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ASSESSMENT OF LOGISTICS SUSTAINABILITY IN FAMILY FARMS BASED ON THE LSR CONCEPT

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Abstract. This paper is an assessment of sustainable logistics in family farms based on the LSR concept. The introduction clearly illustrates the significant contribution of logistics to the sustainable development of farms. For the purposes of this study, five Polish family farms were selected, located in the Wielkopolskie voivodeship, managing arable land with an area ranging from 32 ha to 131 ha, focused on mixed (plant + animal) production with various field arrangement patterns. This study uses a measurement methodology for logistics sustainability, addressing five key areas of LSR, i.e.: purchasing social responsibility (PSR), sustainable transportation (ST), sustainable packaging (SP), sustainable warehousing (SW) and reverse logistics (RL). According to the results, there is a weak (albeit growing) positive correlation between the logistics sustainability level and the area of land, whether it comes to specific main LSR processes or to social, environmental and economic aspects.

Keywords: sustainable logistics, family farms, logistics processes, LSR concept

INTRODUCTION

Agricultural holdings, both large and family-run, are the initial link of food supply chains. This is the place where products and raw materials intended for further processing are manufactured. Also, this level is determinant for the quality for products intended for final customers (consumers), as developed at a later stage. The latter become increasingly interested in the manufacturing conditions and health and safety aspects of food. Also, more and more of them want to know whether the food production processes are environmentally friendly. Social and ethical issues become equally important. As regards these aspects, an evolution of views underpinned by various concepts can be observed. The scope of green measures promoted under the Sustainable Development (SD) concept (World Commission, 1987) was extended with social aspects in another concept referred to as Corporate Social Responsibility (CSR) (Ciliberti et al., 2008), which addresses such aspects as human rights (Robinson, 2004).

The evolving redefinition of objectives of sustainable growth was reflected in almost all types of supply chains, primarily including the food supply chains. As a consequence, the existing conventional strategies for food supply chains became inadequate, thus accelerating the development of a new concept referred to as sustainable food supply chain management (Soysal et al., 2012; Iakovou et al., 2014).

Transport processes were one of the first to initiate a search for green solutions. The scope of this search gradually extended to shipping and logistics processes. The continued evolution towards green logistics resulted in including socially-oriented aspects, just like in CSR. These were the grounds for a new concept of logistics processes, defined as Logistics Social Responsibility (Carter and Jennings, 2002).

In agricultural holdings, logistics plays a major role as it largely affects their sustainable development in

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several dimensions. First, in addition to impacting the quality of agricultural products, it also minimizes production losses (through the proper organization of the physical flow and storage processes) which, in some countries, may reach 60–70% at this level of the supply chain (Gebresenbet and Bosona, 2012; Tan, 2012). Secondly, logistics processes generate important costs in such holdings. According to studies carried out by many scientific centers, the share of logistics in general costs of agricultural holdings ranges quite broadly from around 23% to as much as 54% (Irigoyen, 2014; Pepliński, 2014; Wajszczuk, 2016a). The dominant determinants of these costs are the production profile, field arrangement patterns, internal transport distances and the quality of storage facilities and vehicles.

The optimization of the above processes should be a priority objective on the way towards the sustainable growth of farms. On the other hand, achieving sustainability is a long-term goal due to particularities of agricultural production and its great environmental impact (Zecca and Rastorgueva, 2014).

Considering the abovementioned role and importance of farms in determining the quality and environmental impact of foodstuffs, the objective of this study was to assess the sustainability of logistics in this supply chain link based on the LSR concept.

MATERIAL AND METHODS

For the purposes of this study, five Polish family farms were selected, located in the Wielkopolskie voivodeship, managing arable land with an area of (F1): 32 ha; (F2): 58 ha; (F3): 64 ha; (F4): 71 ha; and (F5): 131 ha, focused on mixed (plant + animal) production with various field arrangement patterns. A research survey was conducted in 2016.

This study uses a measurement methodology for logistics sustainability, addressing five key areas of the LSR concept, i.e.: purchasing social responsibility (PSR), sustainable transportation (ST), sustainable packaging (SP), sustainable warehousing (SW) and reverse logistics (RL) (Ciliberti et al., 2008).

From the previous literature studies it follows that this concept is subjected to continual modification and, for the time being, is more generally intended to evaluate companies of different industries without reference to their specific characteristics (Murphy and Poist, 2002; Ciliberti et al., 2008). Therefore, there are no methods dedicated to specific industries or specific types of businesses that would take into account their particularities.

Considering the above, a modified version of this method was used, adapted to assess the degree of logistics sustainability in family farms. As a result of this modification, adequate sub-processes were identified for the assessment of family farms within each of the main LSR areas (Wajszczuk, 2016b). The selection of sub-processes was based on many years of research conducted by the author in agricultural enterprises active in the field of logistics (Wajszczuk, 2013). As a consequence, 26 PSR sub-processes, 20 ST sub-processes, 8 SP sub-processes, 7 SW sub-processes and 12 RL sub-processes were identified for the purpose of assessing the logistics sustainability of family farms. The social, environmental and economical sustainability areas were identified for each of the above sub-processes.

Because some of the sub-processes have a double or triple dimension of sustainability, the total sum of sub-processes identified in terms of this aspect will be higher than the sum of sub-processes considered, as reflected in Table 1, column a.

Input data was collected in a research survey consisting of questions on the implementation degree of sub-processes within each main LSR process. Afterwards, based on the replies, a score was allocated to each sub-process as follows:

- non-implemented process: 0,
- partially implemented process: 1,
- fully implemented process: 2.

Then, the scores were aggregated within specific main LSR processes and within sustainability areas (Table 1). The point values obtained as a result of the questionnaire were referred to the point scale within individual the LSR's main processes, as well as within the sustainability areas.

With this score aggregation system, it was possible to individually assess each main LSR process (5 indicators) and determine the sustainability implementation degree in the social, environmental and economic area of the LSR concept (3 indicators). Thus, the implementation degree of sustainability in specific areas/main processes will be assessed in terms of LSR based on the following five-grade scale:

- > 80%: the area / LSR main process is highly sustainable,
- 60% to 79.9%: the area / LSR main process is fairly sustainable,

Table 1. Number of sub-processes surveyed and the maximum score within a main LSR process/sustainability area

Sustainability area	Main LSR processes										Total in sustainability areas	
	PSR		ST		SP		SW		RL			
	a	b	a	b	a	b	A	b	a	b	a	b
Social	13	26	3	6	2	4	1	2	2	4	21	42
Environmental	8	16	12	24	7	14	6	12	12	24	45	90
Economic	16	32	12	24	1	2	2	4	3	6	34	68
Total	37	74	27	54	10	20	9	18	17	34	X	X

a: number of sub-processes confirming the implementation degree of a main process/sustainability area
b: maximum score for the implementation of a main process/sustainability area
Source: Wajszczuk, 2016b.

- 40% to 59.9%: the area / LSR main process is moderately sustainable,
- 20% to 39.9%: the area / LSR main process is poorly sustainable,
- < 20%: absence of sustainability in the area / LSR main process.

The percentage scale presented was established with an expert method developed based on the results of pilot studies in agricultural enterprises. As a consequence, a logistics sustainability assessment method dedicated to agricultural holdings was proposed (Wajszczuk 2017).

MAIN FINDINGS

The results of the analysis of the sustainability degree in the social, environmental and economic dimension in the farms under consideration are shown in Table 2. Accordingly, the LSR practices implemented in the farms result in a poor degree (F3, F4 and F5) or absence (F1 and F2) of environmental sustainability.

Meanwhile, a complete absence of sustainability was reported in the social area. Only the largest farm reached the poor sustainability threshold.

In turn, the highest sustainability levels from the logistics perspective were demonstrated in the economic area. A moderate level of sustainability was reported in two farms (F4 and F5). Two other (F3 and F2) showed a poor sustainability level, whereas the logistics processes in farm F1 were found not to be economically sustainable.

The resulting sustainability degree of logistics in the social, environmental and economic dimension in the farms considered is determined by sustainability degrees of main LSR processes. Table 3 shows the results of the analysis of logistics sustainability degrees in main LSR processes.

Table 2. Logistics sustainability degree in specific areas

Sustainability areas	Total in sustainability areas									
	F1		F2		F3		F4		F5	
	score	%	score	%	score	%	score	%	score	%
Social	5	12.5	6	15.0	6	15.0	7	17.5	8	20.0
Environmental	9	11.3	15	18.8	22	27.5	24	30.0	27	33.8
Economic	13	19.7	21	31.8	26	39.4	31	47.0	33	50.0

Source: own elaboration.

Table 3. Logistics sustainability degree in main LSR processes

Main LSR processes	Total in main LSR processes									
	F1		F2		F3		F4		F5	
	score	%	score	%	score	%	score	%	score	%
PSR	10	13.9	15	20.8	15	20.8	19	26.4	21	29.2
ST	12	23.1	18	34.6	27	51.9	31	59.6	31	59.6
SP	3	18.8	3	18.8	3	18.8	3	18.8	6	37.5
SW	0	0.0	2	12.5	4	25.0	4	25.0	5	31.3
RL	2	6.7	4	13.3	5	16.7	5	16.7	5	16.7

Source: own elaboration.

The comparison of indicators for main LSR processes, in accordance with the adopted grading scale, suggests that Sustainable Transportation (ST) is the most sustainable process in all farms under consideration. As regards that process, moderate sustainability was reported in three farms (F3, F4 and F5), whereas two other ones (F1 and F2) demonstrated poor levels of sustainability. Practices fully implemented as a part of that process in farms F3, F4 and F5 included: monitoring vehicle fuel consumption; ensuring the required cleanness of food transportation vehicles; optimizing the driving distances within the establishment; complying with vehicle inspection schedules; mechanization of loading/unloading operations. In turn, as regards smaller farms, only one of the above sub-processes (optimizing the driving distances within the establishment) was fully implemented in farm F2.

As regards RL, none of the establishments under consideration demonstrated sustainable logistics practices. Findings included the absence of any procedures/systems for returning obsolete products, waste recovery monitoring, and return and disposal of plant protection products or other hazardous substances and packaging.

Other main LSR processes are poorly sustainable or, as in the case of F1, mostly non-sustainable.

When it comes to SW (one of the main LSR processes), none of the establishments under consideration used environmentally-friendly forklifts or other loading/unloading equipment in their storage facilities. No practices related to the donation of potential foodstuffs for the local community were in place either. Other SW sub-processes, such as:

- the use of energy-efficient cooling/ventilation/lighting systems in storage facilities,
- the use of procedures for proper storage and disposal of hazardous materials,
- periodic cleaning and disinfection of storage facilities,
- were deployed partially.

When it comes to assessing the sustainability of packaging management processes, two sub-processes were partially deployed in all farms:

- the use of reusable packaging,
- the use of packaging made of recyclable materials.

Also, the largest farm deployed two other sub-processes, however only to a partial extent: the use of packaging made of biodegradable materials and the use of packaging made of components which do not pose any threat to human health or ecosystems.

The last of the main LSR processes assessed for sustainability was the supply process. The effective implementation of this process is important as it largely contributes to competitive edge. The strategic importance of supply was already explained a long time ago by Porter (1985) in his value chain. He paid specific attention to such sub-processes as the qualification of new suppliers and purchasing various types of materials which, in the case of agricultural holdings with a highly diversified production mix, make this process more complex. The third issue addressed by Porter was the need to monitor that process, which became even more important in light of the LSR concept. This is reflected by the number

of sub-processes analyzed in this survey (37). Based on relevant studies, it was concluded that two of the above sub-processes were fully deployed in all of the farms under consideration, namely:

- categorization of suppliers by types of materials/services purchased,
- use of a centralized purchasing system.

Also, a supplier evaluation procedure was deployed in all of the farms considered but only to a partial extent. Note also that the suppliers were classified not only in terms of costs but also by quality of materials/services delivered.

However, a large number of sub-processes analyzed as a part of Purchasing Social Responsibility (PSR) were not implemented at all. The most important ones are:

- classification of suppliers by whether they use quality/environmental management systems,
- classification of suppliers by whether they use environmentally-friendly vehicles,
- monitoring the suppliers in the context of compliance with labor conditions (including employment of minors; breaching the labor standards; compliance with occupational health and safety procedures etc.),
- use of waste reduction incentives for the suppliers,
- creation of programs supporting the development of local suppliers,
- organizing charity events together with the suppliers.

In summary, the case studies carried out in five farms demonstrated a low degree of logistics sustainability. Also observed was a positive correlation between the logistics sustainability level and the area of land, whether it comes to specific main LSR processes or to social, environmental and economic aspects.

As regards the size of the holding, a similar pattern was identified in the studies by Ciliberti et al. (2008). They concluded that the logistics sustainability degree, from the LSR perspective, grew along with the size of the enterprise. According to their studies, only 9.8% of LSR-compliant practices were implemented in small enterprises, whereas in medium and large companies that ratio was 20.3% and 69.9%, respectively.

CONCLUSIONS

This paper presents the results of the assessment of the logistics sustainability degree in selected family farms from the perspective of the LSR concept. The case studies carried out in five farms demonstrated a low degree of logistics sustainability. Also observed was a divergence of assessed sustainability levels in function of farm size. There is a positive correlation between the logistics sustainability level and the area of land, whether it comes to specific main LSR processes or the social, environmental and economic aspects.

According to the analysis of three specific sustainability areas, LSR practices implemented in the farms under consideration result in a poor degree (F3, F4 and F5) or total absence (F1 and F2) of sustainability in the environmental area, and in a total absence of sustainability in the social area. In turn, the highest sustainability levels from the logistics perspective were demonstrated in the economic area.

Meanwhile, as shown by a comparative analysis of indicators for main LSR processes, Sustainable Transportation is the most sustainable process in all farms under consideration. Conversely, no sustainability was reported in the area of Reverse Logistics.

In light of the growing public pressure on improved safety of foodstuffs flow in the supply chain, in order to preserve transparency, agri-business companies who purchase primary products from small farms will require such farms to implement LSR principles to an increasingly large extent. Based on that emerging trend, it may be concluded that even small enterprises, such as family farms, should intensify the implementation of LSR principles in their development strategies, thus becoming responsible suppliers of primary products for large companies.

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