Assessing Dry Ports’ Environmental Sustainability

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The expression “dry port” was initially used to describe a facility useful for redistributing flows of goods arriving by sea. Sustainable development and environmental issues related to ports and sea trade have highlighted the need to enhance transport and trade systems to include green practices, such as the realisation of dry ports.

Keywords: dry port ; inland terminal ; freight village ; interporto ; environmental sustainability

1. Introduction

Historically, ports have been a privileged gateway for the sea-based trade of commodities, contributing to an area’s economic and social development [1]. However, as containers have emerged on a global scale, their relationship with the respective hinterlands has been pointed out. Over time, concepts such as integrated logistics [2] and efficient supply chains [3], together with the growing concern for sustainable development [4] related to ports and sea trade [4], have highlighted the need to enhance transport and trade systems to include green practices, especially for people living in seaport areas [4]. Logistics, in general, has a negative impact on the environment, mainly due to emissions [5][6], so port operators have to meet very high standards of transport services in compliance with rigorous environmental requirements [7]. Therefore, there is ample opportunity to enhance the entire system's sustainability by tackling oil dependency, the impacts of increased railway transport [8], and the development of inland terminals near cities and regions [9].

In light of these premises, the development of intermodality [10][11] and dry-port use [12] may represent an answer to society’s demand for more environmentally friendly transport [10]. In particular, dry ports were first investigated as a solution to reduce port congestion and were considered essential to redistributing sea-based commodity trade flows [13]. However, even though this concept dates back to the 1980s, there are still several ways to define it. The expression “dry port” was initially used to describe a facility useful for redistributing flows of goods arriving by sea. Currently, there is no univocal definition for dry ports and, in foreign languages, different terms are utilised to indicate them, such as “inland terminal”, “freight village”, or “interporto” [15]. This situation makes several definitions available with small differences mainly related to the connection system considered between seaports and dry ports. In 1991, one of the first definitions was formulated by UNCTAD [16], as follows: “Dry port is located near inland from seaports. It is linked directly to seaport or, in the case of international land movement, is in contact with the sources of imports and destination of exports. Dry ports may be used either in a country that has seaports or in landlocked country, but only surface transport modes are involved in giving access to dry port”. Currently, according to Lamii et al. [17], the most cited definitions are those proposed by Roso et al. [18], Jaržemskis and Vasiliauskas [19], and Witte et al. [20], which include, as a possible type of connections, railway, rail plus road, and waterway, respectively. According to Nguyen and Notteboom [21], three main components characterise and distinguish dry ports: (i) they can be considered as cargo unitisation; (ii) they create and/or consolidate the durable link with seaports using high-capacity, frequent, and reliable inland waterway, rail, and/or road services; and (iii) they offer interchangeable services with seaports, such as customs services, cargo storage, or value-added services. Dry port services and their functionality represent the distinctive and peculiar differences compared with conventional inland intermodal terminals [19]. Some more specific elements are dry ports’ functioning, their vicinity to port hubs (i.e., close, medium distance, distant), and the networks linking seaports and hinterlands (i.e., roads, rails, or rivers). These solutions represent a fair trade-off between economic growth and environmental protection, improving rural areas [8], solving issues of geographical discontinuity [22], and increasing job opportunities along the entire logistics chain [23]. Thus, dry ports can be considered as an evolution of intermodal terminals, without forgetting their importance in the logistic management evolution.

However, and in line with Lamii et al. [24], Baydar et al. [25], and Khaslavskaya and Roso [26], it is possible to remark that among the current studies related to the growing importance of dry ports, only few papers concern environmental implications. Moreover, and as it will be better detailed in original text, these latter articles approach the argument in a
general and often not a systematic way, leaving aspects of the environmental implications associated with dry ports and with the United Nations 2030 Agenda and its 17 Sustainable Development Goals (SDGs) unexplored or marginally explored. Consequently, it becomes crucial to fill in these gaps in academic research and, at the same time, to provide actions to support involved stakeholders toward more sustainable dry ports through a proposal of an innovative conceptual framework.

## 2. Dry Ports’ Environmental Sustainability

The findings of the researchers' research ([10.3390/environments9090117](http://10.3390/environments9090117)) provide a more robust synthesis to develop a new conceptual framework. It was built on the critical analysis whose final aim was to investigate the current state of the art related to the assessment of dry ports’ environmental sustainability. The results showed that there is a gap in this field, namely a weak and labile correspondence between the awareness of stakeholders and public authorities and their ability to make dry ports sustainable. Hence, the proposed innovative framework is relevant as a possible and useful tool to address new and specific studies and research, driving and supporting actions and policies toward a reduction in the environmental impacts of dry ports.

Specifically, the innovative framework identifies the variables that affect the dry port’s performance, and therefore, it highlights the need for better coordination among the different aspects (Figure 1). It was revealed that there is no coordination between the various studies and systemic debates on the dry port’s environmental issues, no standardised applicable tools, and no involvement among the various stakeholders. Additionally, a debate is also lacking under the lens of the SDGs of the Agenda 2030.

![Figure 1. Conceptual framework and its variables derived from the SLR. Source: personal elaboration by the researchers.](image)

These results are in line with some other relevant and recent literature reviews published by some academic scholars. Indeed, all of them revealed that there is often a lack of data and an absence of research questions useful to develop a more systemic discussion; a lack of standardised performance indicators; very few publications based on surveys of shippers or transport operators; and many thematic areas on dry ports’ research in the same article. For example, Baydar et al. [26] highlighted the need for more case-based studies and performance indicators analysed by scholars, as most publications on transport and logistics are from non-academic resources. They underlined that the studies on dry ports often focused on more than one aspect of sustainability. Khaslavskaya and Roso [28] observed that the environmental perspective is more in focus in recent studies, but very few publications consider the broader perspective of dry port sustainability. A variety of methods have been used, but research is predominantly represented by qualitative cases and quantitative modelling and optimisation studies. Most of the benefits identified in this research are of an economic nature, although the concept has gained popularity due to the range of environmental benefits identified. Additionally, Lamii et al. [21] found that different themes (optimisation, performance, concept, sustainability, environmental impact, risk management, and financial impact) are sometimes in the same article. It is only since the year 2010 that specific studies have been carried out on the dry port performance, according to economic, environmental, or social criteria. Nevertheless, they stressed the importance to further practical studies on the topic of dry ports and on some topics not adequately considered, e.g., their environmental impact.
Finally, it was found to be crucial to frame the issue of dry ports' environmental sustainability under the umbrella of UN Agenda 2030 and its relative SDGs. These goals aim to implement innovative digital technologies in port management and operations and to optimise physical port infrastructures for sustainability and resilience. From the environmental perspective, the SDGs aim to address air, dust, noise, and water pollution and to protect the environment through community and social-engagement programs.

Actually, the development of dry ports is a key enabler facilitating the achievement of some SDGs according to a sustainable transport approach. Indeed, it offers multimodal sustainable solutions such as the implementation of an integrated intermodal transport system, which brings together multiple stakeholders around shared objectives. Such goals can be achieved only if the interconnections between logistics and SDGs are well-understood and deliberately used to solve trade-offs and to benefit from potential synergies. Specifically, knowledge advancement about these interlinkages is crucial for developing and fostering the diffusion of dry ports; thus, academic scholars have to perform in-depth investigations on how the dry ports can meet SDGs, specifically those correlated to the environmental dimension.

One of the first evaluations was carried out by Alamoush et al., who revealed, even if generically, that this typology of multimodal transport sustains sustainable economic growth, builds resilient infrastructure (Goal 8: Decent Work and Economic Growth), supports inclusive and sustainable industrialisation and encourages innovation (Goal 9: Industry, Innovation, and Infrastructure), and guarantees sustainable consumption and production patterns (Goal 12). There are only a few references to the environmental aspect such as controlling emissions and pursuing energy-efficient building, Goal 3 (Good Health and Well-being) and Goal 13 (Climate Action), respectively. Nevertheless, according to the findings of the present research, other goals can be met by dry ports' implementation: an increase in sustainable mobility and a reduction in traffic congestion (Goal 11: Sustainable Cities and Communities), as well as the protection of water quality (Goal 14: Life Below Water).

References


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