Project Proposal: Genetic Evaluation to Improve Dairy Cattle Health and Production
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Dairy cattle play an important role in a sustainable food system for the Earth's expanding population, contributing significantly to human welfare. In rural communities across the globe, cattle contribute to the livelihoods and nutritional security of millions of people. Dairy animals increase the financial capital of families, serve as credit collateral, and play an important role in empowering women. Of the 133 million farms globally, 37 million have female leadership; in developing countries, dairy cattle have the potential to increase educational attainment for women and reduce gender inequalities. Though dairy cattle are the most efficient of all farm livestock in converting feed protein and energy to food, milk production is energy intensive and animal husbandry practices require mitigation of infectious diseases. Through genomics, one can select for beneficial traits that reduce environmental burden and costs, enhance disease resistance, and improve food production, thus addressing important issues of public concern.

In the United States, the Council on Dairy Cattle Breeding maintains production, health, and genetic records of purebred dairy cattle, providing dairy producers with valuable, easy-to-use breeding information. Cattle are genotyped with chips that have thousands of single-nucleotide polymorphism (SNP) markers, and genotypes are compared to develop pedigrees. This data is crucial in instructing cattle breeding and management decisions, allowing farmers to select and breed healthier, more profitable animals. In the first summer, I intend to analyze Holstein cattle genomic data (SNP markers), breeding evaluations, and health and production traits from the Cornell Veterinary School Teaching Dairy herd. Using extensive health and production data from the herd, I aim to identify specific genetic regions associated with cattle health, dairy production, and disease resistance. I will also assess these animals' genetic progress over the past 3 years to evaluate the effect of previously incorporated genetic breeding recommendations into management decisions. Having classified and understood these traits and the success of the breeding program, I will compile my results, which can then be used in the selection of healthier cattle and optimization of management decisions.

Globally, the dairy industry, one of the largest sectors of the agriculture industry, employs millions. The economic impact of implementing good management practices based in genetics research is enormous; farmers whose livelihoods depend on the success of cattle must understand the genetics underlying favorable traits to not only maximize yield and profits, but also ensure animal safety and health. Providing dairy producers globally with genetic data to inform breeding recommendations and selection decisions will lead to considerable cost-effective benefits for farms and families. Through genetic progress, dairy farmers can strive to reduce the prevalence of disease and maximize production in cattle populations through informed selective breeding with the identification of optimal animals for various production systems. The benefits have financial implications too, as healthier animals require significantly less antibiotics, professional care, and attention. The genetic traits that I will identify will have relevance for entire populations of cattle across the world; the data I intend to analyze will allow me to make conclusions regarding the adaptations of Holstein cattle, cattle that are extensively bred internationally. These findings will be applicable for dairy production internationally and will

inspire further research questions regarding the ways in which genetics can be utilized to select for healthier animals.

My 6-week summer project will focus on learning and conducting genetic research on dairy cattle using the Cornell Veterinary School Teaching Dairy herd. The work will provide me with new understanding and experience in dairy cattle research, including handling animals, conducting wet-laboratory procedures, and evaluating data. I will form a foundation that I can build upon with future undergraduate research in the laboratory of Dr. Heather Huson, my faculty mentor and Associate Professor of Animal Genetics. Dr. Huson has a well-established network of colleagues in the genetics and dairy industry internationally, and she has developed individualized summer research programs abroad for her students in the past. In the second summer of the Laidlaw program, I will have the opportunity to expand my skills by working on a much larger cross-breed cattle project with Dr. Huson's collaborators, a large, dairy cooperative group, in New Zealand. This international experience will afford me the opportunity to work with rural farmers within the cooperative, helping them optimize herd health and food production, and will require both my research experience and community-engaged leadership skills. Beyond this experience, I also hope to work with rural dairy producers in other regions of the world to improve herd husbandry and food production.