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ENVIRONMENTAL CHALLENGES OF TRANSPORT ACTIVITIES IN THE AGRI-FOOD SECTOR

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Abstract

In a society dominated by an ever-evolving transport sector and experiencing profound technological change in all areas, we cannot deny the impact of transport on the environment. This paper has examined the main environmental impacts of transport activities associated with the food sector in order to undertake a critical review of the challenges we may face in developing this sector. The main objective was to show the links between transport activities throughout the food life cycle and the environment. The paper reviewed the main studies in the field and the results identified the main ways in which transport affects the environment and identified some solutions to reduce its impact. The materials used in the research cover a wide range of information on the environmental impacts of transportation activities. Available scientific literature containing information on transportation was used, and the scientific material was analyzed theoretically. Our brief review of the environmental impacts of transportation activities related to agriculture showed that greenhouse gas emissions in this sector are increasing. Our research has shown that it is necessary to use efficient vehicles, reduce transport distances, develop cooperation in transport networks, use new types of packaging, etc.

Key words**:** *transport, food chain, life cycle, emissions, carbon footprint*

INTRODUCTION

In rural areas, inadequate transport infrastructure, combined with the dispersion of producers and the absence of associations or cooperatives, leads to low producer prices and high transport costs [1]. Good rural transport infrastructure is therefore essential to facilitate access to markets, increase agricultural production and develop modern supply chains for agricultural products [5]. Any investment in infrastructure can reduce the cost of procuring inputs and transporting produce to market [20]. However, with the development of roads, railroads, etc. in rural areas, we are increasingly confronted with the phenomenon of increasing greenhouse gas emissions related to the local transport sector [23] and delivery logistics. Therefore, it is very important to "engage farmers in climate mitigation actions and help deliver a range of environmental and economic co-benefits" [2].

Transport in agriculture is generally calculable, as we can determine the necessary technical and human resources (land, fuel, etc.) in advance. For a farm's agricultural machinery, fuel consumption is the most important indicator of transport [26]. However, when calculating fuel consumption, many elements (weight of trailers, load, quality of roads, etc.) must be considered, which vary in time and space. Bernhardt et. al [4] have demonstrated that there are differences in fuel consumption by road type, traffic volume and speed.

There are many environmental problems associated with transport, as this sector is "responsible for a large part of the global consumption of energy and material resources" [3]. The sector contributes significantly to the emission of pollutants and noise, which affects health, plant growth, and biodiversity.

In this context, the purpose of the paper was to analyze the relationship between transport activities related to agriculture and the environment. We highlight the main challenges in this area by looking at work that has been done to identify the environmental impacts of transport activities. In this way, we want to give an overview of the environment

challenges related with transport identified by various researchers in this field.

MATERIALS AND METHODS

This review article examines the links between the transport sector and the environment, drawing attention to the main direct and indirect impacts of this type of activity. The materials used cover a wide range of information summarizing the environmental problems due to transport activities from the available scientific literature.

RESULTS AND DISCUSSIONS

Agriculture contributes to global warming with a large amount of methane and nitrous oxide, while the transport sector contributes with CO2 emissions that have a relatively small impact during the life cycle of the food [15]. However, transport releases CO^2 emissions through the burning of fossil fuels, which are consumed, for example, in transporting produce from the field to the silo, transporting it to processing plants or slaughterhouses, transporting it to the supermarket, transporting inputs (fertilizers, feed and others) etc.

Carbon footprint of transport activities from food chain

According to Konieczny et. al [13], the European food transportation produces 54% of total nitrous oxide, 45% of total CO2, 23% of total non-methane volatile organic compounds, and 20% of other gases. However, the contribution is different according to the type of product, from 50% in fruits and vegetable sector to under 10% for the meat sector. In USA, food transportation utilizes around 19% of the total fossil energy (7% in agricultural production) [Pimentel et al. 2006] and most of the food is transported by truck [22].

The connection between transport and environment

The quality of the fleet can cause large amounts of pollution. There are some measures that can be applied to reduce the impact on the environment, such as use of fuel-efficient vehicles; use of local vehicle brands to reduce maintenance costs; use of professional drivers to improve fuel efficiency; monitoring of fuel consumption and vehicle use; preventive maintenance; and responsible disposal of parts [7].

Within local food distribution systems, it is assumed that there is a smaller ecological footprint because the distances between producer and consumer are smaller and the energy required for transport is reduced [8]. If transport is carried out over longer distances, energy-intensive logistics systems are required [9], which depend on the geographical location, food product, seasonality, and mode of transport [10] and include different transport sectors (transport inputs, packaging transport, waste transport, transport to storage, transport to the point of consumption, etc.).

Reducing the negative footprint of transport on the environment can also be achieved by optimising transport: through joint purchases, the creation of transport networks (by pooling resources, improving travel planning for better sharing of vehicles), the establishment of storage areas, etc. To promote collaboration regarding supply chains and logistics, “partners should reduce packaging and avoid single-use items, plan transport to reduce emissions and favour procurement of locally produced items as long as their supply, durability, adequacy and environmental sustainability can be ensured.” Also, “coordination and collaboration with food aid suppliers, packaging suppliers, transporters is crucial, to identify the most sustainable packaging and research potential alternatives to improve cost-effectiveness and better preserve food aid products throughout the supply chain and shelf life” [6].

The way we ensure the connection between the production site and the distribution centres influences the environmental impact caused by transport. So, choosing suppliers or buyers based on transport distance reduces carbon emissions and pollution. Of course, if possible, means of transport that consume less carbon can be chosen (maritime or rail transport), measures can be taken to support local markets to shorten transport distances

(the purchase of locally produced foods can reduce GHG emissions involved in the transport and storage of food), or a cost-benefit analysis can be carried out depending on delivery time, costs, emissions, capacity, packaging, etc. We can also reduce the need for transport and the associated carbon emissions by consolidating distribution centres or improving warehouse logistics.

The distance required for transport also influences the type of packaging used and indirectly the waste generated during delivery. If the size of packaging is reduced, the fuel needed for transport is reduced. Reducing plastic packaging and promoting reusable packaging also optimises the space required for transport.

LCA - environment impact related with transport

Looking at the life cycle of a food product, agricultural production has a greater impact on the environment compared to other activities such as transport and processing. However, reducing transport-related greenhouse gas emissions in rural areas is important to curb global warming, and many papers propose measuring the direct and indirect environmental impacts of transport systems through life cycle analysis. LCA have been used to analyze transportation systems since the 1990s, as they can provide information on direct and indirect environmental impacts [14].

LCA models can be used as decision support tools to assess the impacts of transportation infrastructure [17] or in infrastructure procurement [25], [12], [24]. In addition, LCA can be used to find environmentally sound solutions for different geographic dimensions of transportation to support sustainability [11].

There are many studies that use LCA models to analyse the effects of transport during the life of a product. Notarnicol et al. [18] point out that these models need to consider emissions from fuel use (based on hours worked, tractor power, farm type and soil) and distances between the locations of agricultural production, inputs and the place of processing, retail, or consumption.

Molina-Besch et. al [16] indicates that food LCAs usually take in consideration the transport from producer to retail, food waste in transport, food transport by households etc. Most studies conclude that the means of transport and distance are very important and that the only solution is to develop efficient packaging or to use reusable large containers. Indeed, the packaging solution of LCA can influence the choice of transport mode, which may be an energy-intensive mode such as air freight or a long-distance road transport. In these cases, the environmental impact of transport is estimated based on the weight of the food and its packaging.

According to Notarnicola et al [19], logistics is an important phase in terms of environmental impact within LCA due to the associated emissions to the atmosphere that occur during transport. In their model they considered: transport by lorry from the producer/farm to a regional distribution centre and from the regional distribution centre to the retailer (a total distance of 500 km); a 20% increase in fuel consumption for refrigerated transport; transport of consumers within a 4 km limit. This model LCA has proven that the environmental impact of transport during the life cycle of the product is less significant than the impact caused by the end-of-life phase of a food product (solid waste treatment, uneaten food, human metabolism excretions, etc.).

Payen et. al [21] show in their LCA model, that the transport from Morocco to France has a major impact on the environment within the life cycle of the tomato: acidification of the soil, eutrophication of the seas and depletion of fossil resources.

CONCLUSIONS

Our brief overview of the environmental impacts of transportation activities related to agriculture has shown that greenhouse gas emissions in this sector are increasing. Reducing this environmental impact can be achieved through the following measures: use of efficient vehicles, reduction of distances, cooperation within a transport network, introduction of new types of packaging, etc. Various LCA models have also been created

to account for transportation activities from the acquisition of the input to the consumer's journey to the destination. They point out many other elements that need to be considered when estimating the impact of transportation, such as: Fuel consumption, energy consumption, type of product, type of packaging, weight of food, change of source of supply to local suppliers, etc.

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