In the case of wholesale food distributors, it's all about location

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In all but the shortest supply chains, food travels through wholesale distribution centers on its way from farm to consumer, and the location of these distributors can have a big impact on the efficiency of a food system. Now, a new mathematical model can help business owners and policy makers determine the optimal locations for such distributors, thanks to a research team led by an engineer in Penn State's College of Agricultural Sciences.

"Our model addresses the problem of how to move food from producers to consumers efficiently," said Hamideh Etemadnia, a postdoctoral scholar and lead author of the study. "In the case of farmers' markets, producers bring their products directly to consumers themselves. But most products are trucked from processing facilities to wholesale distributors, and then on to retail stores. Our model will help identify the optimal locations of these intermediary distributors so as to minimize transportation costs and to maximize the number of producers and retailers that they serve."

Knowing the optimal locations for wholesale distributors, or hubs, may be useful to private-sector firm owners, who can use this information to plan new distribution businesses or to change the locations of their existing distribution centers to maximize their profits and to help lower producers' costs through aggregation. Similarly, policy makers can use these results to assess the effect of alternative definitions of "locally produced foods."

Etemadnia and her colleagues developed the mathematical model to consider transportation and distributor-construction costs, as well as several possible constraints that will allow them to look at various "what if" scenarios.

"The constraints that we built into our model allow us to understand how certain changes might affect the optimal locations of wholesale hubs," she said. "For example, officials who want to promote regional agriculture could place constraints on the distance food travels, to see how their region's existing distribution structure would need to change for such a policy to succeed."

To test their model, the researchers applied it to the meat supply chain in the Northeastern U.S., comprising 433 counties. Using County Business Patterns data from the U.S. Department of Commerce, they identified which counties contain slaughtering or meat-processing facilities, and which counties contain retail meat markets. Inserting these data into their mathematical model, they conducted several simulations to determine the optimal locations for wholesale hubs connecting these slaughter and processing facilities with retail markets. Their results, which will be published in the December issue of *Transportation Research Record*, show how optimal distributor locations change based on a number of variables, including distributor size and capacity, road conditions and gas prices.

The team plans to use the model to conduct simulations with other supply chains, such as those for fresh fruits and vegetables. Other members of the research team include Stephan Goetz, Penn State professor of agricultural and regional economics and director of the Northeast Regional Center for Rural Development, and Khaled Abdelghany and Ahmed Hassan of Southern Methodist University.

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