# Food Animal Initiative **Economic Development Study - Executive Summary**







Prepared By:

NC State University College of Agriculture and Life Sciences and College of Veterinary Medicine

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Dean Richard Linton

College of Agriculture and Life Sciences Campus Box 7601 Raleigh, NC 27695-7601 P:919.515.2668





Dean Paul Lunn
College of Veterinary Medicine
1060 William Moore Drive
Raleigh, NC 27607
P: 919 513 6210

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Please find attached to this letter a report entitled The North Carolina Food Animal Initiative: A Feasibility Study. This report was jointly commissioned by NC State's College of Agriculture and Life Sciences and the College of Veterinary Medicine to evaluate core competencies in the animal and poultry sciences, veterinary medicine and associated disciplines, and to study the feasibility of building upon our capabilities by establishing a Food Animal Initiative (FAI).

The N.C. Plant Sciences Initiative at NC State provides the FAI a public-private partnership model it could emulate as a means to enhance the university's historical areas of strength, address gaps in capacity and proficiency, and drive bold ideas and innovation to support and accelerate the state's largest agricultural sector - animal agriculture. This report will be the springboard for NC State to develop an interdisciplinary, multi-college initiative that will help cultivate scientific breakthroughs and produce well-trained future employees to meet the needs of North Carolina's livestock, poultry sectors, and allied industries.

It is our hope that this report provides a path forward for North Carolina to grow its number one industry. If you have questions and suggestions related to this report, please direct them to either one of us or to Celeste Brogdon at cdbrogdo@ncsu.edu.

Sincerely,

Richard H. Linton, Ph.D., Dean NC State University

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College of Agriculture and Life Sciences

D. Paul Lunn, PhD, MRCVS, Dip. ACVIM, Dean

NC State University

College of Veterinary Medicine

### **Executive Summary**

Animal agriculture, including the production and processing of livestock and poultry, is among the largest industries in North Carolina. The industry's value chain in the state is diverse and integrated, spanning the production of inputs to livestock and poultry production (growth and processing of feed grains and oil seeds, nutritional supplements, veterinary medicine products, etc.), through on-farm livestock and poultry production, and onwards into the value-added processing and distribution of food animal based products. Impacting every county in the state, the animal agriculture value chain provides employment for tens of thousands of North Carolinians across both urban and rural environments and works to supply an assured and growing domestic and international market for high quality animal derived proteins and associated food products. The industry in the state also has unique characteristics, not least of which is that it operates robust integrated systems for swine, broilers, turkeys and layers. North Carolina State University (NC State) has a long-standing history of support for this industry through research, education and extension activities and has structured its work and programs to be responsive to the integrated nature of animal production and processing in the state. Indeed, NC State is the only university in the country that has a totally integrated system for all categories of food animals.

As global demand increases, food animal agriculture represents an industry with significant promise for sustained and expanding economic impacts in North Carolina. At its heart, agriculture is an advanced life sciences industry, driven by R&D and innovation across a range of life science, physical science and engineering disciplines. It is also a complex industry, requiring management of sophisticated supply chains, production within a dynamic and changing environment, dealing with pressures and challenges from biotic and abiotic threats, and is subject to fluctuations in international trade agreements, commodity prices and other economic factors. Because of this complexity, the U.S. has long-supported the agriculture sector and its valuechain activities through the dedicated support and work of Land-grant universities (LGUs) - research intensive universities with a specific focus on the performance of R&D, education, and extension services that are purpose designed to enhance agricultural industry outcomes and solve industry challenges. NC State stands among the preeminent LGUs in the nation, ranked 6th in agricultural research expenditures, 4th in veterinary sciences, and deeply resourced in associated STEM, business and social science disciplines. Because of the diversity of agricultural production in North Carolina and the variety of climatic/production zones in the state, NC State experiences a particularly rich environment for experimentation and the performance of advanced agbioscience research. That said, NC State facilities for research and education in food animal agriculture have experienced evident underinvestment, with 20 or more years of deferred maintenance now significantly impacting the relevance and capabilities of facilities to support research and education that is responsive to the needs and practices of industry. NC State's position in food animal agriculture is at a tipping point - placed well in terms of research and educational reputation and output but restrained in its ongoing relevance to opportunities and needs by less than optimal facilities and infrastructure.

The recent Plant Sciences Initiative (PSI) at NC State illustrates a path forward, comprising an initiative purpose-designed to leverage North Carolina strengths in plant-based agriculture. The PSI has realized extraordinary support and success in its development – driven by careful deliberations in terms of research and education focus areas, associated infrastructure investments, and investment in world-class faculty and transdisciplinary science resources. Similar, but smaller scale, investment has taken place in the NC State Food

Manufacturing Initiative (FMI) also. Now the development of similar momentum is sought at NC State via a Food Animal Initiative (FAI) – a focused collaboration between the College of Veterinary Medicine (CVM) and the College of Agriculture and Life Sciences (CALS) seeking to positively impact the trajectory of the largest sector of agriculture and value-added activity in North Carolina – food animal agriculture. To evaluate the opportunity, identify university core competencies to build upon, assess the needs and opportunities within North Carolina industry, and develop a preliminary action plan for the FAI, NC State retained the services of TEConomy Partners (TEConomy) comprising the same analysis and strategic planning team that performed the economic feasibility analysis and planning assessments for the PSI and FMI.

In performing this feasibility analysis for the FAI, TEConomy has performed a broad range of quantitative and qualitative analytics. The current status of animal agriculture and associated industries are assessed through industry targeting analysis, productivity analysis and additional metrics. In addition food animal research themes are evaluated in detail, together with NC State's specific core competencies, using machine learning algorithms supplemented by on-campus interviews with faculty and reviews of previous surveys of faculty research capabilities and interests. TEConomy also reached-out to business leaders within the food animal industries value chain in North Carolina to assess their interests and thoughts regarding the FAI concept and what they would value in terms of potential research thrusts, education initiatives and related extension work. Learning from several other programs at universities in North America focused on food animal agriculture was also integrated into the project. The net result is an in-depth assessment of the food animal agriculture value chain in the state, the applied issues and needs that industry prioritizes, and the capacity of North Carolina State University to respond to these needs and other opportunities using research, education and extension activity focused through a dedicated Food Animal Initiative.

### A. The Economic Imperative For North Carolina

North Carolina is among the national leaders in food animal agricultural production. Ranked 2nd in the nation in hog production, 3rd in the nation in broiler production and 2nd in turkeys, food animal agriculture is foundational to the overall economics of North Carolina's statewide agricultural industry. Its impact is felt upstream and downstream of livestock and poultry production, with the majority of grain and soybeans grown in the state purchased as animal feed, and the presence of a significant livestock and poultry processing and value-added food products industry. The importance of the food animal sector to the state's agricultural economy is highlighted by the fact that the most recent data from the National Agricultural Statistics Service (NASS) for North Carolina shows that 65.8% of North Carolina's farm revenues are generated by animal agriculture (livestock, poultry and their products).

Having a statewide footprint, agriculture is exceptionally important as a fundamental driver for rural areas of the state, and it also directly impacts suburban and urban North Carolina through processing industries and a significant R&D sector. Using input/output analysis, TEConomy modeled the economic impact of the animal agriculture in the state<sup>1</sup>, finding that just a one-percent increase in production in primary animal agriculture and in downstream value-added processing results in large-scale employment, income and economic output impacts (Table ES-1).

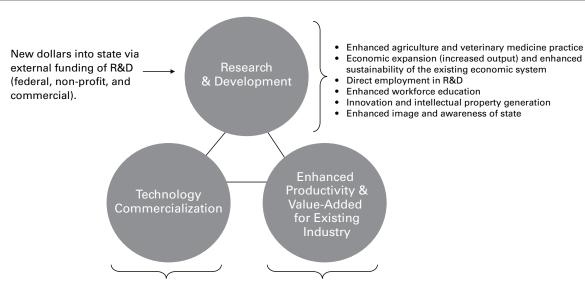
<sup>1</sup> For further detail on the input/output analysis see Appendix D. It should be noted that the food animal production and value-added processing numbers cannot be added together since part of the impacts in processing are derived from generation in increasing demand for local animal production. Adding the two rows would, therefore, lead to some double counting.

TABLE ES-1: ECONOMIC IMPACT OF A ONE-PERCENT INCREASE IN NORTH CAROLINA FOOD ANIMAL AGRICULTURE

	Impact on NC Employment	Impact on North Carolina Labor Income	Impact on North Carolina Economic Output	
1% Increase in Food Animal Agricultural Production	685 additional jobs created	\$42 million in income for NC workers	\$149.5 million growth in state economic output	
1% Increase in Processing of Food Animal Products	1,023 additional jobs created	\$54.1 million in income for NC workers	\$272.7 million growth in state economic output	

As the impact data show, continuing to advance research, education and extension to meet the needs of the food animal agriculture industry in NC is not only necessary for helping the industry adapt to challenges and opportunities, but is also the source of significant economic development benefits. Investing in the R&D, education and extension ecosystem at NC State for food animal agriculture provides multiple pathways to North Carolina economic development as shown on Figure ES-1:

FIGURE ES-1: PATHWAYS TO FOOD ANIMAL AGBIOSCIENCE, VETERINARY SCIENCE AND TECHNOLOGY-BASED ECONOMIC DEVELOPMENT



- · New business development and business sectors
- Economic diversification
- Output and employment expansion
- Exports and income generation for state
- Enhanced local and state tax base

- New and improved products for primary production and industry
- Enhanced production technology and productivity
- Technology-based solutions to problems and production challenges
- Output and employment expansion
- Exports and income generation for state
- Enhanced local and state tax base
- Economic sustainability

Input received from industry representatives and other key stakeholder within North Carolina points to considerable support for a focused initiative at NC State that would enhance research, education and extension work in food animal agriculture. Chapter III of the report summarizes specific industry opinions, and the overall industry input received points to:

- A need for transdisciplinary approaches to complex issues in livestock and poultry agriculture
- A need for modern facilities at NC State able to duplicate the latest production environments for research and education relevance
- Support for a research focus on animal health, infectious diseases and food safety. These are viewed as crucial areas to emphasize, and broad enough in content to allow considerable transdisciplinary engagement and naturally support CVM/CALS collaborations (indeed in discussing other areas, such as nutrition, reproduction, welfare, genetics, etc. the discussion often circled to the impact of these on livestock health and disease resistance).
- Attention needs to be paid to agriculture communications and the use of science-based data and
  information to combat misunderstandings and disinformation that negatively impact the livestock and
  poultry sectors freedom to operate.

### Why a Food Animal Initiative?

The grand challenges facing food animal agriculture increasingly call for transdisciplinary approaches and accommodation of multi-disciplinary research teams, together with an ability to integrate industry researchers into the process. NC State generally lacks the facilities for this activity in food animal agriculture and associated areas (although the CVM does have modern accommodations for industry co-location).

Modern food animal agriculture is increasingly deploying advanced and automated technologies across its production facilities and NC State's current research facilities and research farms lack the facilities to conduct research within relevant modern production environments. Similarly, the lack of representative production environments limits the ability to introduce students to the latest production practices and methods they will encounter when they enter the workforce. The development and testing of advanced technologies and the promise of digital agriculture advancements through sensors and data analytics needs facilities specifically designed or retrofitted to accommodate research, testing and piloting of new and experimental technologies.

Industry is deeply concerned with threats to animal health and food safety. While NC State has faculty expertise in livestock and poultry infectious diseases, veterinary medicine, and associated scientific disciplines, the University lacks sufficient facilities for conducting live animal research that requires Biosecurity Level 2 or 3 facilities. While CALS and CVM scientists are seeking to bring their skills together for transdisciplinary research in infectious disease and animal health, the lack of enough BSL facilities places a block on research advancement.

Advancements are needed in managing waste streams and realizing value from them, in terms of both primary onfarm production and in processing operations – with a desire for moving towards closed loop systems.

While North Carolina shows high levels of productivity in primary food animal production, the state has a comparatively undersized and underperforming processing industry profile. NC State's ability to improve the performance of the processing sector is hampered by a lack of investment in facilities and faculty R&D relating to meat processing and animal-based food product manufacturing. With global demand increasing substantially for high quality animal protein, there is a clear opportunity to advance the industry in North Carolina through enhanced research, education and extension activity in downstream processing. While the Food Manufacturing Initiative is addressing opportunities for increasing value-added to NC produced crops, a matching investment is needed on behalf of animal agriculture.

Animal agriculture research facilities have generally seen limited investment across the national research ecosystem, and North Carolina is presented with an opportunity to make a high-profile investment in facilities, programs and faculty that will propel the University to the forefront of a large global industry that has a substantial footprint in the University's home state.

Development of unique, state-of-the art food animal agriculture and veterinary medicine facilities will help attract the best and brightest talent in associated sciences to NC State.

Input received from stakeholders and from interviews with faculty and staff at NC State, suggests a topline vision for the FAI as shown in the sidebar:

The Food Animal Initiative is viewed by stakeholders, and supported by the core competency, industry needs and opportunity assessment as being a "must do". Its importance to the state will be felt through:

#### **Topline Vision for the Food Animal Initiative:**

Develop a transdisciplinary, multi-college initiative that will propel NC State to the forefront of global food animal research based academic institutions and develop innovations and well-trained students to meet the needs of North Carolina's livestock and poultry sectors and allied industries.

- Directly working to advance opportunities and address needs in a critical area of the North Carolina economy.
- Addressing major applied research needs that require the transdisciplinary capabilities that only an institution of the caliber of NC State can address.
- Raising the standard of facilities for animal agriculture research and education at NC State to best-in-class as opposed to the current status of barely adequate.
- Complementing and leveraging the signature NC State investments in CVM, the Plant Sciences Initiative and the Food Manufacturing Initiative.

## B. What Focus Areas or "Development Platforms" Should a Food Animal Initiative Emphasize

TEConomy undertook detailed quantitative and qualitative assessment of sector needs and university core competencies. The work led to an in-depth understanding of where NC State has current strengths to build upon that are relevant to identified needs and opportunities across the food animal agriculture value-chain. Analysis led to a rating of potential topics, integrating input from university faculty, industry leaders and other key stakeholders. The key elements, or development platforms, for the FAI, became quite clear through this process – with the following development platforms recommended:

#### FIGURE ES-2: RECOMMENDED DEVELOPMENT PLATFORMS FOR THE FOOD ANIMAL INITIATIVE

#### **PLATFORM 1 PLATFORM 2** Integrated Systems for Food Animal Health and Food Safety Digital Animal Agriculture Systems approaches to enhance animal health, Development and application of digital technologies to promote disease resistance and prevent/combat improving the management and profitability of animal infectious diseases and food safety-related agriculture operations. Incorporating sensors micro-organismal contaminations. real-time monitoring, decision support systems, Al and associated technologies and applications. **PLATFORM 3 PLATFORM 4** Food Animal Agriculture Communications Protein Innovation Research-based communications of modern livestock Innovation in protein processing and the development and poultry production and processing operations and of value-added protein and other animal-based practices. Designed to communicate fact-based products. Parallel development of cellular agriculture knowledge for stakeholders and consumers and to and comminuted products and processes. proactively combat mis/dis-information.

(Each comprising research, education, and Extension activities)

**Platform 1: Integrated Systems for Food Animal Health and Food Safety** – a transdisciplinary approach to develop and quantify effective systematic solutions to improve animal health and address pathogen contamination. Will include research, education and extension activity in areas such as:

- Surveillance and monitoring systems in primary production and processing
- Diagnostics and rapid pathogen detection systems
- Immunology, vaccines and immunotherapeutics
- Nutritional impacts on animal health and livestock immune systems
- Microbiome and gut health effects on livestock health
- Housing, management, welfare and handling system impacts on livestock health
- Genetics and livestock improvement for health and pathogen resistance
- Health decision and practices that positively influence animal well being
- Operation of new BSL2 facilities, and potentially BSL 3.

Platform 2: Digital Animal Agriculture – focused on development and application of digital technology in livestock and poultry production and downstream processing operations. The platform leverages NC expertise in engineering, computer science, advanced analytics together with the domain specific expertise contained in CALS and CVM. Will include research, education and extension activity in areas such as:

- Sensors and networked systems
- Advanced analytics and Al
- Machine vision and recognition
- Agricultural engineering
- Animal health and well being
- Food processing.

Infectious diseases and livestock health are what keep producers "up at night". It is a broad area of concern, covering worries relating to emerging/ re-emerging infectious diseases (including exotic infectious diseases), the challenge of reducing antibiotic use, pathogen contamination and food safety, etc. Industry views this challenge as needing an "all of the above" approach now - envisioning a systems approach that uses: vaccines and immunotherapeutics; study of the livestock microbiome to understand impact on health and ability to stave off disease; study of livestock genomics to identify resistance/health traits and markers; nutritional approaches to boosting the livestock immune system (including during pregnancy or in-the-egg); the use of precision/digital technologies to monitor animals and produce early ID of emerging symptoms, and use of precision technologies to combat risk of food safety challenges. This broad area of focus is seen as an excellent area for engagement of both CALS and CVM, plus engineering and other university capabilities.

As discussed below, each of the platforms, including the Digital Animal Agriculture platform will benefit from development of NC State's Lake Wheeler site into a modern research, education and demonstration farm, purpose designed to be fully instrumented and reconfigurable for demonstrating, testing and innovating livestock production systems. This will require livestock housing systems of a high industry standard, fully instrumented and networked to facilitate the development and use of precision animal agriculture technologies. This "Forefront Farm" should be structured to facilitate industry engagement and co-location of university-industry collaborative teams for joint participation in research programs. The Forefront Farm should also form the hub of a network for precision animal infrastructure installed at other major NC State livestock research facilities and at participating industry sites, serving to build a powerful data collection and analysis network for application to work across the platforms.

**Platform 3: Protein Innovation** – Potentially collocated with the envisioned Forefront Farm a platform in Protein Innovation would focus on R&D and training focused on value-added meat and animal protein product processing. Incorporating slaughter and processing operations, the platform and its Protein Innovation Center would allow innovation to be pursued in the safe processing of protein products, integration of sensing and digital technologies into a holistic livestock rearing through processing value-chain, and potential integration of emerging NC State capabilities (and industry interests) in cellular agriculture. This platform could also work on other value-added food animal products, but protein is viewed as a principal demand area based on growth in global population and food demand patterns.

**Platform 4: Food Animal Agriculture Communications** – Voiced by industry and faculty alike, there is strong recognition that freedom to operate in animal agriculture is under threat and subject to significant misinformation and disinformation challenges. TEConomy believes that these challenges should be addressed through a two part approach:

- Design of the recommended Forefront Farm to be visitor friendly (within the constraints imposed by biosecurity), representing a showplace and demonstration site for modern approaches to livestock agriculture and food animal welfare. Forefront Farm can be rapidly integrated into student curriculum, extension programs and public educational events in the state capital.
- Development of a small team at NC State focused on proactive communications with the public, policy makers and other key stakeholders regarding modern animal agriculture and focused on combatting mis/disinformation where identified. The team should connect to and support the existing Council for Agricultural Science and Technology (CAST), which is an existing science-based agricultural communications organization<sup>2</sup> and with other organizations and initiatives such as The Center for Food Integrity<sup>3</sup>. By leveraging existing organizations the Food Animal Initiative can work to meet the goals of combating mis/disinformation without having to undertake major research programs or substantial faculty recruitment in the area.

Animal health and food safety are certainly viewed as a crucial area for the FAI to emphasize by industry. The review of NC State core competencies, across CALS, CVM and beyond, show that this is also a logical area where current and emerging strengths can be built upon collaboratively. Digital Animal Agriculture provides similar opportunities for collaborative research and education activity between CALS, CVM and other University colleges (such as the College of Engineering and the Poole College of Management). The Food Animal Initiative provides an opportunity to do something that is very hard for industry to do (if not impossible), but realistic in a large university setting, that of developing major transdisciplinary programs that integrate multiple fields of study and interest areas into a systems approach to major challenges in integrated food production and processing systems.

- 2 CAST is a nonprofit 501 (c)(3) organization composed of scientific societies and many individual, student, company, nonprofit, and associate society members. CAST's Board is composed of representatives of the scientific societies, commercial companies, and nonprofit or trade organizations, and a Board of Directors. CAST was established in 1972 as a result of a 1970 meeting sponsored by the National Academy of Sciences, National Research Council. The primary work of CAST is the publication of task force reports, commentary papers, special publications, and issue papers written by scientists from many disciplines. The CAST Board is responsible for the policies and procedures followed in developing, processing, and disseminating the documents produced. These publications and their distribution are fundamental activities that accomplish our mission to assemble, interpret, and communicate credible, balanced, science-based information to policymakers, the media, the private sector, and the public. The wide distribution of CAST publications to nonscientists enhances the education and understanding of the general public. CAST addresses issues of animal sciences, food sciences and agricultural technology, plant and soil sciences, and plant protection sciences with inputs from economists, social scientists, toxicologists or plant pathologists and entomologists, weed scientists, nematologists, and legal experts. CAST's mission statement is: "CAST, through its network of experts, assembles, interprets, and communicates credible, balanced, science-based information to policymakers, the media, the private sector, and the public." Its vision statement is: "A world where decision making related to agriculture and natural resources is based on credible information developed through reason, science, and consensus building." See: http://www.cast-science.org/about/
- $3 \quad \text{http://www.foodintegrity.org/about/who-we-are-2/faq/what-programs-does-cfi-offer/}\\$

The Plant Sciences Initiative is investing in a state of the art plant sciences research and education building on the Centennial Campus in Raleigh. The development of the new building is, in part, a response to recognition that agricultural science facilities at the University had become very much outdated and presented a serious constraint to the pursuit of advanced R&D in plant sciences. The same also holds true for facilities on the food animal R&D and training side of the equation. In some areas critical infrastructure that is needed to advance R&D in food animal agriculture is missing altogether (for example animal housing and research facilities with required biosecurity levels, and meat processing facilities), while other facilities and infrastructure are not to modern standards or are experiencing heavy maintenance requirements as they have been used beyond their anticipated life. Overall, the infrastructure and livestock/poultry facilities at NC State no longer are able to demonstrate best industry practices or support the types of advanced research needed to address major challenges in food animal agriculture.

If NC State wants to lead in advanced food animal agriculture research and training, and be able to maximize its positive impacts in North Carolina, it needs to build a food animal Forefront Farm to be able to demonstrate/duplicate current industry standards, and design it to be reconfigurable and fully instrumented to allow for experiments and testing programs. The 1,500 acre Lake Wheeler Road Field Laboratory (Figure ES-3), located in Raleigh, provides an extremely well-located site for development of the envisioned infrastructure, while other sites in the area, such as the Teaching Animal Unit of the College of Veterinary Medicine and CVM infectious diseases research barns and facilities should be considered components of the farm (i.e. it does not all need to be on a single site).

FIGURE ES-3: VIEW OF LAKE WHEELER ROAD FIELD LABORATORY



The Lake Wheeler site contains multiple existing facilities and assets that may be integral to systems approaches to animal agriculture and contains the developable space required for the development of new and renovated assets. Figure ES-4 Illustrates this:

### FIGURE ES-4: ADDITIONAL AND EXISTING ASSETS FOR FOREFRONT FARM AT LAKE WHEELER

#### **Potential Assets to Add**

- . Biosecurity facilities (BSL2+)
- Advanced Instrumented Production Environments (Poultry and Swine)
- Precision Animal Agriculture Technology Development and Data Analytics Hub
- Protein Processing/Innovation Center
- Industry/University Co-Labs
- Education and Meetings / Events Center
- Visitors Center and Center for Food Animal Agriculture Communications



### **Existing Assets**

- Feed Mill Education Unit
- Animal & Poultry Waste Management Center processing Facility
- Swine Education Unit
- Dairy Education Unit
- E. Carroll Joyner Beef Education Unit
- Chicken Education Unit
- Talley Turkey Education Unit
- Animal Health Building

Note: The Teaching Animal Unit (TAU) and infectious diseases research facilities of the College of Veterinary Medicine also represent important components to integrate as non co-located assets for Forefront Farm.

As envisioned, Forefront Farm would form the central location for joint CALS, CVM (and other NC State colleges) interactions and collaborative education, research and extension activity in food animal agriculture, with direct relevance to three of the four platforms:

- Integrated Systems for Food Animal Health and Food Safety
- Digital Animal Agriculture
- Food Animal Agriculture Communications.

It is further recommended that development of a physical Protein Innovation Center take place and be collocated with the Forefront Farm, incorporating existing assets and adding new capabilities as illustrated on Figure ES-5.

### FIGURE ES-5: ADDITIONAL AND EXISTING ASSETS FOR A PROTEIN INNOVATION CENTER

### **Potential Assets to Add**

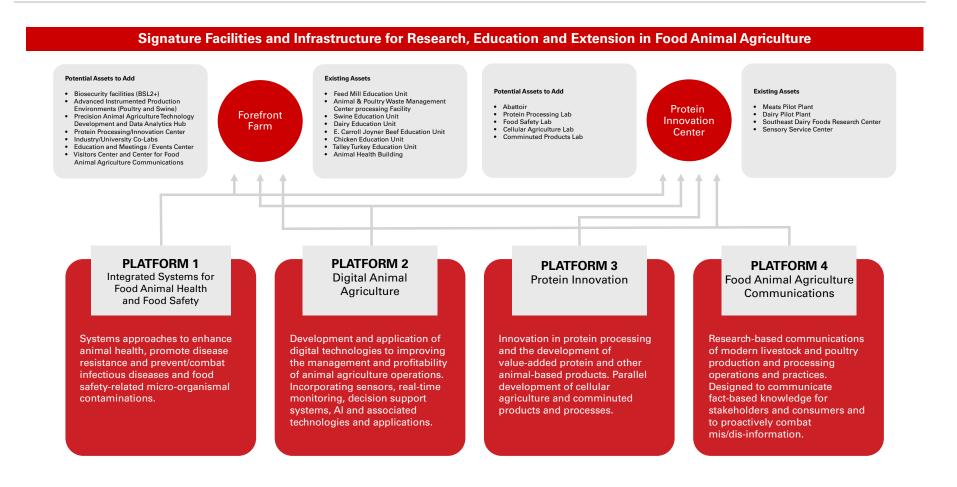
- Abattoir
- Protein Processing Lab
- Food Safety Lab
- Cellular Agriculture Lab
- Comminuted Products Lab

Protein Innovation Center

### **Existing Assets**

- Meats Pilot Plant
- Dairy Pilot Plant
- Southeast Dairy Foods Research Center
- Sensory Service Center

Figure ES-6 shows the recommended signature facilities and infrastructure investments (Forefront Farm and the Protein Innovation Center) and their relationship to, and critical support for, the four recommended development platforms.



Rather than limiting activities in the Food Animal Initiative to just one or two main disciplines of fields, the four platforms proposed for the FAI provide the ability to integrate a substantial number of core competency areas identified across the University into focused initiatives directed at challenge-oriented needs and opportunities of relevance to both global challenges and issues of direct relevance to the North Carolina agricultural economy. Platforms 1, 2 and 4 also provide signature opportunities for CALS and CVM collaboration in areas that are of demonstrated concern and interest to industry and are structured to accomplish work in ways that industry would find highly difficult to do alone. This leverages the transdisciplinary strengths of a world class research university and the Forefront Farm concept focuses investment in assets and infrastructure to support innovative research, technology development, innovation piloting and demonstration. This also builds a unique environment for education and training across undergraduate, graduate and

professional fields. This recommended model also has the advantage of building connectivity to other major NC State initiatives:

- The Integrated Animal Health Management platform clearly brings CVM and CALS together around a
  highly relevant shared focus, and also provides opportunities to link to the PSI in relation to feed impacts
  on animal health and leverage the microbiomics capacity developing within the PSI.
- The Protein Processing platform connects the FAI and the Food Manufacturing Initiative, and gives the Food Manufacturing Initiative a base of operations in Raleigh at the proposed Forefront Farm
- The Forefront Farm provides opportunities for interfacing with the PSI in precision and digital technologies, and its Digital Animal Agriculture platform allows the powerful investment that NC State has made in engineering capabilities and data sciences to be leveraged.

### C. Strategies and Actions to Advance the Food Animal Initiative

The development of the Food Animal Initiative is quite rightly being undertaken using an input process involving multiple stakeholders. A committee comprising CALS and CVM leadership is guiding the process and it is evident that care has been taken in providing an inclusive process that engages faculty, students, industry and other stakeholder groups. TEConomy puts forward the following five strategies (and 40 associated specific actions, outlined in Chapter VI) not as a rigid prescription, but rather as conceptual strategies and actions recommended for further discussion and consideration within the FAI planning process. This mirrors the successful planning and deliberations process used for the PSI.

The strategies and actions have been developed using a series of assumptions:

- The FAI seeks to be world-class signature program for NC State, equivalent in stature to the PSI
- The University will be successful in securing sufficient funds, potentially in the order of \$200+ million to build the infrastructure necessary to realize the Initiative's vision
- Structures and policies will be put in place within CALS and CVM that require faculty collaborations and transdisciplinary research and education program engagement
- The FAI will have a strong orientation towards meeting the applied and prioritized needs of food animal
  production and processing industries of relevance to North Carolina and will be designed to facilitate
  industry/university collaborations.

Five primary strategies are proposed for the Food Animal Initiative:

Strategy 1	Develop a Farm of the Future or "Forefront Farm" as a high visibility, signature development that will provide the modern R&D, education and production environment infrastructure required to propel NC State to the forefront of food animal science and veterinary medicine.
Strategy 2	Build transdisciplinary teams and infrastructure to advance NC State food animal agriculture and veterinary sciences work in the primary development platforms.
Strategy 3	Recruit faculty to reinforce strengths, address skills gaps relevant to the platforms and create opportunities for collaborative research.
Strategy 4	Develop undergraduate, graduate and certificate programs that are focused in the three platforms and developed with input from industry.
Strategy 5	Develop a proactive Food Animal Agriculture Communications program.

As noted above, further detail, including a series of 40 recommended actions are profiled in Chapter VI. Benchmarking analysis performed by TEConomy reviewed several other North American initiatives and programs<sup>4</sup> focused around food animal agriculture (see Appendix A), and it is found that none of these duplicate the comprehensiveness, infrastructure development and development-oriented platform focus envisioned for the NC Food Animal Initiative (although there are important lessons to be gained from them).

### D. Conclusion

As envisioned herein, the Food Animal Initiative is proposed as a multi-college NC State initiative focused on advancing research addressing prioritized food animal industry challenges and education to meet the needs of livestock and poultry production and processing sectors. It is recommended that the Initiative feature a signature investment in a Forefront Farm and collocated Protein Innovation Center, providing the state-of-the-art infrastructure, research and training environments required to support ongoing work of CALS and CVM in food animal agriculture and veterinary sciences, and advance four specific platform-focused transdisciplinary development platforms in Integrated Systems for Food Animal Health and Food Safety, Digital Animal Agriculture, Protein Innovation, and Food Animal Agriculture Communications.

By working in these platform areas, the FAI will have high visibility in areas of substantial importance to North Carolina and national food animal sectors – addressing animal health and food safety (two issues at the forefront of challenges expressed by industry), enhanced production efficiencies through improved animal health, enhanced production efficiencies through the application of digital technologies and data science to food animal agriculture, and innovations to advance the value-added protein processing and food products manufacturing sector for the state. The FAI will also pay close attention to advancing fact-based communications on the realities of modern food animal agriculture, thereby working to secure freedom to operate for modern integrated food animal operations required to meet global food demand.

The FAI's unique infrastructure and platform focus will provide a competitive advantage for North Carolina in applications for external research funding, and serve as a signature attractor for joint R&D programs with industry, and a world-class hub for attracting and training high quality students who will be well prepared to lead future advancements in food animal agriculture and be highly attractive to employers in food animal production and processing industries.

<sup>4</sup> Reviewed in the benchmarking analysis are: Kansas State University Beef Cattle Institute and Animal health Corridor; Michigan (Michigan State University Alliance for Animal Agriculture; University of Georgia, and the University of Saskatchewan Livestock and Forage Center of Excellence. There is significant intelligence and peer learning that may be derived via review of the benchmarking in Appendix A, which covers for each university: initiative background; primary thrusts/elements; origins; governance; industry collaboration; inter-college collaboration; facilities; incentives, and overall lessons learned.