Submission by Solutions from the Land

on behalf of the

North America Climate Smart Agriculture Alliance

In Response to Decision 4/CP.23

Koronivia Joint Work on Agriculture

Topic 2(e) “Improved livestock management systems”

Topic 2(f) “Socioeconomic and food security dimensions of climate change”

April 20, 2020

Introduction

The North America Climate Smart Agriculture Alliance (NACSAA) welcomes the opportunity to submit its views and recommendations regarding topic 2(e) “Improved livestock management systems” and Topic 2(f) “Socioeconomic and food security dimensions of climate change” under the Koronivia Joint Work on Agriculture.

NACSAA is a **farmer-led alliance** for inspiring, educating, and equipping agricultural partners to innovate effective local adaptations that sustain productivity, enhance climate resilience, and contribute to the local and global goals for sustainable development. NACSAA reflects and embraces all scales of agriculture in Canada, Mexico and the United States, ranging from small landholders to midsize and large-scale producers.

This Alliance focuses its efforts on helping both producers and the value chain utilize **climate smart agriculture (CSA)** strategies to enhance the adaptive capacity of North America’s food system. Strategies range from minor adjustments in existing production to major changes in agricultural systems and best management practices, and are organized around the **three CSA pillars**:

Pillar One: *Sustainable intensification of production and ecosystem integrity*

Pillar Two: *Adaptations that build resiliency*

Pillar Three: *Systems that allow farmers to retain and sequester carbon or reduce greenhouse gas emissions and simultaneously improve profitability*

As documented in the Intergovernmental Panel on Climate Change (IPCC) Special Report on Climate Change and Land, **climate change presents numerous challenges to sustaining and enhancing crop productivity, livestock health, ecosystem integrity and the economic vitality of rural communities**. Among the report's key messages: food and forage production are declining in regions experiencing increased frequency and duration of drought; the degradation of irreplaceable soil and water resources will expand as extreme precipitation events increase across our agricultural landscapes; challenges to human, crop and livestock health are growing due to the increased frequency and intensity of high temperature extremes and related spread of pests and crop and animal diseases; and key modes of communication, transportation, water, and sanitary infrastructure are vulnerable to disruption from climate stressors.

These events and conditions represent unprecedented risks to food and energy security, human health, the environment and progress towards greenhouse gas mitigation in North America and worldwide. Farmers, agribusinesses and rural communities across the globe are already experiencing the impacts of extreme variability in weather and a changing climate and know that the threats to their livelihoods are increasing.

The use of a CSA framework is foundational to any agricultural climate strategy. By letting farmers lead and focusing on the economic viability of farming operations as they respond to the changing climate, policymakers can encourage win-win scenarios in which agriculture presents a solution for climate impacts while improving environmental resilience, building strong rural communities, engaging consumers, and ensuring public health and access to nutritious food.

The potential impact of a policy environment which encourages widespread adoption of CSA principles cannot be overstated. **Agriculture is a diverse industry, encompassing a range of farm scales and agro-ecosystem landscapes.** Generalized regional climate conditions do not well represent individual farmers' local weather and climate experiences and their varied impacts on different topographies and agricultural systems (1). Thus, individual farms in each country and geographic region of the world are best served through unique adaptation strategies that enable farmers to co-manage for resources, productivity, profitability and ecosystem health. Their efforts will be most successful when success is defined by outcomes and not prescriptive practices. The complexity of this stewardship – **which requires an "all tools in the toolbox" approach and prioritizes farmer access to multiple choices and innovations** – can seem overwhelming to those looking for an oversimplified "silver bullet" solution.

However, **embracing management complexity reveals one of the world's best chances to reduce atmospheric carbon**. Recent research by soil scientist Rattan Lal – a member of the Intergovernmental Panel on Climate Change (IPCC) – shows that in aggregate, place-based management of soil, vegetation and animal systems across the globe could achieve 157 parts per million of CO_2 drawdown per year by 2100 (2). This represents nearly 40% of 2018's global atmospheric carbon levels. Enabling policies that address climate change by giving each land manager a menu of options to best serve their individual landscapes unlock enormous potential for **farms and forests to lead the world in both economic and environmental sustainability**.

The following are important Action Pathways that NACSAA encourages KJWA to embrace in considering Topic 2(e) "Improved livestock management systems" and Topic 2(f) "Socioeconomic and food security dimensions of climate change":

- Knowledge generation; science and technology innovation development, access and affordability; incentives and investments that support all scales of sustainable intensification production systems; soil, water and resource conservation; and healthy ecosystems.

- Multi-stakeholder collaborative governance models, inclusive of government, private sector, and civil society at appropriate landscape level (watershed, country, region etc.), that develop, implement, and monitor land use and management policies that enable priority economic, social and environmental outcomes.

- Integrated, reflexive and holistic policy frameworks that support new markets for ecosystem services and create economic incentives for all scales of sustainable production of nutritious food, effective management of natural resources, and improvement of rural livelihoods.

- Effective and innovative solutions – policies, practices, programs, and investments – that enable all scales of agriculture, its value chains and rural people to prepare, cope, and recover from climate disruptions and shocks.

Note

Since the crafting of the document began, the world has changed in a radical way due to the spread of COVID-19 into a global pandemic. This event is exposing the vital need for a resilient, safe and sufficient food supply. While much of the world's population has long faced food insecurity as an existing threat – a threat exacerbated by climate change – the emergence of the novel coronavirus has brought this threat to the fore in new and concerning ways.

The most important prerequisite for the battle against COVID-19 is to ensure the healthiest population possible, via stable food supplies in developing and developed countries alike. While the production, processing, transportation and availability of food has been recognized and supported as "essential" in many nations, these key elements of food access have been impeded by the effects of worker shortages, breakdowns in processing and transportation chains, human illness and hoarding sparked by the fear of shortages. Without thoughtful solutions, this problem will only worsen existing food and distribution issues worldwide.

Topic 2(e): "Improved Livestock Management Systems, including Agropastoral Production Systems and others"

Preamble

Animals play irreplaceable roles in human society. While most recognized as a food source containing high-quality protein and other essential nutrients, they may also act as keystone species in developed and developing grassland ecosystems; make contributions to soil health and carbon sequestration; and support household livelihoods and community economic well-being. Livestock production is both a source of greenhouse gasses (GHG) and a vital part of the strategy to mitigate the effects of a changing climate. The 2019 IPCC report documents a concern for rising livestock GHG emissions connected to an increasing demand for animal-sourced foods from low-to-middle-income countries, as well as urban and affluent populations, worldwide (4). Adapting livestock production systems offers potential to reduce net emissions, improve soil quality and sequester carbon as well as better recycle nutrients via diversified crop and livestock agriculture systems. Waste and byproduct resources produced by livestock are essential to production of human foods and feeds that animals consume in a recycling process, with 35% of atmospheric carbon recycled annually in food/feed crops. Furthermore, livestock waste improves soil structure, organic matter, water holding capacity and fertility, thereby increasing crop drought resistance, plant productivity and return of nutrients back to the land.

Dairy and beef cattle, chickens, buffalo, sheep, and goats are sources of meat, milk, eggs, yogurt and cheese which provide the undernourished with high-density, accessible calories and essential nutrients (vitamin B12, riboflavin, calcium, essential fatty acids, zinc, vitamin A and iron) needed for cognitive and physical development, immune functions, and overall health. The FAO advocates practical action in livestock management to reduce GHG emissions in response to the climate crisis while urging that it not come at the expense of other sustainability goals, particularly ending poverty and achieving zero hunger by 2030 (5). In developing countries, livestock are a pathway out of poverty: a way to build assets and accumulate wealth. The challenge is to balance the benefits of animal source foods (ASF) and livestock keeping for nutrition, health and well-being; the role livestock production plays in providing livelihoods to producers at many scales in developing and developed countries; and the urgent need to reduce GHG emissions to tackle the climate crisis, which also is a threat to food security (5).

NACSAA elaborates on these important issues below and uses them in the formulation of recommendations to improve livestock management systems (3, 6-18).

Emissions and Climate Mitigation Solutions

- Based on IPCC measurements, agricultural emissions from animal agriculture in the U.S. during 2018 totaled 619 million metric tons. Of that total, 42% of the emissions – approximately 259 million metric tons in CO_2 equivalents – were related to enteric fermentation or manure management. Enteric fermentation emissions totaled 178 million metric tons, up slightly from prior-year levels. Beef cattle contributed 128 million metric tons, followed by dairy cattle at 44 million metric tons and swine at 2.8 million metric tons. Other livestock, including horses, sheep, goats, bison and mules, contributed 0.62 million metric tons. As a percentage of total GHG emissions, enteric fermentation from livestock represented less than 3% – specifically, 2.66% – of all emissions in 2018. When manure management is included, livestock-related emissions represented less than 4% of all emissions. Importantly, the proportion of livestock-related emissions relative to total emissions declined from 2017's 2.7% (19).

- While total livestock-related emissions as a percentage of total GHG emissions have remained mostly flat in the U.S. for the past three decades, it is important to factor in livestock producers' productivity gains when evaluating total GHG emissions. Compared to 1990, U.S. milk production has increased by 71%, beef production has increased by nearly 50% and pork production has increased by 17%, with very little comparative increase in GHG emissions from animal agriculture. To evaluate how the efficiency gains made in animal agriculture have lowered its environmental footprint, the enteric fermentation emissions per unit of production were measured across beef, pork and dairy. The annual values were then indexed to their 1990 levels. Compared to 1990, enteric fermentation emissions per unit of beef production have fallen by nearly 10%, pork-related emissions have fallen by nearly 20% and enteric fermentation emissions per unit of milk production have fallen by 25%. U.S. livestock producers are doing more with less, which has lowered their per-unit GHG contributions (19).

- Livestock production plays a positive role in management of atmospheric carbon, but its fossil carbon recycling contributions are not well understood or appreciated. Diets consumed by livestock are virtually totally plant-based, meaning that recycled atmospheric fossil carbon is a major ingredient. Cellulose, a major forage plant carbohydrate in animal diets, is 44% carbon, and is an important feed source not utilized by humans, pigs, poultry or fish. Instead, cellulose is a primary product of grazing lands, which fix atmospheric carbon. Carbon dioxide produced by dietary metabolism and exhaled by all livestock becomes available to be recycled repeatedly, recapturing solar energy for the "next crop" of animal feed (2-3, 5-6, 8-10, 15-18, 20-27).

- In the U.S. alone, about 2.5 Gt of carbon emissions from burned fossil sources stays in the atmosphere every year, with the remainder being taken up by ecosystems and oceans. To stabilize atmospheric carbon at its current level would require shifting that 2.5 Gt per year away from fossil carbon sources and towards renewables; while including as essential carbon's relationship with all types of livestock production and livestock feed production associated with the recycled use of carbon; and combined with greater carbon sequestration in all forms (soil, forests, etc.) (5, 15-18, 20, 25-27).

- Livestock play a major role in the integrated production of biofuels due to the fact that biofuel greenhouse gas emissions are 39-43% lower than those of petroleum gasoline (28). Byproducts of biofuel production (distillers' grains) are among the most efficient sources of protein in the food animal's diet. The livestock production market is thus a critical partner to the biofuel industry in the effort to increase use of renewable fuels and to reduce dependence upon fossil fuel use throughout society. The objective is to reduce the irreversible mining of fossil carbon from the earth, which contributes about 5.5-5.8 gigatons (Gt) per year of carbon to the atmosphere over the US (a continual process). These emissions are replaced with solar energy captured by renewable carbon containing products. In this way, livestock production is a key component leading to increased use of biofuels (5, 10, 15-18, 20-27).

- Livestock production is not likely to be able to accomplish the desired reduction in GHGs in the near term, but in combination with increased use of biofuel byproducts and carbon sequestration into soils using a variety of techniques (biochar, changing tillage practices, cover crops, livestock hoof incorporation of manure, etc.) an achievable target is revealed and should be included in the goals of the KJWA program (5, 16-18, 25-27).

Climate Smart Agriculture Production Systems

- Adaptation to changing climates requires significant mitigating changes in traditional animal production, including possible relocation, different housing/ handling systems, adaptation to different feeds, consideration of the impacts of, especially, changing temperatures on animal diseases and their management (including insects and parasites) (30-39).

- There has been a steady trend toward larger, intensified, specialized production facilities, particularly dairy, swine and poultry, in the US (excluding pastoral production which uses ruminants). The argument in favor of intensification is supported by lower cost of unit production, lower unit labor costs, and thus the ability to keep food costs as low as possible.

- There are many examples of intensification of animal production systems for food animal species, which usually result in greater animal unit production and production efficiency. An excellent published example is that of Clapper and Cady (39). This study, which followed another published a decade earlier, demonstrated the significant reduction in carbon emission footprint that animal agriculture is presenting through increased production and efficiency.

- As changes in climate occur (greater variation in temperature, precipitation, hurricanes and other extreme weather events), redesign and relocation of intensive production facilities will be required to transform to changing conditions. While some pastoral or grazing based operations are also extensive (large animal numbers), the land base for these practices in much of North America is finite and unlikely to be expanded. Changing climates will require maintenance of those grazing systems through adaptation of existing grassland species or gradual encroachment of newer, less desirable species which can tolerate temperature and rainfall changes. If these changes can be overcome, the agropastoral systems for livestock can continue their highly climate efficient protein production. Otherwise, major production changes will be needed (5, 16-18, 21-27).

- The economics associated with establishing or sustaining intensive production units are significant. Where relocation is involved, cost may become prohibitive unless the retention of the production capacity warrants investment in support of relocation. Upgrading systems with new technology to save labor has advantages, but retrofitting many aspects of existing systems to adapt to changing climatic conditions may also be cost prohibitive. In those cases, relocation may be the more feasible option. Climate changes, especially intensity and quantity of rainfall in areas subject to flooding, may dictate relocation as the only feasible option.

- Intensification of production usually involves adoption of new technologies, and adaptation to changing climates will continue that trend. Pressure will continue to incorporate production elements that address consumer concerns about animal handling, animal welfare, and environmental protection. Where relocation of production units is required, it will be easier to take advantage of opportunities to adopt these new concepts, technologies and practices (6, 8-9, 33-34).

- If the trend toward higher temperatures continues, animal production structures will need to be modified to avoid heat stress for the animals. With increasing temperatures, facilities may utilize natural ventilation, with some provision for altering in-building environment (fans, evaporative cooling and adjustable side curtains, etc.). Further capacity may be needed to accommodate rising temperatures.

- Automated data capture (currently furthest advanced in the dairy industry, but emerging for other intensive animal production systems) will assist in effective management of all aspects of animal health status. Technological development represents positive, necessary steps for adaptation to changing climates.

- As climates change, plant species will also adapt – either in location or to compatible climates – to survive. That includes feed and forage crops for animals. In cases where grazing lands become less productive and pastoralists have limited relocation possibility, grazing land productivity may deteriorate dramatically with changing climatic conditions. It is possible that new plant species could be introduced, enabling resumption of productive grazing over time. One major consideration relative to grazing animals will be the impact of climate change on rainfall total and distribution. This may render traditional grazing lands unsuitable or unable to support adequate production to be profitable, thus eliminating a significant source of human food and impacting local and indigenous economies (37-47).

- In the cases where animals are raised in confinement or semi-confinement (including pigs and poultry, and to a lesser extent dairy) and feed is transported to them, transportation costs due to distance and other factors will have an impact on sustainability (11-14).

- Seeking alternative feed sources for food animals is a constant process, and alternative feed sources such as biofuel byproducts are very important. Continued research in this area needs to be actively pursued as climate changes impact traditional and locally available feeds (48).

<u>High Quality Protein</u>

- Livestock and their associated byproducts including milk, cheese, eggs and meat are critically important sources of nutrients that sustain life and improve livelihoods. With the goal of ending hunger and a growing world population that is expected to reach nearly 10 billion people by mid-century, demand for animal products will increase exponentially in the coming decades. Foods of animal origin are rich in essential nutrients and play a major role in ensuring proper growth, cognitive development and immune function. As documented by FAO, these nutrients are difficult to obtain in adequate amounts from plant-based foods alone, and including even modest amounts of ASF in diets adds much-needed nutritional value for better health outcomes (5).

- Ruminants (meat/milk) consume “grass” diets (grasses and other non-human edible forage materials produced on grazing lands) to provide about 70% of their energy. Many meat ruminants consume grains during a short “finishing” stage prior to processing and expanding production of “grass-fed” beef further reduces that competition. Trade agreement policies confirm food production as critical. Without animal engagement, food from grazing lands would be significantly reduced, forcing the conversion of high value natural ecosystems to cultivated cropland. Replacing foods of animal origin with alternatives from plant sources must contend with the net removal of otherwise unusable lands from food production. If climate change results in crop failures, the flexibility of animal use of unproductive land is a source of food security. This will increase in importance with changing climates and climate extremes. Populations which may change their migration patterns for food security will face challenges if animals are not part of their food cycle as well as their transportation process (1-2, 5-9, 10-14, 16-18, 21-27, 30-35, 48).

- Substitution of plant proteins on an equal basis for animal proteins must consider the difference in protein quality based on supply of essential amino acids needed in the human body. Proteins of animal origin have a high biological value (BV) of 92% or higher, while those of plant origin may have a BV of only 50-70%. Diets based on plant protein, or meat substitutes using plant proteins, might require twice as much protein to provide the nutritional value of a meat-based source. Animal foods are good sources of B-vitamins (especially B-12), zinc, selenium phosphorus and iron. Other nutrients found in animal-based foods may help prevent Alzheimer’s, Huntington’s, Parkinson’s diseases and dementia, as well as maintain a healthy central nervous system (49-53).

- Animals **convert** lower BV plant proteins in their diets into higher BV proteins in their own bodies or in their products (milk and eggs). This is an important function (32, 49-51).

- Animal food industries must place greater emphasis on developing innovative new products to remain competitive. The dairy and beef industries especially need to increase this emphasis, whereas the turkey and poultry and aquaculture industries have already been far more successful in doing so. Product development includes possible modifications based on genetic alteration and production practices. For example, the dairy industry is using non-invasive genetic selection to alter milk protein to reduce health issues for some consumers. In all cases, foods of animal origin must shift to being perceived as commodities rather than their traditional perception (22, 24, 52).

- As our ability to analyze animal genomes becomes more accurate, it is increasingly possible to select animals (using non-invasive techniques) for specific traits which enhance the role of food animals to contribute to sustainable food production. Desirable traits could include increased efficiency and/or rate of performance and resistance to diseases, as well as resistance to insect/parasite damage. Traits could also add specific desirable "constituents" in the food products produced (39, 47).

<u>Animal Health</u>

- Mitigating the influence of changing climates on sustainable animal agriculture requires management of animal health, a complex matter. This management must address both diseases (bacterial, viral, amoebic, etc.) and health associated with environmental conditions (air, water, soil borne, and both zoonotic and non-zoonotic). Possible interactions with wildlife and other vectors (local and migratory animals and birds, as well as insects, etc.) must also be taken into account (37, 39, 45-47).

- Both extensively and intensively raised animals are subject to changes in health issues, with intensive raising and housing creating a greater opportunity for large-scale outbreaks of disease and other health issues. However, environmentally controlled housing production systems (indoor production) are more biosecure against diseases due to the HEPA filters typically placed on air intakes in the ventilation systems; these filter out infectious pathogens that are harmful to the animals. Thus, the animals are not exposed to harmful pathogens that are often spread through open air (37-38, 40-45).

- First-time exposure to diseases for all animal species (i.e. introduction via changing the location of an existing production system) can lead to catastrophic results when the animals have little or no immunity to a new pathogen (44).

- Significant progress has been made regarding the use of antibiotics in food animals. Of particular note is animal use of antibiotics that have human applications, which may contribute to the spread of antibiotic resistant microorganisms. Historic cooperation between animal and human health groups led to the US's 2018 elimination of non-therapeutic use of antibiotics in animal production; as a result, veterinary prescription is now required for any antibiotics use in animals. This should improve animal and human health groups' ability to more effectively deal with antibiotic resistant diseases, including those whose spread is caused or exacerbated by changing climates (46).

- The American Veterinary Medical Association (AVMA) offers significant information on maintaining animal health, and will continue to play an increasingly important role in providing management as well as therapeutic support for dealing with "new" health issues.

Recommendations – Topic 2(e): "Improved Livestock Management Systems, including Agropastoral Production Systems and others"

1. **Production and Conservation Systems:**

   a. Emphasize and enhance public and private **coordinated** delivery of information and technology to support environmentally, economically sound sustainable animal production. Encourage appropriate integration of production to consumer linkages for maximum efficiency with changing climates.

   b. Promote and incentivize agropastoral and regenerative management practices that accommodate changing climate impacts on established grazing lands. Use all recommended practices to sustainably manage existing grazing lands and pastoral systems used in animal production.

   c. Develop and apply management practices which minimize impact of wildlife transfer of disease vectors to food animals.

   d. Adapt operations for increases in intensity and duration of heat waves suggested by climate modeling. Heat stress can be addressed by altering rations from forage to other feed, increasing available shade, developing and using new facilities with greater climate control capabilities, making additional fresh, clean water available and improving watering systems to avoid water loss and increase water consumption and reuse.

   e. Establish standards, guidelines and certification schemes that enable climate adaptation and mitigation solutions.

2. **Payments for Ecosystem Services:**

   a. Use carbon credits as a mechanism to fund and promote regenerative grazing practices.

b. Support the development of quantified ecosystem benefits and a voluntary, market-based, private-sector funding mechanism/incentive for ecosystem services.

c. Move to adjust agricultural cost assistance (via combined international support, public good investments, payments to producers, international trade policy in a carbon-conscious future market, and other mechanisms) towards incentivizing climate adaptation and mitigation in the livestock sector and the broader food system. Take forward recommendations for scaling up and mainstreaming CSA, improve opportunities for leveraging further agricultural investments.

d. Provide tax incentives for ranchers who adopt conservation Best Management Practices (BMPs) and other emission and runoff mitigation practices on farm.

e. Authorize tax incentives or transferable tax credits between landowners who own the land and producers who lease the land. Allow for an exchange of tax credits for climate mitigation best management practices.

f. Permit the sale of ecosystem credits generated by farmer or rancher actions on public lease land resulting from private actions.

3. **Research:**

a. Support and encourage system-level, integrated research on livestock climate risks; adaptation innovations; the economic value and effectiveness of animal agriculture CSA production practices; decision-making at farm and landscape level management, and methods to align market incentives with desired environmental practices and outcomes.

b. Involve farmers and stakeholders in continuous purposeful multi-directional stakeholder-research-outreach-extension relationships to ensure research reflects the dynamic nature of shifting animal agriculture systems under climate change and stakeholder real-life priority challenges and opportunities.

c. Invest in research for technology and management tools aimed at more efficient application of manure fertilizers and other crop inputs, such as precision equipment and research in animal feed that is aimed at reducing livestock emissions; public breeding programs to provide farmers with regionally adapted seeds and practices; and energy and emissions reduction practices and technologies.

d. Assess potential mitigation and adaptation practices for agricultural grazing lands, with a focus on forage quality improvement and soil health, and work to determine their economic viability, potential to maintain or intensify agricultural production, and carbon sequestration potential.

e. Pursue new climate mitigation options for livestock producers, including manure analysis and the use of manure to sequester carbon and improve soil health as well as new approaches to livestock feed management and feed amendments that reduce enteric emissions, subsequently reducing greenhouse gas emissions from livestock production.

4. **<u>Animal Health:</u>**

a. Focus research priorities on newly emerging and zoonotic diseases appearing as a result of changing climates. Include both food animals and wildlife in investigations to minimize transmission.
b. Identify animal disease vectors appearing in new geographies and contexts due to climate change. Develop management practices for producers and partnerships with wildlife management groups to facilitate disease vector control where possible.

c. Emphasize and support (public and private) genetic assistance in disease control through development of rapid-result, highly specific field tests for identification of diseases based on genetic markers. Develop therapeutics for disease control based on targeted and specific genetic components of disease vectors.

d. Develop and deploy rapid, specific, easy-to-use field tests for livestock diseases to enable efficient control of disease outbreaks.

e. Develop new antibiotics for food animal use in classes that are not used for human medicine.

f. Develop tools to assist in the prediction of disease transmission to more effectively implement management and control strategies.

5. **<u>Infrastructure:</u>**

a. Plan proactively to relocate or pursue alternatives for animal production facilities residing in areas newly classified as floodplains due to a changing climate. Public funding will be required to support expensive relocation processes; plans must be developed with participation from livestock managers well in advance of any need to relocate.

b. Implement innovative facility adaptation for extreme weather events. The facilities not within floodplains – or which otherwise can or will not relocate due to climate shifts – should be hardened to better withstand forecasted extremes, including modifications to waste storage (retrofitted manure storage for heavier/more frequent storm events, etc.).

c. Control confinement facilities for anticipated temperature/humidity increases. Where changing climates result in these increases, confined facilities will require much more significant environmental control to maintain biosecurity, animal health and welfare, and productivity. Public and private development of appropriate technologies will be needed.

6. **<u>Risk Management Strategies:</u>**

   a. Support and encourage system-level, integrated research on livestock climate risks; adaptation innovations; the economic value and effectiveness of animal CSA production practices; decision-making at farm and landscape level management, and methods to align market incentives with desired environmental practices and outcomes.

   b. Explore diversification strategies for those animal agriculture operations which may benefit. Diversification may be of use as a "hedge" against irregularities or uncertainties due to climatic change extremes. This will not be an option for all, but if carefully planned (from both an investment and labor standpoint) may be successful.

   c. Enable, make available and advance genetic selection tools allowing producers to implement targeted and significant changes in animal traits towards specific production goals. Targeted trait selection for adaptation to elements of climate change, disease resistance, produced product composition, etc., is becoming possible and will become steadily more available. Careful planning is required to make genetic selections which may lock the resulting alterations into a total population. Advice and appropriate risk assessment from experts specialized in genetics is essential to plan implementation.

7. **<u>Knowledge Sharing and Decision-making/Capacity Building:</u>**

   a. Integrate the results of research, farmer experiences and their articulated needs, and technology investments to develop accessible, pragmatic, and affordable decision-making approaches that utilize the range of low, mid, and high-tech tools and strategies, as well as effectively connect land managers at farm and landscape scales with data, knowledge and resources.

   b. Incentivize the development of tools, technologies, information and training that enables farmer decision makers to address complex farm-level and landscape-scale challenges (exacerbated by climate risks) and balance management for production, profitability and ecosystem integrity.

   c. Implement institutional processes for governments and other bodies to reevaluate and adjust policies and regulations based on producer input (54). Create and facilitate effective feedback mechanisms to alert policy makers to changing conditions, conflicting and ambiguous regulations, and unduly burdensome bureaucratic paperwork; expedite policy updates that improve farmer decision making and uptake of innovative sustainable production approaches.

   d. Involve and incentivize government, the private sector, and civil society collaborations to encourage agriculture and its value-chains to innovate and develop efficient, effective products in support of agricultural and ecosystem co-productivity.

8. **Clean Energy, Methane Capture and Conversion Investment:**

   a. Continue development of cost-effective technologies to capture energy from animal waste streams using anaerobic digestion, biofuel production and other technologies which **enhance carbon recycling and renewable energy production** from animal agriculture.

   b. Expand operational renewable natural gas production and methane recovery (either direct as scrubbed biogas to pipeline quality or generation of electricity) from livestock operations, crop production and other industries which produce organic waste. Mechanisms available include making further funding and educational opportunities available through government programs, enabling ag/energy industry partnerships and adding compliance targets for organic waste to renewable energy portfolio standards.

   c. Develop regionally appropriate renewable energy sources and technologies, as well as production of fuels and fertilizers from renewable energy sources.

Topic 2(f): Socioeconomic and food security dimensions of climate change in the agricultural sector"

Agricultural production is a food security issue, a livelihood strategy, and a valued export sector that contributes to healthy national economies (55). Local and global changes in climate and increased variability and extreme weather events present serious threats to agricultural production in North America and worldwide. The capacity of agriculture to withstand changes in climate, adapt and innovate has implications for the types and magnitude of cascading shocks that affect food security and rural livelihoods.

According to the United Nations, 10% of the world's population is estimated to live in extreme poverty (56). This average masks extreme variations in poverty, food insecurity and malnutrition in specific populations and geographies. Worldwide, the rural poverty rate is 17.2%, three times higher than in urban areas; almost 13% of people in developing countries are undernourished, and poor nutrition causes 45% of deaths in children under five.

Food security entails food availability with individuals, households, local and national populations having access to sufficient, nutritious, safe food; clean water and sanitary conditions to prepare food; and a stable food supply without regard to chronic and cyclical shocks (55, 57-58). *Low food security* represents conditions in which individuals and households may need to make trade-offs between basic needs (such as housing or medical expenses) and purchasing nutritionally adequate foods, resulting in degraded diet quality. *Very low food security* means individuals and households are consistently living with malnutrition and hunger and missing meals on a regular basis (59-60). *Accessible* food implies all of the following: that food can and has been produced, marketed, transported to where it needs to go and distributed; and that compensation is given for work done at every point in this supply chain, including that of end consumers who may not produce food yet must eat.

Agriculture provides livelihoods for 40% of the world's population and is the largest source of income for poor rural households, with almost 80% of food consumed in developing countries produced on small farms (56). **Livelihoods** are the economic and non-economic self-reliance strategies people use to survive and thrive (61). Agricultural livelihood survival strategies are grounded in the local natural resource base; knowledge, experience and skills; and the social relationships and institutions that mediate access to markets, assets and income streams (55, 61). In developing countries and rural economies agriculture is a primary driver of social and economic organization: either providing a subsidence living through smallholder production of fruits, vegetables, grain and livestock, or supporting access to broader markets and regional infrastructure and remunerative labor opportunities related to the sale, marketing, and manufacturing of crops or commodities and their byproducts (including energy).

National and global markets, tariffs, regulations and public policies affect food imports and exports, balance of trade, and the growth and stability of national economies. Local and global food **systems** consist of many components and interacting complex systems from farm-level production to diverse matrices of value chains and infrastructure encompassing product aggregation, processing, and distribution that move products from farm to market to consumer households (3). *Infrastructure* includes arable land, labor, equipment, slaughterhouses, produce terminals, auction houses, cooperatives, and direct and indirect marketing to consumers carried out by agricultural businesses and entrepreneurs at many scales from large-medium-small food corporations, food hubs, farm stands and local wholesale and retail markets. Each node in the food system can be affected by weather events and long-term climate shifts. How that node responds can result in new opportunity, economic disaster, or net neutral stability to the node itself and cascading effects to connecting systems, upstream producers and suppliers of food and downstream consumers dependent upon availability and access to quality, safe, nutritious foods.

Climate change threatens this and other presentations of agricultural economic viability, and thus socioeconomic and food security outcomes, on every landscape and at every scale. Shifts in weather patterns – both short-term, as in greater incidence of severe precipitation or freezing events, and long-term, as in changing nighttime or average temperatures at different times of year – alter what livestock and crops can be grown in what places, how intensely they can be produced, and the nutritive value of food crops. Land use changes may be necessary to sequester carbon, provide a buffer or avoid flooding in coastal or high-precipitation areas, or otherwise avoid or mitigate disasters. As production systems develop there are also tendencies towards consolidation and/or, alternately, a need for increased inputs to growing systems to increase productivity. This increases efficiency of land use, but may also increase environmental degradation, reducing the land's capability to support further intensification, deliver services unrelated to production, and withstand natural disasters and other climate-related shocks.

Farmers across the world face a complex and difficult question: how to co-produce food systems that provide food security and quality nutrition, rural livelihoods that are economically viable, and healthy soil, water and other ecosystem services under an increasingly uncertain and changing climate. A number of **Sustainable Development Goals (SDGs) of the United Nations** are inextricably linked to the agricultural sector of developed and developing countries. Three high-profile examples – **no poverty, zero hunger,** and **climate action** – are directly addressed by the scalable solutions agriculture has potential to provide (56). Producers in both developing and developed countries share the common challenge of how to make a living that not only assures food security, but also provides quality of life and well-being. US specialty crop grower and Solutions from the Land Co-Chair AG Kawamura puts it this way: "Agriculture must thrive if the SDGs are to be met – ending poverty and other deprivations, improving health and education, reducing inequality, and spurring economic growth – all while tackling climate change."

Pursuit of these end goals requires that pathways be considered less as separate initiatives, but as a holistic vision of agriculture and forestry: a higher-efficiency, more productive, more profitable **model** at both macro and micro scales. One vision of this model positions *priority results to shift food system returns* as **outcomes**, while *building the underlying capacity of producer communities* (to both buy into and act to obtain these returns) are **process and action steps**. Examples of outcomes that can shift food system returns towards food security include increased growth of fresh fruits, vegetables, and food-grade grains; diversified production, processing, marketing and distribution supply chains at levels adequate to fortify local resource networks and economies; and appropriate valuation and incentives for climate resilience and risk management and enhanced conservation of terrestrial, freshwater and marine ecosystems. Examples of capacity building processes and actions include developing and integrating place-based strategies for intensified production of the maximum viable range of unique agricultural products; creating policy around economically sustainable, facilitated regional food system access for elder, youth and limited income residents; removing siloed decision-making at the government rather than producer level by integrating multi-stakeholder partnerships with landscape-scale planning and implementation; responding through research to producer-identified requirements for SDG attainment; and improving the technology and infrastructure, forecasting and adaptive management strategies accessible to producers as they plan their production.

Centering agricultural voices as expert leaders prioritizes producer feedback on the economic viability of outcomes and practicability of process and action steps. Empowering farmers to pinpoint the capacity gaps that prevent their innovation and response to external operational challenges ensures greater stakeholder buy-in to identified pathways and fewer overall barriers to implementation. Furthermore, it honors the contributions of producers – through ensuring profitability and recognition for the social value of addressing SDGs – and thus keeps farmers and their families on the land, providing necessary services.

In many cases, policy frameworks have not yet been harmonized nor information networks built to effectively enable this vision. As a preliminary first step, it is important to recognize that testing and adopting new techniques represents significant financial risk on the part of producers, and that the market has not fully priced in the value of many integrated management answers to SDGs provided by agriculture and forestry. Climate challenges will continue to threaten the implementation of food security and socioeconomic outcome steps until capacity is put into place to make climate and other solutions from agriculture desirable, available, affordable and achievable for farmers at all scales; and action steps identified to ensure climate resilience, equitable economic development and food security alike.

<u>Recommendations – Topic 2(f): Socioeconomic and food security dimensions of climate change in the agricultural sector”</u>

Facing a changing and uncertain climate, the need for strategies to create new options and opportunities for farmers, agriculture, and consumers has never been greater (60). NACSAA supports three key outcomes and proposes the following process and action step components to address socioeconomic and food security dimensions of climate change in the agricultural sector:

<u>Key Outcomes</u>

1. Reduce hunger and improve nutrition by supporting the production of fruits, vegetables, animal proteins, and food-grade grains for human consumption.

2. Create jobs and generate economic growth by diversifying and sustainably intensifying production and processing of food, feed, fiber, and renewable energy.

3. Augment ecosystems services to improve the environment, enhance the resilience of agricultural and forested landscapes and improve the farmer's bottom line under a changing and uncertain climate.

<u>Priority Process and Action Steps</u>

1. **Develop and enable diversified and sustainable intensification production strategies** appropriate to different geographies, cultures and a wide variety of farm types and scales to produce high quality protein, grains, and fruits and vegetables and reconnect production processes that reintegrate livestock, aquaculture, and crop agriculture as systems to better recycle nutrients.

    a. Develop local and landscape scale solutions and partnerships that use climate-smart agriculture strategies to create productive and diverse food systems under uncertain and variable weather and climate conditions so as to produce abundant, nutritious, safe foods; quality livelihoods; and ecosystem sustainability.

    b. Encourage financing, land availability, training and skill development on systems approaches, new technologies, and mentoring opportunities for producers including low resource farmers, women, new farmers, and young people.

    c. Invest in systems research and outreach education focused on diversification and sustainable intensification that is productive, profitable, and promotes a healthy environment.

d. Promote a greater variety of grains that can improve diet quality, diversify production incomes, and improve soil health and reduce field runoff.

2. **Create private activities and public policies that incentivize markets and food system distribution infrastructure** to ensure food access to low income households and vulnerable populations (e.g. elderly, youth, disabled), benefit all scales of production and provide profitable agricultural livelihoods.

   a. Evaluate and incentivize public and private local and regional supply chains, processing and marketing infrastructure to realize potential growth that can reduce food insecurity while creating jobs and strengthening local economies.

   b. Develop "certainty" or "reasonable assurance" processes and risk-mitigation tools to support or create market drivers for public goods and ecosystem services.

   c. Connect local food production to local markets and advocate for advantageous wholesale prices and distribution networks to keep rural food dollars in rural communities and increase local resources.

   d. Strengthen access to credit and a safety net for producers exposed to natural disasters, extreme weather and climate disruptions to production, and crop failures.

   e. Develop policy frameworks that support new markets for climate-adaptions that produce quality ecosystem services and that create economic incentives for sustainable management of forests, coastal waters, lakes and rivers and other natural resources.

   f. Adopt policies that promote public-private partnerships and optimize public and private investments that support food security, jobs, and rural livelihoods.

   g. Devise policy frameworks that promote and assist voluntary, locally led, incentive-based conservation efforts which may vary by country, region, and conservation districts to avoid "one-size-fits-all" policies.

   h. Incorporate sufficient value into sustainable supply chains to compensate producers for risk, management, production, and verification costs related to sustainability outcomes.

3. **Use evidence-based and people-centered approaches** that reflect the concerns of producers and multiple stakeholder groups to implement landscape scale solutions and partnerships (3).

   a. Actively and systematically involve agricultural producers; encourage and equip producer leaders to give voice to concerns about climate disruptions and co-jointly seek solutions to the opportunities and challenges related to logistics and economics of production, ecosystem services, and marketing; as well as priority research, technologies and policy needs.

b. Promote policies, technologies, innovations and systems approaches that are consistent but flexible and reflect different priorities across regions, agriculture systems, socioeconomic, and individual and population nutritional health and well-being contexts.

c. Develop and harmonize policy approaches that monitor, evaluate, and have self-correcting potential to avoid unintended impacts on poverty, food security, livelihoods and other UN SDG goals.

d. Mobilize broad stakeholder coalitions at appropriate landscape levels (watershed, county, region, etc.) to develop solutions and advance land use and management policies in support food security and rural livelihood goals.

4. Energize and integrate systems agricultural research with SDG goals.

a. Adopt integrated research agendas centered on advancing a systems approach to co-producing healthy, nutritious foods; rural livelihoods; and ecosystem services with a focus on real-life practical applications to decision makers and end-users.

b. Empower a designated research council or overarching organization to set a research agenda that cuts across agricultural and forestry land uses and UN SDGs goals.

c. Prioritize research and development that will:
   (1) Ensure the science is accessible and contains feedback loops for decision makers, consumers and producers of food, the agricultural value chain, the policy community, funders, and private sectors.
   (2) Employ a systems approach to research, cross-disciplinary and across various scales of inquiry.
   (3) Promote basic research in natural and social sciences that are foundational to the actionable science, analysis, and models necessary to lead to widespread adoption of evidence-based solutions.
   (4) Lead to localized management that captures regional and local knowledge and conditions and simultaneously stimulates effective, cost neutral or profitable adaptive management approaches in the face of climate and market uncertainties.
   (5) Inform the development of policy and market forces that incentivize the adoption of sustainable working lands management practices and UN SDGs goals zero hunger, no poverty, improved livelihoods, and secure local and national food systems.

d. Create a new emphasis on development designed to get research out of the lab and onto the land as rapidly as possible.

5. **Transform and modernize information networks.**

   a. Empower local and national governments to catalyze public-private partnerships between Internet providers, research institutions, data managers and precision ag technology providers to make available and provide access to all scales of producers, enabling them to fully utilize modern agricultural equipment and technologies that minimize input costs and maximize productivity.

   b. Incentivize these partnerships and other information sources to use public sector networks to support education and decision making. Provide land grant universities, research institutions and governmental extension offices, technical service providers, and other entities with broad access, information infrastructure and resources to in turn make available a body of climate-related, watershed-specific producer decision tools to inform planning and adoption of adaptive management practices and projects.

   c. Encourage and give producers and other stakeholders opportunities to experiment with and incorporate tech trials and precision agriculture infrastructure into existing farm systems via funding-grants and loans. Provide local level training and feedback mechanisms in technology options, ease of use and system integration potential as well as costs of implementation.

   d. Improve access to information that is available to producers; create a science-based, scale-responsive information network for producers across farm sizes and production types within the land management community to serve the needs of producers.

   e. Develop and coordinate systems for communication for a spectrum of landowners and managers and their production systems.

NACSAA
NORTH AMERICA CLIMATE SMART AGRICULTURE ALLIANCE

North America Climate Smart Agriculture Alliance Partners (2020)

- 25x'25 Alliance
- Advanced Biofuels USA
- Agricultural Retailers Association
- American Coalition for Ethanol
- American Farm Bureau Federation
- American Farmland Trust
- American Seed Trade Association
- American Society of Agricultural and Biological Engineers
- American Society of Agronomy
- American Soybean Association
- Association of Equipment Manufacturers
- Association of Public and Land-Grant Universities
- Bayer
- Biotechnology Innovation Organization
- Business for Social Responsibility
- Canadian Federation of Agriculture
- Canadian Forage and Grassland Association
- Council for Agricultural Science & Technology
- Cater Communications
- Center for Climate and Energy Solutions
- Conservation Technology Information Center
- Cornell Institute for Climate Smart Solutions
- Crop Science Society of America
- CropLife America
- Cultivating Resilience
- EcoAgriculture Partners
- Environmental and Energy Study Institute
- Environmental Defense Fund
- Farmers Conservation Alliance
- Family Farm Alliance
- Farm Foundation
- Farm Journal Foundation
- Farm Management Canada
- Fertilizer Canada
- Field to Market
- Florida Climate Institute (FCI)
- Genscape Inc. Un of Illinois Chicago
- ILSI Research Foundation
- Innovation Center for U.S. Dairy
- Iowa Soybean Association
- Iowa State University
- Irrigation Association
- Kellogg Company
- National Association of Conservation Districts
- National Corn Growers Association
- National Farmers Union
- National FFA Foundation
- National Pork Producers Council
- Native Pollinators in Agriculture Project
- OCP North America, Inc.
- Ontario Federation of Agriculture
- Soil and Water Conservation Society
- Soil Health Institute
- Solutions from the Land
- Southeast Climate Consortium (SECC)
- Sustainable Corn Coordinated Agriculture Project
- Syngenta
- The Fertilizer Institute
- The Mosaic Company
- The Samuel Smith Noble Foundation
- The Toro Company
- United Nations Foundation
- United Soybean Board
- University of Florida
- U.S. Department of Agriculture
- U.S. Farmers & Ranchers Alliance
- Western Growers Association
- World Business Council for Sustainable Development
- World Wildlife Fund

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