Journal of Cleaner Production 126 (2016) 382–393

Contents lists available at ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

The fourth-party logistics service provider approach to support sustainable development goals in transportation – a case study of the German agricultural bulk logistics sector

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ARTICLE INFO

Article history:
Received 23 September 2015
Received in revised form
21 March 2016
Accepted 21 March 2016
Available online 12 April 2016

Keywords:
4PL
Sustainability in transportation
Supply chain management
Transportation planning
Case study

ABSTRACT

The approach to integrate a fourth-party logistics service provider in the German Agricultural Bulk Logistics sector marks a new concept that aims at achieving sustainable development goals in transportation, i. e., by realising full truck loads. Against the background of steadily growing transport volumes, it is of paramount importance to develop sustainability concepts in order to mitigate the impacts on the environment. At present, the processes in the domain of the German Agricultural Bulk Logistics sector are characterised by bulk transports, small and medium sized actors and paper-based processes, which offers high potential for process optimizations in terms of sustainability. Therefore, the German Agricultural Bulk Logistics sector currently explores the approach of including a fourth-party logistics service provider into its transport processes in order to render these more sustainable and reduce costs. The objective of this paper is to present the general idea of implementing a fourth-party logistics service provider into a transportation (planning) process, to clarify the different functions of the participating parties and to introduce the modified transportation planning process as artefact. By means of a mixed method approach, we deliver qualitative insights based on semi-structured interviews and quantitative insights based on simulations. Effects and benefits of the approach are identified by means of a case study. Involving the fourth-party logistics service provider as well as the associated transportation planning process in the mentioned logistics area can lead to cost savings up to 38%, helps to reduce environmental pollution and mitigates social barriers in form of existential fears. The results demonstrate the applicability of the fourth-party logistics service provider approach in the sector and underline that this approach supports the achievement of sustainable development goals in transportation. Furthermore, we identify sustainable characteristics and present the mixed method approach which functions as an assessment framework for the fourth-party logistics service provider approach. Furthermore, by adopting the documented features of sustainable supply chain management in the fourth-party logistics service provider approach, an additional value is generated.

1. Introduction

Presently, agricultural supply chains are embedded in a complex global network including actors from the producer to the consumer. This comprises all involved production steps and processes such as dispatch and transportation as well as the distribution of food (Ahumada and Villalobos, 2009; Beske et al., 2014; Trienekens and Zuurbier, 2008). At the same time the demand for safe and sustainable products of high quality is increasing (van der Vorst et al., 2009). Transportation plays a central role in the sustainability of a product from the beginning of the harvesting process to its delivery to the consumer (Konieczny et al., 2013). From an economic point of view transportation has to meet the six main objectives of logistics: deliver the right product, at the right time, at the right location, in the right quantity, with the right quality and for the right price (Seeck, 2010). At the same time transportation should be performed in an ecologically sensitive manner in order to reduce environmental impacts. Furthermore, transportation should

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http://dx.doi.org/10.1016/j.jclepro.2016.03.095
0959-6526/

consider social aspects of sustainability including the interests of all involved actors (Ciliberti et al., 2008).

Initial shipment from the harvesting fields to the warehouse stage, as well as to processing companies, is done in the form of bulk goods transport. The annual volume transported by the agricultural sector in Germany is approximately 3,595,373,000 tonnes, of which 76% (2.8 billion tonnes) are shipped by commercial road transport, 90% of which is inland transportation (Federal Ministry of Food, Agriculture and Consumer Protection, 2012). As a further example, the agricultural sector in the US transports 512,000,000 tonnes of grain per year: 60% of this by road transport, 28% by rail and 12% by water (Association of American Railroads (2013)). In light of enormous global shipping turnover as well as the growing and accelerating pace of trade, business logistics increasingly becomes the focus of transactions among traders, consigners, consignees and producers. This results in new challenges for planning, transactions and the management of transportation. Presently, the agricultural supply chain still has efficiency optimisation options (Beske et al., 2014; Fischer, 2013; Grimm et al., 2014).

The main difference between agricultural supply chains and other supply chains is the permanent modification of goods from the harvest to the processing stage (Ahumada and Villalobos, 2009). Furthermore, the harvesting process is exposed to fluctuating weather conditions, which may result in limited time slots for transportation (Ahumada and Villalobos, 2009). Hence the harvesting period may be a special challenge for transporting and distributing agricultural bulk goods. Frequently, these goods are shipped to warehouses or processing companies. Throughout the year both storage levels and import and export volumes of goods are transported. Transportation therefore requires short planning horizons, especially for the transport of harvested crops (1–4 h) and for the year-round supply for processing. Import and export volumes and long-term scheduled demands of the industry can be handled by longer planning horizons (8–80 h). As in the agricultural sector, the margins of the logistics sector are small (Lowe and Preckel, 2004). Moreover, the logistics sector has to cope with challenges such as haulage, transport time, flexibility, quality, sustainability and reliability in general (Islam et al., 2013). For instance, the consequences of growing traffic volumes are a decrease in the profitability of shipments as a result of traffic jams, increased time for transportation and a decrease in the reliability of deliveries (Golob and Regan, 2002). Furthermore, transportation costs increase due to steadily increasing fuel prices, toll charges and anticipated duties (Green, 2014). The dominance of road transportation has a negative impact factor for CO_2 emissions and thus for sustainability in general (Abbasi and Nilsson, 2012). Although cooperative production methods are not uncommon within the agricultural sector, cooperative approaches such as transportation networks are rarely implemented in the agricultural bulk logistics sector (Salleh et al., 2009).

The aforementioned problems of the sector demonstrate the need for solutions that may be implemented through various approaches. The transportation sector contributes 14% of global CO_2 emissions as a result of the means of transportation including road, rail, air and (marine) navigation (EEA, 2012, 2014). Alternative approaches are the development of intermodal transportation (Macharis and Bontekoning, 2004) or truck sharing (Islam and Olsen, 2014). However, this requires cooperation and a minimum degree of collaboration of all involved actors. Dekker et al. (2012) demonstrate the added value as a result of increased efficiency as well as CO_2 reduction due to intelligent planning of the supply chain including the related transportation. They, furthermore, describe measures such as pricing, supply chain planning as well as strategic and operative decision support within the field of supply chains. The transportation segment has a high potential of improvement in terms of procurement, production concept, distribution of production facilities, means of transportation, routing, and transit time as well as various transportation concepts (Dekker et al., 2012; Schönberger and Kopfer, 2009). One option to provide a planning and service instance for the supply chain is the introduction of the 4PL approach (Vinay et al., 2009).

This article focusses an investigation of the 4PL approach within the agricultural bulk logistics sector to improve sustainability in transportation. While the 4PL approach is implemented in practice, a scientific discussion about the effects and benefits is missing. The target of a 4PL as a superordinated planning agent within a supply chain is a significant reduction in resource use, thus contributing to a more sustainable transportation sector. The 4PL operates as a network integrator within a given supply chain. Its objective is to employ involved actors and available resources efficiently; therefore processes and information and communication technology are needed. Based on previous research, transportation planning could be identified as the main function of a 4PL in the agriculture bulk logistics (Own source). As a consequence the 4PL transportation planning process is presented and assessed by sustainable characteristics. For the assessment a mixed method approach together with the insights of the case study is followed. Semi-structured interviews and simulations of the business process and of the route planning process allow a scientific and practical assessment. These results can be applied as decision support for the 4PL approach. Using this mixed method approach, we answer the following research questions:

RQ 1: *How can the transportation planning process (with an integrated route planning) for the 4PL be designed?*

RQ 2: *What is the added and sustainable value of the 4PL approach in the agricultural bulk logistics sector?*

Our literature search could not detect any significant scientific activities on the application of a 4PL with a focus on transportation planning in the agricultural bulk logistics sector. Such a research effort requires the involvement of all relevant actors including their potential to increase efficiency for a successful implementation. The objective is to show the effects for transportation planning taking into account the specific requirements of the sector, the available calculation time and the cost savings. Furthermore, the results have consequences for the sustainability of the operation, which should be delineated.

This article is structured as follows: Section 2 provides a delineation of the 4PL. Section 3 introduces sustainability characteristics. The research methods are discussed in Section 4, and Section 5 describes the application of the methods. The results are presented in Section 6. The article is concluded with a discussion of the results in Section 7 and a summary in Section 8.

2. Fourth party logistics provider (4PL)

A 4PL is a neutral provider of various services within the supply chain. This provider does not supply assets but endeavours to utilise all provided resources efficiently and sustainably while integrating all involved actors (Hingley et al., 2011; Mukhopadhyay and Setaputra, 2006; Win, 2008). One objective of the 4PL is to minimise individual inefficiencies and, at the same time, increase the efficiency of the entire actor network. The main task is to plan both the supply chain process and transportation. This planning is accomplished by employing IT networking and platforms (Mammitzsch and Francyk, 2012). Therefore, industry-specific exigencies must be taken into account, and corresponding knowledge is required (Bourlakis and Bourlakis, 2005).

Thus, in the context of bulk logistics, it is indispensable to have a sound knowledge of the structures and circumstances in this domain. Therefore, the potential for the increase of efficiency and