

Reviewer 1

1.1. Clearly, the three specific objectives to address these gaps are very broad and provide a daunting challenge to provide measurable progress as described. It is therefore very important that the proposal addresses some specific areas that will have measurable and functional outcomes.

Response: We agree that these aims are necessarily broad, but we do have very specific activities planned, and these activities were selected to focus on tasks that (i) support research needs; (ii) require national co-ordination; and (iii) could not reasonably be funded by existing competitive funding sources. Since the NIMSS section to describe the specific activities and outcomes is limited to 4,000 characters, we have instead expanded on these activities and functional outcomes in the initial section where the specific aims are outlined (*Part B. How does this NRSP pertain as a national issue, Section 2. Continued national need for animal genomics capacity.*)

1.2. The second main point of importance is that this proposal is really focused on developing linkages between academic fields of study and those between scientists in the public sector and scientists and business leaders in the private sector (public-private partnerships). These relationships needed to be funded more strategically, especially if the private sector truly recognizes the value of NRSP-8 as stated in the letters of support.

Response: Thank you for raising this point. We hope that the additional information provided for point 1.1 (above) explains how we will strategically develop these linkages between project members and the stakeholders. Specifically, the inserted text indicates that this project does not seek to solve all identified gaps for stakeholders but rather to define them and identify work that can be done through existing competitive funding programs.

1.3. The main point is that this proposal is requesting funding for travel, salaries, and publications. It seems this funding is just to help complement an overall larger effort, where the connection is not directly defined. The actual amount of work needed to make progress on the objectives is daunting based on this funding. Salary requests are truly minimal for the potential amount of work (the people getting the funds need to be overachievers!).

Response: After discussion with USDA AAs, we appreciate that this NRSP proposal should be very specifically focused on activities which support research and that cannot be done either individually, or by other funding mechanisms (e.g., competitive funding opportunities). With this in mind, we have selected activities that complement a larger effort which will be supported by these other revenue streams (e.g., ongoing and novel research programs supported by federal and foundation funding and by funded public-private partnerships). Therefore, the amount of funding requested for this proposal falls in the range stipulated by our USDA AAs.

1.4. Overall – on travel, it seems logical that the funding should be allocated more strategically on the students versus the private sector, if strong initial linkages are to be established between academic fields. (Example could be to spend the travel on nominated and driven students looking to cross-pollinate at meetings - genome scientists going to ASAS and animal scientist students going to PAG and AGBT). It seems reasonable that

private sector EAB members should pay their own way, if the NRSP-8 is truly valuable to their for-profit activities (see LoS) then company leadership should support such networking travel. They could even provide funding as matching funds, and then have it disbursed back if this helps them justify the travel from a financial perspective. Not sure if this can be implemented, but it better leverages public funds.

Response: We agree that this would be the ideal use of funds and anticipate that our industry partners will be able to support their own travel and perhaps willing to support additional travel opportunities for students. Should this proposal be funded we will make this request, however at this stage we need to include this travel in our budget to ensure that our industry partners are represented in key activities for this project and some of these costs are represented in the *Budget and Budget Narrative Additional sources of funding* section.

1.5. The proposal must detail the travel more clearly! It is not clear how many trips are being budgeted within either the multi-state funding or the additional funding. Please just write out the math that allowed you to derive this number (multiple of the expected itemized costs). This is the expected standard for any proposal. There should be a chronogram showing the timing of the meetings and expected venues for maximum impact along with timing of the publications. Even if the plan is latered later, it is better than nothing.

Response: We have added more information about how travel costs were calculated in the budget (see 2. Budget and Budget Narrative, OTT Multistate Research Funding requested). A timeline of activities has also been included (see Figure 2).

1.6. Clearly identified sponsoring beneficiary stakeholders - The stakeholders are described in the proposal on page 6 and 7. Are the stakeholder targets correctly identified? – One could strongly argue that they are not completely described or targeted for maximum impact. Examples - A teaming up of scientists involved in new phenotype capture techniques often reside within animal pharma companies (i.e. Zoetis, Merck, etc.). Pharma has been acquiring technology to better identify sick animal phenotypes, but in some cases, these vet lead efforts have no intent to overlap this with genomics (except maybe within Zoetis). Groups like this are places where genomic resources can be used to create new discovery platforms by partnerships. So as important as moving genomics into traditional animal science may be, the most important traits for food animals are in animal health where genomic approaches between private-public partnerships could be impactful in elucidating the discover and function of genes and effects of their variants on performance and health of our food animals.

Response: Our strategy for identifying stakeholders was based upon inclusiveness, as this was considered essential for a capacity grant with the goals of supporting bioinformatics across a diverse range of scientists and for building public-private sector collaborations. This means that the stakeholder categories are broadly defined, or perhaps that the stakeholder group is not targeted. However, our experience is that (at least initially) a more targeted approach risks missing opportunities or discouraging stakeholders who would otherwise be interested in collaborating. We appreciate your suggestion of teaming up of scientists involved in new phenotype capture techniques and this is the group that we intended to capture in the *Bioinformatic and data scientists group*; the text of this section has been edited to include this information. Likewise, we have included more specific examples in the *Animal science*

researchers section in part B Relevance to Stakeholders. This information is already expanded in the section A. *Priority Established by ESS*.

1.7. There is no beef representation in the LoS, even though one could easily argue that a large share of funding has been spent on bovine genomics by all USDA agencies. From some informal polling, a few prominent progressive breeders ranking in the top 10 for seedstock production don't know about NRSP8 and its impact on their genomic-based breeding. These breeders are active in BIF and are interested in leveraging genomics to better understand feed efficiency, carbon footprint, and better health in performance production. So, a lot of opportunities in this sector, which is mostly ignored by this proposal. Suggest changing or adding NCBA-Cattlemen's College and NSIF (swine – poultry) to the venues to attend for extension to animal breeders.

Response: Included among the letters of support are five letters from industry stakeholders related to beef and dairy, in addition to three letters from genetics companies that use genetics data from multiple species, including bovine genetics. We agree that not all breeders know about the NRSP-8 project and one of the major objectives of this project is to develop more linkages with these stakeholder groups. We thank you for your suggestion to add NCBA and NSIF as possible for Extension and outreach activities and section B. *Management, Budget, and Business Plan, Planned Collaborations & Outreach* has been edited to include these options.

1.8. Other opportunities at these venues - there are many new phenotype device vendors at NCBA, which could lead to new linkages for developing the outreach network. Also, please define the group "animal breeder". Are these the CSO, CTO, and other geneticists in large multi-national companies?

Response: Again, we thank you for your suggestion. Our members' knowledge of companies developing phenotyping devices and strategies will be required to develop these linkages between private and public sectors. We have noted your suggestion and, if funded, will plan to have our initial events at forums like this to best utilized potential new stakeholder opportunities. Our definition of "animal breeder" was deliberately designed to be broad so that we could include CSO, CTO, and other geneticists in large multi-national companies, as you point out. This information has been added to section B. *Relevance to stakeholders: Stakeholders and their needs*.

1.9. Half the proposal is justification, which leaves little space for actually articulating the initiatives in detail for specific milestones that will allow for the measures of progress towards meeting the three objectives of this proposal. From the current text, it is very difficult to specifically understand scenarios of how the objectives will be met.

Response: The criteria for completing a NRSP Capacity proposal requires the completion of sections outlining how the proposal is consistent with the NRSP mission, the national scope of the project and how it fits with the priorities established by ESS, and these sections are lengthy. Within these limits we have worked to include additional information about the activities for this proposal (see our response to review points 1.1 & 1.5).

1.10. Data scientist is a jargon phrase that could mean anything - it should be made more specific.

Response: We have replaced usage of the term 'data scientist' with more specific phrases (e.g. informatics, engineering).

1.11. This assertion of impact was articulated several times (During that same 4-year period, NRSP-8 members produced 924 publications and obtained over \$43 million in competitive funding - a return on investment of more than \$20 for every dollar provided to the NRSP-8 project). What is the proof that this is a real impact? Would every NRSP-8 member say, "without NRSP-8 funding, I couldn't have written my paper or received my grant?" I think this calculation is overstated and a super simplification of impact that is not accurate. Suggest it to be presented as more of a shared benefit that impacted a certain number of papers.

Response: These figures are based upon impact statements from NRSP-8 annual reports and are cited in the *B. Relevance to stakeholders, 2. Renewal Justification and Business Plan, Rationale for Modest and Sustained Support* sections. In both sections it is noted that these figures refer to the productivity of NRSP-8 members; in both cases we have added text to indicate that this is an indirect measure of impact). While we agree that these metrics are a simplification of the impact of genomics research upon animal industries, it is not clear how else the impact of NRSP-8 should be measured. However, we do note that NRSP-8 has been described as a successful project by multiple USDA administrators and that it is the co-ordination activities of the NRSP-8 program that enabled the initial genome sequencing projects, the subsequent development of genomic-based tools (e.g., SNP chips) and – most recently – enabled the community to participate in the AG2PI initiative.

1.12. The genome citations only track up to 2017, so what happened from 2017 to 2022? Did the NRSP-8 contribute to the haplotype-based third-gen genomes coming from cattle? Just an observation - Curious why USMARC is not part of the membership, because they clearly demonstrate leadership in next gen genomes and pan genome work in cattle. How is this interface?

Response: Dr. Tim Smith from USDA MARC and Dr. Ben Rosen from USDA BARC are active participants in NRSP8 activities and have led the haplotype based third generation genomes from cattle and the pangenome initiatives. However, the online membership directory does not currently reflect their status as NRSP-8 members. NRSP-8 contributions towards both the haplotype based third generation genomes and pangenome efforts include both financial support and scientific expertise. Furthermore, contributions have come from the cattle coordinator committee, of which Ben Rosen is a member and from members of the greater NRSP8 community

1.13. Stakeholder involvement in project development, project activities, review, and/or management plans - So the EAB is limited to 5 members. How do these 5 members represent the entire industry using NRSP-8 supported outputs and extension? There should be a higher-level mechanism in the org chart for EAB to provide input from the entire industry, so how does the EAB get this input?

Response: Thank you for this suggestion, we have increased the EAB to 7 people to better represent the industry groups more effectively (aquaculture, beef cattle/dairy, equine, swine, poultry, and ovine/ruminants) and to include a seventh member that could represent either Extension or informaticians/engineers working on phenotype development. We have added this information to the *Business Plan: External Advisory Board (EAB)* section of the proposal. By having the EAB positions filled by industry representatives we anticipate direct feedback from

industry stakeholders and we will also engage other industry members through our industry-focused roundtable discussions and activities described in *Part B. How does this NRSP pertain as a national issue, Section 2. Continued national need for animal genomics capacity.*

1.14. Overall, the program should be only focused on food animals. Politically, horses have been included with food animals even though they are companion animals; so it is hard to understand why they are still diluting the funding stream for any food animal programs in NRSP. They should not be on the EAB.

Response: We respectfully disagree. The USDA has historically considered horses an agriculturally important species and development of genomics capacity is very often species-agnostic so that bioinformatic analyses developed for equine applications are readily adapted for food animals.

1.15. Don't overstate impact – example in the very beginning are: Genome-enabled technologies “co-developed” under NRSP-8 are.....by “helping” deliver complete genome sequences of seven agricultural animal species and corresponding genetic tools and resources that...

Response: These changes have been made in the text.

1.16. Overall technical merit (sound scientific approach, achievable objectives, review, and/or management plans) - this is a complex endeavor and it's been at least 5-10 years of genomic resources available to the industry, veterinarians, and animal scientists and still the uptake on the later two fields has been limited. The opportunities are there to really establish linkages for extension to capacity building, it would just be more clear of how to do this with a better described plan of the use of funds to create better capacity building opportunities.

Response: We agree that the uptake of genomics-enabled tools has been limited and that there are opportunities to improve this by developing linkages for extension of this capacity building. Additional information about the activities for this proposal (see our response to review points 1.1 & 1.5).

Reviewer 2

2.1 The proposal would benefit from adding details on where the current large-scale "omics" and "genetics" data are stored (databases), what level of integration exists for this data, how accessible they really are to scientists, and how this project will use them.

Response: This answer to this is complex and multilayered (depending on the data type and research group); ensuring that stakeholders can answer these questions is part of the data management and data re-use workshops we propose to do as part of Aim 1. In the best case scenario large scale data sets are stored in public data repositories, and are brought into databases and resources where they can be integrated around a theme (e.g., expression atlases or pangenomes) for use by a broader range of animal scientists. However, the reviewer has rightly indicated that accessibility to scientists remains a problem which we hypothesize is based upon lack of either knowledge or support for data management best practices. To make genomics more accessible to a broader range of scientists we intend to have discussions with stakeholders about the barriers to analyzing, storing, sharing, re-using and archiving these data sets so that we are able to improve data management. More detail about these activities has been added to the proposal.

Reviewer 3

3.1. However, as this group moves from genetics to phonemics, especially considering high-throughput phonemics, this proposal would be greatly strengthened by the addition of engineers (biosystems or agricultural engineering, mechanical engineers, computer scientist, and/or electrical engineering). The use of sensors in the livestock, especially in a commercial setting, is a new area. Many of the sensors are under development. In addition, having an engineer to explain the limitation of the sensors and the potential novel uses of sensors would be of tremendous help to this community. The collaboration between animal scientist and engineers could be very powerful - as the engineers may not have the understanding of the animals - but understand the sensors, electronic data collection techniques, and data analysis techniques that the animal scientist may not understand well. The combination of two such diverse fields would lend itself to innovation in science and technology.

Response: Thank you for your suggestion, we agree that the inclusion of computer scientists and engineers will be important to support genome to phenome capacity. We have added text to explicitly include device engineers throughout the proposal and included them as a stakeholder ("Informaticians and engineers" in the *Stakeholders and their needs* section).

3.2. There would be room for an additional objective. 4. Continue developments of novel sensors to collect real time individual animal data for all animal species. Not only would the genetics and phonemics components be strengthened, but additional grant money could be acquired through the collaboration of engineers and animal scientist.

Response: While we agree with the importance of this aim, the limitation to adding a fourth objective is the budget cap. However, we have added information about how this proposal begins to build collaborations with engineers and scientists developing phenotypic devices and utilizing the data from these devices within this proposal (see our response to review points 1.1, 1.5 & 1.6). Moreover, the AG2PI initiative also provides opportunities for similar collaborations between scientists and engineers.

Reviewer 4

4.1. Addressing the NRSP Mission. Note that NRSP-8 did not sequence or fund the sequencing of the genomes of livestock, but it brought together the community who valued having them and worked both together and independently to obtain them - NRSP-8 provided communication, collaboration and coordination at different levels for all of these efforts. As written, it would seem that these were solely NRSP-8 accomplishments, which they were not. By rephrasing to clarify that NRSP-8 coalesced the community that advocated for and developed these resources, additional species can be added, including aquaculture. Also, NRSP-8 members accomplished far more than work towards sequences and other resources, there were many important contributions to basic and applied animal science described in those 900+ publications.

Response: We apologize for this impression and have revised text throughout the proposal to clarify that the NRSP-8 project supported genomics initiatives.

4.2. I recommend connecting to two additional communities:

1) It would be good to connect with the plant genomics community, as does the AG2Pi project. No need to be redundant with that effort, but like all competitive projects it is temporary, it would

be good to recognize the value in this kind of collaboration (which is inherent in PAG - maybe that is all that needs to be said.

2) I don't see a direct connection to Tribal stakeholders, which could benefit from these efforts. This may not be easy but it is important, NIFA has a program leader that leads Tribal programs.

Response: Thank you for these suggestions. We have two plant genomics community groups in the section *Planned Collaborations & Outreach* (the AgBioData Consortium, and NRSP-10 National Database Resources for Crop Genomics, Genetics and Breeding Research) and expect to co-ordinate with them on complementary activities. Like you, we don't see a path for a direct connection to Tribal stakeholders, although we are happy to explore the possibility. We have included text to reference how we may begin the process of reaching out to Tribal stakeholders to explore their needs (see section *Stakeholders and their needs*, Extension Services), and we anticipate this might be a longer-term activity where we could also partner with the NRSP-10 and AgBioData communities working on crops.

4.3. When referencing phenotypes and/or improving production systems it would be good to include food safety.

Response: Thank you for your suggestion, we have specifically referred to food safety scientists within our definition of Animal Science Researchers in the *Stakeholders and their needs* section. We also reference the impact of this project on food safety in the *Priority Established by ESS* section.

4.4. Leadership team. I think having coordination by Aim instead of Species is a great approach, but how are different species represented in the new structure? How are they represented on the EAB if there are only five members to represent beef, dairy, swine, horse, turkey, layers, broilers, goat, sheep, catfish, trout, salmon, oyster, etc...? Seems this group should be larger, but more importantly, how are species represented in the overall organizational structure?

Response: We have increased the EAB to represent the industry groups more effectively - a representative each for aquaculture, beef cattle/dairy, equine, swine, poultry, and ovine/ruminants and an additional member to represent either Extension or informaticians/engineers working on phenotype development (see *Business Plan: External Advisory Board (EAB)* section of the proposal). As NRSP-8 transitions to capacity building we have re-organized the organizational structure to be focused on tasks relevant to all species rather than having species co-ordinators. We note that (while there will always be the need for adaptations to specific species), species-agnostic design of resources from this project facilitates further collaborations and comparative projects that can advance all of animal genomics.

4.5. Outcome Delivery Schedule - it seems industry is not involved until year 3 with the round-tables, if we begin with the end in mind - I suggest moving this activity earlier in the project.

Response: We apologize for this misconception and have added more detail to clarify the proposed activities and a Figure showing the timeline. Some of our early activities include engaging industry stakeholders to ensure we identify their needs for this project.

4.6. AG2PI is funded thru the competitive NIFA program AG2P that was created and authorized by the Farm Bill and funded thru annual appropriations, but AG2Pi is not directly funded by the Farm Bill.

Response: Thank you, we have edited the proposal to correct this information.

4.7. Under stakeholders and their needs, please include a bullet and description for Extension.

Response: Thank you, we have added this point.

4.8. Target audience - please include undergraduates in the second bullet and an additional bullet for Extension

Response: Thank you, we have added this point.

Reviewer 5

5.1. Further clarify the involvement of stakeholders. As written, stakeholders that will be included in various aspects of the work are identified from contact lists taken from traditional genomics scientist and researchers. Input from stakeholders outside this sphere could broaden the support of the proposal, expand the various inputs of the proposal, and add to the applicability of the outputs from the proposal.

Response: We have clarified that our intent is to initially use our membership contacts to reach out to stakeholders to be involved in activities. However, we will also seek out new stakeholder interactions and some of the ways we will do this are (i) having project meetings and workshops at non-genomics themed meetings; (ii) have stakeholder discussion forums; and (iii) reaching out to Extension agents and specialists (who will have additional industry contacts) and to informaticians and engineers working with phenotype data and devices. We have added additional information to the proposal about these activities and revised the stakeholder section to reflect this intent.

5.2. Consider the role of Extension. The land-grant university system is mentioned in Planned Collaborations & Outreach section, and its components are mentioned and alluded to throughout the proposal. However, Extension is not listed/addressed in the Stakeholders & Their Needs section. Additionally, how will Extension, and other stakeholders, be informed of proposal outputs so they can be disseminated to end-user groups.

Response: We apologize for this oversight and have corrected it in the proposal (see also our response to review point 4.7).

5.3. Clarify the management of outputs and access to outputs. As written, it is not completely clear where data sets, outputs, etc. will be housed, how they will, or can be accessed. Also, how will stakeholder groups/users be made aware of the outputs and what methods will be used to notify/inform stakeholders outside of the traditional sphere of users.

Response: The management of outputs and access to outputs are described in section *D. Outreach, Communications, and Assessment* subsection 5. *Data management plan*. This section states that - although this project will not directly generate genomics data - it will use this type of data and make access to the products produced available to the community via established public resources and repositories. Moreover, we directly state that other resources developed from this project (e.g., reports, worked examples, publications, etc.) will also be made publicly available. We have not outlined every specific place these resources will be made available because of the diversity of data types and products that will be produced. We have added additional information that the products of this proposal will be available on the project website we will set up.

5.4. Consider the value of the work. What specific steps will be taken to assess and evaluate the outcomes of the proposal. Who will be provided with the assessments and how will future efforts change accordingly?

Response: The details of how we will assess the outcomes of this proposal are outlined in *D. Outreach, Communications, and Assessment*, section 3. *Measuring accomplishments and outcomes*. Assessments include quantitative and qualitative measures of each activity along with expected outcomes. The assessments will be included as part of the project's annual report and distributed to the External Advisory Board, (EAB) project members, stakeholders and our project administrators. These assessments and reports will inform our future directions and activities and project members will discuss how to implement changes based upon EAB and administrator feedback at our annual meetings.