SGAFT Tech Ladders + Math = Actionable Education: Part 2

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This article includes three parts:

Part 1: GPN magazine's May 2024 introduction to the technology ladder concept
https://www.nxtbook.com/greatamericanmediaservices/GPN/may-2024/index.php#/p/66

Part 2: SGAFT supplement; technology ladder construction tailored to operational needs

Part 3: SGAFT supplement; analysis of an operation's position on multiple tech ladders to identify next technology to install

The task

A technology ladder for greenhouse irrigation was constructed in the GPN article. The discussion continues with the following steps:

1. Create a list of technology categories that addresses small grower challenges
2. Research each category's technology and build its ladder bottom to top, low tech to high
3. Determine the operation's current position on each ladder and identify the next step up
4. Choose the ladder and next step up that maximizes benefit to the operation

This technology analysis progression is an exercise that generates benefits equal to the effort invested. It requires some homework and vision. The homework is learning about the technology options that are relevant to one's operation. If a system or piece of equipment is too expensive to be realistic, don't waste energy assigning it a step on your ladder. Construct each ladder by assigning technology appropriate for the operation in a logical, ascending order up the ladder. That covers the homework. The vision is viewing multiple technology ladders and their options simultaneously and deciding which ladder's next step is the best investment to make.

The outcome of this exercise is a moment-in-time snapshot for an operation showing multiple tech categories and the step of each ladder the operation is currently on. Grower A may be on step 1 of irrigation, step 5 of environment control, and step 3 of energy conservation while grower B across town may be on completely different steps on the same ladders. Analyzing this snapshot helps aim the next tech dollar at the next logical step up the ladder and tech category that will maximize value to the operation.

Law of limiting factor

Plant nutrition abides by a concept known as the law of the most limiting factor. This concept can be illustrated by visualizing plant nutrition as a wooden barrel standing on end with its individual staves oriented vertically. Each stave represents a single nutrient…nitrogen, magnesium, copper, and so on for all essential nutrients. Next, each stave's length or height represents its nutrient's availability in the root zone at a moment in time.

Now we have a barrel on end with 17 staves of varying heights depending on each nutrient's availability. If we fill the barrel with water it will only fill to the height of the shortest stave. The shortest stave is the limiting factor in how much water the barrel can hold. In plant nutrition terms, the nutrient that's in shortest supply in a relative sense will limit growth, development, and yield even when others are available at optimal levels. If potassium is deficient adding more nitrogen won't result in better growth.

The reason to bring this up is to agree that, indeed, once a nutrient becomes associated with the lowest stave it's the one that limits growth and the one that must receive immediate attention. There's no question, no choosing which nutrient to address. But what happens if we shift gear and use our barrel and its staves to represent categories of technology available to our farms and greenhouses instead of individual nutrients?

Technology adoption doesn't always follow the law of the most limiting factor. Simply looking across six technology ladders and choosing the ladder where the operation is on the lowest step as the technology deserving the next investment dollar is not necessarily the one that will help the operation the most.

To help visualize the reality of multiple technology categories offering benefits to an operation we need a list. Tech categories on my list may not be on yours and visa versa. Here's a list to start the conversation; greenhouse structure, environment control, irrigation systems, benching, lighting, soil/media handling, chemical injection, pest management, energy/shade curtain systems, material moving equipment, inventory management, etc. Some growers will have categories not listed while other growers will not have every item listed above on theirs.

Once an operation's unique set of tech categories is in hand it might seem correct to focus on the tech category where the operation is seemingly the farthest behind. This is where following the law of the limiting factor could be short sighted. Spending money on the category where the operation is on the lowest step might not benefit the operation as much as taking the next step up a ladder from an already higher rung. In some cases widening the gap between an operation's position on side by side ladders rather than closing it may be the better choice profitability-wise.

This is precisely where the homework and vision of this exercise pay dividends proportional to the effort invested. The better one understands the operation's current position on all ladders the easier it is to aim the next tech dollar at the technology that will best serve the business.

Teenage math nostalgia

Turn the clock back to middle and high school math for a minute. The progression from basic to advanced mathematics fits the technology ladder concept. In the GPN section of this article an irrigation technology ladder was constructed. Consider the building of a single technology ladder, mathematically, as simple algebra. For most of us algebra was our first step up the math ladder as teenagers.

Consider starting at the bottom rung of a ladder and adding the next tech step up. This process takes the shape of a simple equation; A + B = C. An example of 'next step up' technology is how humans created tools for cutting wood. Figure 1 illustrates how axe technology dating back thousands of years was once the highest technology for chopping and cutting wood. Then we invented the hand saw (Figure 2) which took its place as state of art tech thereby redefining the axe at a lower technology level.

Figure 1

Figure 2

Shifting to greenhouse technology, among the simplest categories is the glazing covering the structure. The stepladder in figure 3 is all that's needed to represent the category, so far. A single layer of poly, essentially default technology, is ground level. The first step up is double poly, second step twin wall polycarbonate, and top step glass. Additional steps will be needed in the future but, for now, small growers are likely to spend their careers somewhere between double poly and polycarbonate on their greenhouse roofs. Knowing this allows them to include the greenhouse glazing ladder but focus on other tech ladder categories whose options are more dynamic.

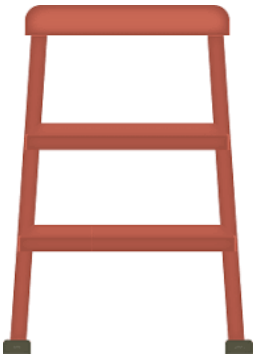

Figure 3

Most of the technology categories we deal with likely fit on the ladder pictured in Figure 4 with its six steps. In the GPN section of this article this ladder was used to illustrate irrigation technology.

Figure 4

Figure 5 shows a ladder category of 6 steps that continues the wood cutting example. I can't remember the last time I used my hand saw, it's now on the ground level representing the lowest tech. Next step up is the corded circular saw that got a generation of us through entry level carpentry and woodworking.

Figure 5

Another step up the ladder finds the same circular saw with cordless technology eliminating the tether to an electrical outlet. Again, thank you NASA for getting the ball rolling on this…cordless tools are to woodworkers what Tang became to juice drinkers as a result of our space program. Another step up and the circular saw becomes more compact, lighter, and versatile, then another step up and it's even more compact and imaginatively configured for increased versatility and ease of use.

Figure 6 completes the wood cutting ladder example. Today the corded circular saw has replaced the hand saw as ground level tech…when's the last time you used a plug in? Rising above it is an assortment of cordless cutting tools that includes the standard circular saw on step two, jigsaw and reciprocating saw on step three, cut off tool and oscillating saw on step four, and cordless band saw on step five. A good bet to place is on steps six and higher being occupied very soon with not yet imagined technology.

Figure 6

Geometry is next

Once the first tech ladder is completed move on to other tech categories. After the first one it gets easier. As the exercise evolves with additional tech ladders, each unique with its number of rungs and tech options, a spatial arrangement unfolds. Now we have a number of different tech ladders side by side to compare. This step of the process is more complex, there are several balls in the air at the same time. This turns into geometry which, coincidentally, is the study of shapes, space, and their relationships.

Building tech ladders in categories of most interest to an operation is unique to that operation. There will be shared foundational similarities accompanied by grower to grower differences. Peaking at your neighbor's homework will not provide all the answers. Once all the ladders are in view identify and highlight which rung of each tech ladder your operation is currently on.

Now the painted picture is complete. An operation may have four or six or even ten ladders for categories of technology of most interest to that grower. The operation's current position on each ladder is clear, the homework's complete.

Next it's time for the analysis to reach its highest level. We're now in trigonometry territory folks; more complex relationships, calculations, and analysis to be covered in Part 3 of this series.