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# Farm Benchmarking: The Application of Business, Conservation and Labor Indicators

Mark Cannella
*University of Vermont*, mark.cannella@uvm.edu

Sara Ziegler,
*University of Vermont*

Qingbin Wang
*University of Vermont*, Qingbin.Wang@uvm.edu

Mary Peabody
*University of Vermont*

Thomas Leahey
*University of Vermont*

*See next page for additional authors*

Authors
Mark Cannella; Sara Ziegler,; Qingbin Wang; Mary Peabody; Thomas Leahey; and Heather M. Darby

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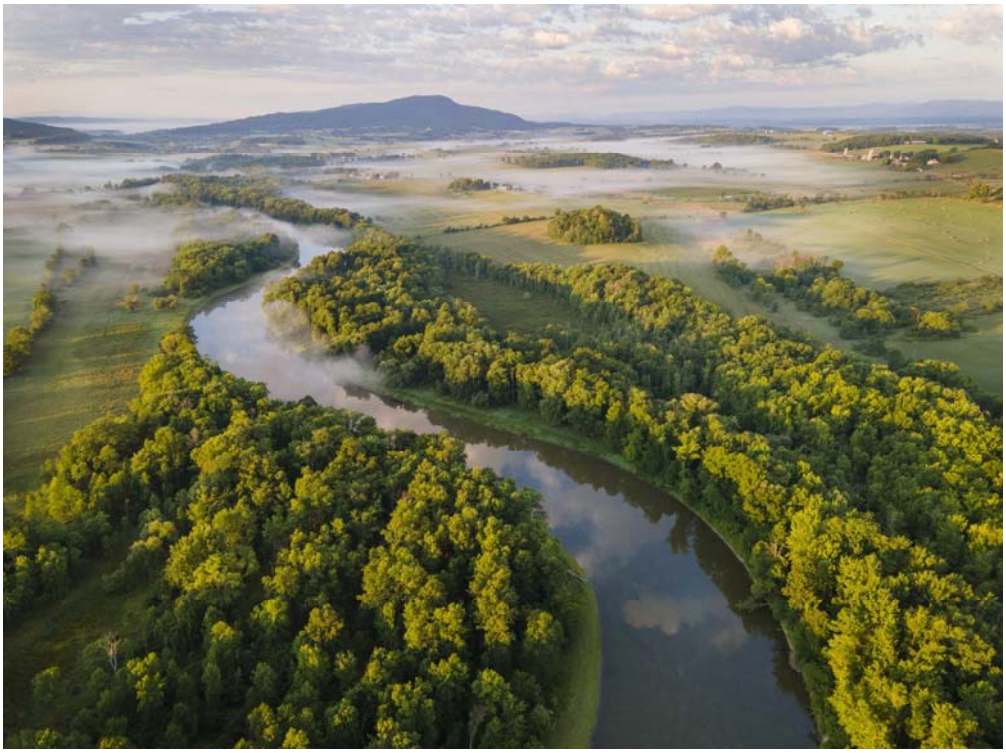

*Photo Credit: Caleb Kenna*

**UVM-ARS Center for Food Systems Research**

*Food Systems Metrics and Data Integration White Paper, January 15, 2021*


Mark Cannella, Extension Associate Professor
Sara Ziegler, Extension Research Specialist
Dr. Qingbin Wang, Professor - Community Development and Applied Economics
Mary Peabody, Extension Professor
Thomas Leahey, Extension Program Specialist
Dr. Heather Darby, Extension Professor


THE UNIVERSITY OF VERMONT EXTENSION

THE UNIVERSITY OF VERMONT AGRICULTURE & LIFE SCIENCES

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## Executive Summary

Farm benchmarking programs will move Vermont's food system towards important sustainability outcomes by establishing enhanced monitoring of priority indicators and facilitating the adoption of best practices. Farmers, researchers, policy agencies and development professionals agree there is a lack of regular and consistent data available to guide private and public initiatives. This paper identifies and contextualizes over forty priority indicators capable of measuring business performance, conservation, farm labor and community development.

Benchmarking methods need to be adapted to better represent the diversity of enterprises present in Vermont's agricultural portfolio. The integration of University Extension objectives with food systems research priorities can catalyze collaborations, educational support and dissemination that ensure both rigorous research and increased likelihood of behavioral change at the enterprise level. This paper describes data collection methods, informational technology, agricultural sector context and features of analysis findings that are appropriate for a range of populations and research goals. Furthermore, this paper demonstrates the necessity of linking enterprise level indicators with broader community and economic development indicators to assess and deploy strategic public policy responses that embody the desired food system values.

Small cohort business benchmark programs and a single conservation data research clearinghouse are proposed as appropriate next steps for the UVM-ARS Center for Food Systems to pursue.

## Objectives and Background

Benchmarking methods offer the opportunity to strengthen and integrate research and extension outreach efforts critical to enhancing the economic and social viability of Vermont's food system while protecting our natural resources. Benchmarks are derived by the regular collection of specific measures where the indicators follow a transparent definition of format and formulae. These benchmarks become the standard point of reference catalyzing status assessments and providing the foundation for informed decision-making. Iterating the process provides the basis for continual monitoring, documenting measurable trends and directing improvement efforts to meet stated goals. The objectives of this paper are to explore the application of benchmarking methodology to current sectors and priority issues facing the Vermont food system. Benchmarking can enhance decision-making, monitoring, and goal progression relevant to stakeholders at all levels (i.e. individual enterprise, sector, and statewide). This paper seeks to introduce relevant indicators that will enhance measurable results in these emerging areas of importance to sustainable food systems: farm business performance, conservation practices, agricultural labor and community development.

### Stakeholder Insights

*"I am underwhelmed by people's lack of use of data in agricultural development and policy in Vermont. I am unimpressed by this lack of data in decision making."*

*- Agricultural Development Program Leader*

*"We face a lack of regular data for our sector. Reported production measures [census, reports] are difficult to relate to the unique and diversified farm profiles in Vermont."*

*- University Extension Specialist*

## Introduction to Benchmarking

Benchmarking emerged from the corporate world in the 1940s and has been evolving in its definition and application ever since (Watson, 1993). Across this breadth of models and applications remains the central premise of benchmarking: utilizing the iterative process of collecting and evaluating data to inform decision-making and best practice adoption for performance improvement. Benchmarks, in essence, are data points. The concept of benchmarking however, is the analysis of a particular data point in reference to other linked variables. A single farm's cost of production is an indicator. The analysis of that cost of production in the context of market prices enables introspective analysis, while the analysis of these total costs compared to prevailing regional labor wages advanced diagnostics on broader societal patterns.

**Structural and Process-based Benchmarks**

Farm benchmarking frameworks distinguish two primary types of indicators: structural and process-based-or-enterprise level. Structural indicators within a business often relate to its position in the business life cycle and are heavily influenced by capital position, land ownership, land rental and off-farm income. Total assets levels or other solvency measures for example are relevant measures to monitor business health, but they are often "situations" the business must

accept for a longer time period. Structural indicators are not likely to be changed immediately through discrete management changes. These structural indicators, however, have power in defining an aggregate group of farms and synthesizing broader trends impacting a sector. Capital position, land tenure format and labor wage rates observed over a larger group or over multiple years can demonstrate ongoing trends and prompt conclusions about community development impacts of such trends.

Process-based or enterprise indicators are those measures that can be directly attributed to and influenced by short term operational decisions within the farm business (Ronan and Cleary, 2000). These indicators are often easily recognizable and relevant to business owners. Examples of process based enterprise indicators linked to operations include: crop yields, cash-based direct expenses, labor hours, sales reports, milk quality statistics and livestock records. These indicators are vital to real-time decision-making and continuous management targeting efficiency and quality. At times this "within-business relevance" comes at a consequence to research efforts. Many internal measures are a reflection of independent business records systems and lack the standardization needed for composite or comparative analysis among a group of businesses.

**Existing Agricultural Benchmarking Programs**

A small number of business programs exist in the Northeast. Primary examples include Farm Credit Northeast Dairy Summary, Cornell Dairy Farm Business Summary (Karszes et. al 2012), and the UVM Organic Dairy Study. Newer livestock and agronomic programs include the Cornell Whole Farm Nutrient Balance Assessment and NYS Precision Feed Management Program (http://nmsp.cals.cornell.edu/). These programs are largely dairy focused. In the Midwest, the Minnesota state and technical college system has pioneered programs that combine on-farm individualized business services with credit bearing continuing education curricula that results in the annual preparation and analysis of farm business records for over 2,100 farms annually (Tjosaas and Lecy, 2020). The Center for Farm Financial Management (CFFM) at the University of Minnesota developed and maintains the FINPAK software program used to analyze these records. The culmination of coordinated outreach education and standardized financial records software is the aggregation of these records in the FINBIN national database that offers opportunities for research and agricultural policy guidance (Delbridge et al, 2015; Nordquist et al, 2012). Complementary software programs and research reports are able to provide farm managers, agricultural lenders and policy makers with the annually updated farm economic information necessary to monitor the health of a single business and aggregate sectors.

Standardized financial assessment framework such as those in Minnesota has provided the foundation for linkage to environmental or social data that can further enhance research and extension efforts. An example of such linkage is seen in a new analysis conducted in 2020 using the Minnesota holding the Minnesota Water Quality certification experienced higher net farm income and net worth among other differences in measures of cost, efficiency, and productivity (Olander & Schloesser,2020). Such robust integrated approaches can only occur once the foundational enterprise-level benchmarking infrastructure has been established. Building this infrastructure in Vermont requires indicators, method and information technology to meet the unique needs of Vermont's diverse small- and medium-sized farms. Limited adoption of non-

dairy across the northeast could present opportunity for wider data integration with other states in our region. Figure 1 provides a visualization of a benchmarking framework as it could apply to Vermont's food system.

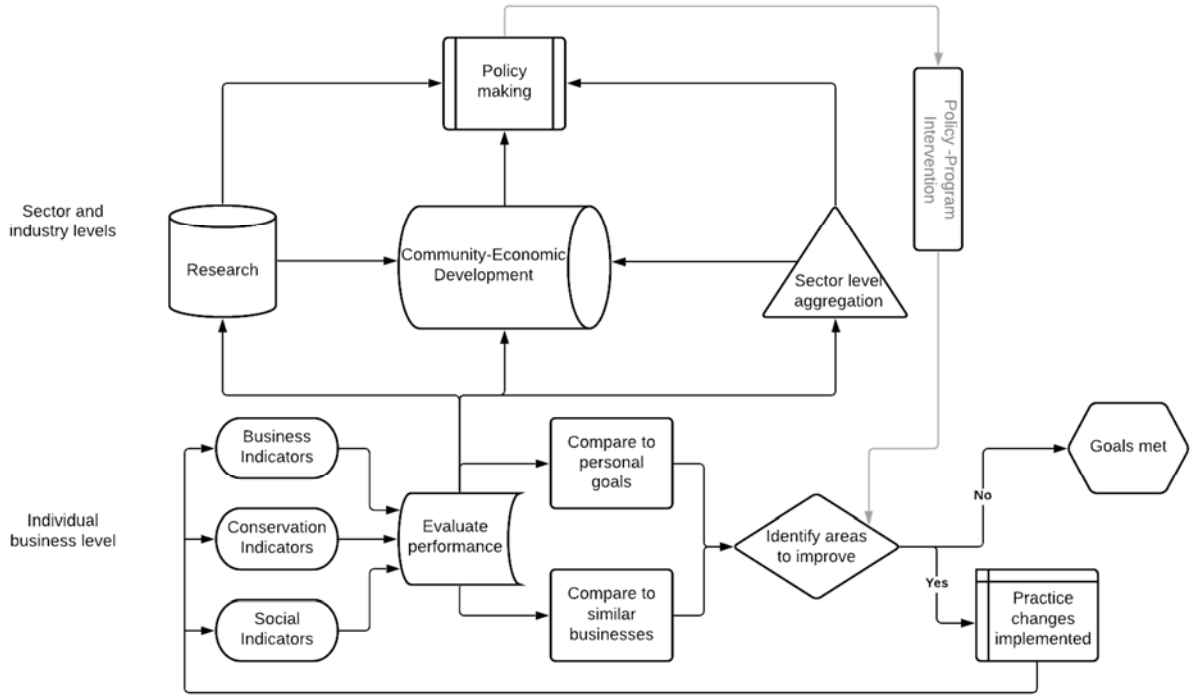


*Figure 1. Visualization of benchmarking framework as applied to Vermont's food system.*

**Existing Farm Conservation Data Sources in Vermont**

In the past, there has been no central location for reporting conservation practices that have been implemented on farms in the state of Vermont. In 2019, the Vermont Agency of Agriculture Food and Markets (VAAFM) created the Multi-Partner Agricultural Conservation Practice Tracking and Planning Geospatial Database (Partnership Database) to provide a tool by which various organizations collect and track such information. However, only conservation practices implemented through state funding sources are reported through the tool. Federal funded practices are tracked by the Natural Resource Conservation Service (NRCS) and may or may not be captured in the Partnership Database. Unfortunately, due to privacy concerns NRCS has not been able to openly share geospatial data with other organizations without permission from the individual farmer.

Thus, conservation practices implemented by farmers without state or federal cost-share are currently not being captured and acreage totals for conservation practices are underrepresented. Similar limitations exist concerning financial expenditures related to conservation practices. Measurement and reporting government spending and without inclusion of farmers' independent financial contributions leads to misleading statistics on aggregate conservation investments. These issues with conservation records contribute to public

misunderstanding, scrutiny of the agricultural community, and causes tension capable of disrupting progress towards the common goal of protecting water quality.

These are the primary missing pieces that state agencies, federal agencies, farmers, and legislators have all commented on – ability to capture acres, practices, and financial investment of farmers in environmental protection. Accurate data that present the full scope of the complex issues at hand are necessary for making constructive, informed policy decisions.

**Existing Agricultural Labor Data Sources in Vermont**

Labor data including the number of jobs, average wages, and trend data are available from the Vermont Department of Labor (https://labor.vermont.gov/) which sources data from the national Bureau of Labor Statistics data pool. These data are summarized into county-level reports describing the general state of economic growth, unemployment and changes in industry sectors. Additional labor and employment information is found through NASS-USDA's Farm Labor Survey which publishes quarterly and annual estimates for the United States as a whole, and each of 15 multi-state labor regions. NASS conducts the Farm Labor Survey in cooperation with the U.S. Department of Labor. The target population includes all farms with $1,000 or more in annual sales value. (NASS Farm Labor Study, https://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Farm_Labor/).

Enterprise-level labor data, while available, are often not considered in local and regional economic policy development due to challenges relating to standardization of data collection, high seasonal variation, and relatively low annual wage rates. Regardless of sector, there is a need for more rigorous agricultural data collection and research at the state level related to agricultural workforce development. Specific labor indicators, when adopted more universally, have potential to prompt business and policy level decision-making and monitor progress towards priority outcomes.

## Methods

This white paper was developed during the period of July 2020 through January 2021. Twenty-one interviews were conducted capturing insight from a diversity of stakeholders including farm owners, state agency personnel, business advisory program leaders, policy leaders, capital providers, community development specialists and researchers. A full list of participating organizations and interview questions are provided in Appendix A.

Project team members completed an academic literature review and assessment of public resources during the project period. Team members were also able to contribute non-published applied research data from recent benchmarking projects. The UVM Maple Benchmark Program (Cannella), Grass Milk Benchmarks Program (Darby/Ziegler) and Organic Dairy Cost Study (Wang/Parsons) offered insights into data collection methods, data management instruments, participant characteristics and farm information. This data was analyzed in the context of trends presented in the literature and stakeholder interviews.

# Results

This paper identifies several indicators that our research team and key stakeholders determined to be most important to advance food system research and dissemination in Vermont. The following section presents indicators for business, conservation and agricultural labor that could be collected through robust benchmarking programs.

## Business Indicators

Farm business indicators are essential for management analysis at the farm level. They offer key insights into which business models, scales of business and agricultural products align with positive or less desirable economic development trends. A high number of Vermont's farm businesses are owner-operated family businesses and they are often sole proprietorship entities. Consequently, farm business metrics can serve as indicators of business viability and household economic conditions related to rural community development. Similarly, financial transactions and resulting records can measure the flow of resources like vendor purchases, capital access, market access and employee compensation through a community.

Business advisors and capital providers interviewed identified farm labor indicators within the business to be one of the most important categories of metrics deserving more attention. Labor is often the largest operating expense on farms and farm profit potential is primarily driven by an owner's ability to successfully manage labor costs. The presentation of labor indicators are within either the business or labor sections or this paper is to prevent redundancy and does not dismiss the strong interdependence of these variables.

Operating farms often have a number of enterprise or process indicators that are more relevant to their farming system or products. A full listing of operational metrics for numerous farming sectors was not within the scope of this study. These measures, however, will follow certain universal themes. Production yields are important, and the power of these indicators increases with the accurate recording of land units, production units (e.g., cows, maple taps, etc.), or labor capacity. A management or farming questionnaire is an essential instrument within a study and must be repeated annually or at the regular time interval to match operational indicators with universal indicators being researched.

## Farm Labor and Community Development Indicators

Agricultural labor remains a pivotal issue for farms interested in adjusting their business size to match their intended goals. The UVM Extension Conservation and Viability on Vermont Small Farms report indicated that labor concerns remain in the top three issues impacting farm viability (Cannella and Kitsos, 2020). Interviews and focus groups conducted in 2014-15 identified labor as a key management issue facing small and medium-sized vegetable farms (Parker, J.S., M. Peabody, K. Liang, B. Holtzman, 2015). Unresolved national immigration policy and limitations of the federal H-2A Temporary Agricultural Foreign Worker program constrain the ability to recruit more employees and embody more transparent migrant labor relationships. Profitability issues perpetuate a situational dichotomy between assimilating new

workers into existing problematic business models and explicit efforts to improve business models to offer more competitive employment positions.

*Table 1: Business and Financial Indicators*

| **BUSINESS INDICATORS** |
|---|
| **Net Income**<br>● Whole farm<br>● Enterprise/Product Level |
| **Sales**<br>● Annual Gross Sales<br>● Per Crop Enterprise Analysis<br>● Gross sales is needed to evaluate all other cost metrics in relation to total sales.<br>● Sales per market day<br>● Weekly/Monthly Sales (as indicated by market channel |
| **Labor**—*See labor indicators in Table 2* |
| **Expenses**<br>● Total Expenses as Percentage of Gross Revenue |
| **Solvency and Capital Access**<br>● Annual Debt Service – cash basis<br>● Total Farm Asset Value (related to farm access-recruitment-access to capital)<br>● Debt to Asset Ratio |
| **Risk**<br>● Cash flow with sensitivity analysis |
| **Others**<br>● Crop sales price ($ per unit)<br>● Profit Margin as $ of Gross Sales<br>● Gross Margin Per Production Unit |

Employee recruitment and retention remain challenged by an abundance of entry-level positions, low wages and seasonal fluctuations. This is exacerbated by the relatively high cost of living in the region which largely outpaces the prevailing wages. An adequate supply of labor is a significant barrier to scale-up every link with the agricultural supply chain. Regardless of the particular sector, there is a need for more rigorous agricultural data collection and research at the state level.

*Table 2: Labor Indicators*

| **LABOR INDICATORS** |
|---|
| **Cost Management**<br>● Paid Labor, Annual ($) (aggregate payroll and benefits)<br>● Paid Labor per crop: production<br>● Paid Labor per market channel<br>● Value of Unpaid Labor (family)<br>● Value of Owner Draws<br>● Standardized Management Allocations |
| **Time Management**<br>● Volunteer Hours per year<br>● Administration Hours and Overhead<br>● Hiring, Training and Onboarding Hours |
| **Wages**<br>● Dollars per hour<br>● Salary levels (annual) |
| **Financial Analysis**<br>● Return on Labor: Net Income Per Full Time Equivalent (FTE)<br>● Sales per FTE<br>● Labor Expense as Percent of Gross Sales<br>● FTE Analysis per enterprise |

Private enterprise labor, regional workforce trends and community development factors are closely linked, but unidirectional causation is equally difficult to identify or remedy. Tradeoffs and tension between competing interests is present. Business owner outcomes vs. employee compensation provides a simple lens, but the compounding public costs and benefits are more difficult to ascertain. Table 3 below offers several consequential community and economic development indicators that can be either collected or informed through strategic food system benchmarking.

*Table 3: Community-Economic Development Indicators*

| COMMUNITY-ECONOMIC DEVELOPMENT INDICATORS |
|---|
| **Jobs**<br>● Full Time Jobs<br>● Part Time Jobs<br>● Seasonal Jobs<br>● Standardized Full Time Equivalent (FTE) per sector |
| **Sales**<br>● Aggregate Sales per Region<br>● Aggregate Sales per Sector<br>● Increase in Sales per Business |
| **Relevant Reference Data**<br>● Cost of Living<br>● Transportation: Commute Time-Commute Distance<br>● Household Income Level |
| **Business Starts-Fails**<br>● Failure Rate<br>● New Business Starts |
| **Ownership Factors**<br>● Demographics<br>● Capital Access |

## Conservation Indicators

The environmental impacts of agricultural systems have been an area of focus in Vermont as the state continues to struggle with water quality and other natural resource concerns. According to the Total Maximum Daily Load (TMDL) implementation plan established for Lake Champlain, the agricultural sector contributes 41% of phosphorus runoff (EPA, 2016). As best management practices that positively impact these factors have already been identified, much focus has been on getting farmers to adopt these practices. However, without baseline measures of key indicators, data-driven methodology and frameworks for collecting and evaluating such data, we have been unable to obtain an accurate view of Vermont's progress on these environmental goals. This lack of direct linkage between proposed practice implementation and real conservation outcomes prompted the EPA to reconsider Vermont's TMDL citing Vermont's lack of sufficient "reasonable assurances" that adequate pollution reductions would be realized (EPA, 2016). This is particularly problematic as agricultural businesses are now being required to meet certain criteria and vast public investments are being made. Frameworks are needed to verify and monitor these efforts.

*Table 3: Conservation Indicators*

| **CONSERVATION INDICATORS** |
|---|
| **Practice implementation coverage**<br>● Total acres in conservation practices[1] i.e.:<br>o No-till<br>o Cover crop<br>o Manure injection<br>o Crop rotations<br>o Management Intensive Grazing<br>o Precision agriculture technologies<br>**Practice implementation costs**<br>● $/acre to implement practices i.e.:<br>o No-till<br>o Cover crop<br>o Manure injection<br>o Crop rotations<br>o Management Intensive Grazing<br>o Precision agriculture technologies<br>**Environmental risk of management**<br>● Soil phosphorus content (ppm)<br>● Whole farm nutrient balance (+/- N, P, K)<br>● Erosion risk models (tons soil/acre/year)<br>● Runoff risk models (0-100+ risk index value)<br>● GHG emission models<br>o lbs. $CO_2$<br>o lbs. $N_2O$<br>o lbs. $CH_4$<br>**Soil condition and health[2]**<br>● % organic matter<br>● % aggregate stability<br>● Active carbon (ppm)<br>● Compaction (psi)<br>● Respiration (mg $CO_2$ / g soil) |

[1]A more comprehensive list of relevant conservation practices can be obtained through NRCS.
[2]Many individual measures of soil health exist. A full list of soil health indicators has been developed for the UVM-ARS Food Systems Center (Neher et al., 2021).

Monitoring of ecosystem services has direct relevance to new state and federal policy (Vermont 2019 Act 83 – Soil Conservation Practice and Payment for Ecosystem Services, and Federal s.3894 - Growing Climate Solutions Act of 2020).

Through interviews with key agricultural and environmental conservation stakeholders and review of the current body of research and literature, the indicators in Table 3 were consistently identified for furthering conservation efforts in Vermont's food system.

The equipment and expertise required to quantitatively measure some of these metric are extremely cost prohibitive. Under these circumstances, models have been developed to attempt to predict these risks under various management scenarios. Although the use of such models greatly limits the cost it also introduces unique limitations. Any model is only as good as the data used to create and validate it. Currently, the models for predicting water quality impacts from agricultural management practices do not include and therefore accurately reflect all management practices in use in Vermont. Furthermore, these models do not actually measure outcomes but, instead, predict an outcome based on a set of input conditions. Although these are useful planning tools they cannot solely be used to monitor conservation efficacy. New sensor technology advances at UVM provide promising opportunities to collect real-time outcomes from the practices farms have implemented.

Stakeholders interviewed for this paper suggested a number of additional indicators separate from business, conservation and labor they felt were important to sustainable food system development. Climate change resilience, farm-based food processing, farm owner wellness and related economic development indicators were among them. See Appendix B: "Indicators for Emerging Issues" for a summary of new trends, suggested indicators and relevant indicators common in fields outside the scope of this paper.

## Data Collection Approaches

This section defines two different approaches to benchmarking data collection systems relevant to the business, labor and conservation indicators presented previously. Primary considerations to data collection include: accuracy of on-farm records, precision level required, sophistication or standardization of indicators and the timing when indicators become available for collection. The utilization of software for the database and analysis are likely to be equally integrated into both data collection methods and eventual analysis. An appropriate data collection plan will also be influenced by the amount of resources available for staff time to collect or manage data. Research consent and protection of sensitive information presents unique considerations to individual projects classified as human subject research.

Different techniques can be used to enhance or verify the accuracy of farm data at different stages of a project. Participant questionnaires, enrollment applications and individual consultation are viable ways to triangulate specific data points prone to inaccuracy. Researchers must also be aware of potential errors resulting from the use of inappropriate records or inaccurately calibrated instruments, especially if benchmark data is self-reported.

**Facilitated-Hybrid Educational Collection**

A common issue facing enterprise-level data collection is that many of the most impactful indicators are not regularly present or accurate within enterprise-level records; these require facilitated data collection in which records are verified for accuracy and handled in a manner that avoids potential distortions. Many successful benchmarking programs utilize this approach, at least in the development phase of the program, as it provides opportunities to pair data collection with educational and technical service opportunities. Often, this type of support allows participants to self-report more reliably in the future. Significant investment in facilitated benchmarking in the early years has the benefit of meeting educational outcomes, increasing validity of research and streamlining the future research process.

**Rapid-Response "Monitor" Programs**

It is important to recognize that, in addition to the expansion of scope, the concept of benchmarking can also be applied to a wide range of timescales. In today's modern technological age, rapid-response and real-time systems are becoming more commonplace, even in the agricultural industry, providing business managers with access to data that can more quickly be utilized in decision-making. Much of this data is now managed by computer software programs and can even be accessed via smartphone applications, greatly expediting data access for many users. One such program is the Dairy Herd Improvement (DHI) program. This national program helps dairy farmers measure and manage herd information such as milk production, quality, herd health and reproductive performance. Data are typically collected monthly and are almost immediately reported back to the farmer through a variety of summarized reports. Raw data can also be integrated into other farm management software platforms to further aid in daily farm management tasks and decision-making.

Although rapid-response systems can be powerful decision-making tools, they present many challenges relating to data collection, management, processing, and reporting in addition to user privacy and consent. Applying the concept of benchmarking to quarterly, monthly, or smaller timescales presents challenges across all aspects of the system. With less time between each benchmarking cycle, the process must be streamlined to allow enough time for all steps to occur before the next data collection point. The more the timeframe is reduced (i.e., weekly scale) the more each step must become more automated or technology-reliant to save time. Relying on these technologies will increase the cost of implementing the program and may hinder participation and/or program longevity. All these must carefully be addressed in designing a system to ensure it both meets the needs of the users but also will remain useful and manageable into the future.

## The Importance of Profiles to Small Cohort Study Group

Benchmarking study design requires an understanding of the industry and different features of business operations that impact measured indicators. Programs in other states with large numbers of benchmarking participants are able test research hypotheses by analyzing and sorting data within existing databases. In Vermont, however, large benchmarking databases are less likely due to limitations in both program resources and the diversity of farm models. The

Center for Farm Financial Management at the University of Minnesota offers program guidance that "sorts" to identify particular producer groups are feasible with ten or more aligned business data records. Using this guidance, future benchmark studies in Vermont will need to incorporate relevant business feature profiles into study design and participant recruitment. Small cohort study groups will need to achieve a contextual goodness-of-fit to relevant business features in order for results to be applicable to a targeted and specific audience.

Stakeholders interviewed for this paper suggested several factors that can be used to group distinctly different business types. The factors include scale of business, scale of enterprise operations, labor models, types of market channels and adoption of specific farming practices. Appendix C: "Cohort Features, Indicators and Research Hypotheses" provides an expanded list of factors that could define distinct groups of study within any single agricultural sector.

The scale of an enterprise as determined by the number of production units is a crucial characteristic that will influence study design and findings. The prevalence of small and very small enterprises must be understood within the industry context in order to design research suited to an appropriate audience. Figure 2 below shows a distribution of respondents to the UVM Northeastern US Maple Producer Survey in 2019. The majority of respondents represent businesses less than 5,000 maple taps and are likely to be hobby or part-time enterprises (see Table 4). In order to design a small cohort benchmarking study relevant to commercially scaled businesses, a clear business scale profile was established before commencing with data collection.

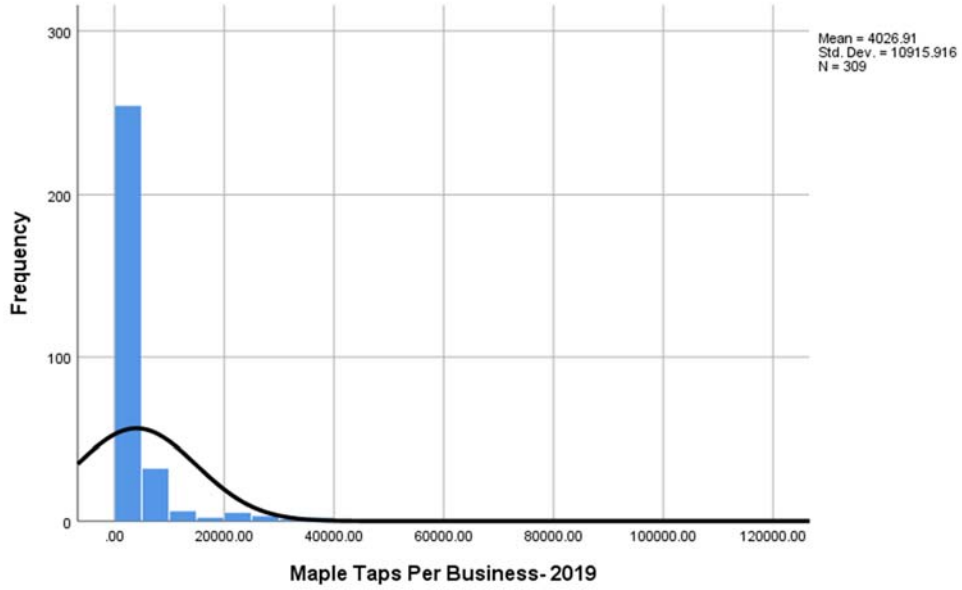


*Figure 2: Distribution of the number of maple taps in regional survey*

*Table 4: Impact of respondent distribution on selected descriptive statistics*

| |
|---|
| **N:** 309 |
| **Mean:** 4,027 |
| **Median**[1]**:** 1,000 |
| **Minimum**[1]**:** 10 |
| **Maximum:** 105,122 |
| **Standard Deviation:** 10,915 |
| **Coefficient of Variation**[2]**:** 2.72 |

[1] The mean "tap count" is influenced by a few very large producers maintaining over 50,000 taps. The median is closer to the tap count of the majority of respondents.

[2] This measure can be used to compare variation across different variables.

Figure 3 shows the distribution of the maple tap scale within a small cohort study intended to inform the development of medium scale enterprises. This study was designed to research and communicate the next stage of growth for small/hobby operators. The study design results in a higher average (mean) tap scale than observed in the regional survey and it excludes participants below or above a specific scale threshold.

In addition to the features of the business entity, our stakeholders emphasized that the traits determining an individual owner's management capacity will also have a significant influence on research. Business advisers and researchers stressed in their interviews that different profiles of management skill and preference will impact the likelihood that farm owners will change practices, pursue new goals and successfully attain different outcomes. Appendix D "Management Capacity Assessments" offers a list of questions that can be asked to farm owners to explore management competencies and better define these characteristic farmers as either research subjects or the audience of research findings.

Specific agricultural sectors are each expected to be composed of sub-groups representing various production systems, scales and market strategies that influence the enterprises. Interviews with produce growers and advisors familiar with the industry provided additional information on specific business models emerging in this sector. See Appendix E: "Produce Farm Profile Characteristics" for profiles within the produce sector that could be relevant for new research.

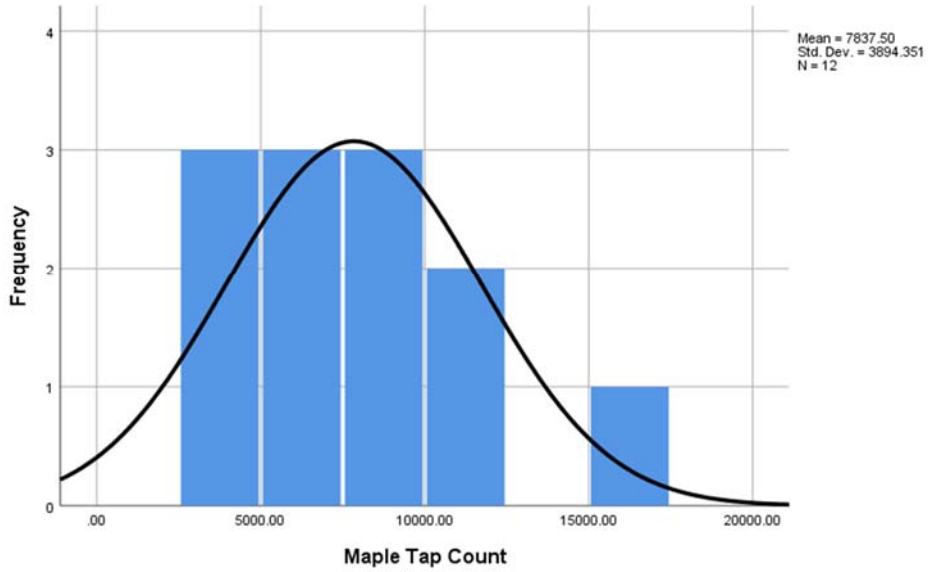


*Figure 3: Distribution of the number of maple taps in small cohort study*

## Outreach Dissemination and Data Presentation

The mission of the land grant university extension system is to relay actionable research results into the hands of practitioners in the community. Successful extension outreach dissemination depends on a sound understanding of both research findings and the stakeholder audience. An extension professional's skills in the areas of outreach curricula, multimedia publications and collaboration with producers and partner organizations facilitate the flow of research into communities.

When it comes to benchmarking, farm business owners, policy makers, capital providers and program leaders are potentially seeking different sets of indicators from basic or statistical analysis. This section explores the interaction of benchmark indicators, the analysis of these indicators and the results most likely to enhance both awareness and decision-making for a variety of audiences.

Table 6 below provides an example using the yield indicator milk production to describe how three categories of decision makers influencing the pursuit of sustainable food system goals could use data from a benchmarking program. Not only would the data provide information on individual results (for the farm), it would also offer basic descriptive statistics often including cohort group average and range (max/min).

*Table 6: Indicator Relevance to Three Audiences*

| Metric÷ | Audience | Interpretation÷ | Decision Making Implication÷ |
|---|---|---|---|
| ÷<br>÷<br>Milk Production per cow per day [Yield Indicator]<br>÷ | Farmer | Evaluate past performance by comparing farm average to that of cohort. ÷ | Improvements in yield require additional information describing how successful farms increase milk production.÷ |
| | Banker, Business Planner | Understand range of production and management performance ÷ | Capital providers seek to determine the risk of lending. ÷ |
| | Policy | Observe the range of production results for the dairy sector.÷ | Consider targeted policy towards lower performing farms or other cohort profiles who would benefit from technical assistance. ÷ |

In the next example we see how a single visual data representation can support decision-making for multiple stakeholders. Figure 4 presents somatic cell count (milk quality measure) on a monthly basis for a group of farms. The yellow dots represent the results for a single farm. A farm owner can observe their own data, and compare their yellow dot to other study participants in a single month. The same owner or a herd management advisor can compare the single farm results to the monthly group average (orange line). Finally, the inclusion of the milk price premium criteria (green line) serves as a point of reference that indicates the direct financial implication of a single farm or the groups monthly average in relationship to the premium eligibility.

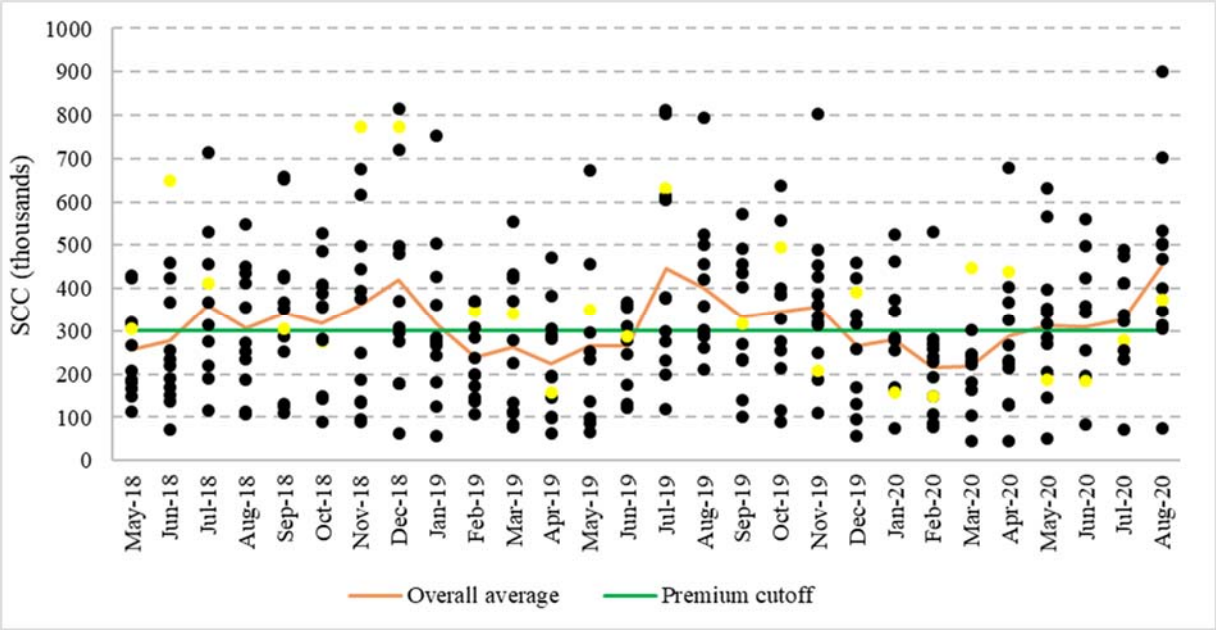


*Figure 4: Somatic cell count reports on dairy farms*

**Performance Level Sorting**

Performance group sorting offers valuable insights into a groups' spectrum of demonstrated performance for measurable indicators. Basic sorting may be accomplished by reference to a mean (above or below average) or most commonly by three groups defined by a range of results. A common analysis presentation is seen in Figure 5, showing the number of farms falling into top, middle and bottom profitability groups and the average results for two indicators within each group.

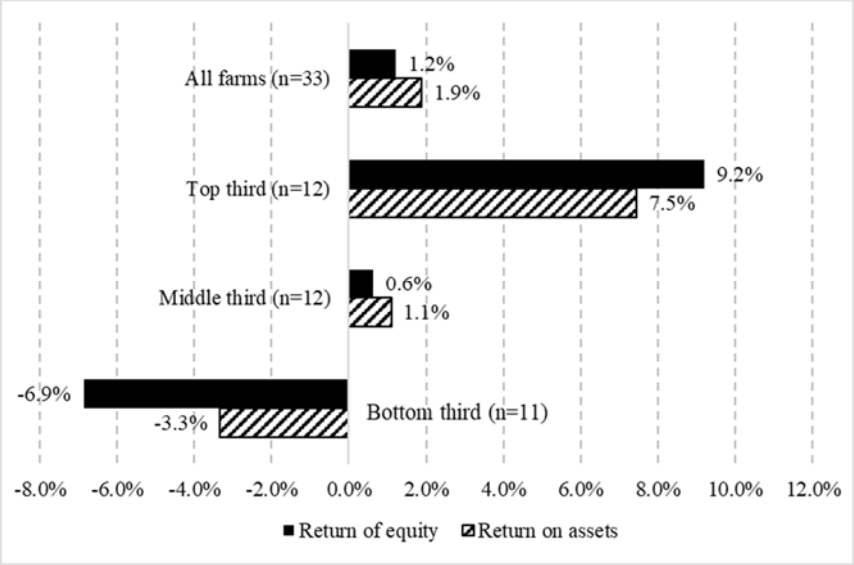


*Figure 5: Organic dairy performance groups-profitability measures (2016)*

**Trend Analysis**

The ability to observe trends over time is very important for aligning policy decisions with the current trajectory of an agricultural sector. In some cases, a decision will seek to perpetuate the same trend. In other cases, an intervention may be desired to moderate or reverse an existing trend toward more favorable outcomes. Figure 6 below provides an example of readily accessible Vermont dairy farm data from state and federal agencies including the number of farms and aggregate production. Similar information is not available for emerging sectors. Stakeholders note that limited data for smaller sectors in Vermont constrains strategic planning that could otherwise determine the potential of these newer or growing contributors to the food system.

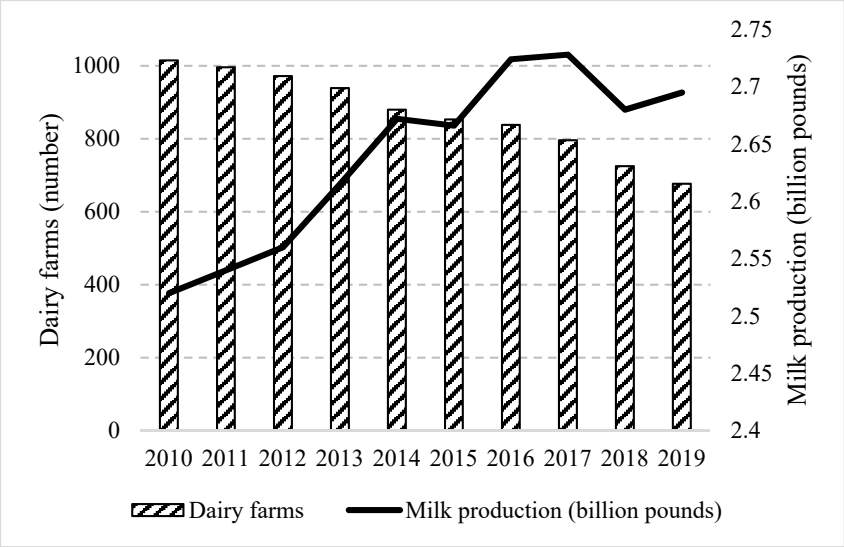


*Figure 6: Vermont Dairy Farm Milk Production*

Multi-year trends of internal indicators are beneficial to private businesses. In Figure 7 the financial trends of a longstanding Vermont dairy farm are seen over its most recent thirteen years. The indicator of Debt-to-Asset ratio reveals a business disruption in 2010-2011 that marks a turning point for the business. Previous years of profitability from 2005-2010 are reflected in a consistent reinvestment and pay-down of existing debt. Unfortunately, indicators show the declining financial position of the business from 2011-2018. Solvency problems reduce the likelihood this business can persist, limit access to additional credit and present obstacles to business transfer to new parties.

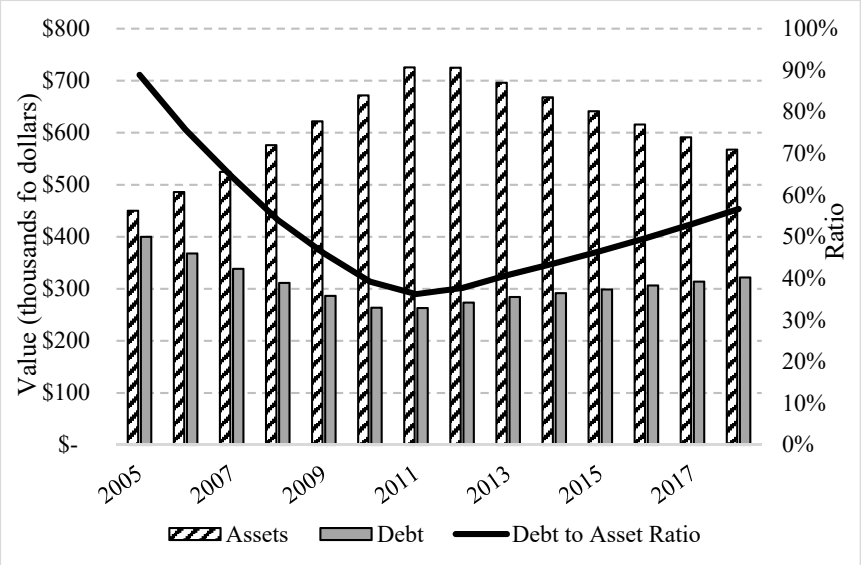


*Figure 7: Financial indicator trend: sample farm*

## Implications

Benchmarking provides the opportunity to prepare high-powered diagnostic research findings that contribute to several different layers in the food system. By their nature, benchmarking programs are intended to be replicated for multiple time periods to provide the necessary trend analysis that determines positive or negative movement towards food systems outcomes. These programs can be readily designed to serve continuous improvement within a private business entity and to generate the public research findings necessary to impact broader communities. In addition, the advancement of environmental and social indicators presents the opportunity for promotion and communication initiatives to promote certain values in the consumer marketplace.

Standardized financial indicators and their use in established business programs is documented to improve on-farm management. Capital access, sector profitability, changing land-use patterns and market dynamics are all public food systems development topics that can be informed by business benchmarking. As a small state, however, small cohort business and labor benchmark studies are the likely starting point to fill the void of desired information. Larger group programs are less likely until farm producers become more familiar with the value they receive through participation. Successful programs are often linked directly to records preparation and tax accounting services to provide complementary and directly tangible value to participants.

Conservation records in Vermont are largely driven by regulation compliance and project participation. No standard or criteria has yet been established to define low, medium or high conservation “performers”. Such a distinction could be utilized to advance small cohort studies that explore conservation adoption in the context of other business or labor indicators identified in this paper. Stakeholders noted the absence of a single conservation data clearinghouse and the desire for annual conservation reporting capable of measuring and monitoring progress towards aggregate conservation outcomes on an ongoing basis.

Grant-based funding models predominant in UVM Extension pose significant limitations to benchmarking program design, implementation, and persistence. Broader institutional commitment capable of spanning time periods longer than 2-3 years are required to synthesize a sustainable data collection model and continual delivery of findings to track long term progress toward sustainability goals. The heavy-lifting of facilitated participant education in the first one to two years of a program comes at a cost, but can often achieve complementary Extension objectives. At the same time this initial investment can lay frameworks and buy-in for longer term research. Coordinating investment into database and informational technology infrastructure that enable self-reporting could sustain program areas several years past initial creation. Automation of informational processing, analysis and reporting is very feasible with standardized indicators.

Stakeholders, however, agree that resource constraints do not prevent a role for benchmarking. Farm owners and agency leaders agree that two to three year sector studies can articulate a better understanding of the likelihood of success between different farming models.

Standardized indicators could also be used for more universal case studies and forecasting exercises that are relevant to business development and statewide planning.

Regardless of the future of comprehensive benchmark programs, the highest short-term relevance of this paper to the UVM ARS Food System Center is in the expertise necessary to link multidisciplinary research initiatives with measurable indicators proven to be necessary and relevant to agricultural businesses. Business, conservation and labor indicators are influenced by context, constraints and trade-offs that occur at the enterprise decision-making level in the food system. Indicators presented here can and should be integrated into ARS multi-disciplinary research efforts to build a more robust body of knowledge equally balanced between sustainability values and the practical enterprise capacity of small and mid-sized farms.

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# APPENDIX A: Stakeholder Interview and Participating Organizations

1. What type of organization do you represent? Please select as many options as necessary from the list below ÷
    - Farm Owner or Manager ÷
    - Conservation or Natural Resource Organization/Agency ÷
    - Agriculture or Food Industry Organization/Agency ÷
    - Capital Provider ÷
    - Educational program/technical assistance ÷
    - Research Institutions ÷

**[Alternative Question: Farm Owners]**

1. What topic areas for this project are most relevant to your business decision-making?
    - Farm Owner Management Factors
    - Farm Economics/Business Viability
    - Farm Labor
    - Research

**[Start Page: Non-Farm Owners]**÷

2. What topic area for this project best reflects how your direct work impact food system decision making. Please select up to three. If you have would like to describe any relevant overlap, use the comment box.÷
    - Farm Owner Management Factors ÷
    - Public Conservation Goals ÷
    - Farm Economics/Business Viability ÷
    - Community Development ÷
    - Farm Labor ÷
    - Educational program/technical assistance ÷
    - Research Institutions ÷

3. What forms of data and indicators do you (or your organization) use to guide your decision-making? ÷
    - Describe/List the metrics: ÷
    - What type of survey questions-published reports offer important indicators? ÷
    - Source, where do you get the data? ÷

4. Do you feel you have adequate access to high-quality data and indicators to support your decision-making?

5. Are there <u>bad data or indicators that get used</u> that you don't think support well informed decision-making?

6. Can you identify any <u>missing data sets/indicator</u>s that would help you do your work better?

- Please describe the type of indicators that would fill this information gap.
- How regularly would you need this information (prompt: monthly, annually, every 3 years?

7. Do you have examples of <u>other sources of data</u> that may be present in other fields or other states that you could direct us to as model?

8. Which formats are best for you to get this information? (Articles available to the public (online, print); Academic journals; Techincal reports or specific bulletins; [For farms: Print based reports; online dashboard)

9. How could your work or management benefit from access to benchmarking indicators?

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**Stakeholders and organizations represented in interview process**

| |
|---|
| Agricultural conservation advocacy organizations |
| Agricultural development organizations |
| Farm business consultants |
| Farm technical advisors (dairy, vegetable) |
| Farm to Plate Farm Viability Indicators Task Force |
| Loan and alternative capital providers |
| Private agricultural enterprise owners |
| University of Vermont researchers and Extension professionals |
| Vermont Agency of Agriculture Food and Markets |
| Vermont Agency of Natural Resources |
| Vermont Housing and Conservation Board |
| Vermont Legislative Representatives |
| Vermont Sustainable Jobs Fund |

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## APPENDIX B: Indicators for Emerging Issues

Stakeholders discussed many significant issues facing farm producers and marketers. The table below lists specific indicators that will have increasing relevance, including a number that are outside this study team's scope of expertise.

| INDICATORS FOR EMERGING ISSUES |
| --- |
| **Market Price Reporting**<br><br>**Dairy: Milk Component Indicators**<br>● Land Efficiency: Butterfat per Acre<br>● Facility Efficiency: Butterfat per Cow<br><br>**Economic Development Indicators**<br>● Percentage of business retained<br>● FTEs by sector of the agriculture economy<br>● Average commute time/distance<br>● Farm sales as a percentage of total receipts for region<br><br>**Climate Change**<br>● Irrigation activity<br>● Field saturation<br>● Climatic conditions and forecasting (Growing Degree Days, precipitation)<br><br>**There is an identified need for better indicators and data on these topics:**<br>● Value-added on-farm processing<br>● Retail farms<br>● Standardized chart of accounts for feasibility studies across sectors<br>● Management capacity characteristics<br>● Personal health and well-being<br>● Social sustainability measures |

## APPENDIX C: Cohort Features, Indicators and Research Hypotheses

| Cohort Feature | Indicators or Categories | Food System Research Hypothesis |
|---|---|---|
| Scale of Production | • Production Units<br>• Land Use | • Large scale enterprises exhibit a cost of production that is lower than market prices paid. |
| Scale of Business Activity | • Annual Gross Sales | • Farm owner capacity to earn full time farm income is related to business scale.<br>• Farm businesses are more likely to remain hobby/lifestyle enterprises until they exceed [specific $ value] in annual gross sales. |
| Labor | • Labor Model Owner/Operator<br>• Part Time Primary Farmer<br>• Local Labor<br>• Seasonal/interns<br>• Professional labor (i.e., H2A) | • How does farm labor model impact market prices and accessibility of product to lower income households?<br>• How do farm labor wages impact market prices for agricultural products? |
| Market Channels | • Direct-to-Consumer Sales<br>• Direct Wholesale<br>• Distributor | • How does market channel activity impact annual farm labor expenses and labor efficiency? |
| Product Mix or Focus | • Range or quantity of product enterprises | • Is diversification of farm product offerings related to farm owner access to capital and borrowing capacity?<br>• How do the rates and magnitude of conservation practices differ between diversified and single-product farm businesses? |
| Business Lifecycle | • New Business (0-5 years)<br>• Mid Stage (5-15 years)<br>• Mature<br>• Exit/Succession Stage | • Does business stage impact the agricultural wages paid?<br>• Does farm profitability differ between [product sector] farms at different stages of business life cycle? |
| Major Technology | • Robotic Milking<br>• High Tunnel, Greenhouse Production<br>• Mechanization of Key Production Stage | • Does the adoption of [x] production technology impact the prevailing wage paid to farm employees? |
| Primary Practice | • Certified Organic<br>• Pasture-Based or Grass Fed<br>• High Investment, High Yield System Design<br>• Low Input, Low Yield System Design | • Does the adoption of [specific practice] impact the labor required to execute farm operations?<br>• Are low input agricultural systems more likely to provide full time farm owner income? |

# APPENDIX D: Management Capacity Assessments

A small cohort benchmarking project will be significantly impacted by the level of business management competencies demonstrated by the key decision makers who are reporting data for their business. Either prior to research study enrollment (application) or within the process (participant questionnaire), collectors must ascertain the management competencies of active participants and consider capacity for adopting new practices. The questions provided below were developed by professional business advisers to assess the decision maker's ability to generate relevant records, understand standard indicators and articulate an assessment of a particular facet of business operations. Using this template, projects exploring conservation or labor management can adapt questions to understand the capacity of participating individuals.

**Sample Business Capacity Questions:**

1. Describe your net worth trajectory over the past three years.
2. What is your net worth?
3. What aspects of your business are losing you money? (Reference crop choice or market channels)
4. What crops/enterprises within your business are making money?
5. Which market channels are performing the best?
6. Can you generate a detailed income statement for the most recent year?
7. Can you generate a detailed cash flow summary for the most recent year?
8. What percent of your time is devoted to managerial activity like records, accounting, marketing, employee oversight and planning investments (rather than direct crop production)?

# APPENDIX E: Produce Farm Profile Characteristics

Fresh produce and fruit farms have received increasing attention in food systems research and agricultural development initiatives. Rigorous economic research on small- and mid-size farms has been slower to develop. Due to the diverse nature of this farming sector any small cohort benchmark projects will need to identify a clear target audience and a focused list of primary business characteristics most relevant to meet research goals.

Stakeholder interviews in Fall 2020 suggested a list of fresh produce business features that will be important to future study design. Overall, the majority of fresh fruit and vegetable farming is best described as small-to-medium scale receiving higher value wholesale or direct prices. Three general profiles of fresh produce farms have been identified that include a combination of parameters based on scale, technology product mix and market channel. These profiles are listed below.

A. **"Very Small Farms":** Farms are approximately 1–2 acres utilizing high labor inputs to produce high-value specialty crops.

B. **"Community Farms":** Farms are approximately 5-20 acres. These farms produce a broad crop mix, are semi-mechanized and sell primarily through Community Supported Agriculture (CSA) models and direct retail markets.

C. **"Medium Wholesale":** Farms are approximately 10-30 acres. These farms produce a smaller refined list of crops and are semi-mechanized.

Additional factors will need to be considered if there is a goal to group similar farms for analysis or benchmarking results comparison. The following factors with any single business or group of businesses is expected to have significant influence on sales, expense, yield and labor indicators:

- Income and expenses associated with bedding plants/flowers
- Cost of goods sold (COGS) for the resale of purchased items
- Labor models (H2A employees, local labor, owner operated without employees)
- Market channel mix (prices received and operating costs to serve that channel)

The factors listed here offer specific insight into the fresh produce and fruit sector that will influence farm and market indicators. A similar framework that considers scale, technology adoption, labor and market channels can be applied to additional sectors considering small cohort benchmarking studies.