Building Resilient Food Systems

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Building Resilient Food Systems

- COVID-19 has seriously disrupted local, state, national, and international food systems at their respective nodes.
- Local farmers remain a part of the solution to building Maryland's Food System resiliency.
- This presentation will focus on Maryland food supply chain and the contribution of the small farming community to Maryland's Food System resiliency.

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I. Maryland Food Production

- According to Maryland Department of Agriculture (MDA, 2020), Maryland truly is America in miniature, also known as “Little America.”
- Although the state of Maryland is small, its diverse geography provides suitable environments for growing a variety of agricultural commodities.
- Maryland agriculture accounts for $19.66 billion and supports 83,619 jobs statewide (USDA NASS, 2017 Census of Agriculture).

Maryland Top Agricultural Products

Product and Market Value		
Product	**2017 (%)**	**Change Since 2012 (%)**
Poultry and Eggs	48	+25
Grains/Oilseed	23	-
Nursery/Greenhouse	9	-10
Dairy	7	-
Cattle and Calves	3	-
Vegetables	3	-
All Agricultural Products		+10
Source: USDA NASS, 2017 Census of Agriculture		

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Maryland Agriculture: Total and Per Farm Overview

State Profile: 2017 and Change Since 2012		
	2017 (#)	Change Since 2012 (%)
Total		
Number of farms	12,429	+1
Land in farms (acres)	1,990,122	-2
Average size of farm (acres)	160	-3
Farm by Size		
1 to 9 acres	2,244	+50
10 to 49 acres	4,559	0
50 to 179 acres	3,332	-10
180 to 499 acres	1,402	-8
500 to 999 acres	490	-9
1,000 to 1,999 acres	402	+2
2,000+ acres		+18

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Maryland Agriculture: Total and Per Farm Overview – Cont.

State Profile: 2017 and Change Since 2012		
	2017 ($)	Change Since 2012 (%)
Total		
Market value of products sold	2.47 billion	+9
Total farm production expenses	1.97 billion	+1
Net cash farm income	679 million	+38
Per Farm Average		
Market value of products sold	198,954	+7
Total farm production expenses	158,404	+<0.5
Net cash farm income	52,997	+36

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Need for Cooperation among Stakeholders

- Between 2012 and 2017, Maryland agriculture has recorded:
  - An increase in agricultural production in general (10%)
  - Increase in net farm cash income (38%)
  - Poultry and eggs production increase (25%)
  - Increase in number of farms (1%) with the highest record (50%) for 1 to 9 acres farms
  - Increase in number of large-size farms: 1,000+ acres
  - Decrease in nursery/greenhouse production (10%)
  - Decrease of land in farms
  - Decrease of average size of the farm
  - Decrease in number of mid-size farms: 50 to 999 acres farms

Need for Cooperation among Stakeholders – Cont.

- As noticed by the Maryland Food System Resiliency Council (2021), in spite of innovative programs aimed at increasing Marylanders' abilities to grow, buy, and eat local; Maryland agriculture still continues to face many challenges, which require cooperation among all stakeholders.

II. Maryland's Food System

- *Maryland' farm system is a complex network of production, distribution, consumption, and disposal nodes layered with policy, services, community engagement and advocacy, economic interests, a changing climate, and human behavior* (Johns Hopkins Food System Primer, 2021).
- Small farming communities are a part of the solution to building Maryland's food system resiliency since they are an essential node in the system.
- If not strengthened, a defected node could cause cascading impacts throughout the system resulting in a less resilient Maryland and food insecure Marylanders (Maryland Food System Resiliency Council, 2021).

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Maryland's Food System – Cont.

- Farm Typology (USDA ERS, 2021):
  - Small family farms: annual gross cash farm income (GCFI)<$350,000
  - Midsize family farms: $350,000<GCFI<$999,999
  - Large-scale family farms: GCFI>$1,000,000
  - Nonfamily farms: Operator do not own a majority of the business
- Small family farms are classified in three categories:
  - Retirement farms: retired but sell at least $1,000 of agricultural products (to qualify under the current USDA farm definition).
  - Off-farm occupation: primary occupation other than farming.
  - Farming occupation: report farming as primary occupation

    Low-sales farm: GCFI<$150,000

    Moderate-sales farm: $150,000<GCFI< $349,999

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Maryland's Food System – Cont.

- Small family farms contribution to the Nation's Food System is significant (USDA ERS, 2021)
  - Most farms in the U.S. are small but account for a modest share of production
  - Small farms are custodians and managers of the bulk of farm assets (i.e., land, natural resources and the environment)
  - Small farms tend to diversify – a risk management strategy
- Yet small farms encounter challenges not faced by large farms
  - Since the nation relies on larger farms for most of its food and fiber in spite of the high number of small farms, agricultural policies tend to favor large farms.
  - The nonfarm economy is critically important to households operating small farms.

Maryland's Food System – Cont.

- Hence, promoting small farms will help strengthen the nodes of the Maryland's Food System.
- Small farmers must be not only exposed to new technologies and innovative ideas through appropriate training (Extension services) but also provided with adequate resources to successfully perform along the food supply chain.
- The following as advocated by the Maryland Food System Resiliency Council (2021) could help strengthen production, distribution, consumption, and disposal nodes of the Maryland's food system:
  - Provide technical assistance to small farmers through MDA's Maryland Food and Agriculture Resilience Mechanism (FARM) program (yet to created) and other existing programs (UMES, UMD, NGOs, etc.) – Recommendation 1.4

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Maryland's Food System – Cont.

- Improving small farms' performance in Maryland food system:
  - Make additional resources available to small farms through potential Federal and State food system grants and programs otherwise underutilized – Recommendation 1.7
  - Assist small farmers increase access to and use of technology to facilitate connection directly with consumers – Recommendation 4.2
  - Diversify opportunities for small and mid-size farmers – Recommendation 4.3
  - Make agricultural policies that not only favor large-scale farms but also address challenges facing small farms given their significant contribution to the food system resiliency.

III. Farmers' Knowledge and Resource Sharing Network

- A network analysis can quantify the depth and breath of a farmer's relationships with other local farmers, buyers and sellers, or other groups and organizations.
- It can also potentially reveal farmers' incentives, situations, and behaviors as well as explain their economic success.
- Networks related to production, marketing, and resource-sharing activities of 196 farmers (nodes) and three measures of network importance (centrality) for each farmers were computed.
- Regression analyses revealed significantly positive effects on the centrality position on farm sales of specialty crops.
  - A famer who adds one additional link or connection can expect a 19-25% increase in sales, all else equal.

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Introduction

- Knowledge about new agricultural practices and technology is diffused through human interactions and network structures.
- Information sources available to farmers include formal, informal social networks, and interpersonal relationships with peers.
- The theory of social networks examines how nodes—consisting of individuals, firms, and organizations—interact with one another, where interactions are represented as links.
- Innovation diffusion is often a byproduct of the actual adoption of technology, which can be enhanced if it occurs in an environment with strong social networks.

Introduction—cont.

- Culture evolves through social network-based exchanges as individuals copy and adopt ideas or suggestions made by individuals who are perceived as leaders.
- The strength of trust-based relationships is immensely important for cooperation among specific groups including limited-resource farmers.
- Social Network Analysis (SNA) is widely used to understand relationships among individuals and groups, including farmers within supply chains.
- Farmers (nodes or hubs) and their connections are defined as edges or links.
- Network measures such as density and inter-node or intra-network distance are the most common, allowing comparisons of networks with others as well as over time.

Introduction—Cont.

- This presentation examines how small and minority farmers' participation and position within social networks affects farm performance.
- More specifically:
  - Assess small farmers' production, marketing, and information-sharing networks and each farmer's network position and centrality.
  - Analyze the roles that network position plays in farm performance in terms of specialty crop sales.

Methods

- Network Concepts
  - Social networks and relations are commonly represented as graphs showing nodes and links, referred to as social network analysis (SNA) maps.
  - Small farmers utilize networks in production, marketing, and resource sharing where within and between network interactions and associated network strength and centrality position, along with demographics, farm, and farmer characteristics, significantly influence the farm performance.

Modeling

- Modeling Factors Influencing Network Positions
  - Consider farmer *i* who has centrality position *k*, defined as P^k_i in network *Z* where *k = {degree in, degree out, closeness in, closeness out, betweenness}.*
  - We are interested in how vector X_i of demographic and socio-economic exogenous factors influence the centrality position of farmer *i*:

$$P^k_i = f(X_i)$$

  - We include respondent (farmer) age, education, ethnicity, and internet access as possible determinants of network centrality position.

Modeling – Cont.

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Methods and Data – Cont.

- Survey
  - Questions on Network Relationship:
    - Among farmers, which one would you go to, to get information about a production problem?
    - Who do you go for marketing problem?
    - Who do you ask for advice on how to apply for credit or file taxes?
    - Who do you ask for advice on agriculturally related information?
- Data
  - 117 small-scale minority farmers
  - 65 from TN
  - 30 from MD
  - 22 from DE

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Results and Discussion

- Network Results
  - *Entire Network*: 68%, 83%, and 63% of farmers in TN, DE, and MD had at least one connection whether in terms of production, marketing advice, or sharing resources
  - Sharing of resources was more common in DE than in TN and MD.
  - *Degree of Centrality Networks*: DE farmers were most densely connected indicating they may live relatively close to one another and know each other better than in TN and MD.
  - *Networking for production and marketing* advice is densest in MD signaling a more exploitation of Washington, DC area markets. Sharing of resources had the lowest density in MD.
  - Networking for production advice is more densely connected in TN networks

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Results and Discussion – Cont.

- Factors Influencing Network Centrality Positions
  - *Farmers' age, gender, race, education; labor use, and farm location*: significantly affect farmer's centrality position (measured by degree-in and degree-out) in the networks.
  - *Farmer's age* is positively associated with centrality position. Farmers 65 years and older are more likely to have higher degree-in centrality, while those 55-65 years are more likely to have higher degree-out centrality as compared to relatively younger farmers (less than 35 years). This suggests that other farmers connect to relatively older and experienced farmers to seek their advice, perhaps valuing their experience.
  - *Gender*: Female-operated farms have lower degree-out centrality indicating that these farmers are likely to connect to fewer other farmers compared to male-operated farms. This result is somewhat unexpected.

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Results and Discussion – Cont.

- Factors Influencing Network Centrality Positions – Cont.
  - *Farmers' Race:* Result suggests that African American farmers are likely to be connected to a larger number of other farmers (in terms of both seeking advice and providing advice) as compared to White farmers.
  - Asian farmers are contacted by more other farmers, but do not necessarily reach out to others in the network for advice.
  - Farmers' Education: Educational attainment has a positive impact on degree-in centrality and a negative impact on degree-out centrality. Specifically, farmers with graduate-level education are likely to have higher degree-in (more people connect to them) as compared to those with less than high school education. On the other hand, these farmers connect to fewer other farmers, as compared to those with less than high school education.

Results and Discussion – Cont.

- The Impact of the Network Centrality on Farm Sales
  - *Farm Sales:* Farm sales are the annual total farm sales ($) from specialty crops.
  - Effects of degree-in, degree-out, and betweenness centralities on sales were estimated.
  - The magnitude of impact is different as the centralities indicate the different ways of involvement and ability in the network:
    - Indicators of number of connections (degree centrality)
    - Proximity or distance of the actors in terms of information access (closeness centralities)
    - Control of information flow (betweenness centrality)
  - Degree-in centrality's positive coefficient of 0.188 suggests that expected farm sales increase with the number of farmers who know or connect to the farmer in question.

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Results and Discussion – Cont.

- Degree-in centrality
  - A unit increase, essentially an additional farmer connection (link) to the node, is associated with an increase in farm sales of about 19%.
  - The higher number of connections likely helps farmers to acquire knowledge and access new technologies and other innovations in farm-related news with the consequence of enhancing farm sales.
- Degree-out centrality: a coefficient of 0.246 indicates that a one-unit increase, essentially an additional farmer connection (out) from the node, increases farm sales by 24.6%.
  - So, how many farmers a farmer connects to has even higher magnitude of impact on sales.

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Results and Discussion – Cont.

- Betweenness centrality: about 3.4% higher farm sales for each one-point increase in betweenness centrality.
  - A significantly positive effect of betweenness centrality on farm sales suggests that sales volume increases as the farmer's power to control information flow increases.
  - Essentially, betweenness centrality is the measure counting the number of times the farmer is between the path (flow) of other farmers.
  - So, the key farmers having a higher degree of ability to control the flow of information also generates higher sales.
- Several other variables influence farm sales:
  - Age and Education: older farmers (36-54 years) and more educated farmers gather farm experience or knowledge over time, which helps in various ways to increase farm sales.

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Results and Discussion – Cont.

- Several other variables influence farm sales – Cont.
  - Effects of gender and race on farm sales: female-owned or –operated farms generate lower sales than those operated by males.
  - Operators or farmers belonging to African American, Hispanic, Asian or multiracial ethnicities generate lower farm sales as compared to White counterparts.
  - The effect of Internet access has results counter to expectation: negative effects on farm sales (?) – maybe if the internet is used more for social media than to seek information related to the farm business.

Research Summary

- The extent of interaction, network structure, and type of agricultural informants are as crucial to information exchange, knowledge transfer, and technology diffusion in farming as they are in other industries.
- This is even more important for small farms, and especially those located in rural areas.
- SNA is a powerful tool that may guide social planning, outreach, and dissemination policy and help to answer important questions, such as how small farmers connect to each other, cluster with one another, and seek information, production, and marketing advice.
- We find several demographic and socio-economic factors influencing the network centrality of small farmers.

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Research Summary – Cont.

- Specifically, age, educational attainment, gender, farm hours and labor use, as well as location factors significantly influence network positions.
- Additionally, the farmer's network position significantly affected their specialty crop sales, regardless of the network centrality measure used—higher centrality (more central, more connection, higher ability to control information) positively influences farm sales.
- For Extension educators and practitioners, our study shows that SNA can serve to identify key individuals within a farming community (network) who can most effectively disseminate information because they are popular and have prestige or the trust of other community members.

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Conclusion and Recommendations

- COVID-19 has impacted Maryland's food system at all levels including production, distribution, and consumption.
- Some challenges were observed in the Maryland food production prior to the COVID-19 pandemic, including the decline in the production of some agricultural products combined with a decrease of land in farms and number of mid-size farms.
- These challenges call for appropriate policies and actions as well as cooperation among all stakeholders.
- Small farming communities are a part of the solution to building Maryland's food system resiliency since they are essential to the performance of the system.

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Conclusion and Recommendations – Cont.

- As indicated in the farm typology, small farms are custodians and managers of the bulk of farm assets. Yet, they are neglected since the nation relies on large farms for most of its food and fiber needs.
- Assisting small farms, especially those in rural areas could help strengthen some nodes of the Maryland's food system.
- These programs will have a significant impact if targeted along the food supply chain (i.e., inputs, production, processing, and marketing).
- As demonstrated by the Social Network Analysis (SNA), networking is crucial for production, marketing, and resource sharing.

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Conclusion and Recommendations – Cont.

- SNA could help community development researchers, economists, and Extension educators develop information delivery strategies that are sensitive to the network-specific attributes of each farmer.
- With SNA, it is possible to reach many farmers and identify key contacts and key informants, especially minority and underserved communities, who otherwise may not have direct contact with mainstream Extension.
- Extension educators ad practitioners could use SNA to identify key individuals within a farming community who can most effectively disseminate information because of they are popular and have prestige or the trust of other community members.

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Q & A

- Thank you!

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