

Network and vulnerability analysis of international spice trade

Zoltán Lakner¹ and Erzsébet Szabó²

¹Corvinus University of Budapest, Department of Food Economics, Budapest, Hungary

²National Agricultural Research and Innovation Centre, Food Science Research Institute, Budapest, Hungary

Abstract

Long-distance trade of spices had formed one of the first global product trade networks. The spice trade development through South Asia and Middle East in around 2000 BC with cinnamon and pepper.

Since the 1960-s, global spice trade has been increasing at an exponential rate, faster than food production itself. Spice fluxes between countries form a complex, dynamic web of interactions. Spice trade has numerous specific aspects compared to trade of the majority of agro-food products, because (1) there is a considerable geographic distance between the most important suppliers and buyers. that's why the international spice trade embraces a considerable, long-distance transport and difficult logistical system; (2) the most important spice producing countries are the relatively lesser developed ones: India, Bangladesh, Pakistan, Iran, Nepal, Colombia, Ethiopia and Sri Lanka are among the top ten most important exporters. Increasing political instability in a number of important middle-and Central Asian countries have further increased the unpredictability of some key actors (nodes) in spice chain. (3) spices are widely used in a range of products (e.g. in meat, canning, poultry processing and meat industry) as well as in gastronomy. Under these conditions an eventual food safety problem at spices can cause a considerable economic and long-range moral loss.

However the importance of spice trade is widely acknowledged, the structure, conduct and performance of this network is hardly known. The aim of research has been to analyse and modelling of the international spice trade network, based on long-range data. Novelties of research are: (1) application of network science concept and methodology on analysis of international spice flows; (2) determination of key players and dynamics of spice trade network; (3) determination of efficiency of food safety control mechanism of EU, based on comparative analysis of trade and food safety network data; (4) modelling of vulnerability of spice trade network by agent-based simulation.

A frequently used measure in the structural analysis of complex networks is the node- or edge-betweenness centrality. It quantifies how "central" is the position of the node/edge in the network, in the sense that high centrality nodes/edges collect large portions of the traffic through the network. For this reason, they also present the Achilles' heel of a network as changes in the status of these nodes and edges will have the largest effect on the whole system, both in connectivity and transport properties. Nodes with top centrality values play a critical role in the spice trade network, because any food-born substance (e.g. chemical or microbiological contamination) will spread most efficiently through them into the rest of the network, while tracing the source of such a substance is difficult due to the large number of network paths running through these nodes. Fast spread is also facilitated by the small value of the average shortest path (measured in hop-counts) of the network.