, receive, and validate, storage of materials and products.	Raw materials, local farmers, small scale producers, agriculture, micro-loans, standards, waste materials, supplier collaboration, basic needs, supplier technical assistance, good enough functionality, robustness, durability, training, education, resource constraints, local partnerships, supplier development, supplier decommodizing, cost reduction, centralized purchasing, customer engagement.
Production concept	Schedule, manufacture, repair, remanufacture, recycle materials and products, packaging,	Outsourcing, low variance, modularity, reduced packaging, labour intensive, basic skills, BOP producers, handicrafts, local production, local farmers, micro-plants, centralized production, decentralized production, assembly, standard interfaces, reduced lead time.
Distribution concept	Receive, schedule, pick, pack, ship orders, order fulfilment, invoicing.	Value propositions, basic needs, bazaars, door-to-door, women, insourcing distribution, local entrepreneurs, awareness campaign, local retailers, kiosks, training and education, rural, remote, partnerships, atomized distribution, on-site demonstration, infrastructure, resource constraints, NGO collaboration, urban slums, villages, small scale entrepreneurs, isolated locations, limited storage, customer support, warranty, post office, rural marketing, franchise, non-profit distribution channels.

social and economic dimension [68]. Inclusion was qualitatively investigated by evaluating if, in what form and to what extent local actors from BOP society were involved in the SC activities. For this analysis, we follow the considerations presented in section 2.1 by application of the dimensions suggested by the scholars in the field of BOP and social exclusion. In particular, we analyse inclusion in terms of access to (1) global knowledge and communication, (2) employment, (3) infrastructure, (4) resources, products and services, (5) rights and standards compliance, (6) charitable giving and (7) development entrepreneurship [23-24, 69].

3.4. Limitations

The study presents several limitations. We chose the cases as we think they represent a broader category of cases [48] for inclusive sustainability business models or SC in BOP markets. However, the selection might be limited to the region or just be specific for Ghana or India, so that the findings might not be transferred to the whole BOP markets. Likewise, the insights gained might be limited to the specific archetype using materials with renewables or based on natural processes and might not be appropriate for other business model types. Moreover, three of four cases belong to the white good industry, so findings might be limited to this sector. Enhancing the number of cases and widening the sectors would strengthen the validity of our approach. In order to develop the hypotheses further, exploratory approaches rooted in the grounded theory methodology are suitable. Thus, the applicability of social exclusion theory in the context of BOP should be analysed in more detail, for instance, in form of interviews or surveys with local actors.

We face all advantages as well as limitations of secondary data [48]. Indeed, there might be sources that we did not find or did not get access to. The given data could be aggregated due to complexity and thus, mix several different levels of analysis. So, there is no control of data quality in general. Moreover, key variables were missing. In order to mitigate these limitations, we mixed several high-quality secondary data and used primary data where applicable.

4. CROSS-CASE COMPARISON FINDINGS

4.1. Product and Business Model Patterns

When compared to similar products which were developed for customers in industrialized markets, it is interesting to note that the selected products all share the following characteristics: (1) simplicity, (2) ease of use (3) minimal features. Additionally, the designs of these products are highly-influenced by the given customer. This customer-centric design implies that the product will be adjusted to cater to local needs all the while displaying important properties like robustness,

dependability, transportability, small size, inflexible design, high durability, capability to function without energy and/or running water, and ability to cope with power outages, circulation holdups and little or no parking space. The selected products also differ from traditional products in that their components are simpler and more economic, and their investment costs are lower as a result. These components are usually made from low cost materials or even waste (*Toyola Stove* and *Oorja Stove*), and indigenous resources (*Bamboo Bike*, *Mitticool Fridges* are fabricated from cooling water and clay). When coupled with their low initial investment costs, the fact that these products also have low lifecycle costs not only makes them affordable but also usable in the long run. The *Mitticool Fridge*, for example, has no maintenance cost since it is non-electric. All items are characteristic of frugal products and processes [14].

All four business models aim at low income users in rural and urban areas. All business models focus mainly on their domestic markets in Ghana (*Toyola Stove* and *Bamboo Bike*) and India (*Oorja Stove* and *Mitticool Fridge*). They all provide customers with cheap and affordable products to contribute to some of the most basic human necessities. However, to make the products affordable for the BOP customers, prices are close to the actual cost with comparably low profit margins. Moreover, the business models include financing services for the end customers as the product price is usually still much higher than a monthly family income. It is noteworthy to mention the element of founder motivation which was of inclusive nature and emphasized no profit maximization goals, but rather stakeholder maximization. Moreover, all four cases were based on financial support in the early beginning. Table 5 shows the main characteristics of the four business models and highlights the respective external financial support.

4.2. Inclusive Operations Patterns

The four SCs show several similarities in terms of their SC structure, and the design of the SC sub-concepts of R&D, procurement, production and distribution. In order to highlight the inclusiveness of the SCs, the respective inclusiveness analysis is sequentially integrated and the SC strategy added. Table 6 gives an overview of the sub-concepts.

R&D Concept

Products are designed to have low initial investment costs, low lifecycle and maintenance costs and low logistics and operations cost structures. All four products were developed centrally and by the main actors in the founding phase of the company. Usually, the actors involved in the R&D activities have a direct relation to the target customers and their needs. The *Toyola Stove* and the *Mitticool Fridge* were developed by local entrepreneurs who had themselves in mind

Table 5: In-depth analysis of inclusive sustainable business models.

Elements	<i>Toyola Stove</i>	<i>Bamboo Bike</i>	<i>Oorja Stove</i>	<i>Mitticool Fridge</i>
Target customer	<ul style="list-style-type: none"> Low income, domestic and commercial users Rural and urban areas Ghana 	<ul style="list-style-type: none"> Low income, domestic users Rural and urban users Mostly in Ghana, but also for further African countries as well as European countries 	<ul style="list-style-type: none"> Low income and mostly commercial users: restaurants, caterers and canteens. Domestic customers in rural areas consumers with the goal to save women from collecting firewood 	<ul style="list-style-type: none"> Low income, domestic users Rural areas Mostly in India, but also UK and further African countries
Value proposition	<ul style="list-style-type: none"> Cheap, healthy and efficient energy supply with varying diameters and 50 % higher fuel efficiency than traditional ovens 	<ul style="list-style-type: none"> Cheap, but resistant bikes to transport heavy goods 	<ul style="list-style-type: none"> Portable, light-weight, efficient and eco-friendly way of cooking, cutting fuel consumption cost by a third compared to the kerosene stoves. 	<ul style="list-style-type: none"> Affordable fridge made out of clay without electricity
Cost and revenue model	<ul style="list-style-type: none"> Cost ~5-6 \$ Price ~ 26-80 \$ Financing services offered to customers and local suppliers 	<ul style="list-style-type: none"> Constant prices with low profit margin – cost ~ 47 \$ price ~55 \$ / 350 \$ Financing services offered to customers 	<ul style="list-style-type: none"> Pricing based on market research of target price Cost ~n.a. \$ Price ~24\$ 	<ul style="list-style-type: none"> Cost ~1000-1200 Rs (own calculation) Price: ~1500-2500 Rs.
Financial support	United States Agency for International Development	Calfee Design (Carbon fibre manufacturer)	British Petroleum energy private limited along with the Indian institute of science, Bangalore, India	Civil engineer placed a first order of 100 fridges and provided financial power for first production

Table 6: In-depth analysis of inclusive sustainable SC patterns.

	<i>Toyola Stove</i>	<i>Bamboo Bike</i>	<i>Oorja Stove</i>	<i>Mitticool Fridge</i>
R&D concepts	<ul style="list-style-type: none"> Centralized, single R&D Modular and scalable design: several manufacturers specialize on a specific production step Variants: varying diameters and an solar lantern as additional product line of the company 	<ul style="list-style-type: none"> Centralized, single R&D: Columbia University and Calfee Design Modular design: products can be preassembled or self-assembled Variants: bamboo bikes with rack, without rack and front basket, male frame for export and female frame for export. 	<ul style="list-style-type: none"> Centralized, single R&D Indian Institute of Science financed by BP Scalable design: three product variants due to different sizes with identical production process Variants: <i>Oorja</i> K60LH, <i>Oorja</i> K30 DLX, <i>Oorja</i> K90 DLX, <i>Oorja</i> Wonder Tawa, <i>Oorja</i> Wonder Fryer Additional products: hot water, generator, boilers, direct heating. 	<ul style="list-style-type: none"> Centralized, single R&D by local entrepreneur who was activated by the negative impact of an earthquake in 2001 Variants: There is only one version of the fridge. However the company also produces cups, pots, bowls, bottles, dinner sets, and filters
Procurement concept	<ul style="list-style-type: none"> Decentralized and local sourcing: parts and raw materials from local manufacturers; self-employed, local artisans collect or buy scrap metal autonomously; financial support to buy larger volumes 	<ul style="list-style-type: none"> Centralized, mostly local sourcing: 80% of raw material sourced in Ghana; metal parts and binding materials from China South Africa and India 	<ul style="list-style-type: none"> Centralized, local sourcing: metal and ceramic parts as well as nut and peanut shells and industrial waste for pellet production 	<ul style="list-style-type: none"> Centralized, local sourcing: different clay compositions
Production concept	<ul style="list-style-type: none"> Decentralized, local production in different quantities: (1) self-employed artisans and craftsman produce or assemble single parts or metal frames; (2) seven production centers 	<ul style="list-style-type: none"> Decentralized, local production: in factories of different sizes: (1) low automation in job shops or (2) high automation in flexible lines 	<ul style="list-style-type: none"> Decentralized, local production: metal and ceramic parts by small local manufacturers; local, small-scale pelletizing machines are provided for local entrepreneurs for compacting local agricultural waste 	<ul style="list-style-type: none"> Decentralized, local production: several smaller factories with production and assembly line
Distribution concept	<ul style="list-style-type: none"> Selective distribution: (1) 2-stage decentralized B2B distribution: seven sales depots and several local dealers and marketing agents; (2) centralized B2C for remote and rural areas Financial support of customers: products are sold on credit, distributors earn commissions 	<ul style="list-style-type: none"> 1-stage decentralized distribution: independent dealers Limited stock keeping: in rural areas often only order on demand 	<ul style="list-style-type: none"> 2-stage decentralized distribution: 35 distributors and 2500 dealers local (NGOs and local people) Financial support of customers: products are sold on credit, distributors earn commissions Application of latest route and demand planning techniques 	<ul style="list-style-type: none"> Centralized, direct sales and distribution Limited stock keeping: transport to customers once a customer places the order
Areas of inclusion of local actors	<ul style="list-style-type: none"> Procurement Production Distribution Financing 	<ul style="list-style-type: none"> Procurement Production Distribution 	<ul style="list-style-type: none"> Procurement Production Distribution Financing 	<ul style="list-style-type: none"> Procurement Production

as potential customers and who designed the products according to their own needs. The *Bamboo Bike* and the *Oorja Stove* were developed by research institutes focusing on developing countries. All four products required substantial financial support in this phase, however became viable business models after market introduction. For all products, a very limited number of variants were created. These variants only aim at the size of the product. In the R&D phase, modular and scalable design characteristics are determined. In this respect, all products are designed in a way that different sizes can be produced with identical tools and facilities as well as standardised production processes. For the *Toyola Stove* and the *Bamboo Bike* also modular design characteristics can be found. The *Toyola Stove* is designed in a way that 26 different parts can be produced and assembled separately to increase the efficiency per production step. The *Bamboo Bike* was designed in logistics- and assembly-oriented way. That means it can be assembled in production facilities or it can be packaged, shipped and easily self-assembled by the end-user.

Procurement Concept

All four SCs are characterised by local sourcing concepts. Most of the required raw materials are sourced locally close to the production locations. This means, that inclusion of local actors takes place in form of raw material and part suppliers. Moreover, in all cases natural (such as bamboo and clay) or waste resources (such as scrap metal, nut and peanut shells, industrial waste) are used. More advanced parts, such as the binding materials for the *Bamboo Bike* are sourced in low cost countries, such as China and India. For the *Toyola Stove*, a decentralised procurement concept is realised. That means that the local producers are responsible for the procurement of raw materials, such as scrap metal themselves and can make use of centralized financing support if necessary. The other three business models organise procurement centrally to realise economies of scale and to take away the financial burden of buying from the often small production actors.

Production Concepts

All four SCs are built around decentralized and local production concepts. Local actors are included into the production in two different ways: (1) Either they work self-employed and use their own workshops and facilities for part production or assembly or (2) local actors can work in decentralized production facilities run either by local entrepreneurs or by the company itself. The *Toyola Stove* is produced mainly by self-employed artisans who conduct a very limited number of production steps and who then sell their work to *Toyola*. Also, the *Oorja Stove* is produced mainly by local manufacturers. Also, the pelletizing is done on small-scale basis from local waste by local entrepreneurs. The *Bamboo Bike* production and

Mitticool Fridge production reflect the more technical character of the products: Here parts production and assembly take place mainly in small factories. It is interesting to mention that *Toyola* designed the manufacturing processes so that local people are incentivised to put more effort and dedication [49]. Depending on the local demand and the factory size, here different levels of production organisation and automation can be found.

Distribution Concepts

The analysed distribution concepts differ from each other. In the first three cases of the *Toyola Stove*, the *Bamboo Bike* and the *Oorja Stove*, decentralised distribution concepts with an intense involvement of local actors are realized. They base on local independent dealers. For the *Toyola Stove* and the *Oorja Stove* this is organized in a two-stage model with distribution centres (*Toyola*: seven depots, *Oorja*: 35 distributors). The *Bamboo Bike* has a one-stage model without distribution centers based on local dealers. For B2C customers, *Toyola Stove* is also sold directly to the customers in a centralized approach. *Mitticool Fridge* does this in a similar manner: There are no dealers, but fridges can only be ordered centrally and are shipped directly from the factories to the customers. To foster sales volume, *Toyola Stove* and *Oorja Stove* dealers offer financial support services to make the products affordable for the BOP customers. Products are sold on credit and the distributors earn around 10% of commissions. In the example of the *Toyola Stove* more than 75% of the products are sold in that way.

Supply Chain Strategy

All business models target BOP markets with high and stable demand as long as prices are low and affordable. As all products serve to fulfil basic necessities or make things easier respectively cheaper in daily life, customers are willing to accept long lead times. For instance, for the *Bamboo Bike* in rural areas, orders are only placed by the dealers if a customer places an order. Following the taxonomy of Christopher et al. (2006), all SCs analysed are typical lean SCs with long lead-times and predictable demand. The recommendation the author gives, can be summarized by “lean planning and execution” [42]. Proof for this SC strategy can be found for all four cases: for *Toyola Stove* labor sharing is applied to increase efficiency, for *Bamboo Bike* and the *Mitticool Fridge* huge investments are made in automation and production lines to increase efficiency and *Oorja Stove* applies latest route and demand planning techniques to increase efficiency. *Toyola* estimates that this increased specialisation helps to increase the productivity of the artisans by about six-fold [50]. Moreover, all SCs show a similar funnel shape: from R&D, to procurement, production and distribution the number of actors and locations as well as the spatial distance between these is increasing in a funnel shape [70, 71].

4.3. Sustainable Supply Chain Patterns

Economic patterns

The four business models have significant economic impact on the local communities. Most significant are employment and income effects as well as entrepreneurial activities due to the inclusion of local actors in the procurement of raw materials and parts, the production and assembly processes and partially in the distribution. In particular, women, children and unskilled workers are included in the activities. This dramatically increases the welfare of those groups. This effect is accompanied by an increased education level. For instance, *Toyola Stove* and *Oorja Stove* offer specific trainings and apprenticeship programs to continuously increase the number of included local actors to meet the increasing demands. For example, *Toyola* pays the individual apprentices a daily allowance of GHC6 (US\$4.16) over a period of three months. Thus, all benefit: the manufacturers profit from an increased income, the apprentices receive a salary as well as a three-month long training that enables them to become self-employed manufacturers, and *Toyola* benefits from being able to provide larger quantities. The *Bamboo Bike* is even said to foster the development of a completely new bamboo industry. Today already, waste materials from the bike production are used for furniture production.

Social patterns

All involved actors benefit from the increased welfare and empowerment. Particular women are integrated in the retail and production activities of *Toyola Stove* and *Oorja Stove*. The *Mitticool Fridge* and the *Bamboo Bike* furthermore increase the life standard and productivity of the customers. Health benefits can be ascribed to all four business models: for the two types of stoves, particular women benefit from lower charcoal and fuel use. The *Bamboo Bike's* main advantage lies in the improved medical supply and for the *Mitticool Fridge* in the increased availability of fresh water and food. The development of local manufacturing activities also contributes to the technological self-reliance of all communities. The inclusive nature of *Toyola's* SC is found in the fact that *Toyola* has been able to engage over 200 basic school leavers, preventing them from peddling petty trade on the streets of urban areas. In fact, there is entire education and learning focus within the organization of *Toyola* which facilitates the knowledge diffusion among different components of the system. In this context, education was part of their strategy for scaling. Manufacturers are also offered incentives for training apprentices to produce stove parts, while the self-employed manufacturers get money for the parts produced by their apprentices. Similarly, in the case of bamboo bikes, the UNDP's Global Environment Facility sponsors the Ghana Bike initiative through its Small Grants Program so that graduated trainees of

Bamboo Bike building will be able to establish their own workshops, and begin to train more young people.

Ecologic patterns

For all cases analysed, significant resource savings can be realised. For the *Toyola Stove*, the *Bamboo Bike* and the *Oorja Stove* in particular production materials and operation resources can be reduced as renewable resources and mainly waste materials are used. For the *Mitticool Fridge*, the resource savings are achieved due to no electricity usage in operation. This goes together with improved air and water quality as well as CO₂ emissions. Recycling or reuse is also facilitated due to modular construction (table 7).

4.4. Principles of Sustainable Value Creation in Inclusive Supply Chains – Mitigating Social Exclusion

Based on the findings, several principles for value creation in inclusive and sustainable SCs can be derived:

- Centralized R&D activities with insider knowledge on target customers' needs can lead to significant economic and ecologic benefits.
- Local sourcing activities can create significant sustainability benefits.
- Decentralized production and assembly processes employing modular design and BOP actors as employees and collaborators can lead to significant economic and social benefits.
- Distribution channels which build on local infrastructure and social systems and employ BOP actors as distributors, entrepreneurs, and franchisees, can lead to significant social and economic benefits.

One main aspect our research revealed is that the business model design and SC strategy must be designed in a way that allows an inclusive SC concept design. Only for products with stable and high demand and comparably long lead times, a lean SC strategy can be realized that leaves room for the integration of local actors. Table 8 summarizes the main findings for good practices, strategies and principles applied in the cross case study. In the following table, we aim to limit the sustainability impact to the SC concept design without consideration of the availability of the products for BOP customers itself.

By actively including and engaging marginalized communities in employment and social activities, global knowledge networks, all spheres of life including social status, family relationship and psychological well-being can be positively affected and therefore the sustainable poverty alleviation of BOP societies achieved, and finally social exclusion is mitigated. Thus, by focusing on sustainability, standards, entrepreneurship, and a stable venture capital network in the early business development the private sector can strengthen social inclusion.

Table 7: Sustainability patterns of the cases.

Dimension	Toyola Stove	Bamboo Bike	Oorja Stove	Mitticool Fridge
Ecologic	<ul style="list-style-type: none"> • Resource savings: saving of tree cutting and improved biodiversity • Improved air quality: reduced CO₂ emissions 	<ul style="list-style-type: none"> • Resource savings: preservation and rehabilitation of forests • Improved air and water quality: less energy and chemical consumption and CO₂ emissions; less soil erosion in harvest area 	<ul style="list-style-type: none"> • Resource savings: pellets made from waste materials • Improved air quality: reduced CO₂ emissions 	<ul style="list-style-type: none"> • Resource savings: no electricity use while no waste is generated • Reduced toxicity, improved recycling
Social	<ul style="list-style-type: none"> • Welfare and empowerment of involved actors: in particular women in retail, and increasingly in production • Health benefits: 40–50% reduced charcoal use • Technological self-reliance: local manufacturing 	<ul style="list-style-type: none"> • Welfare and empowerment of involved actors: in particular women, street children, unskilled and disabled • Improved life standard and productivity • Health benefits: improved medical supply; transport of medical professionals, supplies and patients. • Education: children taken to school on bicycles; increased school attendance • Technological self-reliance: local manufacturing 	<ul style="list-style-type: none"> • Welfare and empowerment of involved actors: in particular women involved in retail activities • Health benefits: reduced CO₂ emissions • Technological self-reliance: local manufacturing 	<ul style="list-style-type: none"> • Welfare and empowerment of involved actors • Improved life standard and productivity • Health benefits • Technological self-reliance: local manufacturing
Economic	<ul style="list-style-type: none"> • Employment and income effects: involvement into SC-activities • Education and entrepreneurial activities: trainings and apprenticeship system; establishment of learning culture and knowledge diffusion • Financial support system: low income customers can buy stoves and to pay back their loans using money savings from charcoal 	<ul style="list-style-type: none"> • Employment and income effects: involvement into SC-activities; rural inhabitants can transport more goods over longer distances • Development of a bamboo industry: bamboo can be used for diverse applications, waste materials already go into furniture industry 	<ul style="list-style-type: none"> • Employment and income effects: involvement in SC-activities • Education and entrepreneurial activities: trainings and financial support system for founding and sales • Financial support system for low income customers 	<ul style="list-style-type: none"> • Employment and income effects: involvement in SC-activities, in particular for unskilled workers • Saving of traditional knowledge of pottery

Table 8: Inclusive good practices and sustainability patterns identified.

SC	Good practices and principles identified	Main sustainability patterns
<i>SC strategy</i>	Lean and leagile SC strategies	
<i>R&D concept</i>	Focus on basic functionalities Customer-centric design Low cost materials Investment costs covered by external funding partners Centralized development with explicit knowledge about target customers' needs BOP actors as co-designers and inventors	Mainly ecologic and economic due to use of energy-efficient and low-cost materials as well as reduced lifecycle cost Social impact inform of health benefits
<i>Procurement concept</i>	Local suppliers Close supplier relationship with high level of trust, in form of financial support and intense trainings BOP actors as suppliers	Ecologic and economic impact due to reuse of waste materials and employment effects Social impact due to welfare and empowerment
<i>Production concept</i>	Labor intensive production and assembly Decentralized production and assembly processes Low variance of basic products with scalable design Modular design BOP actors as partners, collaborators and employees	Mainly economic impact due to employment and education Social impact due to welfare and empowerment as well as technological self-reliance
<i>Distribution concept</i>	Locally embedded distribution channels ensuring reach of remote locations Traditional channels with 1-stage and 2-stage distribution via independent sales agents as well as direct delivery BOP actors as distributors, franchisees, entrepreneurs and consumers	Economic and social impact due to employment, education and empowerment of local distributors

5. DISCUSSION

All characteristics of inclusive sustainable SCs – as highlighted in section 2.4 – can be found in the four discussed cases. We deliberate and compare our findings with literature insights in order to derive hypotheses for further research.

Motivation and Business Formation

All products have been developed and all companies have been founded with the specific willingness to involve people in SC activities: Product design and variants have been selected according to this intention. For this underlying motivation, also the business models have not changed significantly over time, but still all four business models operate with comparably low profit margins, do research on financial solvency of BOP customers and offer financial services to keep demand high. This is similar to findings of Venn and Berg (2013) who suggest that employee motivation and engagement can drive social outcomes at the BOP [47]. Our sample of four cases suggests that the sustainability of a business model at the BOP is highly dependent on the underlying motivation and financial power of the founder. All enterprises have been founded on the basis of external financial aid. Big investors in the background covered the almost unsurmountable investment cost and associated risks for the local entrepreneurs.

H1: A strong social mind-set of the founders can lead to more inclusive operations.

H2: External financing combined with inclusion of BOP actors are necessary and sufficient conditions for sustainable operations in BOP markets.

Inclusive Supply Chain Strategy

All business models and SCs analysed are based on products for the basic needs of daily life of any person to have access to food and mobility. Due to the frugal character of all products analysed, very low product prices can be realised. These products show high price elasticity. Thus, all four business model meet very high and stable market demands. Due to the rather basic character of product demand, customer requirements are not changing over time. Thus, as a result, all analysed SCs are designed according to a lean SC strategy. In comparison with SCs from industrialized countries, a more or less stable demand could be assumed for the product groups analysed, however, due the missing willingness of customers to wait, here a rather lean SC of type II – continuous replenishment will be realized [42]. Furthermore, in a lean SC structure, processes can be optimized due stable demand and the accordingly long planning horizons. Investments and optimization activities can be realized. This strategy is also one major advantage for the realization of inclusion activities: Necessary adaptations in product design, training efforts and loss of economy of scale advantages due to the decentralized character of procurement, production

and distribution can only be absorbed due to the lean character of processes. It would be possible to also realize a lean – postponement concept with a product variation in the last production or distribution stage.

H3: In early stages of BOP market development an inclusive SC strategy is based on lean concepts.

Inclusive Supply Chain Structure

In all cases, R&D is centralized in one place and guided by one main actor which is often the founder. However, in all cases R&D was either accomplished by surveying target customers or by persons who have lived in the target customer group for a long time. As a result, the products created optimally fit BOP customers' needs. This increases inclusion created by the product itself (see section 2.1, [69]). The need for in-depth and intimate knowledge of the target customer group is congruent with literature findings, as Zeschky et al. (2011) found that MNC aiming to develop products and services in BOP develop local R&D offices in target markets and employ local engineers [72]. The inclusion in the downstream SC stages of procurement, production and distribution is based on the involvement of local actors in value-adding activities. The reduction of procurement cost by the use of waste and local materials is a central element of all procurement concepts. Waste materials are locally available and thus transportation cost is low. Due to the simple product structure, mostly raw materials are procured. Only a limited number of parts is sourced globally on the global markets, in particular Asia. The focus on local raw materials in BOP SCs is also acknowledged by [9]). It can indeed lead to SC efficiencies and greener SCs [12]. Yet, a holistic investigation between the trade-off of economic, social and ecological outcomes is needed [5, 9]. It can be shown that the inclusive SC design positively influences corporate success and at the same time impacts sustainability. Production and assembly take place locally. Step by step, production is scaled to small-sized factories. However, huge factories do not emerge, but rather additional small and decentralized factories close to the markets. Distribution is in all cases highly decentralized. Local distributors and dealers are at the core of the distribution concept. They have direct contact to customers. However, the financial risk is taken off the local distributors, by two mechanisms. Products are either sold on a commission basis in shops or only ordered when a customer order is placed. Distributors provide financial services to spread the product price month rates. All SCs analysed show a similar funnel shape: from R&D, to procurement, production and distribution the number of actors and locations as well as the spatial distance between these are increasing in a funnel shape. Thus, we derive the following hypotheses:

H4: The type and the intensity of social inclusion potential depend on the SC stage.

This can be further specified according to the product- and value adding-dimension:

H4a: For product-related inclusion, R&D concepts show the highest potential to mitigate social exclusion.

H4b: For value adding-related inclusion, the closer the SC stage to the customer, the higher the potential of social inclusion.

H5: Social exclusion highly relates to the way the supply chain is established in a business model.

Therefore, we can formulate further conditions:

H5a: Inclusive SCs mitigating social exclusion are based on a local context and concept (founder, network, stakeholders, staff, materials, etc.).

H5b: Inclusive SCs mitigating social exclusion are based on a decentralized context and concept.

Successful Scaling

In line with the findings of Gold et al. (2013), the examples of *Bamboo Bike* and *Mitticool Fridge* show that the combination of global and local solutions to reach high scales and at the same time respecting local values and norms is one success factor to reach high production volumes in remote areas for poor people [9]. Local actors, included in the different SC concepts and the company's management, have a relationship of high dependency. However, in all four examples loyalty is of high importance. On the one hand, no example was found that local actors initiated own companies based on the acquired knowledge or that there were irregularities in the financial flows. On the other hand, the management adapted wages according to company's success and kept the decentralized structure instead of exploiting potentials of economies of scale in centralized factories etc. The reason for that can be found in the very well working incentive systems as well as in the company culture that was created with focus on inclusion and poverty alleviation. In the example of the *Toyola Stove*, also organisational structure enables and increases loyalty structurally: The production and assembly structure is used in such way, that every producer only receives specific information about the part he is about to produce. Thus, no part producer has all necessary information to produce and assemble the entire product.

Another driver for the successful scaling are the training and education concepts which ensured that the business models not only have unlimited demand, but have also unlimited access to actors for inclusion. The focus on education and training of stakeholder makes *Toyola* a special case and represents practices other companies can learn from. This is especially important since Munir et al. (2010) emphasize the importance of knowledge-driven ventures at the BOP and their significant social impact [73]. Additionally, Hall and Matos (2010) highlight the difficulties in knowledge diffusion between companies and BOP partners. The more successful the scaling and the more advanced the product, the more there is a tendency to also approach mid-income customers and to enter foreign markets [32]. This requires on the one hand a strong

and centralized management, financial resources and an advanced product. In total, there is a fair distribution of costs and benefits along partners [46]. We can derive the following hypotheses:

H6: Structural and social compliance can reduce significantly the moral hazards in supply chains with vulnerable actors.

6. CONCLUSIONS AND FUTURE RESEARCH DIRECTIONS

This study investigates four cases of inclusive and sustainable business models and SCs at the BOP in India and Ghana to explore similarities and differences and in order to develop a first understanding on the question how SC strategy, SC design and sustainability impact are linked. As Yawar and Seuring (2015) suggest, SC discourse should incorporate social aspects related to societal development [30]. Therefore, this study brings in several important theoretical contributions. Firstly, it proposes inclusive sustainable SC strategies as an option for social inclusion in BOP markets. Secondly, it extends the inclusive business models and inclusive growth discourse to inclusive SCs. Thirdly, by combining inclusion and sustainability as foci for SC analysis in selective BOP markets, new insights were gained. Inclusive sustainable SCs seem to mitigate social exclusions through different conditions.

Inclusive SCs create social impact through the value proposition providing basic functionality, affordable and robust products and services. Self-sufficiency of the underlying business models is achieved by large production volumes and build on low-income, domestic users, the usage of local resources and capabilities as well as on the development of local competencies and networks. These are produced in SCs with lean strategies characterized by comparably long lead times and a stable demand patterns. The resulting SC structures have the shape of funnels: the number of involved local actors increases from product development to procurement, production and distribution. In other words, few local actors are involved in research and development activities, more in procurement and production, and many actors are typically involved in distribution.

- Further research could broaden the number of cases and could involve the analysis of extremely successful or even failed examples. Moreover, be a quantitative investigation of the derived good practices and principles with focus on specific industries and regions would strengthen the research in the field. Moreover, the study could be extended towards the service industry. In particular, logistics service provision, order management as well as maintenance, repair and overall should be analysed regarding the applicability of the principles identified and its impact on sustainability.

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