UNIVERSITY OF GEORGIA
EXTENSION

Systems Thinking Mindset

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Think about a jar of peanut butter on your local grocery store shelf. Now, think about all the steps that were required to get that jar onto the shelf for you to buy. First, a farmer needed to have prepared the field in which the peanut plants were sown. Next, a combination of farmer and natural conditions had to be just right for the plant to grow and for the peanuts to eventually be harvested. Once harvested, the peanuts needed to be cleaned, processed, and transferred to a food manufacturing facility.

At the food manufacturing facility, the raw peanuts had to undergo several preconditioning and transformational steps to go from raw product to a peanut butter-ready input. The preconditioned peanut was then combined with other inputs to become the product we think of as peanut butter. However, the journey does not end there. A large batch of finished jars would have left the manufacturing facility and been shipped all around the country to regional distribution centers. The jars would have then been transported in smaller batches and sent to individual stores. Once reaching the store, someone would have had to unload the jars, unbox them, transport them to the sales shelf, and then make sure they were properly coded in the checkout system.

This process is extraordinarily simplified when you think about all the other potential steps in the process, from marketing, sales, brand awareness, nutrition education, agricultural inputs, and so forth. Given the journey of a single jar of peanut butter, it is easy to see how the role of systems can be difficult to observe unless we are looking for them.

This is why systems thinking is so important and how, as Extension professionals, we can use this concept to better understand not only that which we easily observe right now, but also all of the other steps that led to this point.

The Fundamentals of Systems Thinking

The textbook definition of a ***system*** is "an interconnected set of elements that is coherently organized in a way that achieves something" (Meadows, 2008, p. 11). In other words, ***systems thinking*** is a way of examining the interconnections between elements. This may include both the direct and indirect effects between elements.

For example, thinking about our jar of peanut butter example above, how might the price of a jar of peanut butter be influenced by an increase in gasoline costs? Given what we know about the peanut butter value chain, we know shipping and transportation are important linkages in the process. Therefore, we might conclude that an increase in gasoline, and therefore transportation costs, would probably be reflected in the price of the peanut butter—the increased costs need to be covered somewhere.

Similarly, think about how an exceptional growing season for peanuts might also impact the cost of a jar of peanut butter. If there is a larger number of peanuts available as a raw commodity, prices will likely drop. If the commodity input price drops, the cost of the final jar of peanut

butter will probably drop as well.

The connections between transportation and crop productivity and the final cost of a jar of peanut butter are several, sometimes dozens, of steps removed from the finished product. However, the indirect effect of all these preliminary conditions does have an impact. Looking for the connection between elements is the foundation of systems thinking.

According to Rutherford (2019), systems are composed of three parts: "Elements, interconnections, and functions or purpose" (p. 22). Using the 4-H program as an example:

- **Elements**: Youth participants, agents, 4-H curriculum, state-level Extension objectives, and so forth.
- **Interconnections:** In-school programs, fairs, club programs, judging programs, youth-agent interactions, relationships with peers, and so forth.
- **Functions or purpose:** "The mission of Georgia 4-H is to assist youth in acquiring knowledge, developing life skills, and forming attitudes that will enable them to become self-directing, productive, and contributing members of society" (Walsky, 2024, p. 9).

Based on our jar of peanut butter example above, the (very high-level) elements would be the farmer, processor, manufacturer, transportation, retailer, and consumer. The interconnections would include each time the peanut/peanut butter moved from one element to another. The function or purpose of the system would be to sell jars of peanut butter to consumers.

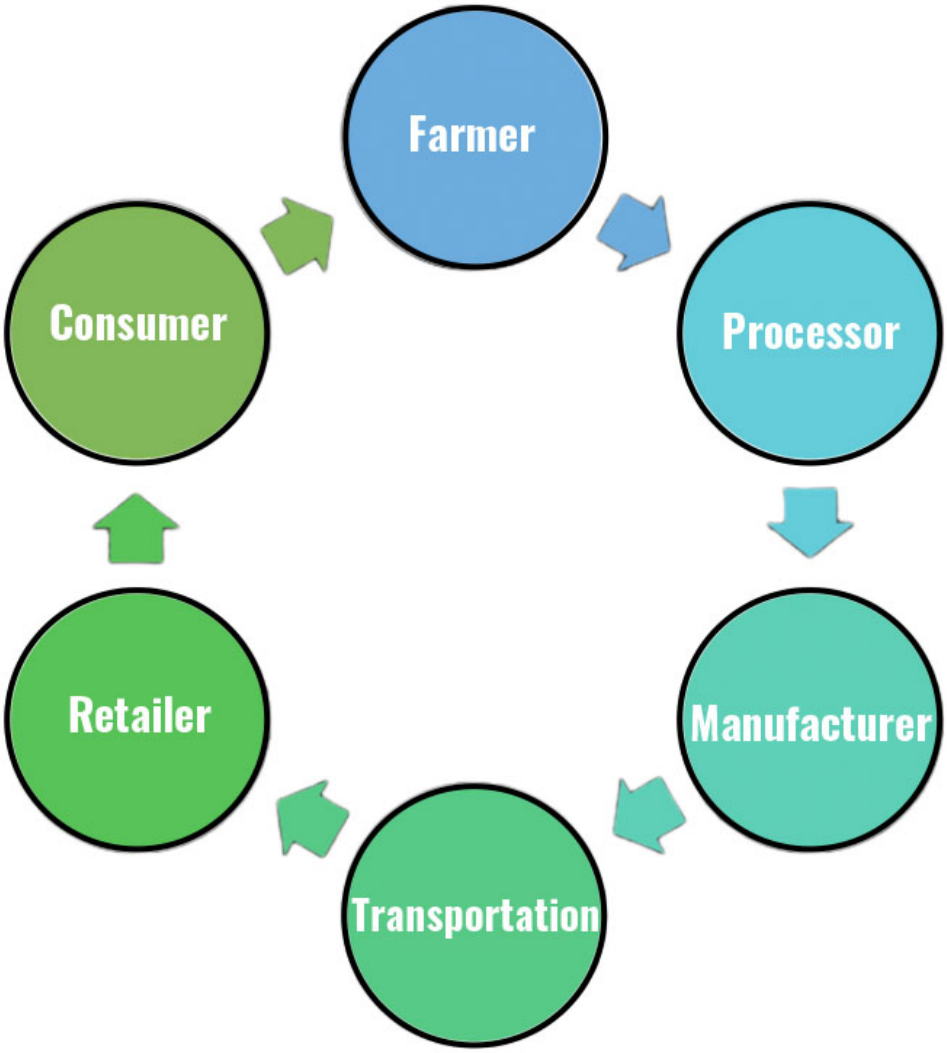

Figure 1. Elements and Interconnections in a System Designed to Sell Jars of Peanut Butter.

Looking for Patterns in Systemic Thinking

One of the core principles of systems thinking is the underlying assumption that the system should exist for some purpose. We are not necessarily looking at a completely random set of events and then trying to draw conclusions from them. Instead, we are looking for patterns that logically connect to some eventual purpose. From this perspective, systems should have an underlying pattern that we can identify and explore further.

It is easy, especially as Extension professionals, to engage with farmers, communities, programs, and so forth from the initial needs assessment through the final program evaluation. However, if we were to try to identify every potential external reason why a program was a success or failure, there could be an almost infinite amount of data we would need to collect. Instead, systems thinking gives us a structured and judgment-based approach to understanding what happened and why.

Pattern recognition is about observing something that happens repeatedly. For example, think about the following hypothetical situation. Assume that your Extension program fiscal year concludes at the end of July each summer. You typically request supplementary funding from your county 2 weeks before the end of the fiscal year. Meanwhile, you have a colleague in the county parks and recreation department whose fiscal year ends in May. Each year, you submit your budget and receive approximately 50% of your original request at the end of July. Meanwhile, your colleague generally receives between 90%–100% of their request. Both of your programs are viewed as highly valuable in the community, and both enjoy support from stakeholders and policymakers. You find yourself questioning why your requests do not receive the same level of support as your colleagues.

Systems thinking gives us the ability to look for patterns that might be causing the observed effects. It turns out your county has a large July 4 celebration every year. Every year, the celebration runs over budget, which then requires the county to cover the extra costs by cutting budgets in other areas. The annual funding issue you experience might be related to the timing of your request versus the quality of your request or the nature of the parks and recreation request—it is the result of a pattern.

It is helpful to frame systems thinking in the following manner: What are the events you are interested in? What are the **patterns** that are typically associated with the events? And what is the **systemic structure** that facilitates the patterns? This model is a great way to move from a very reactive, present-oriented event perspective to a creative, future-oriented **system structure** perspective.

From the hypothetical example above, the event is not receiving funding for your program. The pattern is repeatedly receiving less funding than requested. The systemic structure is the timing of the request based on the end of your fiscal year relative to other county commitments.

As Extension professionals, we have numerous responsibilities and priorities that usually all require significant focus and effort simultaneously. Given this reality, systems thinking can be a very useful tool when trying to improve programs, determine why something happened the way that it did, or answer other program-related questions. Knowing what we are looking for (patterns) and why (purpose) is a very good place to start.

Characteristics of Systems

Once we identify the pattern and purpose that we are interested in investigating, it is helpful to use some systems thinking terminology to facilitate the next steps in the process. To help conceptualize a high-level system, think about a very basic bathtub. Generally, there would be a faucet for water to flow in, a tub to hold the water, and a drain where the water can leave the tub. These three elements constitute what we refer to as the stock—the level of water in the tub—and the flows, which include the faucet (input or inflow) and the drain (output or outflow).

The ***stock*** is defined as "an accumulation of material or information that has built up in a system over time" (Meadows, 2008, p. 188). This could include items like the number of participants who attend a program, the amount of funding secured for programmatic requests, the number of cattle producers in our county, the number of fifth graders who participate in school for each program, and so forth. From a practical perspective, systems thinking is most helpful when we are applying it to some purpose.

The ***flows*** are defined as "material or information that enters or leaves a stock over a period of time" (Meadows, 2008, p. 187). This could include items such as the number of rising fifth graders (inflow), the number of graduating fifth graders (outflow), carryforward budget from the previous year (inflow), amount of money spent on all programming during the year (outflow), number of new calves born in the county (inflow), the number of mature cows which are culled in the county (outflow), and so forth.

To summarize, a stock represents some value that we care about, and flows are inputs or outputs that affect the stock. There are some very basic stock and flow rules that are helpful when thinking about system dynamics.

1. If there is more inflow than outflow, stock increases.
2. If there is more outflow than inflow, stock decreases.
3. If inflow = outflow, this is called dynamic equilibrium.
4. We can increase the stock by either increasing inflow or decreasing outflow.
5. Stocks tend to act as a barrier and keep inflows and outflows independent.

These stock and flow rules can be very helpful when trying to understand patterns.

Thinking about our jar of peanut butter example earlier, if there was a year with an exceptionally good peanut harvest and there were more peanuts than could be processed by a food manufacturer, the food manufacturer may look at the stock (in this case, available peanuts) and decide there is a manufacturing capacity issue (need to increase outflow). Investing in new equipment to process the peanuts might result in more sales. However, after investing in this infrastructure, the next year's peanut harvest might be much less than average because of a drought (decreased inflow). Now the manufacturer has unused capacity because there are too few peanuts available on the market (stock decreases). By only focusing on stock (peanuts available) and outflow (jars of peanut butter), the manufacturer missed seeing how critical the inflow (peanut harvest) was to the system.

Application of the Systems Thinking Mindset

Systems thinking provides a framework to analyze situations in a very pragmatic manner. Using these foundational concepts, Extension professionals can improve their programs as well as help stakeholders diagnose and analyze the critical issues they are facing.

Using the examples below as a guideline, Extension professionals can apply a systems-thinking mindset to their efforts and those of their stakeholders. Below is a series of Extension-related examples using a systems-thinking mindset.

Example 1: Participants in a Master Gardener Program

- ***Stock****: Items of interest*—number of participants in the Master Gardener program
- ***Inflows****: Inputs to the system*—number of new registrants
- ***Outflows****: Output from the system*—number of participants who quit the program
- ***Question/Purpose****:* How can we increase the number of participants in the Master Gardener program?
    - Inflow—increase the number of individuals who register.
        - Action—increase awareness of the benefits of participation in the program.
        - Action—increase marketing activity.
        - Action—request referrals from existing members.
        - Action—include a QR code on the registration page in all Extension publications.
    - Outflow—decrease the number of individuals who quit the program.
        - Action—reduce the total time commitment required for participation.
        - Action—reduce the total financial commitment required for participation.
        - Action—move program timing to align with participant availability.
        - Action—move the program's physical location to make it more convenient for participants.

Example 2: Adoption of Beef Cattle Weaning Best Management Practices (BMPs)

- ***Stock****:* Number of producers using calf weaning BMPs
- ***Inflows****:* New producers adopting BMPs
- ***Outflows****:* Producers reverting to traditional, non-BMP practices.
- ***Question/Purpose****:* How can we increase the number of producers adopting BMPs?
    - Inflow—increase the number of producers who adopt BMPs.
        - Action—increase BMP demonstrations on farms.
        - Action—provide economic data to support the adoption of BMPs.
        - Action—share success stories from other local producers.
        - Action—increase marketing and awareness.
    - Outflow—decrease the number of producers who revert to traditional, non-BMP practices.
        - Action—provide training to overcome inertia and cultural resistance.
        - Action—provide ongoing support for producers after adoption.
        - Action—deal with negative outcomes associated with BMPs directly

and transparently.

Example 3: Rates of Type 2 Diabetes in a Community

- ***Stock****:* Number of individuals in a community with Type 2 diabetes
- ***Inflows****:* New community members diagnosed with Type 2 diabetes
- ***Outflows****:* Community members no longer diagnosed as Type 2 diabetics
- ***Question/Purpose****:* How can we reduce the number of community members with Type 2 diabetes?
    - Inflow—decrease the number of individuals diagnosed with Type 2 diabetes.
        - Action—provide prescreening for at-risk individuals.
        - Action—implement health and nutrition curriculum in elementary school.
        - Action—distribute health resources to community members.
    - Outflow—increase the number of individuals no longer diagnosed as Type 2 diabetics.
        - Action—provide individualized health and exercise plans for individuals diagnosed with Type 2 diabetes.
        - Action—develop an activity program for individuals with Type 2 diabetes.
        - Action—share success stories of individuals able to put their Type 2 diabetes into remission.

Summary

Systems thinking provides a framework and language to better describe many of the situations we see and experience every day. For example, there are dozens of events that are interconnected to end up with a jar of peanut butter on the shelf available to purchase. Considering the organization of these events for this purpose is a crucial aspect of the process.

Looking for repeating patterns and then connecting events to patterns to systemic structure helps to broaden the scope of what we are looking at, as well as what we are looking for. From this perspective, it is easier to identify what we are interested in (stock) and associated inputs (inflows) and outputs (outflows). With this information, we can apply the systems-thinking mindset to recommend specific actions.

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