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Sustainability assessment and climate change resilience in food production and supply

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Abstract

To improve food security a conceptual integration beyond the scope of production in the agricultural sector due to examination of critical supply chain system compartments and levels of services (“integrated food production and supply systems”) is proposed. For creating systematic results, a platform integrating various perspectives of experts has been established following the principle of triple helix stakeholdership (business practice, public management/policy and also science). During a series of workshops, the main actors, success factors, challenges and communication strategies have been identified for shaping sustainable food supply chains under use of systems thinking and the application of Participatory Systems mapping (PSM). In this line, the paper presents how “system maps” based on the method of PSM are used to gain insights into sustainable logistics services facilitating sustainable consumption patterns, enabling participatory considerations and the productive exchange of knowledge.

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Keywords: Integrated Food Production and Supply Systems; Sustainable Supply Chain Management; Climate Change Resilience; Sustainability Assessment; Logistics Services; Sustainable Consumption; System Dynamics; Participatory Systems Mapping

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1. Introduction

The human society is facing complex and interrelated problems of unsustainability. An essential threat represents the ongoing destabilization of regional food systems' capacities due to a mix of interacting factors, such as climate change, population growth, overuse of resources, change of consumption modes, governance failures and problems in fair resource allocation and distribution under the increasing pressure and uncertainty. Currently 1.4 billion of the global population is living on less than 1 Euro a day, unable to adapt to an upcoming crisis; one billion of them is living in rural areas where agriculture is the main source of livelihood [14]. The 'green revolution' in agriculture, especially starting from the 1950s, increased agricultural productivity and contributed beside general economic growth in some regions of the world to reduced poverty rates, even if this progress is still patchy across countries. Stable improvement is heavily depending on local as well as international governance and investment policies as well as the implementation of fair economic trade rules in the globalized food and agriculture market. However, achievements were received without considering environmental externalities, leaving e.g. soils degraded and groundwater depleted, and have been undermining the ecological resource base. Moreover, many of the achievements strengthen the dependency on fossil energy and have led into less resilient production systems because of reduced crops diversity.

These underrepresented issues become more relevant in times of climate change and its regional impacts on agricultural systems. Taking into account two decades of underinvestment and vague innovation policies in agriculture, coupled with the growing competition for land and water and rising input prices, agricultural systems are now becoming more vulnerable than ever [6]. Therefore, it is expected that due to the world's demographic development in its global differentiation, together with the significant effects of global climate change and resulting shifts for all organic production systems (agriculture, forestry, use of natural or semi-natural ecosystems), rural regions will undergo severe pressure in terms of their economic and ecological productivity, supply effectiveness of the population and the general societal prosperity in the next decades. From a systems perspective the situations also bears enormous risks for the globally expanding urban centers, because of their restricted self-sufficient food production capacities and critical dependencies on the already affected rural areas, with which they stand in a source-sink-relationship.

Sustaining the agricultural system is dependent not only on shaping sustainable production ways. The entire food supply chain must be analyzed systematically considering also further downstream and also upstream stages of the supply chain, industrialized combination of ingredients and further processing of food products, and in particular, their distribution, including the storage/ turnover and transportation to retailers and the consumer as well as the consumption phase and waste disposal [5]. In this context, logistics services are continuously expanded and adapted. Hereby, logistics service providers support in coordinating cross-company activities in a supply chain [9]. In the last years, social issues of sustainability (health and safety issues as well as employee income in developing and emerging countries) are increasingly questioning the producer and distributor business relations with the logistic industry and their Key Performance Indicators (KPI) after scandals and public debates were significantly raising the consumers' awareness. Thereby, a sustainable lifestyle (closely related to logistic services) is vitally important, because it favors reduction of resource consumption together with implementing technological and business innovations [12].

Up to now the main objective of logistics services is to co-ordinate activities in a way that meets customer requirements at minimum cost [1]. In the past, this costs have been defined in terms of the internal operations invest within the supply chain. As concern for the environment rises, companies must take more account of the external costs of logistics associated with climate change and further damage to the environment, e.g. due to various emissions and massive resource consumption [11]. Supply chain capacities to reduce environmental externalities represent a powerful lever to enhance ecological resource efficiency across the whole lifecycle of a food product and is finally a more commanding means than just the ecoefficient optimization of the production phase [8].

Thus, this paper contributes to exploring ways of reduced externalities and to achieving a more sustainable ratio between economic, environmental and social objectives considering the operational functions of logistics. Through a better understanding of the interaction of consumer behavior and logistics services, the paper gives insights about relevant factors with regards to alternative last mile distribution modes as well as supply chain transparency by taking into consideration new forms of business models, such as the Sharing Economy [11]. Facilitating this aim, a

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