

To Greener Pastures: An Action Research Study on the Environmental Sustainability of Humanitarian Supply Chains

Mohammed Hossein Zarei, Ruth Carrasco-Gallego and Stefano Ronchi

Accepted manuscript PDF deposited in Coventry University's Repository

Original citation:

Hossein Zarei, Mohammed. "To Greener Pastures: An Action Research Study on the Environmental Sustainability of Humanitarian Supply Chains." *International Journal of Operations and Production Management* (2019).

<http://dx.doi.org/10.1108/IJOPM-12-2018-0703>

ISSN: 0144-3577

Publisher: Emerald

Copyright © and Moral Rights are retained by the author(s) and/ or other copyright owners. A copy can be downloaded for personal non-commercial research or study, without prior permission or charge. This item cannot be reproduced or quoted extensively from without first obtaining permission in writing from the copyright holder(s). The content must not be changed in any way or sold commercially in any format or medium without the formal permission of the copyright holders.

To Greener Pastures:

An Action Research Study on the Environmental Sustainability of Humanitarian Supply Chains

Mohammad Hossein Zarei^{1&2&3*}, *Ruth Carrasco-Gallego*², *Stefano Ronchi*¹

1) School of Management, Politecnico di Milano, Via Raffaele Lambruschini, 4, 20156 Milan, Italy

2) Department of Organization Engineering, Business Administration and Statistics, Escuela Técnica Superior de Ingenieros Industriales, Universidad Politécnica de Madrid, C/José Gutiérrez Abascal, 2, 28006 Madrid, Spain

3) Faculty of Business and Law, School of Strategy and Leadership, Coventry University, Coventry, UK

* corresponding author: mohammadhossein.zarei@polimi.it

Purpose: While humanitarian supply chains (HSCs) inherently contribute to social sustainability by alleviating the suffering of afflicted communities, their unintended adverse environmental impact has been overlooked hitherto. This article draws upon contingency theory to synthesize green practices for HSCs, identify the contingency factors that impact on greening HSCs, and explore how focal humanitarian organizations (HOs) can cope with such contingency factors.

Design/methodology/approach: Deploying an action research methodology, two-and-a-half cycles of collaboration between researchers and a United Nations agency were completed. The first half-cycle developed a deductive greening framework, synthesizing extant green practices from the literature. In the second and third cycles, green practices were adopted/customized/developed reflecting organizational and contextual contingency factors. Action steps were implemented in the HSC for prophylactics, involving an operational mix of disaster relief and development programs.

Findings: First, the study presents a greening framework that synthesizes extant green practices in a suitable form for HOs. Second, it identifies the contingency factors associated with greening HSCs regarding funding environment, stakeholders, field of activity, and organizational management. Third, it outlines the mechanisms for coping with the contingency factors identified – inter alia, improving the visibility of headquarters over field operations, promoting collaboration and resource sharing with other HOs as well as among different implementing partners in each country, and working with suppliers for greener packaging. The study advances a set of actionable propositions for greening HSCs.

Practical implications: Using an action research methodology, the study makes strong practical contributions. Humanitarian practitioners can adopt the greening framework and the lessons learnt from the implementation cycles presented in this study.

Originality/value: This is one of the first empirical studies to integrate environmental sustainability and HSCs using an action research methodology.

Keywords: *Environmental Sustainability, Green Practices, Humanitarian Logistics and Supply Chain, Action Research, Collaborative Management Research, Contingency Theory.*

1. Introduction

Humanitarian supply chains (HSCs) are complex and globally stretched. When a crisis unfolds in a region, international relief supplies rush to the afflicted region. Similarly, with ongoing operations, beneficiaries are mostly located in developing regions whereas most supplies are procured from developed countries far from the point of consumption. In 2016, only around 13% of humanitarian supplies were procured by United Nations (UN) agencies from least developed countries (UNOPS, 2016), who are themselves major recipients of humanitarian assistance. The global magnitude of operations in HSCs impact the ecological environment, a topic hitherto overshadowed by the urgency of HSC research.

From a practical perspective, the need to green HSCs has gained momentum in light of efforts such as the Joint UNEP/OCHA Environment Unit (UNEP/OCHA, 2018) and the UN environmental management initiative (Greening the Blue, 2018). Yet, greening is largely overlooked when it comes to implementation. Many past humanitarian operations have harmed the environment – failure to meet waste treatment standards leading to environmental contamination in Haiti and the largest outbreak of cholera in recent history (Cravioto et al., 2011), dried up wells from excessive drilling for water by humanitarian organizations (HOs) in Afghanistan (Weinthal et al., 2014), over-provision of fishing boats with consequent fish stock depletion in humanitarian recovery operations in post-tsunami Sri Lanka (Alexander, 2006), and long-lasting insecticidal nets distributed in Kenya to fight malaria appropriated by locals as fishing nets releasing hazardous chemicals into water (Minakawa et al., 2008), among others. These examples justify the dire need to consider the environmental sustainability of HSCs.

From research perspective, the literature about green HSC is scarce. Sarkis et al. (2012) were among the first to address the problem by identifying a list of barriers to greening relief operations. This list was further developed by Abrahams (2014) in an empirical study in a post-disaster setting. Haavisto and Kovács (2014) conducted a content analysis on HO annual reports to discover how they address different expectations concerning sustainability. They found very little in the annual reports on green supply chains and green products. They urged future research to investigate how HOs address greening initiatives in their procurement decisions and transportation. More recently, the studies of Kunz and Gold (2017) and Jilani et al. (2018) advocated the integration of sustainable supply chain management into HSC literature. Specifically, Kunz and Gold (2017) proposed a framework of sustainable HSCs and tested it through four case studies in disaster rehabilitation. They found that, to minimize the ecological impact of HSCs, the long-term requirements of beneficiaries and HSC contingency factors should be considered primarily in supply chain design.

While efforts were made to conceptualize the triple bottom line in HSCs (Remida, 2015; Meduri and Ahmed, 2016), the utility of such models for practitioners has yet to be tested. Other studies on green HSCs focused on merely one area, namely product design (Parisi et al., 2016), procurement (Van Kempen et al., 2017), packaging waste (Regattieri et al.,

2016), and reverse logistics (Peretti et al., 2015; Battini et al., 2016), leaving the holistic view to future research. Furthermore, a recent stream of literature has emerged in operations research where environmental sustainability is scrutinized in modelling HSC problems (Laguna-Salvadó et al., 2018; Cao et al., 2018).

A review of the literature reveals that, despite calls from research and practice, only a handful of studies exist on green HSCs. Comparing with the literature on sustainable supply chain management, this is in line with the research of Rajeev et al. (2017) who found that few studies were conducted in less-developed economies, where most humanitarian and development supply chains operate. Silvestre (2015) attributed this scarcity of studies to additional barriers to sustainability due to higher degrees of complexity and uncertainty inherent in less-developed economies. Second, HSC management has emerged as a distinct sub-domain of supply chain management due to its fundamental differences with commercial supply chains. In order to address the environmental sustainability in this sub-domain, it is imperative that the specificities impacting the greening of HSCs are identified. Besides Abrahams (2014) and Kunz and Gold (2017), no study could be found that pursues this objective. Third, most studies merely *measure* or *observe* the status quo of environmental sustainability in HSCs and do not explore the mechanisms through which HOs can cope with humanitarian specificities inherent in greening supply chains.

This weakness is compounded in the HSC literature by an abundance of conceptual papers but a dearth of evidence-based research (Pedraza-Martinez and Van Wassenhove, 2016; Kunz et al., 2017). Due to field-specific constraints, little empirical research has materialized and “*researchers tend to shy away from implementation*” (Kovács and Spens, 2011, p. 41). Furthermore, HSC literature is heavily skewed to the disaster-response phase while ongoing operations such as development programs, oriented to building more resilient communities, remain poorly addressed. Interestingly, prioritizing disaster response helps to widen the environmental sustainability gap in HSCs (Abrahams, 2014). As HOs become increasingly involved in an *operational mix* – i.e. both relief and development operations – and as the boundaries between operational types continue to blur, HSC research should focus more on this issue (Kovács and Spens, 2011, Besiou et al., 2014; Stauffer et al., 2016; Jahre et al., 2016).

This article seeks to bridge these gaps by conducting an action research study on greening an HSC. In particular, it addresses the following research questions:

- *How can extant green practices be suitably framed for HSCs, involving an operational mix of disaster relief and development programs?*
- *What are the specificities of humanitarian context that impact on greening HSCs?*
- *How can HOs cope with such specificities to green their supply chains?*

The rest of the article is as follows. Section 2 presents the study's theoretical underpinning. Section 3 describes the article's collaborative methodology and introduces the case. Sections 4, 5, and 6 outline the first, second, and third cycles of collaboration, respectively. Section 7 synthesizes the findings and formulates a set of actionable propositions. Section 8 discusses the theoretical, practical, social, and methodological contributions. Finally, Section 9 presents the conclusions, pinpoints limitations, and suggests avenues for future research.

2. Theoretical Underpinning

Wide agreement exists on the peculiarities of HSCs and the need for a study approach distinct from their commercial counterparts (Pedraza-Martinez and Van Wassenhove, 2016). Similarly, it is essential to understand how such specificities play a role in incorporating environmental sustainability into HSCs. An appropriate theoretical view deepens such an understanding. Stakeholder and institutional theories can enhance our understanding of how different HSC actors (e.g. donors, suppliers, HOs) interact for greening HSCs and what their motives are for so doing. Furthermore, developing a theoretical view around the disaster cycle perspective involving preparedness, response, and reconstruction (Tabaklar et al., 2015) can relate each phase to its specific sustainability practices and requirements. These theories, however, may fall short of utility in distinguishing the specificities intrinsic to the HSC context and, more importantly, in elucidating how such specificities impact the design and implementation of green practices.

In addressing the aforementioned research questions, this article builds on contingency theory for its theoretical underpinning. In its rudiment form, contingency theory posits that no single model of organizational management inherently works better than any other. Rather, different organizations are contingent upon various factors in their internal and external environment, known as contingency factors (Woodward, 1965; Lawrence and Lorsch, 1967). The utility of contingency theory in studying HSC sustainability has been demonstrated by Haavisto and Kovács (2014) and Kunz and Gold (2017). Moreover, since HSC sustainability is a nascent research area, contingency theory is an appropriate theoretical lens through which to scrutinize emerging and less-developed operations management areas (Sousa and Voss, 2008).

Contingency theory holds that organizations achieve high performance by maintaining a *fit* between their structures and the contextual factors in their operating environment (Donaldson, 2001). Drazin and Van de Ven (1985) introduced three forms of fit: *selection* explores the essence of the link between organizational context and response variables; *interaction* considers performance as a resulting effect between the organizational context and response variables; *system* addresses the relationships among multiple contextual factors and response variables, and their resulting effect on multiple performance criteria. *The selection* form of fit is used here to explore how HOs adopt/customize/develop and

implement green practices to cope with organizational and contextual contingency factors without measuring performance (e.g. carbon footprinting).

The theoretical underpinning comprises three main constituents (Figure 1): On one side is the independent variable incorporating the categories of organizational and contextual contingency factors; on the other side is the response variable of green practices. While non-profit organizations and HOs face internal and external contingency factors affecting their organizational behaviour and adoption of different practices, little research has been undertaken on combined internal and external contingency factors (Bradshaw, 2009). Similarly, contingency theory literature argues that the simple sequence of *contextual contingencies to organization* neglects the role of organizational contingency factors, and that theoretical models should include both contextual and organizational contingency factors (Zajac et al., 2000; Miller, 1981). Likewise, this article's theoretical underpinning considers both organizational and contextual contingency factor categories. In order to distinguish them, the factors concerning the internal environment of HOs and headquarters are assigned to organizational contingency factors while exogenous factors concerning the actors outside HOs – but inside HSCs – are deemed contextual contingency factors.

Figure 1

In line with classic contingency theory (Tosi and Slocum, 1984; Morgan, 1986), this study adopts *organizational structure* and *organizational subsystems* as the chief categories for organizational contingency factors. In HOs, organizational structure plays a major role in decision making due to unique characteristics such as decentralization and dynamism (Gatignon et al., 2010). Considering organizational subsystems as an organizational contingency category helps to distinguish between the impact of different departments on the response variable. As for contextual contingency factors, this study adopts the main categories of contingency factors influencing non-profit organizations as developed by Cornforth (2003): *field of activity*, *stakeholders*, and *funding environment*. In this study, the *field of activity* is translated into HSC specificities. External supply chain *stakeholders* are suppliers, third-party logistics providers (3PLs), implementing partners, other HOs, and beneficiaries (Kovács and Spens, 2007). Finally, *funding environment* concerns donors and their funding of HSCs. It should be noted that the empirical investigation unearths the contingency factors while the theoretical underpinning proposes a categorization into which the contingency factors fall.

In line with the contingency views of Kunz and Gold (2017) and Haavisto and Kovács (2014), this article's theoretical underpinning contends that combining sustainable supply chain management and HSC management is contingent on considering contingency factors in the humanitarian context and organization. Thus, HOs adopt or customize extant green practices or develop new ones to cope with organizational and contextual contingency factors. Moreover, they can occasionally benefit from the interactions between organizational and contextual contingency factors (shown by a dashed-line in

Figure 1). For example, the procurement department (as a subsystem) can encourage donors (funding environment) to fund the implementation of green practices.

3. Methodology and Case Description

Collaborative and action research methodologies are the umbrella terms for a new mode of research seeking to address the double hurdle of practitioner relevance and scholarly excellence (Starkey and Madan, 2001). They entail research *in* action rather than *about* action where the researcher is not a mere observer but an agent of change intent on co-generating *actionable scientific knowledge* (Coghlan, 2011). Deploying action research methodologies has been advocated to advance the field of operations and supply chain management (Näslund et al., 2010; Coughlan and Coughlan, 2002) and specifically address the relevance gap and dearth of empirical research into HSCs (Sabri, 2018).

This study's methodology is *collaborative management research* (CMR) defined by Pasmore et al. (2008a, p. 20) as "an effort by two or more parties, at least one of whom is a member of an organization or system under study and at least one of whom is an external researcher, to work together in learning about how the behaviour of managers, management methods, or organizational arrangements affect outcomes in the system or systems under study, using methods that are scientifically based and intended to reduce the likelihood of drawing false conclusions from the data collected, with the intent of both improving performance of the system and adding to the broader body of knowledge in the field of management".

Selecting CMR as the methodology coheres with the study's theoretical view. Collaborative research methods produce *practical knowing*, which differs from *scientific knowing* in that it is *particular* and *situational*, emanating from *contextually-embedded* data (Coghlan, 2011). In moving from one setting to another, CMR determines what modifications are needed and decides how to react to new contingencies (Shani et al., 2012), making it consistent with the choice of contingency theory. Moreover, both contingency theory and CMR aim to provide organizations with similar results; the main objectives of contingency theory in operations management is to generate advice on the specific practices that incline organizations towards achieving fit (Sousa and Voss, 2008). Likewise, the fruit of CMR, in addition to the production of scientific knowledge, is *action steps*: a set of recommendations to address a certain managerial issue upon which a shared understanding has been achieved through collaboration (Shani et al., 2012).

3.1. Description of the CMR Case

The collaboration described in this article is focused on the supply chain of male condoms procured by the United Nations Population Fund (UNFPA). In line with the mission "*delivering a world where every pregnancy is wanted, every childbirth is safe and every young person's potential is fulfilled*", UNFPA's main focus is on maternal, sexual, and reproductive health. In addition to its large-scale development operations in over 150 countries, UNFPA is actively engaged in various relief operations. Provisioning sexual

and reproductive health during emergencies is recognized as an indispensable human right (Sphere Association, 2018). Within the first hours of an emergency, UNFPA delivers sexual and obstetric care to protect pregnant women and prevent sexually transmitted infections and unwanted pregnancies (UNFPA, 2018). UNFPA's relief operations are associated with the Sustainable Development Goals (United Nations, 2018) – specifically with goals 3 (good health and well-being) and 5 (gender equality) to reduce child and maternal mortality (targets 3.1 and 3.2), eradicate the epidemic of AIDS (target 3.3), ensure universal access to sexual and reproductive healthcare and family planning services (targets 3.7 and 5.6), and eliminate female genital mutilation (target 5.3).

Considering the research gaps identified in section 1, the rationale for choosing male condoms is twofold. First, UNFPA is the biggest procurer of male condoms in the world with a spend exceeding \$18 million in 2015 (UNFPA, 2018). This confers a privileged position on UNFPA in the HSC of prophylactics in leading other supply chain actors towards sustainability. In turn, employing an action research methodology allowed for exploiting this leverage to make impactful interventions and address the gap on the need for empirical research with greater relevance to humanitarian practitioners. Second, male condoms epitomize a product that shares the characteristics of both relief and development supply chains and, thus, addresses the research gap on operational mix. Relief products supply chains are characterized by unpredictability and lack of information on demand, non-structured decision-making, and urgent requests for supplies (Holguín-Veras et al., 2012). In order to deal with such specifications, HOs principally rely on preparing and prepositioning *kits* to ensure a rapid emergency response that meets the needs of afflicted populations. UNFPA maintains stocks of roughly 20 different essential reproductive health kits, condoms being one of the major kits (UNFPA, 2011). On the other hand, the supply chains of development programs, include products with less uncertainty in demand, more structured decision-making, and steadier patterns of requesting supplies (Holguín-Veras et al., 2012). Anew, male condoms are widely distributed in developing countries through public distribution programs (e.g. campaigns), in health centres and clinics, and by direct delivery (e.g. to vulnerable beneficiaries and sex workers). Thus, the knowledge gleaned from greening the condom supply chain can be extrapolated to both relief and development supply chains.

3.2. Elements of the CMR Case

In a CMR study, several aspects need to be outlined, viz. objective, collaborative relationships, CMR cycles, and outcomes (Shani et al., 2018). The objective of collaboration was to improve the environmental sustainability of the UNFPA male condom supply chain from the perspective of the procurement department at headquarters. Therefore, this study analyses the *HSC* to identify contingency factors and to investigate how it is influenced by interventions from headquarters. The collaboration was conceived from the mutual interest of both parties without UNFPA funding. UNFPA

was already involved in inter-agency dialogues for sustainable procurement with the intent of extending it to the whole supply chain. The researchers were interested in the topic of green HSCs given their practical and academic relevance, and appeals from previous research. The *study team* was composed of three researchers (the authors) and the *management team* comprised six UNFPA managers; referred to collectively as the *CMR team*. The composition of the study team was:

- A PhD researcher in green HSCs with a background in operations management and industrial engineering;
- An associate professor with expertise in sustainable supply chain management and reverse logistics;
- A full professor of purchasing and supply management;

The management team consisted of:

- The *head of procurement and supply division* (hereafter, division head) responsible for steering the CMR team, granting the study team access to organizational data, and approving action steps devised by the CMR team to implement in the HSC;
- A *supply chain specialist* to help the CMR team with logistics management and coordination with country supply chain officers;
- Two *regional procurement managers* to support the CMR team in collaborating with suppliers and country offices, especially in development programs;
- A *project coordinator* to help with field projects and relief operations;
- A *contract associate* to support the team on contractual and legal issues;

Physical meetings took place at UNFPA's European headquarters in UN City, Copenhagen, with many additional virtual meetings, conversations, and email exchanges in between. The collaboration lasted over three years from late 2014 to early 2018, and two-and-a-half cycles of CMR were completed. The first half-cycle focused on developing a greening framework as a point of departure for implementation. The second and third cycles aimed at implementing action steps derived from the greening framework.

At each joint meeting, the study team proposed several green practices based on self-development or the greening framework. The practices were placed in *collective inquiry* where the contingency factors that might impact implementation were investigated. The CMR team discussed how to customize the proposed practices or develop new ones to address the contingency factors. When a *shared understanding* was reached, revised green practices – in the form of action steps – were communicated to the pertinent UNFPA staff by the division head. The utility of implemented action steps was continually assessed. Oftentimes, during implementation, new contingency factors arose that necessitated re-customization of green practices in subsequent meetings. The study team was engaged in data collection, reviewing that data, creating a shared meaning from the data, and identifying possible action steps – which were then implemented by the

management team. The study team co-monitored the implementation, planning further action steps and devising corrective actions based on implementation results.

By way of clarification, three basic concepts frequently used in this CMR study are highlighted: green practices, contingency factors, and action steps. Green practices were raw recommendations derived from the greening framework and developed by the study team to improve the environmental sustainability of the HSC. Contingency factors pertained to the organizational (internal) or contextual (external) environment of the HO that either hindered or enabled the implementation of green practices. Finally, action steps were revised green practices, introduced to cope with the contingency factors identified.

4. Cycle 1 (Developing A Greening Framework)

As a point of departure for the collaborative project, the study team developed a greening framework by synthesizing extant green practices for HOs. This synthesis of the literature relates to a principal role of researchers in CMR: providing academic knowledge, not readily available to practitioners, from scientific sources (Pasmore et al., 2008a) and serving as an essential first step in a collaborative research project (Edmondson, 2011). Generally, each CMR cycle involves *design* of the research process, *inquiry*, and *results implementation* (Shani et al., 2018). Since this cycle sought to develop a greening framework for the whole project and did not include implementation, it is referred to as a half-cycle.

A comprehensive synthesis of extant green practices tailored to HSCs was required. The study team decided to develop a framework since no sustainability framework for HSCs could be found in the literature. To ensure the inclusiveness of the framework, the management team put the study team in contact with supply chain and procurement specialists from UNICEF and UNDP¹.

The study team started with supply chain mapping to identify key supply chain actors, activities, and their interrelations; in an operational mix-based HSC, a focal international HO (headquarters) orchestrates supply chain operations. In the HO, the procurement department often takes responsibility for logistics management in addition to its purchasing and supply management responsibilities. That is commonplace when some logistics activities are outsourced or implemented by other actors, such as implementing partners, under the supervision of headquarters. Hereafter, *procurement department* refers to the organizational subsystem managing both procurement and logistics operations.

HOs involved in an operational mix often keep limited prepositioned stocks at headquarters supply centres for emergency first response whilst most stock is held by

¹ UNFPA, UNICEF, and UNDP are all members of an informal inter-agency task team on sustainable operations (<https://savinglivesustainably.org/>).

prequalified suppliers. For relief operations, in addition to the prepositioned stocks at headquarters, suppliers may preposition extra stocks to guarantee a certain level of relief inventory and update HO regularly with relief stock positions. For development programs, national delegations estimate demand from the field data, historic demand, and future programs/campaigns, and send it to the procurement department at headquarters. The department processes the demand and forwards purchase orders to suppliers. After local inspection, the products are directly dispatched to the listed destinations either by suppliers or 3PL (contracted by supplier or HO). The carrier delivers the items to national delegations who then store them in local distribution centres with responsibility for last-mile distribution (LMD) and reverse logistics. During LMD and reverse logistics, other HOs may interact with development and relief operations. Figure 2 depicts the supply chain mapping of the HSC described.

Figure 2

According to the supply chain mapping, four main activities emerged: *Inbound logistics* which involves flows into supplier plants, *outbound logistics* from suppliers to destination countries, *LMD* from local distribution centres to beneficiaries, and *reverse logistics* concerning the flow of items for reuse, recycling, and disposal. Moreover, four main supply chain actors were identified; *suppliers*, *3PLs*, *implementing partners*, and *other HOs*. The procurement department harmonizes each actor vis-à-vis its corresponding activities: suppliers and 3PLs for inbound, outbound and reverse logistics, and implementing partners and other HOs for outbound, LMD and reverse logistics.

In developing the greening framework, procurement department responsibilities concerning suppliers and 3PLs were considered *conventional* responsibilities while those concerning implementing partners and other HOs were considered *sector-specific* responsibilities. Conventional purchasing and supply management responsibilities were adopted from Van Weele (2005). For sector-specific responsibilities, combinations of supply chain actors and their corresponding activities were incorporated into the framework. Table 1 represents the greening framework. The lateral row presents the conventional (in white) and sector-specific (in grey) responsibilities. The first column on the left shows the main supply chain areas of intervention: supply chain configuration, inventory, transportation, and packaging. Their selection was inspired by the classification of green supply chain management areas by Srivastava (2007) and by recommendations of specialists from the aforementioned HOs. The data in Table 1 present green practices that correspond to the intersecting responsibility and supply chain area of intervention. Due to the diversity of academic knowledge in sustainable supply chains, a *concept-centric literature review* based on Webster and Watson (2002) was conducted to find relevant green practices. Table 2 presents the search strategy and the stages involved in selecting green practices. Following development, the greening

framework was verified by the management team and three procurement staffs from the aforementioned HOs at the end of half-cycle 1. The development process took around six months.

Table 1

Table 2

5. Cycle 2 (First Cycle of Implementation)

First, a joint meeting was held to *design* the cycle where it was agreed to aim for an initial implementation of green practices from the framework. Next, the study team prepared a roadmap for the cycle delineating the responsibilities of members, deliverables, and meetings planned over a one-year period and sent it to the management team.

The first step was to understand the status quo of sustainability in the HSC. The study team designed questionnaires for responses from UNFPA staff in the field and headquarters as well as suppliers. The management team distributed the questionnaires. Within two months, responses from UNFPA staff and 12 suppliers were collected and sent back to the study team, showing extant green initiatives across the supply chain. Furthermore, the division head provided the study team with a procurement and logistics dataset of male condoms from 2013 to August 2015 (current time at cycle 2) for further orientation of researchers. The dataset included the details of all purchase orders and shipments including date, item description, weight, quantity, price, supplier/3PL details, destination, mode of transport, and intermediate inventory.

The study team took a month to analyse the dataset and the responses to questionnaires so that potential areas for improving sustainability could be identified. Based on the results, the study team selected appropriate green practices from the greening framework and developed a set of recommendations, which was sent to the management team in the form of a report. After their review, another joint meeting was held to discuss the applicability of the green practices proposed. The rest of this section portrays, for each supply chain area of intervention, how green practices were put into collective inquiry, what contingency factors were identified, and whether and how the green practices were turned into action steps considering contingency factors.

5.1. Supply Chain Configuration

The configuration of the condom supply chain was investigated both for supplier facilities and local warehouses. Almost all supplier facilities were located in East Asia. Conversely, most beneficiaries were in Africa and Latin America, requiring long-haul transportation. The study team started with the green practice *local procurement* from the greening framework since it could lead to significant reductions in the distances travelled and,

consequently, reduce the emissions emanating from logistics. In case local suppliers were not available, building manufacturing plants close to high-demand regions was considered next. However, several barriers were in the way. First, higher costs of production and quality inspection of non-Asian suppliers propelled UNFPA to procure most of the demand from Asia. As the supply chain specialist remarked during the joint meeting at the end of the cycle *“Recently, we made a bid for a Latin American country and we were interested in local sourcing. But the prices of local suppliers were almost double the prices of Indian suppliers [including transportation] ... Donors assess our performance very much based on price. We need to raise the awareness that environmental sustainability sometimes comes with a cost”*. Second, ecological rubber extent presupposes the natural abundance and higher quality of rubber trees in East Asia, leaving a few countries with appropriate resources in Africa and Latin America (Warren-Thomas et al., 2015). Third, donors imposed constraints: most funds had to be spent annually or were tied to a specific purpose, constraining UNFPA’s ability to undertake long-term facility planning.

As for the location of warehouses, besides the stocks held by suppliers, UNFPA stored condoms only in national inventories. By reviewing the procurement data, the study team realized that East and West Africa are where most procurement is spent. Moreover, due to severe demand fluctuations, UNFPA faced delivery delays and increased air transport costs. Building regional warehouses could add a supply chain echelon which to cushion fluctuations and decrease air transport usage. Here again, there were several barriers: limited financial resources, short-term and earmarked funds, import/export barriers, and diversity and customization of products by each country, which acted against establishing regional warehouses. The CMR team continued to brainstorm on the development of original action steps to improve supply chain configuration. For suppliers, speeding up the process of prequalification for several African suppliers and ordering from existing prequalified suppliers closer to destinations (considering available stocks and capacity) were action steps that were implemented.

In addition to supply chain configuration, coordination among supply chain actors – an area contingent on configuration (Rudberg and Olhager, 2003) – was recognized as having a major role to play in greening. At the end of cycle 2, the CMR team revisited the greening framework and decided to focus on coordination as a distinct supply chain area of intervention in the next cycle.

5.2. Inventory and Warehousing Management

Inventory and warehousing greening in cycle 2 was focused on fostering collaboration among other HSC actors. Building on the green practices of *joint warehousing with other HOs* and *joint warehousing of relief and development aid*, the management team strengthened collaboration with WFP, the inter-agency logistics coordinator, to facilitate the shared use of United Nations Humanitarian Response Depots (UNHRD). Coexistence of other HOs with mutual fields of operation, higher standardization, and lower diversity of relief items with waived customs were facilitating contingency factors for joint inventories with WFP.

For development products, UNFPA initiated collaboration with USAID, another major procurer of condoms, for joint warehousing. Moreover, the management team explored procurement synergies with other HOs, leading to the signing of a joint long-term agreement with UNICEF to source 30 mutual products from two suppliers. Another agreement with Global Fund initiated joint procurement of male condoms. Both joint agreements offered a leveraged position to UNFPA over suppliers that, in turn, facilitated incorporation of sustainability into supplier practices. However, unlike relief operations, inter-organizational collaboration in development programs came into force only for mutual products.

5.3. Transportation and Shipment Management

During cycle 2, the study team conducted a preliminary carbon footprinting of the supply chain based on the dataset and the data collected from questionnaires. The carbon footprinting analysis identified outbound logistics as the hotspot, suggesting it as the starting point for greening transportation. The study team further scrutinized the dataset and detected individual shipments from Asian suppliers that were dispatched to the same or neighbouring African countries concurrently. The findings were placed in collective inquiry at the CMR team meeting to investigate the causes. The problem was partly due to insufficient intra-department management; for example, the procurement officer in charge of Malawi demand worked in isolation from the officer managing neighbouring Mozambique. Contingency theory asserts that subsystems dealing with highly uncertain environments, such as HO's departments, have members oriented to task accomplishment rather than interpersonal relationships with other subsystem members (Lawrence and Lorsch, 1967).

Given that many shipments shared routes either fully or partly, the greening framework was able to assist with these practices: *consolidation from suppliers to close destinations* and *joint deliveries through spatial or temporal pooling*. For shipments with proximate suppliers (origins), consolidation was not a feasible option. *"In our model [of supply chain], we don't really consider this. It's the suppliers who manage the shipments. So, if the orders are issued to two different suppliers, each will have its own contract and own shipper and those shippers may not be the same, even if both suppliers are located in the same country"* stated the contract associate. The department distributes the demand received from country offices among its prequalified suppliers, who were unaware of each other's operations. Therefore, consolidation at origin requires fundamental supply chain redesign to integrate the suppliers' orders and align them for shipment consolidation.

Next, the study team proposed consolidation of shipments with close destinations in regions with high demand (mostly east and west Africa). It was seen as a feasible solution and put into action. However, the results were not satisfactory at the end of cycle 2; *"We have tried several times to ship the goods to a regional warehouse and then distribute to neighbouring countries... It took us months! Because when you enter goods in one country, then you need the support of national authorities to move the cargo somewhere else... That's almost impossible. It was so difficult that sometimes we even exported it*

back to Europe and then again to the neighbouring country! It is more complicated than it seems!” explained the regional procurement manager. One contingency factor was the complex customs regulations of national governments for development products (as previously found for supply chain configuration). Another factor was the low cooperation of national authorities. The problem of host governments imposing restrictions on HSCs through extreme bureaucracy and import/export barriers is supported by Kunz and Gold (2017) and Kunz and Reiner (2016).

Apart from internal consolidation, the study team proposed *joint use of 3PLs with other HOs* and *fleet consolidation for collaborative outbound with other HOs*. For relief products, UNFPA collaborated with WFP and UNHCR to share freights for outbound logistics, customs clearance, and LMD. This action step was shown to be successful with several emergency shipments consolidated and distributed during cycle 2. It also allowed UNFPA to benefit from UNHCR’s and WFP’s better access to certain regions and their freight price agreements. For development items, however, there was no organization hosting a coordination mechanism, and inter-organizational collaboration was sporadic. For example, UNFPA had already collaborated with UNICEF and UNDP to use similar 3PLs for some shipments. Besides the collaboration’s temporary nature, the initiative was instituted for pure economic interests and greening was an ancillary benefit. To improve collaboration over development programs, the study team, employing the green practice *use of collaborative platforms to increase the integration of fleet management with other HOs*, suggested developing an organized platform to increase coordination among development organizations. For example, a search of procurement bids² in UN development organizations revealed more than 50 notices for Ethiopia, many with similar delivery times and adjacent suppliers. Although the division head was in favour, developing such a platform was beyond the procurement department’s authority, requiring higher-level backing from all development organizations. “*The harmonization of development programs stops at contractual level and there is no unified mechanism for integration. Development organizations are not aware of each other’s shipments.*”, stated the division head.

With LMD, establishing collaboration is even more challenging due to field specificities such as poor infrastructure and scattered rural areas. According to Burlando et al. (2006, p. 5) “*With the existing operations, it is quite possible that a WHO medical van would visit a village one morning, then a WFP food truck would visit that afternoon*”. Building upon the green practice *Fleet consolidation for joint LMD with other HOs*, UNFPA and WFP expanded their collaboration into LMD through a joint pilot operation in the Democratic Republic of the Congo during the second cycle. They mapped out where joint operations and deliveries were possible. The collaboration achieved reduced environmental emissions from LMD by decreasing the cumulative number of trips by both HOs.

5.4. Packaging and logistics-related product specifications

² United Nations Global Marketplace (UNGM)

Before initiating collaboration, the department engaged in collaborative dialogues with suppliers about greening their operations. A set of Eco requirements for condom manufacturers was defined including acquiring ISO 14001 certification, meeting local regulations on waste water treatment and air pollution, using recycled material, and eliminating plastic from outer packaging (UNFPA Procurement Services Branch, 2013).

The CMR team started from the logistics implications of packaging because the division head, based on her managerial insights, believed opportunities existed for improvement. Since condoms are bulky but light, freight load is well below its maximum weight capacity causing the freight to *cube out before it weighs out* (McKinnon, 2005). Therefore, the study team delved into the volumetric analysis of freight transport because increasing the weight reduces the overall environmental impact of transportation (McKinnon, 2005, Wever, 2011). With three levels of packaging, the study team proposed increasing the number of condoms per secondary packaging to maximize the fill rate during transportation since modifying secondary packaging to fit logistical needs was easier than primary packaging where strict rules and regulations applied (Sohrabpour et al., 2012). A contextual contingency factor in UNFPA's LMD was supporting the increase: in both development and relief LMD, condoms were often given to beneficiaries in the form of strips from the secondary packaging, restricting its function to the point of distribution. Therefore, due to the specificities of the humanitarian context and different perceptions among beneficiaries, delivering secondary packaging was not mandatory, as in commercial supply chains.

After consulting the quality control department, a pilot test was conducted with a supplier to increase the number of condoms per secondary packaging (was 144). A stratification structure separated by cardboard made it possible to load 1000 condoms per secondary packaging (10 squares of 100). The new packaging arrangement created considerable improvement in fill rate and volumetric freight design. There was, however, a drawback; more condoms were contaminated from lube leakage and had to be discarded.

Another action, in line with pooling resources for inventory and transportation, was to expand collaboration with USAID to standardize and integrate packaging. Here, one factor that impeded the standardization of development products was the diversity and customization of packaging based on country recommendations. Finally, the study team identified *less-than-container-load* shipments by several carriers. After joint discussions, the division head prohibited less than container loads for port-to-port shipments, excepting intermodal transport due to the risk of theft during modal shift.

6. Cycle 3 (Second Cycle of Implementation)

The cyclic approach of collaborative research posits that a fact-finding stage is performed at the beginning of each cycle involving evaluation of previous cycle(s), seeing what was learnt, and proposing corrective actions for the new cycle (Coghlan, 2011). The study team sent a report to the management team evaluating the action steps implemented

during cycle 2 and suggesting further green practices based on outcomes. Similar to cycle 2, a joint meeting was held at headquarters to design cycle 3 and discuss implementation of newly suggested green practices. The implementation and scrutiny of results in cycle 3 took 17 months. This section describes the green practices, contingency factors, and action steps in cycle 3.

6.1. Supply Chain Coordination

One of the sector-specific responsibilities of the procurement department is coordination of logistics with implementing partners at the downstream of supply chain. From the beginning of cycle 2, a palpable impediment was low visibility of the procurement department over operations of country offices. Accordingly, the CMR team revisited the greening framework and focused on supply chain coordination as a distinct area of intervention. The procurement department's reach and visibility ended on transferring products to country offices. The division head explains the situation at cycle 2:

*“UNFPA mostly ensures delivery to country offices; thereafter, it is up to the country offices to take on the distribution...We don't know much what happens to condoms after delivery to country offices. We have no idea whether they reach beneficiaries, expire in stocks, or burn due to superstitions!”*³

This bifurcation was the root of many logistics problems affecting not only LMD but also amplified over the upstream of the supply chain. The department was unable to make opportune demand forecasts due to low visibility on country stocks: *“We don't have enough information about national stocks much in advance. So, we are afraid to end up with tons of condoms that nobody wants”*, the regional procurement manager disclosed. Fundraising activities were also adversely affected: *“... it is important to have a clear and right projection to have the appropriate fundraising based on that”* she added. Sudden stock shortages at country level in the absence of headquarters' foresight put pressure on suppliers. Sometimes, a large urgent demand from a country office had to be shared between two or more suppliers leading to several shipments. It was also the main cause of air shipments discharging high emissions.

Based on the theoretical underpinning, the low visibility problem is rooted in the decentralized organizational structure of HOs. Contingency theory argues that organizations dealing with heterogeneous or uncertain environments, such as HOs, tend to have more boundary units and lean more towards decentralization (Thompson et al., 1967; Tosi and Slocum, 1984). Therefore, to make a fit, green practices should not only be aligned with the contextual contingency factors but also the visibility of headquarters over field operations (the dashed-line in Figure 1) should be enhanced.

³ The quotation reflects the situation of UNFPA at the start of cycle 2 in 2015 and is no longer valid. As described in subsection 6.1, by the end of the collaboration, UNFPA could significantly improve its visibility over the products after delivering to country offices, an effort that is still ongoing. *“The goal of UNFPA is to be able to fully track product movements until reaching beneficiaries and we are still trying to improve it.”* stated the division head when collaboration ended, and this manuscript was sent to UNFPA for evaluation.

The study team investigated the use of *integrated electronic logistics management information system* and *ICT-based platforms* by country offices and headquarters. The team focused on implementing tracking and tracing technologies such as barcodes throughout the HSC to improve visibility of transportation and inventory management. By the end of cycle 3, major action steps on the use of ICT technologies and barcodes were implemented by headquarters, allowing for the tracking of wrapped pallets until final distribution.

At policy level, country offices were encouraged to exercise greater accountability to headquarters concerning their stocks and LMD by reporting regularly. Moreover, in line with the green practice *mutual engagement of the HO and country office in LMD*, the management team boosted the active participation of headquarters representatives in country offices.

At the time of writing, efforts to bridge the visibility gap were still in progress with significant advances made. This quotation from the division head at the end of cycle 3 sums up the transition: “*We can put a checkmark on this [use of technologies for inventory and LMD]. We have done a lot to increase the visibility of headquarters in country offices over the past years... We have been increasingly involved in LMD recently due to our fiduciary responsibility*”. Moreover, following efforts to accelerate the prequalification process in cycle 2, two African suppliers became prequalified by the end of cycle 3.

6.2. Inventory and Warehousing Management

Efforts to foster collaboration with other supply chain actors continued into cycle 3, and the increased visibility sharpened the focus on country office inventories. The study team tried to address inventory problems such as frequent small shipments and emergency air deliveries by considering two green practices from the framework: *emission reduction by reducing shipment frequency and adjusting inventory level* and *greener inventory management through order lot sizing and safety stock*. However, some debates about appropriate inventory levels and safety stocks took place. In addition to the risk of excess ordering, the reluctance of national authorities to fund was another barrier acknowledged by the division head: “*More and more donors are saying we have been funding contraceptives now for 50-60 years... They want to see graduation plans and they want to reduce funding so that national governments step up and fund more from their own national budget. That is not happening in many countries, THAT IS THE ELEPHANT IN THE ROOM. Many countries are not so interested in their contraceptive agenda. It is so under-funded and neglected and difficult to get the political commitment from governments to fund it.... therefore, to tell them that they should keep even higher safety stocks is very difficult, while they don't have AT ALL enough stocks as it is*”.

From a theoretical perspective, low national funding and reluctance by national authorities to support contraceptive planning are contingency factors that thwart green inventory practices being adopted. To address the problem, country offices were encouraged to devise long-term contraceptive plans and update them annually. Such plans included details of projected national programs, campaigns, prediction of emergencies,

and the estimated resultant demand. Moreover, in some countries, UNFPA worked with more than one implementing partner – for example, country office, ministry of health, and local NGOs – each holding their own stocks separately. The management team tried to promote cooperation and information sharing among its implementing partners in each country so that each other's stocks could be used in case of shortages.

6.3. Transportation and Shipment Management

While the action steps started in cycle 2 were still progressing, reverse logistics were given attention in cycle 3. UNFPA relied on “safe disposal and management of unused, unwanted contraceptives (UNFPA, 2013)”, “WHO guidelines for safe disposal of unwanted pharmaceuticals in and after emergencies (WHO, 1999)”, and national regulations for handling reverse logistics and unused condom disposal. The CMR team was motivated to restudy reverse logistics on becoming aware of the shortcoming that the guidelines offered little on logistics nor gave consideration to sustainability as a main criterion in selecting disposal methods. Handling the reverse flow of unused condoms was already included in suppliers' contracts for recalled, damaged, and substandard products. However, for unsolicited donations and expired condoms, no specific reverse logistics planning was in place. The study of Kovács and Spens (2011, p. 37) advocated the problem: *“unsolicited supplies have led to the incineration of many donations and reverse logistics is yet to be researched in the humanitarian context”*. For UNFPA, the problem was partly due to the low visibility of headquarters over country office operations. *“In one case in [country's name], the government told us that they will be meeting the national regulations for the disposal. When we asked for the pictures, it was basically a dug hole, they just put fuel, and burnt the condoms. That was how they were disposing according to the government guidelines!”* stated the project coordinator. The efforts to improve visibility in cycle 3 also contributed to the better management of reverse logistics.

Another cause was poor facilities in developing and humanitarian regions for recycling and environment-friendly disposal. *“In [country's name], there was only one company that met the standards for handling disposal and they just had a very small oven. I remember once they were burning condoms for one week.”*, the project coordinator remarked. After further data gathering and analysis, the study team prepared a reverse logistics planning report including a review of suitable disposal methods and their prioritization based on environmental friendliness. The report focused on the primary packaging of condoms, made of polyethylene and aluminium, because the remaining packaging was made from cardboard boxes that could be recycled even with limited facilities. The main challenge was separation of condoms from primary packaging, especially with mass quantities. In a nutshell, the following disposal methods were suggested in the order of environmental friendliness: return to authorized recycling facilities, high-temperature incineration, low-temperature incineration, and landfill. Where recycling facilities were lacking, the plan recommended accumulating products at a collection point before transportation to a recycling facility, preferably using empty backhaul vehicles, as suggested by the greening framework. Where landfill was the only

option, the plan suggested using a shredder or compactor to degrade the packaging prior to disposal so that the risk of scavenging – a prevalent contingency factor in developing and humanitarian settings – was mitigated. Close supervision of all transportation and inventory operations was crucial to prevent scavenging and pilferage. The plan was presented for joint discussion and then revised based on managerial insights and past experiences. For example, instructions to country offices were added in response to the management team recommendation that upfront agreements should be established with local facilities possessing high-temperature incinerators, such as cement manufacturers, to access their kilns. After approval, the guidelines were communicated to country offices in the form of a standard operating procedure.

6.4. Packaging and logistics-related product specifications

While pilot tests with suppliers and USAID continued in cycle 3, the team focused on improving leaflets and cardboard packaging. Based on the green practice *local adaptation of packaging to address regional customers' needs*, the study team proposed printing leaflets solely in the language of the destination country to reduce leaflet size. The management team withheld approval because it deprived UNFPA of the benefits of economies of scale in purchasing similar products. Brainstorming by the CMR team fashioned the following action steps: printing on both sides of the leaflet, reducing the font size and making the text more succinct, using thinner recycled paper, and standardizing leaflet material and content for all suppliers. Moreover, the cardboard in the outer packaging decreased from three layers to two without diminishing the quality.

Upon completion of cycle 3 in January 2018, the rigour, reflectiveness, and relevance of the CMR process were evaluated using the criteria introduced by Pasmore et al. (2008b). Moreover, based on the recommendation of Kunz et al. (2017), the final draft of this manuscript prior to submission was returned to and approved by UNFPA to ensure the validity of the findings.

7. Synthesis of Findings and Propositions

This section synthesizes the findings of the study and develops propositions for greening HSCs. Table 3 summarizes the findings from the action research. Columns *green practices*, *contingency factors*, and *action steps* correspond to the first, second, and third research questions, respectively. Green practices were either adopted from the greening framework or developed during the implementation cycles. As for contingency factors and their categorization in the theoretical underpinning, few, albeit important, factors fall into organizational categories. *Low visibility of headquarters over country offices' operations* was identified as an influential contingency factor related to organizational structure. Larger HOs tend to decentralize their organizational structure to improve responsiveness and performance (Gatignon et al., 2010). In doing so, however, poor alignment among decentralized units, especially between headquarters and implementing partners, can impair traceability and visibility. *Insufficient intra-departmental control* at procurement department level was another contingency factor related to organizational

subsystems. Propositions *P1* and *P2(a)* shed light on these organizational contingency factors, respectively. On the other hand, most of the contingency factors identified belong to contextual categories vis-à-vis funding, stakeholders, and field of activity. Propositions *P2(b)*-*P5* elaborate further on these contextual contingency factors. Lastly, the right-hand column presents the action steps through which HOs cope with the contingency factors identified.

Table 3

Based on two-and-a-half cycles of collaboration and the results synthesis presented in Table 3, this study formulates five *actionable propositions*. *Actionable* or *design propositions* (Denyer et al., 2008) “offer a general template for the creation of solutions for a particular class of field problems” (p. 395) and “contain information on what to do, in which situations, to produce what effect and offer some understanding of why this happens” (p. 396).

Throughout the collaboration, a major impediment to implementing action steps was poor visibility of headquarters over field operations, an organizational contingency factor rooted in decentralized organizational structures. It was found to be influential in all supply chain areas of intervention resulting in poor projections for downstream inventories, uncoordinated LMD, and little planning for reverse logistics, all of which led to reduced environmental sustainability in the HSC. This is supported in the study by Eftekhar and Van Wassenhove (2016, p. 2) which criticized “*limited visibility of headquarters on local operations*” and concluded that “*HOs need to realize that what seems logical from the headquarters’ perspective may be illogical or inconvenient for the field*”. The recent review by Garcia-Torres et al. (2019) also argued that enhanced traceability throughout the supply chain leads to improved sustainability. Thus, this study proposes:

P1: Improving the visibility of headquarters over field operations through mechanisms such as integrated electronic logistics management information systems, enhanced presence of headquarters staff in delegations, and engagement in LMD will have a positive impact on the environmental sustainability of HSCs.

Another organizational contingency factor influential in sustainable supplier management was poor interaction among employees in the procurement department and insufficient managerial control of internal integration, resulting in uncoordinated and overlapping purchase orders. The capriciousness inherent in the humanitarian context magnified the issue. Integrating internal capabilities and materials requirements in the procurement department are important determinants of sustainable supplier management (Reuter et al., 2010). Thus, the following proposition is posited:

P2(a): Internal integration within the procurement department will have a positive impact on ordering and delivery operations, and, thereby, will improve the environmental sustainability of HSCs.

Local procurement presented another issue for sustainable supplier management. It is known that local procurement improves the environmental sustainability of HSCs (Van Kempen et al., 2017). However, the existence of functioning suppliers in the afflicted area and their quality and price are major contextual contingency factors in implementing local procurement in a humanitarian context. During cycles 2 and 3, UNFPA could successfully increase its share of local procurement. The key was to engage early with suppliers and develop a pool of trusted suppliers through prequalification programs. Generally, the supplier-buyer relationship in the humanitarian context is intermittent, with HOs only reaching out to suppliers at the onset of a crisis. It would be difficult to integrate sustainability into procurement amid such hasty relationships. Hence, the second proposition regarding supplier management is:

P2(b): Local procurement in humanitarian and developing contexts is hampered by lower quality, availability, and price competitiveness of local suppliers. HOs can stimulate local procurement through early supplier development and prequalification programs.

Inter-organizational collaboration with other stakeholders along the HSC for outbound logistics, LMD, and reverse logistics was recognized as a sector-specific responsibility of the procurement department in cycle 1. Carrying out such *contextual* responsibilities with respect to other stakeholders is identified by Kovács et al. (2012) as skills essential to humanitarian logisticians. Later, the outcomes of cycles 2 and 3 confirmed that, whenever UNFPA engaged in inter-organizational collaboration, improvements in environmental sustainability were observed. The collaboration was in the form of joint procurement, inventory and transportation, all of which reduced the corresponding operations and, consequently, the environmental impact emanating from operations. Exploiting existing collaboration mechanisms, such as UNHRD in this study or *Logistics Cluster* in the wider humanitarian context, was a contextual contingency that promoted inter-organizational collaboration and, thus, sustainability. This finding is supported by the recommendations of the Joint UNEP/OCHA Environment Unit (2014) where “*poor coordination at and between all levels, even among traditional humanitarian responders*” is identified as a barrier to environmental mainstreaming in HSCs (p. 23). Furthermore, it accords with the growing amount of research in the commercial literature arguing that supply chain collaboration improves sustainability (Chen et al., 2017). It is therefore postulated:

P3(a): *Fostering collaboration with other HOs active in the humanitarian field, inter-organizational agreements for supplying mutual products, and exploiting established logistics collaboration mechanisms will reduce the emissions emanating from inventory operations, outbound logistics, and LMD in HSCs.*

However, we have observed different motives and degrees of inter-organizational collaboration in relief and development contexts. HOs are criticized for low collaboration in relief operation (Balcik et al., 2010), although some coordination mechanisms are already in place. We observed even lower levels of collaboration in development programs that were contingent on distributing similar products, further hindered by lower standardization and greater diversity of development products, all identified as contextual contingency factors. This was a counter-intuitive observation since more difficulties were expected with greening relief products due to the greater urgency and time criticality, but it was in general agreement with the study by Wild and Zhou (2011), which asserted that commonality of products among HOs gives rise to inter-organizational collaboration leading to more sustainable procurement. This prompts the second proposition regarding inter-organizational collaboration:

P3(b): *In development programs, inter-organizational collaboration for sustainability is contingent on sharing mutual products whereas, in relief supply chains, it is contingent on operating in similar geographic regions, regardless of product mutuality.*

Coming to the funding environment, several contextual contingency factors were found to be influential; firstly, in countries where governments and local donors had long-term funding plans for contraceptives, action steps could be implemented more effectively. Secondly, the awareness and interest of donors in sustainability was a key motive for holding HOs accountable for sustainability. Thirdly, in line with the literature (Sarkis et al., 2012; Pedraza Martinez et al., 2011; Besiou et al., 2014), this study observed reduced levels of sustainability and performance when funds were earmarked by donors. Therefore, it is proposed:

P4: *HOs that rely more on short-term and earmarked funds, or are funded by donors with less sustainability awareness, are less likely to succeed in improving the environmental sustainability of their HSCs.*

Finally, for packaging and product specifications, it was found that beneficiaries, compared to commercial customers, have lower expectations regarding aesthetics, product layout, and packaging material. This contextual contingency factor facilitates the modification of packaging, especially the secondary packaging of humanitarian products (Sohrabpour et al., 2012), in a way that reduces waste and improves logistics-related

product specifications, such as volumetric freight design and higher packaging fill rates. Thus, it is proposed:

P5: Lower expectations of beneficiaries in HSCs from packaging help to reduce packaging material and waste, and improve packaging fill rates and volumetric freight design.

8. Discussion of Contributions

8.1. Theoretical Contributions

This study makes three contributes to HSC literature. The first contribution is identifying three types of contingency factors that impact on greening HSCs; first, it unearths original contingency factors not identified by previous research; for example, different packaging needs and perceptions of beneficiaries compared to commercial customers as a facilitating factor, and risk of scavenging as a critical consideration in reverse logistics planning. Second, the study identifies contingency factors known to impact other HSC areas. Limited visibility of headquarters over delegations, for example, was found to negatively impact fleet management policies (Eftekhar and Van Wassenhove, 2016), overall performance in disaster operations (Gatignon et al., 2010), and decision-making in logistics management (Rodríguez-Espíndola et al., 2018); this current study identifies it as an impeding factor for greening LMD and reverse logistics. Third, it confirms contingency factors already identified to impact greening HSCs by previous studies such as low donor awareness of sustainability, poor inter-organizational collaboration (Sarkis et al., 2012), strict import/export regulation, and earmarked funding (Kunz and Gold, 2017).

The second contribution centres on how to *customize* extant green practices or *develop* new ones to cope with the contingency factors identified. In the first case, the study showed how extant green practices to improve the volumetric usage of freight (e.g. McKinnon (2005)) were customized based on the contingency factor *different packaging needs of beneficiaries* and resulted in an improved packaging design to fit the humanitarian context. The second case is exemplified by the development of reverse logistics standard operating procedures that consider contingency factors such as unsolicited donations, risk of scavenging, and poor recycling facilities in a humanitarian context.

Third, the study elaborates contingency theory in the field of HSC research through horizontal contrasting (Fisher and Aguinis, 2017) with the field of sustainable supply chain management. This article's theoretical underpinning postulates that, similar to commercial organizations, HOs can achieve a fit between their context and green practices either by developing/customizing green practices or by influencing their operating environment (or both). The latter, denoted by the *interaction* dashed line in Figure 1, emerged in several interventions – for example, raising more flexible or national

funds (impact of subsystem on funding environment) or stimulating cooperation among implementing partners (impact of subsystem on stakeholders).

8.2. Practical and Social Contributions

This article makes strong practical contributions by highlighting the mechanisms through which HOs can green their HSCs, such as improving visibility over delegations by increasing the presence of headquarters staff and employing ICT to track products during LMD. Moreover, practitioners can avail of the proposed greening framework, which synthesizes green practices tailored for HSCs. They can also benefit from the collaborative process of designing and implementing relevant action steps for their HSCs.

Although the objective of the study was to improve environmental sustainability, the implemented action steps contributed also to social sustainability. Prequalifying African suppliers and increasing the share of local procurement along the HSC created jobs for local communities and supported local capacity building. Moreover, other action steps regarding improved visibility, long-term national planning for contraceptives, proper disposal of expired condoms, considerably improved social welfare, and providing beneficiaries with better access to contraceptives.

8.3. Methodological Contributions

Since applying action research methodologies to supply chain management is growing (Näslund et al., 2010), this study contributes to action research in the field of HSC by answering the calls to conduct more empirical research (Pedraza-Martinez and Van Wassenhove, 2016) and addressing the relevance gap in HSC research through academic-practitioner partnerships (Kunz et al., 2017). It makes three specific methodological contributions. First, while maintaining collaborative relationships is a major challenge in conducting CMR (Pasmore et al., 2008a), this article asserts that the challenge is even greater in the HSC context. During this study's CMR, three members of the management team were transferred to other UN organizations. After each change, the CMR team had to orient the replacement to the project. In one case, the position was not even filled: *"HOs constantly change their size in response to real-world situations; For example, due to the problem of refugees, the number of staff at UNHCR [in this headquarters] increased from 10 to 100 in recent years."* remarked the division head. Hence, we identify staff circulation as a common organizational practice in large HOs (Van Wassenhove, 2006) and changes in HO size as barriers to conducting CMR in HSC.

Second, while in commercial settings, involving organizational managers and external researchers in the CMR team would provide sufficient grounds for subsequent implementation of action steps, in the case of HOs, involving field staff in the development of action steps is recommended. In cycle 3, when the logistics coordinators of two delegations were involved in developing reverse logistics planning, the management team encountered less field resistance and better cooperation for implementation.

Third, external researchers collaborating with HOs not only provide the knowledge not readily available to practitioners (e.g. the greening framework), co-generate action steps,

and co-monitor implementation, but they are also deeply involved in data collection and analysis, which can reveal findings not previously known to HOs given the volatile operating environment. For example, the issue of individual shipments going to similar or neighbouring countries would not otherwise be discovered.

9. Conclusion

This study presented two-and-a-half cycles of collaboration between academia and humanitarian practitioners on greening an HSC. The first half-cycle developed a greening framework as a reference for selecting green practices and responded to the first research question about framing the academic knowledge in a suitable manner for HSCs. The second and third cycles aimed at developing action steps and implementing them. The implementation cycles addressed the second and third research questions by identifying the specificities of greening HSCs and exploring how HOs can adopt, customize, and develop green practices to cope with the specificities identified. The study makes theoretical, practical, and methodological contributions to the field of HSC research and paves the way for its development to *green HSC*.

The study is not devoid of limitations. First, it is based on collaboration with only one HO, although efforts were made to increase the generalizability by involving several HOs in the supply chain mapping and development of the greening framework. Hence, some of the findings, particularly those pertaining to contraceptives, are specific to the case, while most of the contingency factors identified and the mechanisms to cope with them can be generalized to the HSC context. Second, the supply chain areas of intervention in the proposed greening framework are not exhaustive; some areas such as supplier manufacturing operations were beyond the scope of this study and therefore excluded. Moreover, although the greening framework placed coordination within the procurement department's responsibilities, it had not initially considered coordination as a distinct supply chain area of intervention. In cycle 3, the CMR team revisited the greening framework and focused on coordination between headquarters and other supply chain actors as a pivotal supply chain area. Third, Pasmore et al. (2008b) suggest three-, five-, and ten-year follow ups to fully validate the impact of collaboration. The findings are limited to the three years of collaboration and do not include such follow-ups.

Green HSC is still in its infancy and many future research avenues are open. Further research is needed to identify the contingency factors in greening other HSCs, explore how HOs address them, and compare the findings with those of this study. In order to investigate the *transferability* of findings, the first author has initiated similar partnerships with other humanitarian organizations. Moreover, investigating the green practices specific to each phase of the disaster cycle as well as the specificities of greening humanitarian cold chains and perishable products deepens our understanding of green HSCs. Methodology-wise, this study contends that green HSC epitomizes an appropriate area for conducting action research since academic knowledge and practical know-how are both limited but complementary.

References

- ABRAHAMAS, D. 2014. The barriers to environmental sustainability in post-disaster settings: a case study of transitional shelter implementation in Haiti. *Disasters*, 38, S25-S49.
- ALEXANDER, R. 2006. Build Back Better: Mantra Aside, An Aid Gone Wrong Story? Bangalore, India.
- BALCIK, B., BEAMON, B. M., KREJCI, C. C., MURAMATSU, K. M. & RAMIREZ, M. 2010. Coordination in humanitarian relief chains: Practices, challenges and opportunities. *International Journal of Production Economics*, 126, 22-34.
- BATTINI, D., PERETTI, U., PERSONA, A. & SGARBOSSA, F. 2016. Sustainable humanitarian operations: closed-loop supply chain. *International Journal of Services and Operations Management*, 25, 65-79.
- BESIOU, M., PEDRAZA-MARTINEZ, A. J. & VAN WASSENHOVE, L. N. 2014. Vehicle Supply Chains in Humanitarian Operations: Decentralization, Operational Mix, and Earmarked Funding. *Production and Operations Management*, 23, 1950-1965.
- BRADSHAW, P. 2009. A contingency approach to nonprofit governance. *Nonprofit Management and Leadership*, 20, 61-81.
- BURLANDO, F., WASSENHOVE, L. N. V. & VOORHES, M. 2006. United Nations Inter-Agency Coordination in Southern Africa. Insead.
- CAO, C., LI, C., YANG, Q., LIU, Y. & QU, T. 2018. A novel multi-objective programming model of relief distribution for sustainable disaster supply chain in large-scale natural disasters. *Journal of Cleaner Production*, 174, 1422-1435.
- CHEN, L., ZHAO, X., TANG, O., PRICE, L., ZHANG, S. & ZHU, W. 2017. Supply chain collaboration for sustainability: A literature review and future research agenda. *International Journal of Production Economics*, 194, 73-87.
- COGHLAN, D. 2011. Action Research: Exploring Perspectives on a Philosophy of Practical Knowing. *The Academy of Management Annals*, 5, 53-87.
- CORNFORTH, C. 2003. Conclusion: contextualising and managing the paradoxes of governance. In: CORNFORTH, C. (ed.) *The Governance of Public and Non-Profit Organisations*. New York: Routledge.
- COUGHLAN, P. & COUGHLAN, D. 2002. Action research for operations management. *International Journal of Operations & Production Management*, 22, 220-240.
- CRAVIOTO, A., LANATA, C., LANTAGNE, D. & NAIR, G. 2011. Final report of the independent panel of experts on the cholera outbreak in Haiti.
- DENYER, D., TRANFIELD, D. & VAN AKEN, J. E. 2008. Developing Design Propositions through Research Synthesis. *Organization Studies*, 29, 393-413.
- DONALDSON, L. 2001. *The Contingency Theory of Organizations*, Thousand Oaks, California, SAGE Publications, Inc.
- DRAZIN, R. & VAN DE VEN, A. H. 1985. Alternative Forms of Fit in Contingency Theory. *Administrative Science Quarterly*, 30, 514-539.
- EDMONDSON, A. C. 2011. Crossing Boundaries to Investigate Problems in the Field: An Approach to Useful Research. In: MOHRMAN, S. A. & LAWLER, E. E. (eds.) *Useful Research: Advancing Theory and Practice*. Oakland, CA: Berrett-Koehler Publishers.
- EFTEKHAR, M. & VAN WASSENHOVE, L. N. 2016. Fleet management policies for humanitarian organizations: Beyond the utilization–residual value trade-off. *Journal of Operations Management*, 44, 1-12.

- FISHER, G. & AGUINIS, H. 2017. Using Theory Elaboration to Make Theoretical Advancements. *Organizational Research Methods*, 20, 438-464.
- GARCIA-TORRES, S., ALBAREDA, L., REY-GARCIA, M. & SEURING, S. 2019. Traceability for sustainability – literature review and conceptual framework. *Supply Chain Management: An International Journal*, 24, 85-106.
- GATIGNON, A., VAN WASSENHOVE, L. N. & CHARLES, A. 2010. The Yogyakarta earthquake: Humanitarian relief through IFRC's decentralized supply chain. *International Journal of Production Economics*, 126, 102-110.
- GREENING THE BLUE. 2018. Available: <http://www.greeningtheblue.org> [Accessed].
- HAAVISTO, I. & KOVÁCS, G. 2014. Perspectives on sustainability in humanitarian supply chains. *Disaster Prevention and Management: An International Journal*, 23, 610-631.
- HOLGUÍN-VERAS, J., JALLER, M., VAN WASSENHOVE, L. N., PÉREZ, N. & WACHTENDORF, T. 2012. On the unique features of post-disaster humanitarian logistics. *Journal of Operations Management*, 30, 494-506.
- JAHRE, M., KEMBRO, J., REZVANIAN, T., ERGUN, O., HÅPNES, S. J. & BERLING, P. 2016. Integrating supply chains for emergencies and ongoing operations in UNHCR. *Journal of Operations Management*, 45, 57-72.
- JILANI, A., ALI, Y. & KHAN, M. W. 2018. Greening of humanitarian supply chain with focus on logistics. *International Journal of Business Performance and Supply Chain Modelling*, 10, 49-66.
- JOINT UNEP/OCHA ENVIRONMENT UNIT 2014. Environment and Humanitarian Action: Increasing Effectiveness, Sustainability and Accountability. Geneva.
- KOVÁCS, G. & SPENS, K. M. 2007. Humanitarian logistics in disaster relief operations. *International Journal of Physical Distribution & Logistics Management*, 37, 99-114.
- KOVÁCS, G. & SPENS, K. M. 2011. Trends and developments in humanitarian logistics – a gap analysis. *International Journal of Physical Distribution & Logistics Management*, 41, 32-45.
- KOVÁCS, G., TATHAM, P. & LARSON, P. D. 2012. What Skills Are Needed to be a Humanitarian Logistician? *Journal of Business Logistics*, 33, 245-258.
- KUNZ, N. & GOLD, S. 2017. Sustainable humanitarian supply chain management – exploring new theory. *International Journal of Logistics Research and Applications*, 20, 85-104.
- KUNZ, N. & REINER, G. 2016. Drivers of government restrictions on humanitarian supply chains: An exploratory study. *Journal of Humanitarian Logistics and Supply Chain Management*, 6, 329-351.
- KUNZ, N., VAN WASSENHOVE, L. N., BESIOU, M., HAMBYE, C. & KOVÁCS, G. 2017. Relevance of humanitarian logistics research: best practices and way forward. *International Journal of Operations & Production Management*, 37, 1585-1599.
- LAGUNA-SALVADÓ, L., LAURAS, M., OKONGWU, U. & COMES, T. 2018. A multicriteria Master Planning DSS for a sustainable humanitarian supply chain. *Annals of Operations Research*.
- LAWRENCE, P. R. & LORSCH, J. W. 1967. *Organisation and Environment: Managing Differentiation and Integration*, Boston, Harvard University Press.
- MCKINNON, A. C. 2005. The economic and environmental benefits of increasing maximum truck weight: the British experience. *Transportation Research Part D: Transport and Environment*, 10, 77-95.

- MEDURI, Y. & AHMED, F. A. 2016. Key focus areas in emergency relief: a conceptual framework aligned with triple bottom line. *International Journal of Emergency Management*, 12, 392-402.
- MILLER, D. 1981. Toward a New Contingency Approach: The Search for Organizational Gestalts. *Journal of Management Studies*, 18, 1-26.
- MINAKAWA, N., DIDA, G. O., SONYE, G. O., FUTAMI, K. & KANEKO, S. 2008. Unforeseen misuses of bed nets in fishing villages along Lake Victoria. *Malar J*, 7, 165.
- MORGAN, G. 1986. *Images of Organization*, Thousand Oaks, California, SAGE Publications, Inc.
- NÄSLUND, D., KALE, R. & PAULRAJ, A. 2010. Action research in supply chain management – A framework for relevant and rigorous research. *Journal of Business Logistics*, 31, 331-355.
- PARISI, S., ACHILLAS, C., AIDONIS, D. & FOLINAS, D. 2016. Conceptual design of a telecommunications equipment container for humanitarian logistics. *International Journal of Business Science and Applied Management*, 11, 12-23.
- PASMORE, W. A., STYMNE, B., SHANI, A. B. R., MOHRMAN, S. A. & ADLER, N. 2008a. The promise of collaborative management research. In: (RAMI), S. A. B., S.A., M., W.A., P., B., S. & N., A. (eds.) *Handbook of collaborative management research*. Thousand Oaks, CA.: SAGE.
- PASMORE, W. A., WOODMAN, R. W. & SIMMONS, A. L. 2008b. Toward a More Rigorous, Reflective, and Relevant Science of Collaborative Management Research. In: SHANI, A. B., MOHRMAN, S. A., PASMORE, W. A., STYMNE, B. & ADLER, N. (eds.) *Handbook of Collaborative Management Research*. Thousand Oaks, California: SAGE Publications, Inc.
- PEDRAZA MARTINEZ, A. J., STAPLETON, O. & VAN WASSENHOVE, L. N. 2011. Field vehicle fleet management in humanitarian operations: A case-based approach. *Journal of Operations Management*, 29, 404-421.
- PEDRAZA-MARTINEZ, A. J. & VAN WASSENHOVE, L. N. 2016. Empirically grounded research in humanitarian operations management: The way forward. *Journal of Operations Management*, 45, 1-10.
- PERETTI, U., TATHAM, P., WU, Y. & SGARBOSSA, F. 2015. Reverse logistics in humanitarian operations: challenges and opportunities. *Journal of Humanitarian Logistics and Supply Chain Management*, 5, 253-274.
- RAJEEV, A., PATI, R. K., PADHI, S. S. & GOVINDAN, K. 2017. Evolution of sustainability in supply chain management: A literature review. *Journal of Cleaner Production*, 162, 299-314.
- REGATTIERI, A., PIANA, F., BORTOLINI, M., GAMBERI, M. & FERRARI, E. 2016. Innovative portable solar cooker using the packaging waste of humanitarian supplies. *Renewable and Sustainable Energy Reviews*, 57, 319-326.
- REMIDA, A. 2015. A Systemic Approach to Sustainable Humanitarian Logistics. In: KLUMPP, M., DE LEEUW, S., REGATTIERI, A. & DE SOUZA, R. (eds.) *Humanitarian Logistics and Sustainability. Lecture Notes in Logistics*. Cham: Springer.
- REUTER, C., FOERSTL, K., HARTMANN, E. & BLOME, C. 2010. Sustainable Global Supplier Management: The Role of Dynamic Capabilities in Achieving Competitive Advantage. *Journal of Supply Chain Management*, 46, 45-63.
- RODRÍGUEZ-ESPÍNDOLA, O., ALBORES, P. & BREWSTER, C. 2018. Decision-making and operations in disasters: challenges and opportunities. *International Journal of Operations & Production Management*, 38, 1964-1986.

- RUDBERG, M. & OLHAGER, J. 2003. Manufacturing networks and supply chains: an operations strategy perspective. *Omega*, 31, 29-39.
- SABRI, Y. 2018. Deploying Collaborative Management Research Approaches in Humanitarian Supply Chains: An Overview and Research Agenda. In: KOVÁCS, G., SPENS, K. & MOSHTARI, M. (eds.) *The Palgrave Handbook of Humanitarian Logistics and Supply Chain Management*. London: Palgrave Macmillan.
- SARKIS, J., SPENS, K. M. & KOVÁCS, G. 2012. A Study of Barriers to Greening the Relief Supply Chain. In: SPENS, K. M. & KOVÁCS, G. (eds.) *Relief Supply Chain Management for Disasters: Humanitarian Aid and Emergency Logistics*. Hershey PA, United States of America: IGI Global.
- SHANI, A. B. R., COGHLAN, D. & CIRELLA, S. 2012. Action Research and Collaborative Management Research: More than Meets the Eye? *International Journal of Action Research*, 8, 45-67.
- SHANI, A. B. R., TENKASI, R. R. V. & ALEXANDER, B. N. 2018. Knowledge and Practice: A Historical Perspective on Collaborative Management Research. In: BARTUNEK, J. M. & MCKENZIE, J. (eds.) *Academic-Practitioner Relationships: Developments, Complexities and Opportunities*. Routledge.
- SILVESTRE, B. S. 2015. Sustainable supply chain management in emerging economies: Environmental turbulence, institutional voids and sustainability trajectories. *International Journal of Production Economics*, 167, 156-169.
- SOHRABPOUR, V., HELLSTRÖM, D. & JAHRE, M. 2012. Packaging in developing countries: identifying supply chain needs. *Journal of Humanitarian Logistics and Supply Chain Management*, 2, 183-205.
- SOUSA, R. & VOSS, C. A. 2008. Contingency research in operations management practices. *Journal of Operations Management*, 26, 697-713.
- SPHERE ASSOCIATION 2018. *Sphere Handbook: Humanitarian Charter and Minimum Standards in Disaster Response*, Geneva, Switzerland, Practical Action Publishing.
- SRIVASTAVA, S. K. 2007. Green supply-chain management: A state-of-the-art literature review. *International Journal of Management Reviews*, 9, 53-80.
- STARKEY, K. & MADAN, P. 2001. Bridging the Relevance Gap: Aligning Stakeholders in the Future of Management Research. *British Journal of Management*, 12, S3-S26.
- STAUFFER, J. M., PEDRAZA-MARTINEZ, A. J. & VAN WASSENHOVE, L. N. 2016. Temporary Hubs for the Global Vehicle Supply Chain in Humanitarian Operations. *Production and Operations Management*, 25, 192-209.
- TABAKLAR, T., HALLDÓRSSON, Á., KOVÁCS, G. & SPENS, K. 2015. Borrowing theories in humanitarian supply chain management. *Journal of Humanitarian Logistics and Supply Chain Management*, 5, 281-299.
- THOMPSON, J. D., SCOTT, W. R. & ZALD, M. N. 1967. *Organizations in Action: Social Science Bases of Administrative Theory*, Transaction Publishers.
- TOSI, H. L. & SLOCUM, J. W. 1984. Contingency Theory: Some Suggested Directions. *Journal of Management*, 10, 9-26.
- UNEP/OCHA. 2018. Available: <http://www.unocha.org/themes/environmental-emergencies> [Accessed 1 April 2018].
- UNFPA 2011. Emergency Reproductive Health Kits. 5 ed. <https://www.unfpa.org/resources/emergency-reproductive-health-kits>.
- UNFPA. 2013. *Safe Disposal and Management of Unused, Unwanted Contraceptives* [Online]. Available: <http://www.unfpa.org/sites/default/files/resource->

- pdf/Safe%20Disposal%20and%20Management%20of%20Unused%20Unwanted%20Contraceptives_2.pdf [Accessed].
- UNFPA. 2018. Available: <http://www.unfpa.org/> [Accessed 1 April 2018].
- UNFPA PROCUREMENT SERVICES BRANCH 2013. UNFPA Green Procurement Strategy. <https://www.unfpa.org/resources/green-procurement-strategy>: UNFPA.
- UNITED NATIONS. 2018. *United Nations Sustainable Development Goals* [Online]. Available: <https://www.un.org/sustainabledevelopment/sustainable-development-goals/> [Accessed].
- UNOPS 2016. Annual Statistical Report on United Nations Procurement.
- VAN KEMPEN, E. A., SPILIOTOPOULOU, E., STOJANOVSKI, G. & DE LEEUW, S. 2017. Using life cycle sustainability assessment to trade off sourcing strategies for humanitarian relief items. *The International Journal of Life Cycle Assessment*, 22, 1718-1730.
- VAN WASSENHOVE, L. N. 2006. Humanitarian aid logistics: supply chain management in high gear. *Journal of the Operational Research Society*, 57, 475-489.
- VAN WEELE, A. J. 2005. *Purchasing and Supply Management: Analysis, Strategy, Planning and Practice*, United Kingdom, London, Thomson Learning.
- WARREN-THOMAS, E., DOLMAN, P. M. & EDWARDS, D. P. 2015. Increasing Demand for Natural Rubber Necessitates a Robust Sustainability Initiative to Mitigate Impacts on Tropical Biodiversity. *Conservation Letters*, 8, 230-241.
- WEBSTER, J. & WATSON, R. T. 2002. Analyzing the Past to Prepare for the Future: Writing A Literature Review. *MIS Quarterly*, 26, xiii-xxiii.
- WEINTHAL, E., TROELL, J. & NAKAYAMA, M. 2014. *Water and Post-Conflict Peacebuilding*, Routledge.
- WEVER, R. 2011. Design for volume optimization of packaging for durable goods. *Packaging Technology and Science*, 24, 211-222.
- WHO 1999. Guidelines for the Safe Disposal of Unwanted Pharmaceuticals in and after Emergencies.
- WILD, N. & ZHOU, L. 2011. Ethical procurement strategies for International Aid Non-Government Organisations. *Supply Chain Management: An International Journal*, 16, 110-127.
- WOODWARD, J. 1965. *Industrial Organization: Theory and Practice*, Oxford, Oxford University Press.
- ZAJAC, E. J., KRAATZ, M. S. & BRESSER, R. K. F. 2000. Modeling the dynamics of strategic fit: a normative approach to strategic change. *Strategic Management Journal*, 21, 429-453.

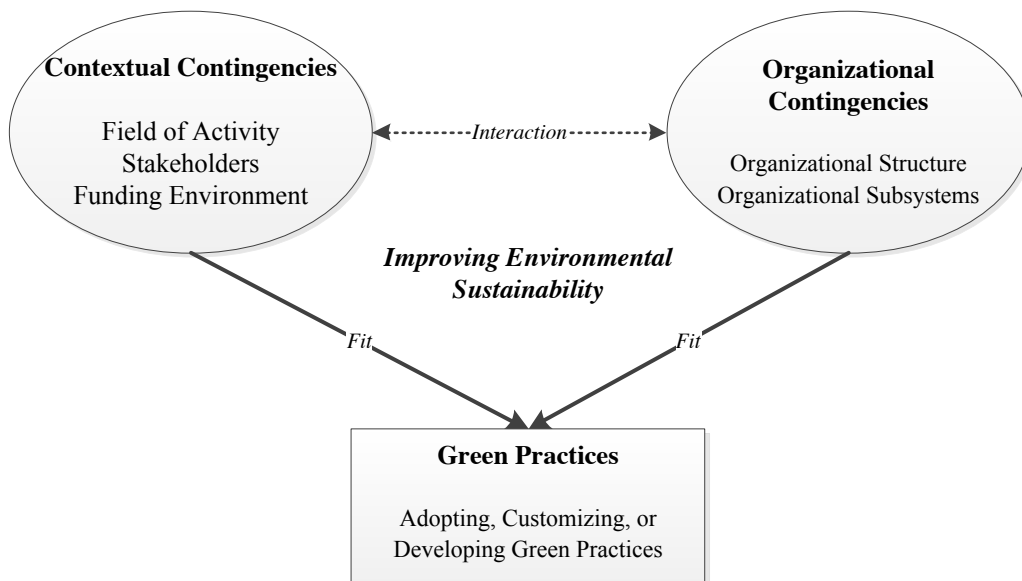


Figure 1: The Theoretical Underpinning of the Study

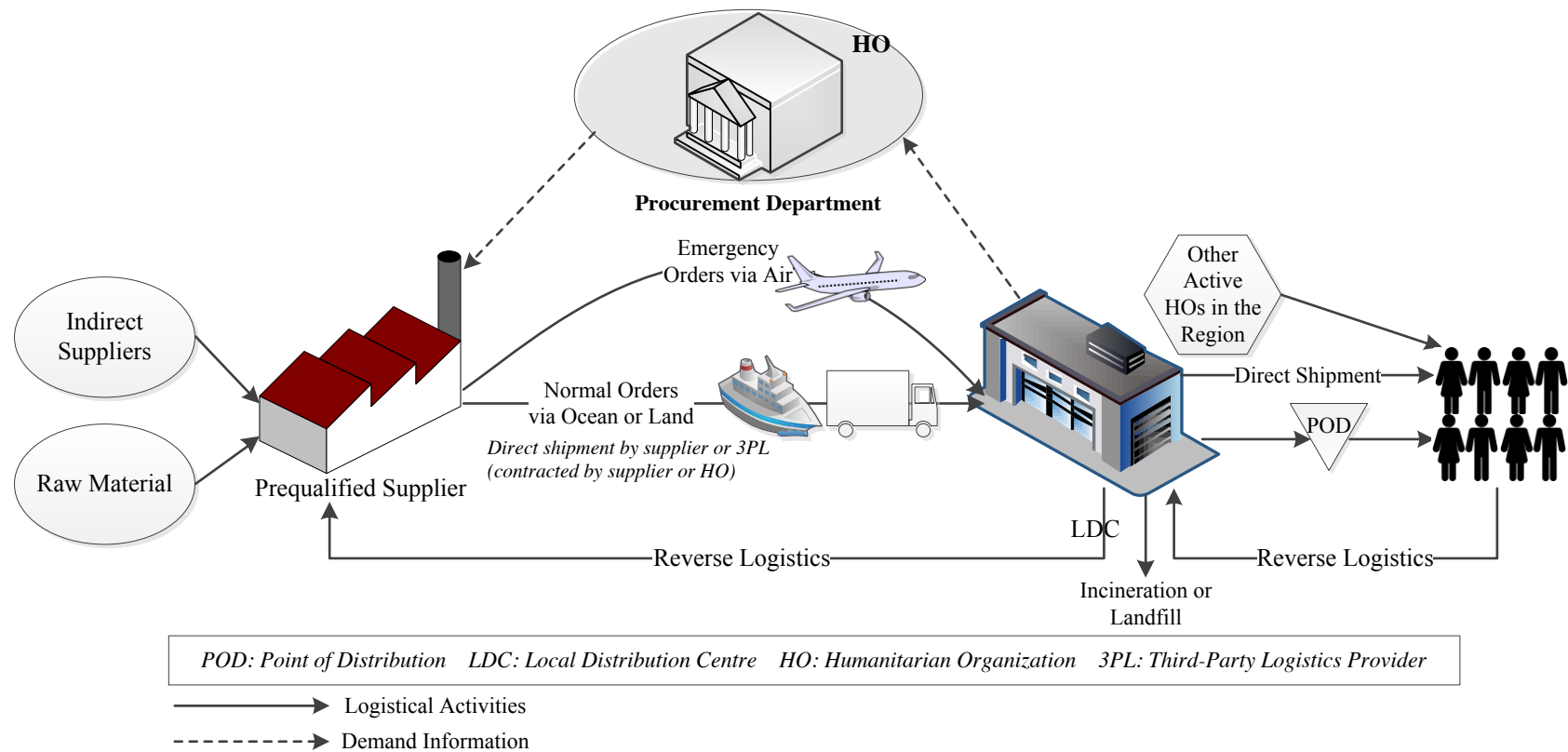


Figure 2: Mapping of an Operational Mix-Based HSC Orchestrated by a Focal HO

Table 1: The Greening Framework

	<i>Conventional responsibilities dealing with suppliers and 3PLs</i>				<i>Sector-specific responsibilities dealing with other humanitarian actors (i.e. implementing partners and other HOs)</i>		
Procurement Duties Supply Chain Areas	Defining purchase specification	Supplier selection	Contract management	Ordering, expediting, and evaluation	With other HOs for outbound and LMD	With implementing partners for LMD	With other HOs & implementing partners for RL
Supply chain configuration		Local procurement Selecting suppliers closer to the point of consumption and raw material				Building LDCs closer to beneficiaries rather than country offices Use of local resources for warehouse construction	Considering reverse flow of aid and the location of current recycling facilities for location planning of LDCs
Inventory and warehousing management <i>(excluding warehouse location)</i>		Considering environmental impact of suppliers' inventory operations for supplier selection Integrated inventory management and supplier selection	Negotiating vendor-managed inventories Leveraging purchasing power (coercive power) and incentives (non-coercive power) for incorporating sustainability into contracts	Emission reduction by reducing shipment frequency and adjusting inventory level Greener ordering and inventory management policies (e.g. green order lot-sizing, EOQ, and safety stock) Integrated ordering, inventory, and transport management	Haulage sharing with other HOs for inventory replenishment Joint procurement and warehousing with other HOs Joint warehousing of relief and development aid	Use of integrated electronic logistics management information system by implementing partners and other HOs for inventory management Energy efficient LDC design considering refrigeration, insulation, heating, and humidity control Use of green energies for LDCs, generating green energy from warehouse activities, warehouse waste management, local sourcing of material, and acquiring green warehousing standards (e.g. BREEAM, LEED, GREENSTAR, CASBEE, and DGNB)	Designing inventory control systems considering returned flow of products Turning recovered inventory into serviceable products at LDCs
Transportation and shipment management	Merging fuel efficiency policies with sustainable vehicle procurement Consideration of sustainability criteria in fleet procurement (e.g. engine efficiency, dual-fuel fleet, and aerodynamic profiling)	Selecting suppliers & 3PLs with: - higher vertical and horizontal collaboration with other suppliers & 3PLs - stronger ICT resources such as onboard vehicle monitoring systems,	Incorporating environmental logistical legislation and standards into contracts (e.g. ISO 14001) Including requirements about sustainable procurement standard	Collaborating with carrier for modal shift to greener mode or intermodal transport Use of multiple criteria decision making and decision support	Use of collaborative ICT-based platforms to increase the integration of fleet management with implementing partners and other HOs Joint use of 3PLs with other HOs	Mutual engagement of headquarters with implementing partners in LMD Deploying computer software for fleet management and vehicle assignment Optimizing LMD routing and delivery scheduling	Focusing on environmental returns rather than commercial returns Reuse of aid items (e.g. wheelchairs, beds, and tents) and logistics items (pallets, crates, trolleys, and bins)

		<p>intelligent transportation, track-and-trace systems, and computerized vehicle scheduling system</p> <p>- higher capability in return load management</p> <p>Competitive sustainability dialogue procedure with shortlisted suppliers</p> <p>Reviewing the adequacy of sustainable criteria for 3PL selection prior to contractual agreement</p>	<p>ISO20400 in contracts</p> <p>Including reverse logistics terms such as buyback and return, and revenue sharing, in contracts</p> <p>Incentivizing (through contracts) shift to greener modes or intermodal transport</p>	<p>systems for green supplier evaluation</p> <p>Consolidation from suppliers to close destinations</p> <p>Joint deliveries through spatial or temporal pooling</p> <p>Monitoring and evaluation of sustainability in indirect suppliers</p> <p>Employing empty running backhauls vehicles for reverse flow of packaging and products</p>	<p>Joint outsourcing of logistics to 4PLs with other HOs</p> <p>Fleet consolidation for collaborative outbound and LMD with implementing partners and other HOs</p> <p>Use of internet for identifying mutual backhaul opportunities with other HOs</p>	<p>Using local drivers familiar with the area of LMD</p> <p>Driver training and management</p> <p>Designing and implementing vehicle maintenance policies</p> <p>Replacing oversized and overaged vehicles</p> <p>Reducing vehicle tare weight</p> <p>Use of drones and helium-filled hybrid cargo airships for LMD</p>	<p>Reverse flow transportation planning of product and packaging for recycling, incineration, or landfilling</p> <p>Employing empty running LMD backhauls vehicles for reverse flow of packaging and products</p>
<p>Packaging and logistics-related product specifications (excluding transportation planning)</p>	<p>Collaborating with supplier for:</p> <ul style="list-style-type: none"> - improving the volumetric usage of freight through packaging - designing environment-friendly packaging - greener redesign of products considering refurbishment, reuse, recycling, returnability, and recovery - using returnable packaging instead of disposable packaging - product simplification <p>Minimizing packaging waste and material toxicity</p> <p>Local adaptation of packaging to address regional customers' needs</p>	<p>Considering sustainability of packaging for supplier selection</p>	<p>Including environmental laws about packaging and packaging waste in contracts (e.g. EU Directive 2004/12/EC and 2015/720)</p> <p>Considering the environmental sustainability of industrial packaging, i.e. the packaging between direct suppliers and indirect suppliers in contracts</p>	<p>Packaging postponement</p>	<p>Product and packaging standardization with other HOs</p>	<p>Planning with implementing partners for collection of packaging waste during LMD</p>	<p>Local reuse of packaging (e.g. secondary or tertiary packaging of medical equipment, gas cylinders, kegs, containers of chemicals, and glass bottles)</p> <p>Encouraging implementing partners to collaborate with local businesses for recycling or incineration of packaging and unused products</p>

Table 2: Search Strategy for Selecting Green Practices for the Greening Framework

Stage	Details of procedure and criteria
Stage 1: Journal selection	<ul style="list-style-type: none"> • Journals in the categories “Operations Research & Management Science” and “Management” in <i>InCites Journal Citation Reports</i> were considered. • Journals not covering supply chain management topics and sustainability practices were excluded. • After internal discussion, the research team selected an initial list of 10 journals based on relevance and 2014 <i>Journal Impact Factor</i> (the most current <i>Impact Factor</i> available at cycle 1), as follows: <ul style="list-style-type: none"> - Journal of Operations Management - International Journal of Production Economics - Omega – International Journal of Management Science - European Journal of Operational Research - International Journal of Production Research - Production Planning & Control - Production and Operations Management - International Journal of Physical Distribution & Logistics Management - Supply Chain Management: An International Journal - Decision Sciences
Stage 2: Initial keyword search	<ul style="list-style-type: none"> • Combined keywords from the responsibilities and supply chain area of intervention, for example, “supplier selection” and “inventory/warehousing” • Search database: The selected journals • Search space: Title, abstract, and keywords • Time range: 2005 to 2015 (current time at cycle 1)
Stage 3: Review and selection	<ul style="list-style-type: none"> • The title and abstract of each result were reviewed to find out if the paper offers any green practices. • To ensure objectivity of the selection process, green practices were defined as practices/recommendations that could be implemented to improve the environmental sustainability of supply chain. Therefore, articles that investigated the following topics were excluded: <ul style="list-style-type: none"> ○ Literature reviews ○ Theorization about sustainability ○ Evaluating interrelationships among sustainability-related factors ○ Articles investigating sustainability and firm performance ○ Articles investigating merely social sustainability ○ Articles not relevant to HSCs such as sustainability and pricing <p><i>Example of an excluded result: “The relationship between dynamic firm capabilities and sustainability performance”</i></p> • Some of the results were specific to HSCs. These results were reviewed carefully to identify any implications for environmental sustainability; <i>Example: “joint warehousing of relief and development aid (Jahre et al., 2016)”</i>. • Green practices found from the shortlisted results were assigned to the corresponding position in the greening framework, i.e. the intersection of the responsibility and the supply chain area of intervention.
Stage 4: Backward and forward search	<ul style="list-style-type: none"> • For the shortlisted results in stage 3, backward and forward searches on the citations and citing articles were conducted using similar keywords. • On the results of backward and forward search, a similar procedure to that in stage 3 was followed.
Stage 5: Synthesis and identification of themes	<ul style="list-style-type: none"> • A total of 75 papers were identified in stages 3 and 4. All the identified green practices were inserted into the greening framework. • If no relevant result was found, the corresponding part in the greening framework was left blank. • Some of the identified green practices were fragmented, repetitive, or overlapping. All the green practices were synthesized, and the emerging themes were used in the greening framework.
Stage 6: Verification and update	<ul style="list-style-type: none"> • The relevance of the selected practices was reviewed by each member of the study team individually. • The greening framework was verified by the management team and three procurement staffs from the other aforementioned HOs at the end of half-cycle 1. • Green practices were updated at the beginning of cycle 2 and cycle 3 with relevant recent articles.

Table 3: Recommended Green Practices, Identified Contingency Factors, and Implemented Action Steps

	Green practices <i>Selected from the greening framework or developed based on the outcomes of prior implementation by the study team</i>	Contingency factors <i>Identified as having an impact on the implementation of green practices (the pertaining category from the theoretical underpinning mentioned in parenthesis: ORGANIZATIONAL-related categories presented in capital letters and contextual-related categories in italics)</i>	Action steps <i>Adopted, customized, or developed green practices to cope with or to consider the identified contingency factors that were implemented</i>
Supply chain configuration and coordination	Local procurement	Higher costs and lower quality of suppliers in developing countries and humanitarian setting (<i>stakeholders</i>)	Placing a bid for local sourcing in Latin America (F)* Speeding up the prequalification of local suppliers (S) Ordering from existing prequalified suppliers closer to destination (S)
	Building manufacturing plants or regional warehouses in east and west Africa (SD)**	Short-term funding (<i>funding environment</i>) Earmarked funding (<i>funding environment</i>) Donors' limited awareness of greenness (<i>funding environment</i>) Stricter regulations for import/export of development products (<i>stakeholders</i>) Higher customization and diversity of development products (<i>field of activity</i>)	No action steps during collaboration, but building regional warehouses was considered a solution to be discussed with donors and other stakeholders in future
	Collaboration with country offices for LMD	Low visibility of headquarters over country offices' operations (<i>ORGANIZATIONAL STRUCTURE</i>)	Integrating ICT systems at country offices and headquarters (S) Tracking wrapped pallets using barcodes (S) Enhancing the presence and circulation of headquarters' representatives in country offices (S) Improving the reporting of country offices on their inventories and LMD (S)
Inventory and	Joint warehousing and procurement with other HOs	<i>For relief products:</i> Coexistence of HOs in a region (<i>stakeholders</i>) + ***	<i>For relief products:</i> Collaboration with WFP to facilitate the shared use of UNHRD (S) <i>For development products:</i>

		<p>Established inter-organizational coordination mechanisms such as UNHRD (<i>stakeholders</i>) +</p> <p>Higher standardization and lower diversity of relief (<i>field of activity</i>) +</p> <p>Waived customs (<i>field of activity</i>) +</p> <p><i>For development products:</i> Inter-organizational collaboration limited to mutual products (<i>stakeholders</i>)</p>	<p>Collaboration with USAID for joint warehousing of male condoms (S)</p> <p>Signing long-term agreements with UNICEF and Global Fund for procuring more than 30 mutual products (S)</p>
	Improving inventory management to reduce emergency air transport and frequent replenishment shipments	<p>Low national funding (<i>funding environment</i>)</p> <p>Reluctance of national authorities to facilitate contraceptives planning (<i>stakeholders</i>)</p> <p>Low cooperation among national authorities (<i>stakeholders</i>)</p>	<p>Holding more safety stocks at national inventories (F)</p> <p>Devising long-term plans at national level for contraceptives needs and updating it annually (S)</p> <p>Promoting information sharing among national delegations to harmonize national inventories (S)</p>
<i>Transportation and shipment management</i>	Consolidation of shipments for either adjacent suppliers or adjacent destinations	<p><i>For consolidation from suppliers:</i> Insufficient intra-departmental control (<i>ORGANIZATIONAL SUBSYSTEMS</i>)</p> <p>Low integration among suppliers (<i>stakeholders</i>)</p> <p><i>For consolidation at destination:</i> Stricter regulations for import/export of development products (<i>stakeholders</i>)</p> <p>Low cooperation by national authorities (<i>stakeholders</i>)</p>	<p>Consolidation of shipments for two adjacent African countries (F)</p>
	Joint outbound logistics and LMD with other HOs	<p>Coexistence of several HOs operating in a region (<i>stakeholders</i>) +</p> <p>Better access of some HOs to specific regions (<i>stakeholders</i>) +</p>	<p><i>For relief products:</i> Collaboration with WFP and UNHCR to share freights for outbound logistics and customs clearance (S)</p> <p>Collaboration with WFP for LMD through a joint pilot operation in Democratic Republic of Congo (S)</p> <p><i>For development products:</i> Collaboration with UNDP and UNICEF to share a 3PLs for outbound logistics (S)</p>

	Integrated online platforms for inter-organizational transportation and fleet management for development programs	Inter-organizational collaboration limited to similar products (<i>stakeholders</i>) Poor managerial support at different organizations to implement coordination mechanisms (<i>stakeholders</i>)	No action was taken
	Collaboration with country offices and delegations for RL planning (SD)	Unsolicited donations (<i>funding environment</i>) Scavenging of disposed products in developing countries and humanitarian setting (<i>field of activity</i>) Poor recycling facilities in developing countries and humanitarian setting (<i>field of activity</i>)	Developing a standard operating procedure for country offices to sustainably recycle and dispose of expired products (S)
<i>Packaging and other logistics-related product specifications</i>	Improving the volumetric usage of freights through packaging	Different packaging needs and perceptions of beneficiaries from commercial customers (<i>field of activity</i>) +	Increasing the number of condoms in secondary packaging from 144 to 1000 in a pilot test with a supplier (S) Prohibiting 'less than container loads' for port-to-port shipments (S)
	Inter-organizational collaboration for standardization of packaging (SD)	Different packaging needs and perceptions of beneficiaries from commercial customers (<i>field of activity</i>) + Inter-organizational collaboration limited to similar products (<i>stakeholders</i>)	Collaboration with USAID to standardize and integrate packaging (S)
	Improving leaflets and cardboards in packaging (SD)	Benefiting from economies of scale in purchasing from suppliers (<i>stakeholders</i>) Different packaging needs and perceptions of beneficiaries from commercial customers (<i>field of activity</i>) +	Printing leaflets only in the language of the destination country (F) Printing on both sides of the leaflet, reducing font size and making the text more succinct, using recycled and thinner paper, and standardizing the material and content of leaflets for all suppliers (S) Decreasing cardboard material in outer packaging from three to two layers (S)

* S: action step implemented successfully

* F: action step failed or was not implemented

** SD: self-development

*** +: facilitating contingency factor