Since the mid-2000s, many MENA countries have shifted to an import-based strategy to meet their food security needs, making the region more dependent on global food trade networks. This brief examines wheat trade trends and potential implications through a series of social network analyses. We limit our focus to wheat, a critical crop for food security in many MENA countries. Our analysis reveals that many MENA countries are importing more and they tend to form new ties with established exporters, resulting in distinct communities of export hubs and their importing partners. We also find over time a trend towards consolidation in the region, with Russia increasingly acting as a lead exporter for the entire region. We also find evidence that sub-regional differences (e.g., the degree of dependence on major export hubs) are shrinking.

**Abstract**

Since the mid-2000s, many MENA countries have shifted to an import-based strategy to meet their food security needs, making the region more dependent on global food trade networks. This brief examines wheat trade trends and potential implications through a series of social network analyses. We limit our focus to wheat, a critical crop for food security in many MENA countries. Our analysis reveals that many MENA countries are importing more and they tend to form new ties with established exporters, resulting in distinct communities of export hubs and their importing partners. We also find over time a trend towards consolidation in the region, with Russia increasingly acting as a lead exporter for the entire region. We also find evidence that sub-regional differences (e.g., the degree of dependence on major export hubs) are shrinking.

**Keywords**

Food Security, Global Value Chains, Social Network Analysis
Introduction

Food security in the Middle East and North Africa (MENA) depends on complex trade networks to feed the growing population. Research on food production shows that environmental and socio-political conditions have disrupted food value chains in MENA countries, which are now the largest importers of cereals in the world. The resulting import dependency exposes MENA countries to high risks when exporting countries are unable to meet global demand, thereby constraining global markets and raising food prices. This research brief examines wheat-trading patterns within the Middle East and North Africa through social network analysis (SNA) to complement our work on wheat global value chains (GVCs) and food security in the region (see Duke Minerva Research Brief 01).

GVCs refer to the sequence of value-added activities that comprise the creation, delivery, and end-use of a given product or service. The framework examines actors, activities, policies and transformations that occur in global and local wheat networks and their effects on food security outcomes. SNA complements GVCs by mapping and measuring relationships and trade flows to investigate the trade structure of MENA’s wheat value chain, trading partners and the degree of dependency on one or more partners for imports. The social network approach also provides varied measures for power of actors in specific network positions.

Using FAO trade data from 2000 to 2011, we find that MENA’s wheat network has grown over the past decade with the Black Sea region growing in importance, accounting for almost 23% of imported wheat to the region (see figure 1).

Figure 1: Major Trade partners 2000-2011

Structurally Efficient Growth: 2000-2011

In the early 2000’s, diminishing ground water supplies, inconsistent seasonal rainfall, and growing populations within MENA necessitated a policy shift away from self-sufficiency. From 2000 to 2011, MENA’s wheat trading network grew, becoming more interconnected and further oriented around trading hubs (i.e., major exporting countries). As many nations in the region moved towards increased imports, they also sought to diversify sources of wheat but were limited by the number of exporting countries who could meet MENA’s food gap.

Figure 2 shows that the size of MENA’s network grew since 2000, peaking in 2008-2009.

![Figure 2. Comparison of Cohesion Measures, Size and Density](image)

The increase in density since 2009 indicates the network is becoming increasingly interconnected within hubs. Density is defined as the number of actual ties within a network over the number of potential ties. The relatively small change in density given the growth of the network over time, however, indicates that new connections are forming between importers and already highly connected exporters, such as the United States, France, or Russia, instead of the emergence of new suppliers to the region.

Interestingly, the data indicate the majority of any given MENA country’s imported wheat is restricted to three trading partners, on average 72 percent, which further suggests that the diversification of trade networks is limited by the number of nations that can supply wheat to the region. Additionally, the network has few redundancies, indicating that a tie between a country and its trading partners is a weak predictor of ties between other nations. For example, the fact that Saudi Arabia is trading with Yemen and the US does not obligate Yemen to also trade with the United States.

3) Network size is the number of importers and exporters involved in the MENA wheat trade. Density is the number of actual ties within a network over the number of potential ties.
Relational Communities and the Rise of Russia

Amidst the rise in import dependency, Russia has become one of MENA’s leading export partners. Russian imports to the region increased by 25% from approximately 27 million tons of wheat in 2007 to more than 36 million tons in 2011. The region’s other leading exporters include: France, the US, Canada, and Australia.

Figure 3 highlights MENA’s relational communities for the years 2007-2011, showing Russia’s growing prominence, especially for Egypt. Using a Girvan-Newman clustering algorithm, we see three communities, two focused around major hub-partner relationships, and a third characterized by smaller hub-partner relationships. The first community (red in the figure) consists of two major hub partner-relationships—between Algeria and France, and Morocco and France. We find the hub-partner relationships between France, Algeria, and Morocco to be persistent for the entire period.

Figure 3. Girvan-Newman Clustering Analysis of MENA (2007-2011)

Source: FAOSTAT 2014

The second community (in green) consists of one major hub-partner relationship, Egypt and Russia, and a set of major hub small-to-medium partner relationships. Russia is Egypt’s and the Levant’s primary source country for wheat. Russia’s role as a major hub is relatively new. In 2002, Russia became a primary source for wheat imports to Syria and Lebanon and to Egypt in 2005. The relationship holds even during wheat export bans by Russia (see Duke Minerva Research Brief 03 for more detail).

The third community (in blue) consists of smaller and less persistent hub-partner relationships encompassing oil-exporting states such as Saudi Arabia, Qatar, the UAE, and Iran. These countries tend to enter into fewer long-term trading relationships and to distribute the tonnage of wheat they import between various partners more evenly. The community’s largest and most stable hub-partner relationships are between the US and Iraq, followed by Yemen and Australia.

Distinct trade communities imply that trade relationships are not easily changeable and persist over time. Persistent hub-dominated communities imply risks for importing countries because the sourcing networks of importing countries dependent on hubs tends to be less diverse, with Egypt being a notable exception.

4) The Girvan-Newman clustering algorithm identifies communities by assigning weights to all the edges based on path length, iteratively removing edges until no ties remain, and then grouping nodes with more connections to each other than to the rest of the network into communities.
Implications: Hubs over Time, 2000-2011

To explore what risks a hub-oriented network might have for the region, we examine changes in each importer’s authority centrality over time, allowing us to capture differences between countries in terms of trade hubs. In this context, exporters tend to be hubs to the extent that they have ties to numerous highly connected authorities; importers tend to be authorities to the extent that they have numerous ties to highly connected hubs. Authority centrality scores range from 0 to 1, where 0 signifies no connections and 1 denotes a connection to all the network’s hubs.

Applying authority centrality in this context allows us to measure the potential risks associated with a hub-oriented network by measuring changes in a country’s dependence on hubs over time. The data suggest that a country’s dependence on hubs is an indicator of its brokering position. Figure 4 compares Egypt’s, Algeria, Saudi Arabia’s, and the UAE’s authority centrality scores over time. The y-axis represents a country’s average authority centrality score over the past five years. The green line indicates Egypt, the red line Algeria, the blue line the UAE, and the purple line Saudi Arabia. The black line indicates the network’s average authority centrality score.

Figure 4. Comparison of MENA’s Leading Importers’ Average Centrality to Regional Hubs (5 Year Average).

Source: FAOSTAT 2014

Comparing the five-year average of authority centrality scores of major wheat importers such as Egypt and Algeria to growing wheat importers such as Saudi Arabia and the UAE, we see a general trend towards convergence both in their trends and in the regional average, indicating MENA has become more interconnected. The whole region is increasingly buying wheat, and buying it from the major hubs. Figure 4 also suggests that oil-importing states still tend to have more ties with hubs than oil-exporting states, but this difference is shrinking. In the event of a crop crises (e.g., the Russian crisis of 2010), this trend implies increasing risk for importing countries because the sourcing network of the entire region is more dependent on hub countries.8

6) Authority Centrality is the eigenvector centrality of the adjacency matrix of \(X^*X\), or how highly connected country \(i\) is to the countries with the highest proportion of the network’s out-directed ties
8) This brief builds on Danice Brown’s 2014 Masters Project for Dukes Master of Public Policy Program, “Calculating Risk for Food Crises in the Middle East: The Role of Social Network Analysis.”