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UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

Subsidiary Body for Scientific and Technological Advice

Forty-fourth session
Bonn, 16–26 May 2016

Item 5 of the provisional agenda
Issues relating to agriculture

Views on issues relating to agriculture

Submissions from Parties and admitted observer organizations

1. The Subsidiary Body for Scientific and Technological Advice (SBSTA), at its fortieth session, invited Parties and admitted observer organizations to submit to the secretariat, by 9 March 2016, their views on issues relating to: (1) the identification of adaptation measures, taking into account the diversity of the agricultural systems, indigenous knowledge systems and the differences in scale as well as possible co-benefits and sharing experiences in research and development and on the ground activities, including socioeconomic, environmental and gender aspects; and (2) the identification and assessment of agricultural practices and technologies to enhance productivity in a sustainable manner, food security and resilience, considering the differences in agroecological zones and farming systems, such as different grassland and cropland practices and systems. The SBSTA requested the secretariat to compile the submissions into a miscellaneous document for consideration at SBSTA 44.[1]

2. The secretariat has received nine such submissions from Parties. In accordance with the procedure for miscellaneous documents, these submissions are attached and reproduced* in the language in which they were received and without formal editing.[2]

3. In line with established practice, the 3 submissions received from intergovernmental organizations and the 12 submissions received from non-governmental organizations have been posted on the UNFCCC website.[3]

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[1] FCCC/SBSTA/2014/2, paragraph 87.

* These submissions have been electronically imported in order to make them available on electronic systems, including the World Wide Web. The secretariat has made every effort to ensure the correct reproduction of the texts as submitted.

[2] Also available at <http://unfccc.int/5901.php>.

[3] <http://unfccc.int/7482.php>.

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* This submission is supported by Bosnia and Herzegovina, Montenegro, Serbia and the former Yugoslav Republic of Macedonia.

Paper no. 1: Argentina

UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE (UNFCCC), SUBSIDIARY BODY FOR SCIENTIFIC AND TECHNOLOGICAL ADVICE (SBSTA)

ISSUES RELATED TO AGRICULTURE

Following the conclusions of the 40th session of the Subsidiary Body for Scientific and Technological Advice (SBSTA) contained in document FCCC/SBSTA/2014/L.14 of June 2014 and taking into account the conclusions of SBSTA 38, Argentina appreciates the opportunity to submit its views on the following matters:

a) Identification of adaptation measures, taking into account the diversity of the agricultural systems, indigenous knowledge systems and the differences in scale as well as possible co-benefits and sharing experiences in research and development and on the ground activities, including socioeconomic, environmental and gender aspects. FCC/SBSTA/2014/2.
b) Identification and assessment of agricultural practices and technologies to enhance productivity in a sustainable manner, food security and resilience, considering the differences in agro-ecological zones and farming systems, such as different grassland and cropland practices and systems. FCC/SBSTA/2014/2.

Both issues will be addressed in the workshops organized in the context of SBSTA 44 in 2016. For this reason, below there are elements which could be useful for them and the preparation of reports on both workshops (to be addressed in SBSTA 45, together with the reports of the two previous workshops held in June 2015 within the framework of SBSTA 42).

In general terms, Argentina reaffirms the contents of its earlier communications and interventions on this area, as well as its support to presentations by the G77 plus China in previous sessions of the SBSTA. In particular, we would like to stress the need to consider at SBSTA the special vulnerability of the agricultural sector to the adverse impacts of climate change, taking into account as a general framework the principles and provisions of the United Nations Framework Convention on Climate Change (UNFCCC).

Today, according to the IPCC, there is sufficient evidence that climate change is increasing the frequency and intensity of extreme climate events. Latin America and the Caribbean is a region particularly vulnerable to these phenomena, which severely affected the region in recent years. This impacts on the development of agricultural production systems. Therefore, any measure to be taken in order to mitigate the effects of climate change should necessarily consider and respect the specific national, regional and local conditions under which such production systems are implemented.

In that context, agriculture is one of the sectors most affected by the phenomenon of climate change, which is of grave concern considering that this very sector at the same time serves the fundamental and priority purpose of protecting food security. Such a crucial role and such a delicate balance have been safeguarded in the Paris Agreement achieved by UNFCCC Members in December 2015 (COP21). Also, it should be recalled, in accordance with the agreement reached in COP21, that it will be needed to ensure that food production is not threatened. This role of agriculture becomes even more significant if it is also considered that the sector is of critical importance to economic and social development and the eradication of poverty, since a large part of the population of many developing countries depend on agriculture for subsistence.

In this sense, Argentina has committed itself to increasing its food supply to the world, so that it moves from feeding 400 million people at present to feeding 680 million people in 2020, thus substantially contributing to the achievement of world food security. Responding to the challenge of satisfying the needs of today's world inevitably requires to increase food production, which, as previously said, will have to be done under changing climatic conditions.

Taking all these matters into account, it is undeniable that the agricultural sector needs to be strengthened including by increasing national capacities and international cooperation for technology development and transfer, for the improvement of the adaptive capacity of agricultural systems so that they can continue meeting the food needs of today's world.

Considering the foregoing, Argentina finds it necessary to continue advancing technical and scientific work in the SBSTA, in order to take the adaptation measures required to prevent and minimize the adverse impacts of climate change on the agricultural sector, thus contributing to social welfare, economic development and the alleviation of hunger and poverty.

As a contribution to the discussions in the workshops to be held at SBSTA 44, some national experiences and programs being implemented in Argentina to meet the challenges of the agricultural sector posed by the adverse impacts of climate change are provided below.

ADAPTATION MEASURES, TAKING INTO ACCOUNT THE DIVERSITY OF THE AGRICULTURAL SYSTEMS, INDIGENOUS KNOWLEDGE SYSTEMS AND THE DIFFERENCES IN SCALE AS WELL AS POSSIBLE CO-BENEFITS AND SHARING EXPERIENCES.

The Ministry of Agro-industry works on the development of productive initiatives and strategies in the area of adaptation to climate change, especially promoting and generating knowledge and technological improvements, including:

Adaptation and resilience of family farming in the Northeastern region of Argentina (NEA) in the face of the impact of climate change and its variability.

Funded by the Adaptation Fund, this project is intended mainly to enhance the adaptive capacity and resilience of small producers in the face of the uncertainty caused by variations between floods and droughts, temperature changes and isohyet movements as a result of climate change. Its lines of work include research to evaluate the impact and the variability of the phenomenon in the Northeastern region of the country.

It should be stressed that this initiative is also part of the strengthening of information systems, the monitoring and management of climate information, training on productive management optimization and the implementation of water access systems through groundwater and rainwater harvesting, as well as the storage, treatment and distribution of water for domestic and productive consumption.

Increasing climate resilience and improving sustainable land management in the Southwestern region of the Province of Buenos Aires.

Also funded by the Adaptation Fund, this project is aimed at reducing the vulnerability of ecosystems to desertification processes caused by climate change in agricultural systems of the Southwestern region of the Province of Buenos Aires. To this end, it seeks to implement sustainable land management with the purpose of preserving and strengthening the ecosystem functions of regulation and provision. On the other hand, it is intended to create a strengthened institutional framework that is appropriate to deal with the negative impacts of climate change as well as to promote the adaptation of the productive sector.

Research program on climate risks, impacts, vulnerability and adaptation.

The National Institute of Agricultural Technology (INTA) has a research program to deepen the knowledge about climate patterns in the different regions, which is essential for planning activities leading to achieve more sustainable production and to ensure the livelihood of their producers.

Rural territorial planning

Between 2011 and 2013, the Project "Strengthening of Capacities Allowing to Deal With Rural Territorial Planning Processes" was carried out together with the United Nations Food and Agriculture Organization (FAO), carried out the project "Strengthening of capacities that allow the processes of Rural land use in participatory and interactive way". In its context, stakeholders were trained in the methodological aspects of territorial planning and the design of a territorial plan for the district of Tunuyán in the Province of Mendoza. Also, training was provided in the implementation of this issue in different provinces of the country. This approach has contributed to core aspects of climate change adaptation and a search for greater efficiency in productive systems.

There are also other projects being developed in the area of rural territorial planning. For example, the Agricultural Risk Office of MINAGRO worked on obtaining geo-referenced maps of areas that are fit (optimal, suboptimal, regular, marginal) and unfit for particular agricultural activities, with specification of the nature of the observed limitations, taking into particular consideration the climate-related limitations.

Actions regarding the spread of pests.

The National Health and Agri-Food Quality Service (SENASA) is building capacities for the collection of monitoring data on pests or adverse climatic conditions which extend as a result of changes in temperature and precipitation patterns and affect the vulnerability of agricultural systems. In particular, there are specific programs for the monitoring of soybean rust, the development of citrus zones in the Northern region of the country, and the phytosanitary surveillance of fruits and vegetables in Patagonia.

Early Monitoring and Assessment of Desertification.

Arid, semi-arid, and dry sub-humid areas represent 75% of the total area of the Argentine Republic. For this reason, the National Action Program to Fight Desertification monitors and assesses the effects of deterioration, desertification and drought, in order to contribute to the planning of strategies for the achievement of the sustainable development of the affected areas. Work is also being conducted on the establishment of a national environmental information system, which is a central element in the strategy to fight desertification and is therefore valuable for communities located in areas vulnerable to this phenomenon, especially in view of the potential climate change effects on the territory.

National System for the Prevention and Mitigation of Agricultural Emergencies and Disasters (Law 26,509).

In the event of climate disasters and emergencies, a state of emergency is declared, and strategies are adopted to: financially assist victims for the reconstitution of the productive apparatus, control and monitor the welfare system so that the resources allocated are used for the proposed purposes, assist farmers to reduce losses during the emergency or agricultural disaster in order to recover the capacity of production systems, and reduce vulnerability to future events.

For example, in February 2016, the Ministry of Agro-industry declared a state of agricultural emergency in six provinces of the country (La Rioja, Corrientes, Santa Fe, Chaco, Córdoba and Entre Ríos) with the implementation of the above strategies. Specifically, some regions in southern Cordoba that suffered great losses as thousands of hectares went under water due to heavy rain. This law grants tax exemptions and credit benefits to producers who suffered crop and yield damage.

Agricultural Weather information systems.

INTA has a network of automatic weather stations for keeping records and files on agro-climatic variables. There are now 150 operating agricultural weather stations. Also, stations record data on climatic variables, which, after being processed, are included in maps with their respective indices and values. Based on this, Argentina maps are designed representing the monthly rainfall and rainfall anomaly in a specific month, measured as a relative and absolute values, to obtain from extremely relevant data such as intra-annual rainfall variability, data of great importance in the design of measures for adaptation climate change and risk reduction.

Commission on Climate Change for Agriculture, Livestock, Fisheries, Food and Forestry.

The Commission was created in 2014 under the Ministry of Agro-industry. It consists of different areas of the Ministry and its decentralized agencies with competence in the area of climate change.

The Commission is intended to assist, coordinate and propose actions and tools to address the causes and effects of climate change on agriculture, livestock, fisheries, food and forestry at the national level. It is made up of five groups of work ad hoc on the following topics: adaptation, mitigation, UNFCCC work, observatory of impacts and greenhouse gases, and diagnosis (a horizontal group).

PRACTICES AND TECHNOLOGIES TO ENHANCE PRODUCTIVITY IN A SUSTAINABLE MANNER.

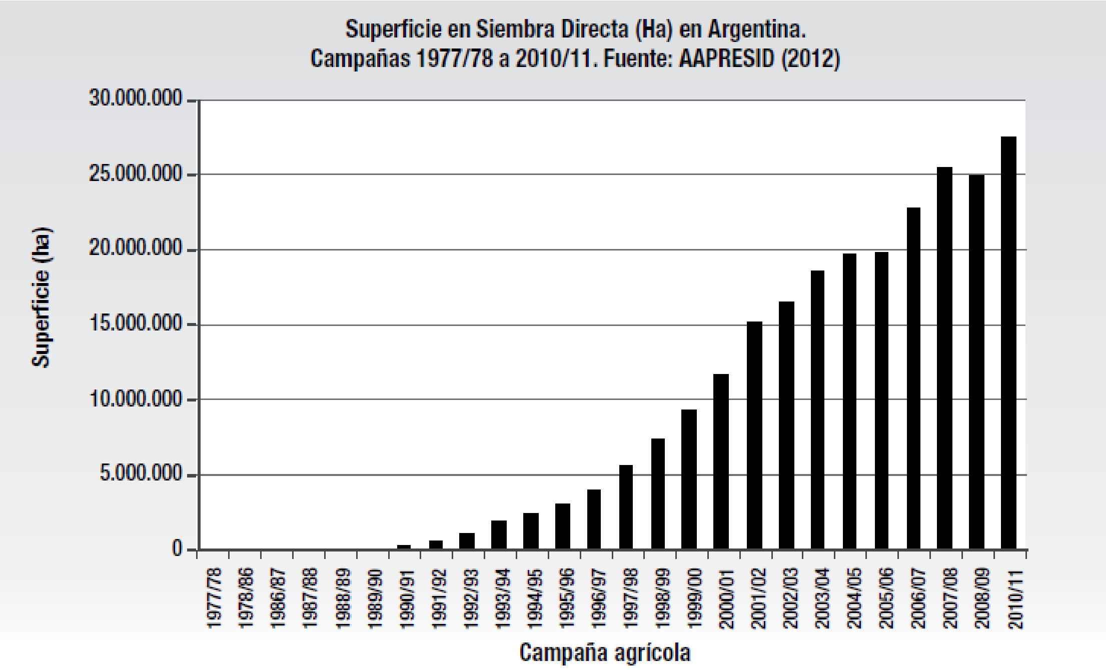
In recent decades, the agricultural sector has adopted several soft and hard technologies in order to face the adverse effects of extreme climate phenomena such as droughts, floods and the increase of salinity in soils. There follows a description of strategies widely used in Argentina.

No-till farming

This system is widely used in Argentine agriculture (more than 80% of the area) and is intended to keep plant debris on the soil surface in a country where climate changes deepen the effects of water and wind erosion.

No-till farming is an “environmentally virtuous” practice since not turning over the soil makes it possible to preserve plant debris, which helps to stop erosion. This represents an important step in the efforts to increase agricultural production in a context of fight against food insecurity.

In that sense, it is important to highlight the work carried out by INTA and public-private associations in the development of awareness-raising and training activities with the purpose of reversing the process of soil degradation and improving the sustainability of grain production, thus promoting the reduction of the impact of some extreme events.



Development of genetically modified varieties

Argentina has extensive scientific knowledge about varieties which are adapted to water, thermal and saline stress, knowledge that is reflected in national programs that allow to spread technologies and, subsequently, to learn about the results of their application. Biotechnology offers new strategies to provide resistance to different pathogens through genetic engineering. These strategies are safe both for people and for the environment and are considered to have no material cost of use.

In that sense, Argentina has developed genetically modified varieties which optimize their performance with approaches that differ according to the new agro-climatic limitations; for example, they are adapted to water/thermal stress or adapted to different pests (since modifications in rain patterns create different agro-environmental conditions favoring the emergence of new pests and weeds as well as increasing the incidence of the existing ones).

Among the national biotechnological events obtained as a result of the technological innovation policies fostered by the Government, it is important to highlight drought-resistant soybeans, salinity-resistant soybeans, wheat varieties resistant to fusarium and to night thermal stress, and other varieties that have longer growth cycles (with higher photoperiodic sensitivity). Argentina also promotes the development of feed crops adapted to water and saline stress (alfalfa – program for the improvement of the tolerance to salinity under irrigation – tropical grasses such as gramas, buffels and others).

Water management systems

In Argentina, the irrigated area covers 2.1 million hectares. Irrigation is very important in arid regions as it contributes to increase their productivity. In this regard, Argentina has established the goal of creating a National Irrigation Plan to double the irrigated area. The increase of the irrigated area is mainly promoted in regions where rising temperatures are expected increasing the water demand for crops, which cannot be met by small rainfall increases (for example, in the Center and

Northern area of the Pampas region). Also, more efficient irrigation systems (drip irrigation) have been implemented in the Andean region.

Argentina also promotes the selection of annual crops with more efficient use of water to use in feed reserves, so as to improve their apparent efficiency as compared with perennial pastures.

2.4 Modifications in the sowing dates of crops

As a result of changes in temperature patterns, sowing schedules were modified to avoid stress periods. Late sowing strategies were adopted for corn to avoid thermal stress and summer drought. Also, sowing was advanced to take advantage of the longest periods free from frosts, making double cropping possible in some cases.

SBSTA PROPOSED WORK

Taking into account the above, some of the issues that, in our view, could continue to be studied from the scientific and technological point of view in the SBSTA are the following:

- Study on the impact of climate change on pests and diseases as well as well as weed distribution, which affect different production systems
- Obtaining germplasm adapted to thermal and water stress, in crops such as wheat, rice and maize
- Identification of specific technologies being used or developed with special emphasis on the analysis of the economic, technical, institutional, social, and environmental barriers that prevent or delay local development or transfer of identified technologies, and the evaluation of potential technological alternatives
- Strengthening the implementation of national plans for climate change
- Implementation of a website listing adaptation actions implemented in each country and explaining them in detail for their replicability and knowledge.

Paper no. 2: Democratic Republic of the Congo on behalf of the least developed countries

LDC GROUP SUBMISSION ON ISSUES RELATING TO AGRICULTURE

This submission is made by the LDC Group in response to the SBSTA 40 (June, 2014) conclusions. The SBSTA, recalling Article 9 of the Convention, on the basis of the objective principles and provisions of the Convention, in accordance with decision 2/CP.17, paragraph 75, continued discussions and concluded that it would undertake scientific and technical work, taking into account the conclusions of SBSTA 38, in the following areas:

- (c) Identification of adaptation measures, taking into account the diversity of the agricultural systems, indigenous knowledge systems and the differences in scale as well as possible co-benefits and sharing experiences in research and development and on the ground activities, including socioeconomic, environmental and gender aspects;
- (d) Identification and assessment of agricultural practices and technologies to enhance productivity in a sustainable manner, and food security and resilience, considering the differences in agro-ecological zones and farming systems, such as different grassland and cropland practices and systems.

Recognizing that agriculture holds the key to LDCs' sustainable and rural development, a top priority on the global agenda now is how to feed the projected world population of nine billion by 2050. This task is especially formidable in LDCs, where close to 75% of the small scale farmers directly or indirectly rely on rain-fed agriculture and agro-pastoralism as a source of livelihood. LDCs' capacity to produce and secure food is likely to be challenged by limited adaptation measures, taking into account the diversity of the agricultural systems, indigenous knowledge systems and the differences in scale as well as possible co-benefits at regional, national, and local levels. There is limited experience on climate research and gender issues in relation to national development in the LDCs. Therefore, only sharing those limited experiences in research and development and on the ground activities, including socioeconomic, environmental and gender aspects would not help the LDCs much in attaining food security and rural development. There are also limited skills in the LDC food security arena in identifying and assessing agricultural practices and technologies that would enhance agriculture productivity in a sustainable manner, enhance food security and resilience, considering the differences in agroecological zones and farming systems. Thus, ensuring food security in LDCs requires urgent actions that would improve the production and productivity of agriculture systems and promote climate-resilient agriculture in a sustainable manner.

One most important factor in identifying and addressing adaptation measures in LDCs is the adequate provision of finance because adequate provision of finance is cross-cutting in all development spheres of the LDCs. For example, the UNEP *Africa Adaptation Gap Report*, released prior to the Warsaw climate conference in 2013 found that adaptation costs for Africa, which has a greater number of LDCs, alone could reach approximately US$350 billion annually by 2070 should the 2°C target be significantly exceeded, compared to US$150 billion lower per year if the target were met. Another UNEP study estimates that for South Asia, which also consists of many LDCs, the average adaptation cost could be as high as US$40 billion. The UNEP *Adaptation Gap Report (2014)*, on the other hand, highlights that Least Developed Countries and Small Island Developing States are likely to have far greater adaptation needs. Without early efforts to implement adaptation measures in these countries, the report continued, the existing adaptation gap will widen as greater financial resources will need to be committed later. Considerable opportunities abound in the LDCs for using existing knowledge (i.e. a combination of scientific and indigenous knowledge) on climate change and adaptation more effectively. For example, in The Gambia, some farm communities use their existing indigenous knowledge on wind speed and direction at the beginning of the rainy season to precisely gauge a drought year. If the wind speed is high and it moves in the West to East direction that means that drought could be expected in that year. So, the farmers would prepare to plant early so that their crops can mature early for harvest before drought sets in. This example of an indigenous knowledge could be blended with scientific knowledge to come up an Early-Warning Indicator that could be used to mitigate a drought season. In many LDCs, however, there is a lack of systematic identification and analysis of adaptation knowledge gaps. Therefore, integrating and interpreting scientific evidence in combination with indigenous knowledge from different sources and making it available to farmers and decision makers at all levels is one of the most important knowledge needs of the LDCs.

Identification and assessment of agricultural practices and technologies is crucial to enhance productivity in a sustainable manner, increase food security, and build community resilience. In the LDCs there is a need to accelerate the propagation and international transfer of agriculture practices and technologies to increase food security and enhance adaptation measures, many of which already exist. This requires governments to remove challenges to technology uptake, for example through provision of incentives, enactment of regulations, and strengthening of public and private institutions. Critical to the successful uptake of technologies for adaptation is their applicability beyond increasing resilience to climate change. The UNEP Adaptation Gap Report (2014) states that experience shows that it is easier to scale up the deployment of adaptation technologies when they meet a number of other human needs in addition to providing climate benefits. As an example of successful technologies, the same report looks at scientifically-developed seeds which can be used to sustain agriculture within the context of a changing climate—critical for most LDCs, given the dependence of large proportions of the LDC population on farming.

Recommendations

- The UNFCCC should create a repository of adaptation options, in relation to agriculture and food security, which can be integrated in development decisions by the LDCs.

- The international community should continue to promote and adequately provide financial support for research and development and gender issues with regard to sustaining food security in the LDCs.

- Consideration of knowledge gaps in relation to agriculture and food security should be integrated more explicitly in project and program appraisal and design to ensure that the knowledge produced responds better to user needs and identified knowledge gaps in the LDCs.

- The UNFCCC and the UNCCD may start working on how to strengthen synergies on (c) above by, among other things, taking measures and organize a scientific workshop to highlight issues of interest to the LDCs.

Finally, we note that it would be helpful for SBSTA to welcome the participation of some international organizations with work areas on the two mentioned-topics at the workshop to present more up-to-date scientific information.

Paper no. 3: Mali on behalf of the African Group

SUBMISSION ON ISSUES RELATED TO AGRICULTURE UNDER SBSTA

This submission is made by the African Group following the SBSTA 40 (June, 2014) conclusions that called for submission on issues related to agriculture in four areas. The SBSTA, recalling Article 9 of the Convention, on the basis of the objective principles and provisions of the Convention, in accordance with decision 2/CP.17, paragraph 75, concluded that it would undertake scientific and technical work, taking into account the conclusions of SBSTA 38, in the following areas:

> (c) Identification of adaptation measures, taking into account the diversity of the agricultural systems, indigenous knowledge systems and the differences in scale as well as possible co-benefits and sharing experiences in research and development and on the ground activities, including socioeconomic, environmental and gender aspects;

> (d) Identification and assessment of agricultural practices and technologies to enhance productivity in a sustainable manner, food security and resilience, considering the differences in agro-ecological zones and farming systems, such as different grassland and cropland practices and systems.

PART A: Identification of Adaptation Measures in Agricultural systems

Agriculture will in the foreseeable future remain the economic mainstay of most African countries, contributing directly for food security, employment and supply of industrial raw materials. Currently over 65% of the continent's population derives its livelihoods directly from smallholder rain-fed farming of crops, livestock and freshwater fisheries. Available empirical evidence on impacts of climate change on agriculture and livelihoods in Africa reveal critical shortcomings of current agricultural production systems: including supporting policies, institutions, technologies, knowledge bases, infrastructure and levels of financing. Furthermore, scientific evidence shows that Africa's diverse agro-ecologies and their associated agricultural production systems are invariably vulnerable on climate change and climate variability, but yet they require different adaptation responses. The increasing frequency and severity of droughts, seasonal dry spells, high and low temperature stresses as well as floods are threats, not only to agricultural production, but also to industry, commerce, trade and viability of traditional institutions, all of which have been anchored on agriculture. Recognizing the magnitude of responses required at different scales in the different agro-sectors, there are calls across Africa for adaptation measures that support transformation of agricultural systems. Such adaptation measures will require large financial investments at different levels of policy planning, technical and knowledge support, and local/community levels.

1. **Adaptation measures**

The adaptation measures in agricultural systems could be grouped into two broad categories:

(i) Adaptation measures that could open up opportunities for total transformational changes, with critical implications on planning, local and national planning, financing, governance, policy frameworks, and institutions value chain development, economic incentives, research and database development, and knowledge processes.

(ii) Adaptation measures that could bring large incremental gains and changes, including technical interventions, technological changes.

2. **Policy and institutional adaptation measures**

Effectively, Africa requires a major shift in current agricultural policies and supporting institutions in order to create an enabling environment for agricultural transformation in the context of the continent's vision, the SDGs and the Paris Agreement. The overall entry point for effective adaptation measures in African agriculture will hinge on robust national and sub-regional policy frameworks and action/implementation plans that are inclusive and cascading to local scales. Major areas requiring policy interventions are:

a) Establishing mechanisms for fostering new innovative and inclusive partnerships bringing together private, public and civil society actors (state and non-state actors) to support emerging climate change adaptation initiatives in agriculture;
b) Developing new funding mechanisms and frameworks that provide incentives for investment in new/alternative value chain development including support for emerging production systems, processing industries and marketing channels;
c) Establishing financing mechanisms to support evidence and data generation and use for informed decision making;
d) Promoting learning-based research and extension approaches that centered on integration of indigenous knowledge and contemporary scientific approaches;
e) Establishing robust institutional arrangement for promoting availability and access to primary production resources (land, water, infrastructure, agricultural finance/insurance), improved technologies and agro-inputs (machinery, seeds, fertilizers, agro-chemicals).

3. **Technical adaptation measures to increase productivity and resilience of current agricultural production systems**

Recognizing that national government and communities are already responding, not only to climate variability and change, but to other agricultural production challenges, there is an urgent need to build on the available knowledge base to build their adaptive capacity. Investments that focus on efficient resource use in water, soils and land management have potential to significantly improve productivity (50 to >100%) and sustainability of current agricultural systems. Most agricultural production systems are constrained by lack of access to appropriate improved/advanced technologies, relevant information and knowledge and capacity building support mechanisms in specific technical areas including those reflected in part B of this submission. These technical measures need to be coupled with context-specific actions on robust pest and disease interventions and promotion of post-harvest technologies.

3.1 Adaptation measures to achieve total transformation in African agriculture systems

Long-term adaptation against climate change and climate variability in Africa evidently requires measures that support a total and sustainable transformation of current agricultural systems. Financial investments are particularly imperative in supporting development of the following underlying pillars for transformative adaptation:

a) Development and/strengthening alternative agricultural (crop and livestock) value chains. This entails a critical review and futuristic analysis of current agricultural value chains and associated roles of different private and public sector actors;
b) Infrastructure development to support multi-scale and inclusive participation of rural and urban communities in 'new African agriculture';
c) Promoting new advances in technology development and associated knowledge and capacities on: agro-centered renewable energy (wind, solar, geothermal, hydro); crop and livestock production (including breeding, mechanized production and agro-processing); and soil-water resources management (including fertilizer production; soil/land conservation, improved agronomic techniques, and pest/disease management);
d) New designs in efficient management of crop-livestock interactions including approaches for transforming current agro-pastoral and pastoral farming systems.

4. Main knowledge gaps

Effective adaptation and transformation of agriculture in Africa will be conditional on addressing current knowledge and capacity gaps that are inherent in the systems and will inevitably be aggravated under the new transformational processes. This calls for accelerated generation of data and evidence to support the required transformational change processes. For example, there is evidence on impacts of climate change and variability on agricultural systems in Africa, but not in sufficient detail and scale to inform disaggregated planning and decision-making processes for specific contexts. There is a lack of critical mass of technical expertize and organizational structures to meet the demands agricultural transformation: examples include limited early warning systems; limited reliable data for integrated agriculture planning and market dynamics.

PART B: Identification and Assessment of Agricultural Practices and Technologies to Enhance Productivity: (Include diversity of agro-ecological zones)

Africa remains the most food insecure, exposed and vulnerable continent globally to the impacts of climate change in part due to its overdependence on subsistent and rain-fed agriculture and therefore vulnerable to climate change. Despite uncertainties with current observations and future projections of climate change it is widely acknowledged that climate change, manifesting in changing rainfall patterns and increase in temperatures is one major cause and threat to food production and food security in Africa. Africa continues to face serious impacts resulting from droughts and prolonged dry spells, high risk of flooding in many places, emergence of new pests and diseases and increase in temperature, which affect agricultural production. The impacts of climate variability and change vary according to the agro-ecological zones (AEZs). The African farming systems could be broadly categorized into:

- Crop – based farming systems
- Mixed farming system (crop & livestock)
- The Livestock pastorals systems
- Coastal farming systems/ fisheries

The climatic projections are consistent with recent climatic trends in many regions in Africa. For several decades, vulnerable communities using indigenous knowledge or external support have experimented and adopted various agricultural technologies and diverse farming systems to cope with or adapt to climate risks. Apparently, impacts of climate change on agricultural productivity continue to be severe in SSA. This is attributed to low adoption of key production technologies that enhance adaptation and increase productivity and poor management of the production. This is mainly due to capacity constraints – knowledge and financial. With increased evidence of climate change impacts, there are calls for strong public support and increased access to improved technologies. There are some success stories from different Agro ecological zones (AEZs) and farming systems in each zone combined with limitations for adoption, however adoption still remains a challenge and it is therefore essential for increased support to improve agricultural productivity, promote resilience and attain food security in Africa.

IDENTIFICATION OF RESILIENT AGRICULTURAL TECHNOLOGIES AND PRACTICES

The list includes practices and technologies that have been tested and proved effective in different farming systems.

Practices	Technologies	Comments
Value addition in Seed Technologies	Seed technologies - breeding new varieties (e.g. drought tolerant varieties/crops, can withstand flood and water logging problems, heat tolerant and improved pest and disease resistance)	Drought, heat, floods and emerging pests and disease call for new varieties of seeds and that will be more tolerant to these climate stresses
	Integrated technologies for pest and disease control	Control emerging Climate Change related pest and diseases
Soil & Water management	Water harvesting, storage and use. Examples: Bulky infrastructure and Earth dams in villages and other appropriate sites. Others include:	Persistent droughts and floods call for technologies for drought and floods management/ control to improve water security

	Zero tillage Conservation agriculture Soil fertility management Erosion control technologies	
Agronomic practices	Efficient salinity management practices (sea level rise, salt water intrusion, underground soil water movement, salinity of irrigated lands	Soil, water and plant management under changing climate
Improvement in seed supply system – packaging, distribution		Beyond breeding cultivars, quality Seed need to be to be accessed through proper and efficient channels
	Livestock breeding technologies	There is a need to identify and promote breeding for traits resilient to climate hazards (drought and heat stress) for resilience
ICT platforms	ICT for extension services(mobile phones and other ITC tools)	Support increased access to (extension, market, weather/Climate) information and advisories. Improvement of uptake of technology and practises
Fisheries	Aquaculture	Provide alternative protein sources
Crop and livestock insurance packages based on weather information		Weather and non-weather based insurance schemes. Enhance partnerships between government (for good regulatory), insurance (to supply cover) and farmers/ livestock keepers
Forestry and agro forestry		Using trees to improve soil fertility and landscape management
Agro Advisories including climatic and agriculture information	Technologies and tools for Weather and Climate information services and applications	Improved climate service delivery such as weather forecasts including seasonal forecast.
	Technologies to reduce post-harvest losses e.g. storage improvement and processing practices (harvesting, processing and storage technologies)	Over 30% of harvest is lost due poor handling. Less than 10% is targeted within the next decade.
Promote cooperatives approach for marketing		To promote collective marketing and infrastructure
Investment opportunities/ Big business/ Transformation	Value addition technologies	Integrating farmers into the global food value chains

Assessment of Practices/technologies	Suitability of technologies and practices							
	Geographic relevance	Productivity	Sustainable				Role in food security	Promotes resilience
			Ecological	Economical (affordability)	Social cultural			
			- Nutrient cycling - Water Use Efficiency - Water Holding capacity		Gender sensitive	Acceptability		
Diversification/ Crop & Management								
- Intercropping	2	✔	✔	✔	✔	✔	✔	✔
- Crop rotation	2	✔	✔	✔				
- Seed Technologies	1	✔					✔	✔
- Crop harvest loss technologies	1					✔	✔	✔
- Agro-forestry	1	✔	✔	✔	✔	✔	✔	✔
Soil & water management								
Cover Crops	2	✔	✔	✔	✔	✔	✔	✔
Mulching	2	✔	✔	✔	✔	✔	✔	✔
Minimum Tillage	2	✔	✔	✔	✔	✔	✔	✔
Rain water Harvesting	2	✔	✔	✔	✔	✔	✔	✔
Micro Irrigation techniques	2	✔	✔	✔	✔	✔	✔	✔
Livestock and Rangeland Management								
Improved livestock breeds	2	✔					✔	✔
Improved Feeding Strategy	2							

Rotational Grazing	2	✔					✔	✔
Improved Livestock Health	1	✔					✔	✔
Climate Information & Risk Management								
ICT(Mobile based tools)	1	✔			✔	✔	✔	✔

NB:

Key for Geographic Relevance/ Agro-ecological zones

1 – ALL, 2- ASAL (Arid & Semi-Arid Areas), 3 – Sub-Humid/ Humid Areas

KEY ISSUES FOR TRANSFORMATION OF AFRICA'S AGRICULTURAL SYSTEMS PRODUCTION

The African Group calls for further support in the following key intervention areas to enhance uptake of resilient agricultural technologies and practices consequently meet food security in Africa:

Crop and livestock breeding

Seed technologies including breeding new varieties (e.g. drought tolerant varieties/ crops, to withstand flood and water logging problems, heat tolerance and improved pest and disease resistance. Beyond breeding cultivars, quality seed needs to be to be accessed through proper and efficient channels. For livestock, there is a need for technologies to support identification and breeding for traits resilient to climate hazards (drought and heat stress) for resilience.

Water and land management plus infrastructure for water and land management

Persistent droughts and floods call for extensive investment in technologies for drought and floods management/ control to improve water security. Special focus should be enhancing Water harvesting, storage and use through structures like Bulky infrastructure and Earth dams in villages and other appropriate sites. Others include: Conservation agriculture, Soil fertility management and soil erosion control technologies. This intervention is essential because despite their proven benefits over the past four decades only 3% of the cropland is equipped for agricultural water management in SSA and this is only concentrated in four countries: South Africa (30%), Madagascar (20%), Nigeria (5%) and Ethiopia (5%). Over 10% coverage is targeted in the next decade.

Agro-processing technology to reduce post-harvest waste

Over 30% of harvest is lost due poor handling. Less than 10% is targeted within the next decade. Technologies to reduce post-harvest losses e.g. storage improvement and processing practices (harvesting, processing and storage technologies) are therefore necessary. Investment opportunities for integrating farmers into the global food value chains are essential for realization of transformation within the agricultural systems.

Integrated Pest and Disease Management for Agriculture

Integrated technologies for pest and disease control are necessary to address emerging climate Change related pest and diseases.

Enhanced Insurance Packages and financing for reducing risks to farmers

Weather and non-weather based insurance schemes are necessary in order to reduce risks associated with the impacts of climate change and variability. There is need therefore to enhance partnerships between government (for good regulatory), insurance (to supply cover) and farmers/ livestock keepers.

Climate Information Services and Application for Agriculture.

Support for increased access to (extension, market, weather/Climate) information and advisories are necessary for improvement of uptake of technology and practises.

Finally, the African Group is looking forward to its participation at the workshop and subsequent discussions on this agenda item that will lead to the adaption of a COP decision at COP 22 in Marrakesh Morocco.

Paper no. 4: Netherlands and the European Commission on behalf of the European Union and its member States

SUBMISSION BY THE NETHERLANDS AND THE EUROPEAN COMMISSION ON BEHALF OF THE EUROPEAN UNION AND ITS MEMBER STATES

This submission is supported by Bosnia and Herzegovina, the Former Yugoslav Republic of Macedonia, Montenegro and Serbia.

Subject: **Views on identification of adaptation measures and assessment of agricultural practices and technologies to enhance productivity in a sustainable manner**

The Hague, 24 February 2016

General remarks

In line with the conclusions by the SBSTA chair[1] the EU welcomes this opportunity to provide views on the following topics:

1) the identification of adaptation measures, taking into account the diversity of the agricultural systems, indigenous knowledge systems and the differences in scale as well as possible co-benefits and sharing experiences in research and development and on the ground activities, including socioeconomic, environmental and gender aspects.

2) the identification and assessment of agricultural practices and technologies to enhance productivity in a sustainable manner, food security and resilience, considering the differences in agro-ecological zones and farming systems, such as different grassland and cropland practices and systems.

Challenges and opportunities related to agriculture

The findings of the IPCC's 5th assessment report[2] (AR5), the Structured Expert Dialogue (SED 2013-2015)[3] and the IPCC expert meeting[4] on Climate Change, Food and Agriculture,, are a cause for deep concern, in particular with regards to agriculture and forestry. The AR5 further substantiates how essential it is to achieve our long term goal of limiting global temperature change to less than 2°C above pre-industrial levels. Other reports, such as the Global Risks Report 2016[5] and the Global Nutrition Report 2015[6], also highlight the linkages between adverse climate change and risks to food security.

The positive outcome of COP21, a robust, long-term, ambitious and fair agreement, as well as initiatives under the Lima Paris Action Agenda will help to steer and shape the discussion for future climate action. References to "safeguarding food security and ending hunger", "gender equality" and "the rights of indigenous peoples" in the Paris Agreement are welcomed by the EU and they are also very relevant to our agriculture SBSTA discussions. Participants at the LPAA meetings stated that although agriculture has a potential to be part of the solution to fight climate change, it needs

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[1] http://unfccc.int/resource/docs/2014/sbsta/eng/l14.pdf
[2] https://www.ipcc.ch/report/ar5/
[3] http://unfccc.int/resource/docs/2015/sb/eng/inf01.pdf
[4] http://www.ipcc.ch/pdf/supporting-material/Food-EM_MeetingReport_FINAL.pdf
[5] http://www3.weforum.org/docs/GRR/WEF_GRR16.pdf
[6] http://ebrary.ifpri.org/utils/getfile/collection/p15738coll2/id/129443/filename/129654.pdf

platforms and networks to share information and encourage innovation, and that we also need new approaches to change the incentive structure for sustainable food production.

Farming and food production are important elements of the European economy and society. Within its 28 Member States, the EU has 12 million farmers with an additional 4 million people working in the food sector. It also has 500 million consumers that all require a reliable supply of healthy and nutritious food at affordable prices. Therefore food production in Europe requires a robust, resilient and resource efficient domestic agriculture sector, with an emphasis on sustainable and climate resilient practices, that at the same time contribute to mitigation of climate change. EU food production as well as non-food biomass production also need to provide positive environmental and development returns to rural communities.

The Common Agriculture Policy (CAP) of the European Union provides the overall framework for a European system that allows farmers to fulfil their multiple functions in society, the first of which is to produce food. The 2013 reform of the CAP aims at further integrating environmental aspects of agriculture, such as maintenance of biodiversity, soils, and landscapes. Farmers can be adversely affected by climate change and the CAP provides them with financial assistance to adjust their farming methods and systems to cope with the effects of a changing climate[7]. Agricultural production is also a source of emissions and therefore also needs to positively contribute to the EU GHG mitigation efforts.

The set of case studies listed below (which are expanded on in the annex of this submission) help illustrate the wide diversity of measures carried out by Member States throughout the EU:

Adaptation measures and their co-benefits:

- Pasture Base Ireland (p.4)
- Innovations in freshwater storage for agriculture and horticulture (p.4)
- Locally-Led Agri-Environment and Climate schemes (LLAEC) in Ireland (p.5)
- Finnish National Climate Change Adaptation Plan (p.5)
- More space for rivers (p.5)
- Combatting invasive plants (p.5)
- Improving soils quality and strengthening the adaptation to climate change through sustainable techniques of Conservation Agriculture (LIFE12 ENV/IT/000578), Italy (p.6)
- UK approach to adaptation and underpinning research (p.6)
- Development of salt-resistant potato-varieties (p.7)

Sustainable increase of productivity, food security and resilience:

- Beef Data & Genomics Programme in Irelands RDP 2014-2020 (p.7)
- Origin Green (p.7)
- Climate Programme for Finnish Agriculture (p.7)
- Sown Biodiverse Pastures in Portugal (p.8)
- Sweden – Focus on nutrients (p.9)
- The agro-ecological project in France, a policy framework for sustainable climate action (p.9)
- Latvia - fertilization planning under integrated pest management and precision agriculture (p.10)

[7] http://enrd.ec.europa.eu/enrd-static/en-rd-events-and-meetings/seminars-and-conferences/quality_design_measures/en/quality_design_measures_en.html

- UK - Agricultural Technology (p.11)
- UK - CB5 (p.11)
- Sustainable Intensification in the UK (p.11)
- Knehtilä Farm – Finland (p.11)
- Low Emission Dairy products (p.12)

International Cooperation

- FoodAfrica (Improving Food Security in West and East Africa through Capacity Building in Research and Information Dissemination) (p.12)
- Climate Change Adaptation, disasters prevention and Agricultural Development for Food Security - ANADIA Niger (p.12)
- Geodata for Agriculture and Water (G4AW) (p.12)
- International Climate Smart Agriculture Initiatives - the Netherlands (p.12)

Scope of the work on issues related to agriculture[8]

The EU considers that it is important to build on the momentum from Paris. This includes the recognition on how strongly agriculture featured in many countries' INDCs. An analysis[9] by CCAFS of 160 Party submissions found that 103 INDCs include agricultural mitigation actions, and of the 113 Parties, that included adaptation in their INDCs, 102 included agriculture among their adaptation priorities. Therefore there is clearly an opportunity to take advantage of the information shared in the two workshops this May, to showcase technical & policy examples to assist countries in achieving their ambitions on agriculture adaptation and mitigation as set out in their INDCs.

The EU believes that there is a need to take stock of all relevant initiatives and work conducted at national, regional or international level on those issues, particularly by international networks and organizations such as CCAFS[10], FAO[11], IFAD[12], and to compile and consider relevant work already done on mitigation and adaptation under the UNFCCC[13]. Collaboration with other UN organisations on this such as UNCCD[14], UN Water[15], UNISDR & the Hyogo Framework[16], WMO[17] and UNEP[18] is also encouraged.

The SBSTA work on issues related to agriculture needs to be consistent with the outcomes of COP21 in Paris and assist parties with the implementation of current and future Nationally Determined Contributions in both adaptation and mitigation, and could be considered also in the technical examination processes on adaptation and mitigation launched to enhance action pre-2020. The EU is happy to work with other parties to ensure that future SBSTA discussions and outputs are consistent with this. The EU would also like to reaffirm the views expressed in its three recent

[8] Decision 2/CP.17 paras 75-77
[9] https://cgspace.cgiar.org/handle/10568/69115
[10] CGIAR Research Program on *Climate Change, Agriculture and Food Security* www.ccafs.cgiar.org
[11] United Nations Food and Agriculture organization (FAO) www.fao.org
[12] International Fund for Agricultural Development (IFAD) www.ifad.org
[13] FCCC/SBSTA/2010/10, FCCC/TP/2008/8, FCCC/SBSTA/2008/12
[14] United Nations Convention to Combat Desertification (UNCCD) www.unccd.int
[15] UN Water www.unwater.org
[16] United Nations International Strategy for Disaster Reduction (UNISDIR) www.unisdr.org
[17] World Meteorological Organisation (WMO) www.wmo.int
[18] United Nations Environment Programme (UNEP) www.unep.org

UNFCCC SBSTA submissions on issues related to agriculture[19], while also noting the views expressed by other parties in previous submissions and during the SBSTA discussions to date.

[19] http://unfccc.int/resource/docs/2012/sbsta/eng/misc06.pdf
http://unfccc.int/files/land_use_and_climate_change/redd/submissions/application/pdf/20130903_subm_eu_agriculture_sbsta39_rev.pdf
http://unfccc.int/resource/docs/2015/sbsta/eng/misc01.pdf

Annex: EU and National case studies and good practices

In the EU there are a number of policy instruments assisting farmers in dealing with climate change such as:

- Rural Development Policy[20] as part of the European Common Agriculture Policy
- the current European Framework Programme for Research and Innovation (HORIZON 2020[21])
- The EU Adaptation Strategy[22] also addresses knowledge gaps through research and the European climate adaptation platform (Climate-ADAPT).

Sustainable agriculture and food security are at the top of the EU's long-term policy agenda. They are an important aspect of the EU's dialogue with partner governments. Agriculture that is both sustainable and more inclusive and also protects biodiversity will play a major role in eradicating poverty, food insecurity and malnutrition.

In particular, the EU's food security policy focuses on smallholder farmers, as evidence shows that investments in agricultural smallholdings provide the greatest returns in terms of poverty reduction and growth. This emphasis on smallholders is one of the cornerstones of EU food security and agricultural development cooperation.

The EU supports developing countries' efforts to advance their agricultural sector through a number of programmes and initiatives. It backs activities contributing to equitable and social development, environmental sustainability, value chain development, market integration, and demand-driven agricultural research and innovation. In addition, the EU has been an active supporter of initiatives to reduce food waste[23] and improve resource efficiency.

Adaptation measures and their co-benefits:

Pasture Base Ireland[24] (PBI)

PBI is a grassland management decision support tool which captures and records grass growth measurements and background agronomic data on Irish farms, and links grass growth to local meteorological weather data. The aim of PBI is to provide farmers with information to address underperforming areas of their farms and increase grazed grass utilisation across a broad spectrum of production systems and regions. Prescribed management practices to improve grazed grass utilisation can in some cases contribute to enhancing C sequestration of soil. As the database matures, PBI has the potential to develop grass growth forecasts. Through forecasting, PBI has implications for climate adaptation as it can potentially ensure available forage and better utilisation of grassland during periods of climate variability.

Innovations in freshwater storage for agriculture and horticulture– The Netherlands

Farmers and horticulturists are dependent on a steady supply of fresh water. Due to climate change there are both more frequent periods of severe droughts and period with intense rainfall in The Netherlands. A rising sea level in combination with soil subsidence leads to salinization of (costal) soils, with severe negative consequences for most crops. Farmers and horticulturists therefore take more and more initiative to make themselves less dependent on the central water systems to become more resilient to the effects of climate change. For example, a Dutch horticulturist created a water storage basement under his greenhouse, which he uses as buffer in times of heavy rainfall to prevent flooding in the area. An experiment is running to link this form of water storage with sprinklers in the greenhouses. On some of the islands in the southwest of the Netherlands, pilots are in place where agricultural drainage systems supplement the natural freshwater groundwater system. These 'freshwater bubbles' not only keep the salinized water on

[20] http://ec.europa.eu/agriculture/rural-development-2014-2020/legislation/index_en.htm
[21] http://ec.europa.eu/programmes/horizon2020/en/area/agriculture-forestry
[22] http://ec.europa.eu/clima/policies/adaptation/what/index_en.htm
[23] http://www.fao.org/save-food/partners/en/
[24] http://www.teagasc.ie/publications/2013/2808/index.asp

a distance, but can also be used in periods of drought. Other countries have shown much interest in the knowledge and experience that is created in these pilots.

Locally-Led Agri-Environment and Climate schemes (LLAEC) in Ireland

Environmental and biodiversity challenges can manifest themselves in a particular manner at local level. LLAEC schemes embrace local knowledge and practice to encourage the 'bottom-up' development of bespoke projects that respond to these specific challenges. One such example is the Burren Programme[25] which supports the sustainable agricultural management of high nature value farmland in the Burren region of the west of Ireland. Through the programme, climate adaptation can be facilitated through the conservation of traditional plants and grasses tolerant to local abiotic stresses, and the re-introduction of livestock species adapted to the local environment.

Finnish National Climate Change Adaptation Plan

In the 2014, the Finnish Government adopted a resolution on the national climate change adaptation plan. The aim of the plan is that the Finnish society has the capacity to adapt to changes in the climate and manage the risks associated with climate change.
http://mmm.fi/documents/1410837/1888935/MMM-%23193086-v1-Finland_s_National_climate_Change_Adaptation_Plan_2022.pdf/c2bfec7b-ae73-4247-b666-26a3ed363f99

More space for rivers – The Netherlands

The Netherlands partly lies below sea level and in large parts is dissected by rivers eventually forming a delta. To promote safety and reduce the risk of uncontrolled flooding, a programme has been set in motion to give the rivers more space. One of the action points of the programme is to designate areas of land that can be used as temporary water retention areas to prevent water damage and risk in densely populated areas. Land owners suffering agricultural loss are subject to reimbursements. One example is the agricultural polder Noordwaard, an area of 4450 hectares in the delta of the two rivers Rhine and Meuse in the south of the Netherlands. In the past, dykes were built to protect the area of Noordwaard from floods. In the light of occasional extreme rise of water levels that are expected to become more and more frequent due to a changing climate, a project has started in 2009.

Part of the Noordwaard has been re-designed and transformed from an area protected by dykes to an area open to high water. In the middle, a high-water channel was formed to drain the large volumes of river water to the sea. This involved lowering the dykes to create inlets and outlets for high water to maintain lower water levels and safety in a wider river trajectory. The area protected by dykes in the Noordwaard is now smaller than it was. Prior to depoldering, 80% of the polder had an agricultural function: primarily crops, but also some dairy farms and horse farms. The new flood channel is no longer suitable for agriculture, but the other parts of the Noordwaard can still be used as before.

The principle behind this approach was to give the farmers a sustainable perspective on the future. Indeed, to maintain agricultural activities on the sides of the channel, high quays were built on both sides of the flood channel, with a surface area of approximately 600 hectares. Thanks to the cooperation with the residents, businesses and other stakeholders in the area, the depoldered Noordwaard will offer plenty of opportunities for nature, economic activity and recreation. In order to keep the unique area accessible to all of its users, the infrastructure will be kept intact as much as possible. The roads in the high-water polders are suitable for cars, agricultural vehicles and cyclists. The roads in the low-water polders are primarily intended for agricultural vehicles and bicycles. During periods of extremely high water, the high quays will form the routes to evacuate the area.
https://www.ruimtevoorderivier.nl/depoldering-noordwaard/

[25] http://burrenlife.com/

Combatting invasive plants– The Netherlands

It is important to take quick and efficient measures to combat invasive plants or to keep them in check as their expansion can be very rapid, especially due to climate change. In the Netherlands this is for example the case for water plants that are released from aquaria or enter the country spontaneously. The Ministry of Economic Affairs, in collaboration with several organisations, has developed the iWaterplant-app. The app recognizes water plants based on a picture. In this way invasive water plants can be reported to responsible authorities who can then take immediate action.

Improving soils quality and strengthening the adaptation to climate change through sustainable techniques of Conservation Agriculture LIFE HELPSOIL – (LIFE12 ENV/IT/000578) - Italy

Life HelpSoil is a project financed by the LIFE+ Environment Policy & Governance Programme of the European Union, aimed at testing and demonstrating innovative solutions and soil management practices helpful to enhance soil functions as well as resilience and adaptation of agricultural systems to the impact of climate change. The project started on 1st July 2013 and will conclude on 30th June 2017, it involves 20 demonstrative farms along the Po Plain and the bordering hilly areas of the Alpine and Apennine margin.

Conservation Agriculture with the reduction of mechanization (fewer hours of machinery use and lower power of tractors) results in a reduction of fuel consumption (with an estimated decrease up to 70%) and thus in a reduction of GHG emissions. The most important outcome, however, is given by the protection and development of soil functionality; in fact, such practices lead to the conservation and incorporation of organic matter into the soil, thus contributing to the reduction of CO2 emissions and the mitigation of climate change. Furthermore, the increase of the organic matter improves the physical and chemical qualities of soils and the edaphic biodiversity, enhancing fertility and assimilability of water and nutrients, thereby ensuring greater resistance of crops to environmental stresses and stability to agricultural production, reducing erosion and soil susceptibility to compaction and improves the ability to filter and buffer pollutants. In this way, the conservation agriculture practices can contribute significantly to increase the resilience and adaptation of terrestrial ecosystems to climate change while representing a mitigation strategy in agricultural sector. The project compares areas under Conservation Agriculture with the current soil management in each demonstrative farms for three years (three consecutive cropping cycle), monitoring collecting agronomic and technical data about soil functionality and agri-environmental performance related to the techniques implemented in the sample farms (irrigation, fertilization, pest management and erosion control). These actions will be based on consolidated indicators and methodologies.

The final results of LIFE HelpSoil project will be collected in "Technical guidelines" aimed at promoting the application and dissemination of Conservation Agriculture practices and of innovative and improved farming techniques, and to find its implementation in the context of Regional Rural Development Programmes. The purpose is to identify management practices in agriculture in the whole Veneto region and Po area that could be identified as "Best Available Techniques", for an agriculture durable and capable of producing larger ecosystem services. The main beneficiary of the project results are farmers and agronomists, associations and companies operating in the agriculture sector. Communication and dissemination actions as envisaged by the project (field days, newsletters, seminars and conferences, etc.) have been designed to promote opportunities for technical growth and exchange of knowledge and will be public available on the web.
http://www.lifehelpsoil.eu/en/innovative-management-practices-of-agricultural-lands

UK approach to adaptation and underpinning research

The UK Government published the first Climate Change Risk Assessment in January 2012. Based on the 2009 UK Climate Projections, it identified over 700 risks to the UK from a changing climate and focused on around 100 of them to determine their severity and likelihood in the short, medium and long term. For the second CCRA, Defra has commissioned the independent Adaptation Sub-Committee of the Committee on Climate Change to produce the underpinning Evidence Report. UK government will then produce the CCRA Government Report, which will be laid before Parliament no later than January 2017. The ASC is being assisted by around 100 independent academics and consultants in the preparation and peer review of the report.

The UK approach to adaptation, as set out in the Climate Change Act 2008, calls for a five yearly Climate Change Risk Assessment (CCRA) and a corresponding programme of activity to address the impacts identified in each assessment, the National Adaptation Programme (NAP). The Adaptation Sub-Committee (ASC) of the Committee on Climate Change was also set up under the Act and has a statutory role to assess progress on the NAP report and provide advice on the delivery of the CCRA.
The 2012 UK Climate Change Risk Assessment informed the first NAP report published by Defra in July 2013, which contains over 370 actions to prepare the UK for the impacts of climate change. The second CCRA in 2017 will address gaps identified in the first CCRA and cover areas where the science has advanced significantly.

Development of salt-resistant potato-varieties– The Netherlands

Globally, about 1.5 million hectares of land is salinized. In The Netherlands a quarter of the land is prone to salinization. The Dutch vegetable and potato sector has found ways to adapt to this climate-change related phenomenon. A Dutch company called Silt Proefbedrijf Texel set up several field experiments in 2010, monitoring the salt-tolerance of common crops such as barley, sugar beet and potato. One of the successes of these experiments is the growing of potatoes in salty conditions. The first batch was harvested in 2013 and the cultivation of the most successful varieties is being scaled up. Dutch growers do not only enjoy improvement of their own crops but also have additional commercial interests: colleagues from North Africa, Australia and the Middle–East have contacted Dutch growers to ask them for salt-tolerant planting material. In 2015, the first salt-tolerant potatoes were harvested in Pakistan, through the project "Securing Water for Food".

Sustainable increase of productivity, food security and resilience:

Beef Data & Genomics Programme in Irelands RDP 2014-2020

The BDGP has been designed with a core focus on lowering emissions in the beef sector via support for increases in herd quality and efficiency. The programme requires DNA sampling of breeding stock to establish a reliable genomic breeding index and to identify animals of superior genetic merit with lower associated GHG emissions. These animals are then utilised as replacement stock in BDGP participating herds. Herds participating in the programme must use 4 or 5 star[26] maternal (replacement) bulls (or AI equivalent) on 50% of their replacement herd by the end of the programme. There are also a range of other associated additional climate benefits such as the production of lighter cows better suited to climate adaptation.

Origin Green[27]

Origin Green is an initiative promoted by the Irish Food Board, An Bord Bia, to encourage farmers and food processors to engage directly with the challenges of sustainability. To support the roll out of Origin Green at farm level, An Bord Bia, in conjunction with Teagasc, developed the Carbon Navigator support tool. The Carbon Navigator collects farm management data on beef and dairy farms, and identifies practical areas that impact on the farms environmental and economic performance. The outputs are used to assess the performance of the farm against peers. The programme delivers feedback and advice on practices that effectively reduce the carbon-footprint of farm produce and improve the economic performance of the farm. The five core elements of the Carbon Navigator to deliver economic and environmental benefits are as follows:

- *Length of the Grazing Season*
- *Improved Genetics and Breeding*
- *Improved Nitrogen Efficiency*
- *Improved Manure Management*
- *Energy efficiency*

[26] The Euro Star index is used to rank the performance and characteristics of bulls. The stars range from a ½ star (bottom 10%) to 5 stars (top 10%).

[27] http://www.origingreen.ie/

Over 43,500 Irish beef farms have been audited to date under the Beef and Lamb Quality Assurance Scheme[28] (BLQAS), accounting for 90% of our total beef production. 18,000 Irish dairy farms (effectively all dairy production) have signed up to the Sustainable Dairy Assurance Scheme[5] (SDAS) and are now in their first audit cycle. The application of the Carbon Navigator at farm level is also is linked to other elements of Irelands RDP 2014-2020 such as Knowledge Transfer Programme and Beef Data and Genomics Programme.

Climate Programme for Finnish Agriculture

The Ministry of Agriculture and Forestry has drawn up a climate programme for Finnish agriculture, called "Steps towards Climate Friendly Food". Its objective is to enhance the sustainability of the Finnish food system. The programme presents 76 measures to facilitate the adaptation of food production and consumption to climate change and/ or to mitigate the change. Link to the programme:
http://mmm.fi/documents/1410837/1867349/Climate_programme_agriculture_WEB_03072015.pdf/1a6f135c-068c-48aa-ad00-787562628314

Sown Biodiverse pastures in Portugal

Sown Biodiverse Pastures are a system of pastures developed in the 1970s in Portugal by David Crespo. They differ from conventional pastures by making use of diversity (fig.1) and the functional complementarity of plant species in increasing crop production. The true extent of these pastures in terms of Biodiverse Engineering is only patent in their full name - Sown Biodiverse Permanent Pastures Rich in Legumes. "Permanent" because once sown, they are maintained for a long period of time (at least 10 years). "Sown" because improved and selected seeds are introduced (fig.2) with higher yields than those occurring naturally in seed systems.
Its epithet "Biodiverse" is due to the fact these pastures are sown with mixtures of large numbers and varieties of seeds (up to 20) and therefore possess a wide range of genetic material to add to what is already in place. This diversity gives the pasture greater adaptability to microtopographic variations. Along with its specific diversity, it results in greater adaptability to annual climatic variations. It also provides greater resistance to environmental factors and greater photosynthetic capacity.
The proportion of legumes in the seed mix is significant, and that is why the pastures are labelled "Rich in Legumes" (fig. 3). Legumes fix nitrogen directly from the atmosphere through microorganisms belonging to the genus Rhizobium, concentrated in root nodules (fig. 4). Nitrogen is thus consumed by grasses, preventing it from existing in too higher concentrations. High biological nitrogen fixation avoids the use of nitrogen fertilizers, which cause greater environmental impacts and high greenhouse gas emissions.
The combination of these features leads to biodiverse sown pastures to have sustained increases in productivity. Being more productive, they provide more food for animals and also increase the organic matter (OM) in the soil associated with the roots. OM is a key parameter in farm management, it is important for agronomic and environmental reasons. Soils rich in organic matter are less susceptible to erosion, have higher water holding capacity and are richer in nutrients and thus more fertile (fig. 5). Additionally, legumes decrease the input of nitrogen fertilization and consequently reduce environmental impact, in addition to more effective control of spontaneous vegetation, with consequent reductions in the costs of maintaining pastures and the fire risk associated with the use of fire for regeneration of pasture.

For all the above reasons, Sown Biodiverse Pastures constitute an alternative agricultural system that optimizes both the economic and environmental performance of farms. Both these aspects are particularly relevant in areas susceptible to agricultural abandonment and desertification (fig. 6).

[28] As part of its mandate, An Bord Bia provides a number of farm quality assurance schemes. Quality assurance plays a fundamental role in promoting Irish food and provides the platform for consumer promotion of product quality.

http://www.terraprima.pt/en/projecto/2
https://www.youtube.com/watch?v=WR4tINbSXp4

Sweden - Focus on nutrients

Measures to reduce the carbon footprint of agriculture often go hand in hand with reducing other environmental impacts such as impacts on water and nutrient losses. In short, to make use of the farm's resources as efficiently as possible, which is a key component in enhancing productivity in a sustainable manner. The project Focus on Nutrients is a joint venture between The Swedish Board of Agriculture, The County Administration Boards, The Federation of Swedish Farmers and a number of companies in the farming business.

The purpose of the project is to reduce emissions of greenhouse gases and nutrient leaching as well as to ensure a safe use of plant protection products. In order to fulfill these objectives the project focuses on increasing awareness and knowledge on nutrient management efficiency by offering advisory services that are free of charge to the farmers. Farmers can, for example, receive advice on measures such as Crop rotation and soil fertility

- Nitrogen efficiency
- Manure management
- Energy efficiency

The core of the project is education and individual on-farm advisory visits. This allows farmers and advisors to identify measures and best-practices that will effectively reduce the environmental impact of farm produce and improve economic performance. Beyond the on-farm advice the project management of Focus on Nutrients also arranges courses for both farmers (on a regional level) and advisors (on a national level). Furthermore, Focus on Nutrients has a website where farmers that are not eligible for the individual advice can calculate their own nutrient balances. The website also contains tools to help farmers make efficient use of nutrients.

The project has also collected and provided information about which of the measures carried out by farmers have had a positive or negative environmental impact. This has been done through newsletters, continuation courses for advisers and with documentation for adviser visits. Because of this, innovations in the environmental field which have been profitable to implement have also reached the farmers when advisers provide production advice. Focus on nutrients is funded by the Swedish Rural Development Program and by environmental taxes paid by farmers. The project started in 2001 and currently has more than 8 000 members. More than 54 000 farm visits have been carried out since the beginning of the project.

***The agro-ecological project in France*.**

Launched on the 18th of December 2012, and officially recognized by law in September 2014, this is an ambitious initiative meant to bring a mobilizing perspective for French agriculture to develop environmental performance as a competitive advantage. Based on pioneers' experience, the project aims at developing new, low inputs practices and production models that preserve natural capital, while answering food security and climate change challenges. Tailor made solutions are developed and widespread resulting from farmers collective field experimentation (GIEE: economic and environmental interest groups), using modern and traditional knowledge. Innovation is rooted in territorial development and value-chains, in order to add value to agro-ecological products. All public instruments are mobilized (agronomic research, development, advisory system, education and training...). The multi-stakeholder governance of the project includes a roadmap and indicators to assess progresses and impacts.

Some examples:

- since 2014 almost 250 GIEE (4000 farmers) have been officially recognized acting in various thematic fields (agroforestry, soil conservation, water management, nitrogen fixing crops, biodiversity...) ;
- a free farm based diagnostic tool has been developed to encourage progress and compare practices ;
- the European Innovation Partnership (EIP) is used to strengthens multi-partners farm based innovation and the diffusion of agroecological knowledge and practices ;
- the education system for farmers and agronomists has been reformed (new content and diplomas) ;
- several national plans have been launched, for example on "vegetal proteins", "nitrogen management and biogas", "sustainable seeds", and more recently "Agroforestry".

http://agriculture.gouv.fr/roadmap-development-agro-ecology
http://www.ag4climate.org/programme/ag4climate-session-3-4-brun.pdf

Latvia - fertilization planning under integrated pest management (IPM) and precision agriculture

Nutrient management planning serves as win-win solution for agricultural production (higher yields and quality), environment and climate. It optimizes the balance between production and GHG mitigation in agriculture. Ministry of Agriculture of Latvia recognizes importance of fertilization planning through support to precision agriculture technologies and by incorporating fertilization planning into national legislation.

Increasingly there has been growing interest in healthy safe food and environment to ensure maintenance of soil fertility, water production and biodiversity. IPM serves as problem solving approach to pest control, but it cannot be done without improvement in basic crop management practices, such as crop rotation, appropriate sowing dates and densities, adequate cultivation techniques and fertilization planning.

In 2015 Latvian Government adopted national regulation that requests fertilization planning in each farm that uses pest protection materials in its production system. This requirement acts as win-win solution for both farmers and the environment. Appropriate and well-considered fertilization motivates farmers to analyze their farming systems, saves money as well as improves the environment and reduces GHG emissions. Reduced soil degradation, maintenance and enhancement of soil organic matter, are also positive co-benefits of fertilization planning in the context of climate change.

Precision technologies such as from Yara and GreenSeeker can serve as a very effective tool to complement nutrient management planning and further enhance the win-win benefits to the farmer without compromising environment and soil quality.

It is estimated that expected yield rise in case of precision agriculture in Latvia is about 3-7%, saved nitrogen fertilizer from 2–14% (winter and summer grains and rape) and overall reduction of nitrogen balance is about 20 kg/ha.

UK - CB5

A wide range of mitigation options exist for agriculture, many of which work by increasing the efficiency of production and reducing losses of energy or nutrients to the environment. By improving productivity and reducing input costs many of these options are cost beneficial to the farmer. Defra have undertaken research on the most effective and cost efficient mitigation measures in a number of projects including the development of decision support tools that help identify options that satisfy multiple production and environmental outcomes at the lowest cost to the farmer. In addition economic research on a small number of demonstration farms has demonstrated the benefits of a well-tailored mitigation plan to improve the total factor productivity[29], a measure of the efficiency of the conversion of inputs to saleable products[30].

Potential options include:

- Better nutrient planning, management and application
- Improved crop and livestock breeding
- Improved animal health (reduced endemic disease)
- Better dietary formulation for livestock
- Improved livestock husbandry
- Improved manure management, including AD
- Land Management, Soil carbon sequestration and peatland restoration
- Improved fuel and energy efficiency

Many of these options are already being encouraged by the Industry Task Force via their GHG Action Plan[31]. Defra are working with industry to encourage genetic improvement in the beef herd via the Beef Genetic Improvement Network[32]. We work with international colleagues via the Global Research Alliance on Agricultural GHGs to better understand the linkages between livestock health and reduced emissions[33]. Defra has conducted social science research to better understand the motivations of farmers and their decision making in order to more effectively influence the sector and drive forward productivity.

UK - Agricultural Technology

As the world's population is likely to exceed 9bn by 2050, and as resources become increasingly scarce, the UK Government sees the need to invest in technology to boost agricultural productivity that will feed the global population. It is investing £180m in agricultural technology, £70m in research through a Catalyst Fund and £80m to date in four new Centres for Agricultural Innovation, on data, informatics and sustainability metrics, crop health, livestock, and precision engineering.

The £70m the UK Government is investing in the Agritech Catalyst Fund is supporting 98 projects that, if they get to market, will enhance agricultural productivity not just in the UK but could benefit businesses and individuals across the world. Specific examples of projects include:

- providing UK oat producers with world leading agronomic 'tools' to maximise grower returns and capitalise on the increasing demand for food grade oats;
- developing a low cost shade net structure to protect crops from the extremes of wind and solar radiation which is cooled and humidified with seawater, using the prevailing wind to drive the evaporative cooling process;
- exploiting novel canopy sensors for improved disease management, variety selection, and resilience in wheat;
- developing resource-use efficient strawberries for substrate production; and an innovative wheat research and breeding project targeting food security in India and Pakistan as well as benefitting the UK wheat growers through the eventual introduction of high yielding wheat hybrids.

Sustainable Intensification in the UK

The Sustainable Intensification Research Platform (SIP) is a Defra and Welsh Government funded initiative to identify ways of increasing farm productivity, reducing environmental impacts & enhancing ecosystem services. It is managed

[29] A measure of the efficiency of conversion of inputs to outputs
[30] http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=17814
[31] http://www.ahdb.org.uk/projects/GreenhouseGasActionPlan.aspx
[32] http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=15846
[33] http://globalresearchalliance.org/dashboard/animal-health-and-ghg-emissions-intensity-network/

through three coordinated projects. The platform is exploring ways of translating and integrating current knowledge on agricultural land management into systems-based approaches to help land managers, the agri-food industry and policy-makers to balance economic, environmental and social, outcomes from farming. The platform has 3 main objectives:
To establish a collaborative research platform that builds links between researchers, policy, industry and other stakeholders to (i) facilitate the translation of existing and emerging research and (ii) catalyse new interdisciplinary research on the environmental and productive aspects of agricultural land management.

- To undertake research towards the goal of improving understanding of the interaction between economic, environmental and social outcomes of English and Welsh agriculture within a geographical and socio-economic context.
- To develop, test and demonstrate approaches to translate systems-based agricultural research to help farmers, policy makers and other land management stakeholders to increase agricultural productivity and profitability while reducing environmental impacts, enhancing biodiversity and delivering wider ecosystem services.

Knehtilä Farm - Finland

Knehtilä Farm, the winner of the 2015 environmentally friendly farm competition (competition by WWF in the Baltic Sea region[34]), has developed a network of several organic producers and processors. In the integrated system, the grain from the fields would be milled in Knehtilä, and baked to bread by Samsara, an organic bakery which has established its operations on the farm. Energy from gas charred using local, low-value wood as feedstock would be used for both the drying and milling of the grain, as well as for the ovens of the bakery. The losses from milling and baking would be used as feed for hens in the neighboring henhouse which is producing organic eggs for the bakery. Biomass from green manuring leys in Knehtilä's organic crop rotation combined with the hens' manure and manure from local horse stables would be processed by anaerobic digestion. The result would be biogas, used for running the farm machinery and for local sale to passenger cars. The effluent, the nutrient-rich produce from digester, as well as the biochar produced as by-product in making gas by charring, would be used as organic fertilizer and soil conditioner in the farm fields. With this system the biomass loops are closed and the cooperative is able to operate in a sustainable manner. The aim is that this model will be reproduced by other farms around Finland.
Link to the project´s website: http://blogs.helsinki.fi/palopuronsymbioosi/english/
Link (in Finnish): https://www.youtube.com/watch?v=V5dPw2P6rRE

Low Emission Dairy products– The Netherlands

The Dutch dairy industry's methane and nitrous oxide emissions are very low, especially per unit. This is due to innovations in the field of manure treatment and feed administration but most and foremost also due to the selection of animals with a high milk production. The Dutch dairy company FrieslandCampina (and others) market this knowledge worldwide.

International Cooperation:

FoodAfrica (Improving Food Security in West and East Africa through Capacity Building in Research and Information Dissemination):

FoodAfrica is a research and development programme enhancing food security in West and East Africa. The objective of the programme is to provide new knowledge and tools for researchers, decision makers and local farmers to improve local food security. The FoodAfrica Programme is implemented in six countries: Benin, Ghana, Cameroon, Kenya, Senegal, and Uganda.
Food Africa is mainly funded by the Finnish Ministry for Foreign Affairs (MFA) and coordinated by Natural Resources Institute Finland (Luke). CGIAR institutions have an important role in the FoodAfrica Programme. The participating CGIAR institutions are Bioversity International, International Food Policy Institute (IFPRI), International Livestock Research Institute (ILRI), and World Agroforestry Center (ICRAF). Other research partners of the FoodAfrica Programme are the University of Helsinki, and HAMK University of Applied Sciences. https://portal.mtt.fi/portal/page/portal/mtt_en/projects/foodafrica

[34] http://wwf.panda.org/what_we_do/where_we_work/baltic/news/?255676

Climate Change Adaptation, disasters prevention and Agricultural Development for Food Security (ANADIA Niger) - Italy

The project is a training and Research-for-development project co-funded by the Italian Cooperation and implemented by the Institute of Biometeorology of the Italian National Research Council (IBIOMET-CNR) in collaboration with the Niger National Meteorological Service (DMN) and the Interuniversity Department of Regional and Urban Studies and Planning (DIST) of the Politecnico and the University of Turin, Italy.

ANADIA Niger aims to strengthen national and local capacities of technical services in Niger for the mainstreaming of climate change adaptation and climatic risk reduction in sectoral strategies and local planning. The object of the action-research project "ANADIA-Niger" is to define a methodology for climatic risks analysis and evaluation appropriate to the micro and meso scales and to test it in Niger.

Agricultural droughts and floods are increasingly common in many Sahelian regions due to climate change. Even if risk is rarely taken into consideration in local adaptation planning, risk analysis and evaluation can greatly improve climate risk mitigation and adaptation planning at all levels from farmer to policy makers.

The approach was based on the establishment of interdisciplinary working groups at national and local levels interacting in the definition and the application of the methodologies. The working group was supported by a practical on the job training process on specific case studies.

The main methodological finding of our action-research is that improved services for key stakeholders can be provided according to the scale by strengthening the relation between local and national technical services and integrating scientific and local knowledge. Second, the project confirmed that climate services have a great potential for application in risk reduction and climate change adaptation even in remote rural areas of Sahelian countries. Website: http://www.fi.ibimet.cnr.it/progetti-1/progetti-attivi/ANADIA-Niger-en?set_language=en

Geodata for Agriculture and Water (G4AW) – The Netherlands

As a programme, commissioned by the Dutch Ministry of Foreign Affairs 'Geodata for Agriculture and Water' (G4AW) improves food security in developing countries by using satellite data. http://g4aw.spaceoffice.nl/en/

International Climate Smart Agriculture initiatives – The Netherlands

The Netherlands supports the work of the Global Alliance for Climate Smart Agriculture (GACSA) (http://www.fao.org/gacsa/en/) and the Global Research Alliance on Agricultural Greenhouse Gases (GRA). Additionally, The Netherlands supports several international initiatives that strengthen the capacity of smallholders to adapt to climate change, for instance IFAD's Adaptation for Smallholder Agriculture Programme and the CGIAR's Climate Change, Agriculture and Food security Programme.

Paper no. 5: New Zealand

Introduction

This submission sets out New Zealand's views and experiences in relation to practices and technologies that sustainably increase agricultural productivity, food security and resilience, and adaptation measures with co-benefits. This is in response to the invitation issued by SBSTA40 under the agenda item "Issues related to agriculture".

Summary

2. In assessing practices to sustainably enhance agricultural productivity it is important to consider the global context of climate change and food security. The Paris Agreement reflects Parties' collective desire to address food security and climate change concerns together, and provides a new framework for SBSTA work on agricultural issues. Specifically, identified technologies and practices should support increases in agricultural productivity, while at the same time adapting to a changing climate and supporting efforts to limit the increase in global average temperatures to well below 2°C above pre-industrial levels. Global mitigation efforts will need to include the agricultural sector, although the emissions pathways followed will be different to those required in other sectors (where emissions will reach near-zero).

3. New Zealand has taken a leadership role in promoting investment in agricultural greenhouse gas research. This research is already delivering promising results and is likely to provide mitigation avenues in the future. New Zealand farmers are also reducing emissions intensity through productivity and sustainability improvements, and are undertaking measures to enhance the resilience of New Zealand farming to a changing climate. Examples of these measures are provided in this submission.

Global context for SBSTA Issues Related to Agriculture

4. There is now a global consensus on the need for Parties to address both food security and climate change contemporaneously. This has been recognised explicitly by the Paris Agreement. In addition, Goal 2 of the United Nations Sustainable Development Goals commits Parties to strive to "End hunger, achieve food security and improved nutrition and promote sustainable agriculture". These developments reflect the global context in which SBSTA is considering "Issues related to agriculture".

5. References within the Paris Agreement to food production and food security reflect the collective desire of Parties to recognise the relationship between food security and climate change objectives. The FAO forecasts that global food production will need to grow by 70% by 2050 in order to meet increasing food demand while improving nutrition.[35] The FAO also forecasts that, if no further mitigation measures other than efficiency improvements are implemented, this increase

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[35] Alexandratos, N, Bruinsma, J (2012). World Agriculture Towards 2030/2050. The 2012 Revision. ESA Working paper No. 12-03. FAO, Rome.

in food production will result in agricultural emissions increasing by 30% by 2050.[36] All Parties to the Paris Agreement will communicate nationally determined contributions and pursue domestic mitigation measures to achieve their contributions. For many Parties, agricultural emissions represent an important proportion of national greenhouse gas emissions. These Parties will need to carefully consider appropriate domestic measures that advance both their food security and climate change objectives.

6. Holding the increase in global average temperatures well below 2°C above pre-industrial levels, and pursuing efforts to limit temperature increase to 1.5°C, will require mitigation actions to be undertaken in all sectors. Global mitigation scenarios that set the world on a pathway to limit warming to less than 2°C above pre-industrial levels assume 2050 global agricultural greenhouse gas emissions will remain at levels similar to today. This is in contrast to other sectors, where the assumption is emissions will reduce to near zero.[37] For example, within these same scenarios, global carbon dioxide emissions from the energy supply sector are forecast to decline by 90%. The forecast divergence in sectoral pathways is driven by the limited mitigation potential in agriculture compared with other sectors. As the Structured Expert Dialogue on the 2013-2015 Review reported "CO_2 removal technologies are needed to compensate for past GHG emissions overshooting the target and, more importantly in the second half of the century, also for emissions that cannot be reduced to zero (e.g. non-CO_2 emissions from agriculture)" (paragraph 26).[38]

7. It is also important to recognise the different atmospheric characteristics of methane and carbon dioxide. As a long-lived gas, carbon dioxide accumulates in the atmosphere over time, so carbon dioxide emissions will need to be reduced to net-zero in order to stabilise atmospheric concentrations. Methane, making up some 70% of the greenhouse gas emissions from agriculture, has a short atmospheric lifetime. Atmospheric concentrations of methane can therefore be managed to achieve stabilisation without reducing emissions to net-zero.[39]

8. Figure 1 below illustrates the forecast mitigation pathways for methane emissions from agriculture, and carbon dioxide emissions. New Zealand notes that significant mitigation from agriculture is forecast to occur, but the reduction trajectory will be different for the shorter-lived methane emissions. The Structured Expert Dialogue reported that "although reducing non-CO_2 emissions can be an important element of mitigation strategies, the temperature change is mainly determined by the cumulative budget of CO_2 emissions, and CO_2 emissions drive long-term warming" (paragraph 26).

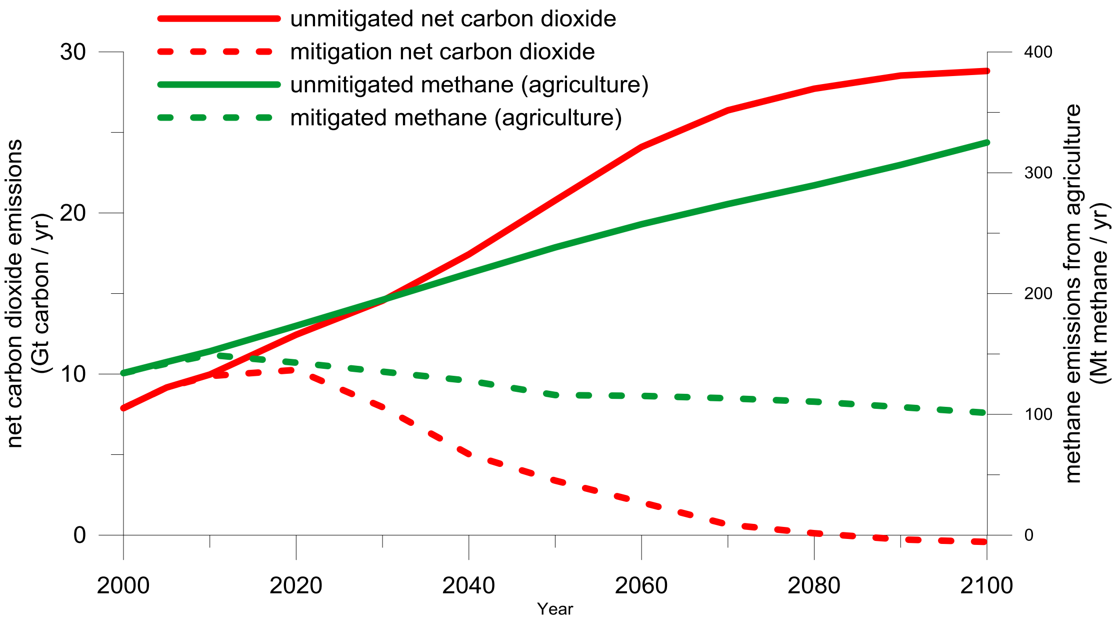
Figure 1: Agricultural methane pathway consistent with 2°C warming contrasted to carbon dioxide pathways

[36] Tubiello, F et al. (2014). Agriculture, Forestry and Other Land Use Emissions by Sources and Removals by Sinks. FAO Statistics Division ESS/14-02. FAO, Rome. www.fao.org/docrep/019/i3671e/i3671e.pdf

[37] Gernaat, D et al (2015). Understanding the contribution of non-carbon dioxide gases in deep mitigation scenarios. *Global Environmental Change* 33, 142-153.

[38] UNFCCC (2015). Report of the structured expert dialogue on the 2013-2015 review. http://unfccc.int/resource/docs/2015/sb/eng/inf01.pdf

[39] IPCC (2014). Climate change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the 5th Assessment Report of the Intergovernmental Panel on Climate Change. IPCC, Geneva, Switzerland.



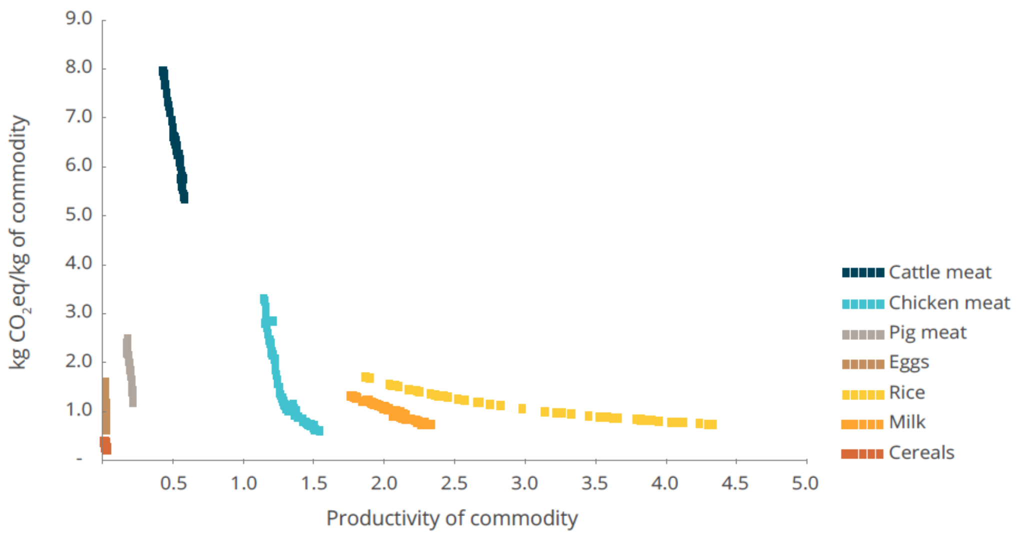
Global net CO_2 emissions (fossil fuels, cement production, and LULUCF) and global CH_4 emissions from agriculture, without mitigation (red) and with stringent mitigation consistent with limiting global temperature increase substantially below 2°C. Emissions are from the Representative Concentration Pathways (RCP) underpinning the most recent IPCC assessment (RCP8.5 and 2.6 for unmitigated and stringent mitigation scenarios, respectively).[40]

Enhancing productivity in a sustainable manner

9. Improvements in agricultural productivity in New Zealand (such as increased animal fertility, faster rearing and larger meat animals, improved feed management and utilisation, and improved animal health) have improved on-farm greenhouse gas intensity by approximately 1% per year since 1990. The relationship between productivity and emissions intensity exists across agricultural products globally and is displayed in Figure 2 below. Some of the productivity improvement in New Zealand can be attributed to a period of agricultural policy reform, beginning in 1984, which dramatically reduced the level of government support for agriculture (removing agricultural subsidies and trade protection). Eliminating this government support increased the incentive for farmers to pursue efficiency gains through more efficient use of inputs and reducing stock levels. Despite these efficiency improvements, absolute agricultural emissions in New Zealand have increased by 14% as production has increased. Emissions would have increased by 40% however, had today's production occurred at 1990 efficiency levels.

Figure 2: Greenhouse gas intensity and productivity of commodities, 1961-2010

[40] van Vuuren, D. et al (2011) The representative concentration pathways: an overview. *Climatic Change* 109, 5-31; Riahi, K. et al (2007) Scenarios of long-term socio-economic and environmental development under climate stabilization. *Technological Forecasting and Social Change* 74, 7, 887-935; van Vuuren, D. et al (2007) Stabilizing greenhouse gas concentrations at low levels: an assessment of reduction strategies and costs. *Climatic Change* 81, 119-159.



Source: FAO (2014): Agriculture, Forestry and Other Land Use Emissions by Sources and Removals by Sinks (footnote 2)

10. Currently, reducing the adverse impact of agriculture on water quality is a policy priority for New Zealand. This entails an effort to improve both effluent and nutrient management. As nitrous oxide emissions and nitrate loss (impacts water quality) are closely linked, efforts to improve nutrient management can be expected to have multiple sustainability benefits while also improving productivity.

11. Two water quality accords have been negotiated between the New Zealand dairy sector, government and other stakeholders (2003, and 2013).[41] A key measure in the first accord was the universal use of nutrient budgets by dairy farmers in assessing fertiliser needs (promoting efficient use of fertiliser). Since 2003, nitrogen fertiliser use per cow has peaked and subsequently decreased by 18%. The 2013 accord introduced further measures, such as the modelling of nitrogen loss from all dairy farms. This information will enable dairy farmers to view nitrogen loss and nitrogen efficiency as performance indicators, and, if necessary, take measures to reduce the farm nitrogen loss.

New Zealand investment in agricultural mitigation research

12. New Zealand is a global leader in the promotion and extension of agricultural greenhouse gas research. New Zealand is a founding member of the Global Research Alliance on Agricultural Greenhouse Gases (GRA), and has hosted the secretariat since its inception. New Zealand has also established a dedicated research centre (New Zealand Agricultural Greenhouse Gas Research Centre) as a focal point for agricultural mitigation research in New Zealand.

[41] Dairying and Clean Streams Accord (2003) and Sustainable Dairying: Water Accord (2013) http://www.dairynz.co.nz/media/3286407/sustainable-dairying-water-accord-2015.pdf .

13. New Zealand undertook this leadership role having identified a need to include investment in new research within a long-term agricultural mitigation strategy. The majority of agricultural emissions result from the biological processes of microbes present in soils (nitrous oxide), in livestock rumens (enteric methane), and in lagoons (rice paddy and manure management methane). The biological nature of these emissions pathways creates a complex challenge in developing methods and technologies to reduce agricultural emissions. In other sectors it may be possible to shift investment and practices from emitting technologies to an emission-free alternative (e.g. from coal to wind-powered generation of electricity). The agricultural sector must instead focus on reducing the activity of the emitting microbes within complex microbial ecosystems. In most cases it will be neither possible nor desirable to entirely eliminate emitting microbes.

14. A number of current research efforts are showing promising results: [42]

a) The successful identification of animal-safe compounds that inhibit the production of methane in the rumen. Short-term trials have shown a reduction in enteric methane of greater than 30%.

b) The identification of animals that naturally produce lower levels of enteric methane (without reduced productivity), and in addition showing this trait is heritable (allowing for breeding of this trait).

c) Identification of supplementary feeds (e.g. brassicas) that are compatible with a pasture-based system and reduce the level of enteric methane produced by ruminants.

d) Progress towards developing a vaccine that would selectively suppress methane-producing microbes in the rumen. Trials have successfully raised antibodies in animals and laboratory tests have shown methane suppression, but proof-of-concept to reduce methane production in field trials is the next step.

e) A global census of livestock rumen microbial populations has been completed and shows that a common group of microbes are responsible for producing enteric methane in all forms of ruminant agriculture. [43] This supports a view that, if technologies such as a vaccine can be commercialised, they will have global applicability (as opposed to only being applicable for certain breeds or locations). This study attracted collaborators and samples from 73 different organisations globally and analysed more than 700 samples from a wide range of ruminant species.

New Zealand agricultural adaptation measures and practices

[42] For a summary of research programmes and their distance from commercial maturity, see NZAGRC (2015b). Reducing New Zealand’s agricultural greenhouse gases: what we are doing. New Zealand Agricultural Greenhouse Gas Research Centre, Palmerston North. www.nzagrc.org.nz.

[43] Henderson, G et al. (2015). Rumen microbial community composition varies with diet and host, but a core microbiome is found across a wide geographical range. Scientific Reports 5:14567, doi: 10.1038/srep14567

15. New Zealand has developed a diverse set of adaptation responses to climate variability and change. New Zealand has described a number of adaptation measures in our previous submissions under this agenda item.[44] Our most recent submission highlighted New Zealand's policy focus on the principle that responsibility for risk management lies with farmers, and that government policy should not remove the incentive for farmers to adequately manage the risks posed by adverse events. The submission also outlined early warning systems employed in New Zealand.

16. Additional examples of adaptation measures that provide co-benefits for productivity and mitigation are:

a) ***Irrigation:*** Increased use of water storage and expansion of irrigation schemes helps mitigate the risk and uncertainty from drought and increases productivity.[45] Limited data suggests that in some contexts, for example on dry stony soils that have lower natural carbon stocks, introducing irrigation can also have the co-benefit of significantly increasing soil carbon and thus further contributing to mitigation objectives.[46]

b) ***Increased use of low-protein feeds:*** In New Zealand's pasture-based agriculture system dairy cows typically take in 50 to 100 percent more protein than that required for production. As an adaptation measure in response to a series of droughts, many farmers have invested in new capital such as feeding systems. Once supplementary feeds are introduced into the pasture-based system it allows farmers more control over the nutrient content of animal diets, allowing greater optimisation of protein content and, as a co-benefit, reducing nitrogen excretion rates per unit of product (and consequently nitrous oxide emissions intensity).[47]

c) ***Restoration of marginal land:*** Land that is economically marginal for agriculture is often employed for agricultural uses. New Zealand has begun to look at a variety of mechanisms to facilitate the retirement of marginal agricultural land (often restoring this land to forestry). Development of farm models that allow for greater disaggregation between different areas within a farm holding has allowed farmers to identify uneconomic areas within a holding that is economically profitable overall and selectively retire these areas. The Afforestation Grant Scheme allows land owners to receive a grant for new forest plantings in exchange for the Government receiving the first ten years of carbon credits accrued by a new forest, while the Erosion Control Funding Programme has a specific focus on afforestation of erosion prone land.[48] The retirement of land from grazing allows increased carbon storage through

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[44] New Zealand's most recent submission (2015) can be accessed here: http://www4.unfccc.int/submissions/Lists/OSPSubmissionUpload/55_83_130766350695863566-NZ%20SBSTA%20submission%20agriculture%20%20May%202015.pdf

[45] NZIER and AgFirst (2014). Value of irrigation in New Zealand: An economy-wide assessment. New Zealand Institute for Economic Research, Wellington. www.mpi.govt.nz/document-vault/5014

[46] NZAGRC (2015a). Reducing New Zealand's agricultural greenhouse gases: soil carbon. New Zealand Agricultural Greenhouse Gas Research Centre, Palmerston North. www.nzagrc.org.nz

[47] NZAGRC (2015b). Reducing New Zealand's agricultural greenhouse gases: what we are doing. New Zealand Agricultural Greenhouse Gas Research Centre, Palmerston North. www.nzagrc.org.nz

[48] See: https://www.mpi.govt.nz/funding-and-programmes/forestry/afforestation-grant-scheme/ ; and https://www.mpi.govt.nz/funding-and-programmes/forestry/erosion-control-funding-programme/

revegetation, and reduces the sediment load within some flood-prone catchments in highly erodible hill country.[49]

d) ***The role of international trade in enhancing food security and resilience:*** Food security in New Zealand is ultimately assured by taking full advantage of the opportunities provided through international trade. While a major drought or flood may severely impact production of key commodities throughout New Zealand, the same event will not have a significant impact on food production at a global level, and as a result New Zealand food prices (and food security) are unlikely to be affected as a result of a local extreme weather event. The IPCC Fifth Assessment Report (Working Group Two) notes that "There is medium evidence and medium agreement that deepening agricultural markets through trade… could help reduce market volatility and offset supply shortages that might be caused by climate change" (9.3.3.3.2).[50] At a global level, extreme weather events can be expected to have a less severe impact on food security in a world with a predictable and stable global trading system versus a world where trade in is more restricted or unstable.

Views on future work of SBSTA on issues relating to agriculture

17. SBSTA's earlier work on 'Issues relating to agriculture' has provided a base of knowledge on specific issues countries are facing in preparing agricultural sectors for climate change. This work first covered the role of early warning systems, management of extreme events, and understanding the risk to agricultural systems to climate change. This work should be taken forward to support Parties in preparing their agricultural sectors for the impacts of climate change.

SBSTA work is now moving to an investigation of the measures, practices and technologies to both adapt agriculture to climate change and enhance agricultural productivity in a sustainable way. The outcome of COP21 is particularly relevant in considering this second component of the SBSTA work. References to food security and food production in the Paris Agreement reflect Parties' collective desire to align climate change policies with global goals on food security and nutrition. Following the review of submissions made by Parties and observers, and the completion of the workshops in May, Parties should reflect on next steps in SBSTA. New Zealand considers it important that further work by SBSTA supports Parties to incorporate mitigation of agricultural emissions into nationally determined contributions in an appropriate manner.

18. New Zealand is willing to elaborate its thinking by making a presentation at the upcoming SBSTA44 workshop.

[49] Rhodes, D. (2001). Rehabilitation of deforested steep slopes on the East Coast of New Zealand's North Island. Unasylva 207, Rehabilitation of degraded sites. FAO, Rome. www.fao.org/docrep/004/y2795e/y2795e06.htm

[50] IPCC (2014). Climate change 2014: Impacts, Adaptation, Vulnerability. Contribution of Working Group II to the 5th Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK and New York, USA. See in particular Technical Summary and Chapter 9.

Paper no. 6: Sri Lanka

Subsidiary Body for Scientific and Technological Advice (SBSTA)

Issues related to agriculture

Sri Lanka - Country Submission

Sri Lanka - Introduction

Sri Lanka is an island in the Indian Ocean located at the tip of the Indian Subcontinent. The island has a total land area of 65,610 km^2 including 2,905 km^2 of inland water bodies. The maximum width east-to-west is 240 km and length in north-south direction is 435 km. It is located between 5°55' to 9°5' N and 79°42' to 81°53' E and hence has a tropical monsoonal climate. Extensive faulting and erosion over time have produced a wide range of topographic features with three distinguishable elevation zones within the island: the Central Highlands, the plains, and the coastal belt. In the south-central part of Sri Lanka, the rugged Central Highlands span around 65 km in the north-south direction with peak elevation at 2,524 m. The Highlands are the hydrologic heart of the country as almost all the major perennial rivers originate here spreading radially from the highlands to the coast. Most of the island's surface consists of plains between 30 and 200 meters above sea level. In the southwest, ridges and valleys rise gradually to merge with the Central Highlands, giving a dissected appearance to the plain. A coastal belt about thirty meters above sea level consists of scenic sandy beaches indented by bays and lagoons.

Despite its relatively small extent, the Sri Lankan landmass exemplifies a variety of climatic conditions. There are four important geographical and topographical features in Sri Lanka which considerably influence the climate over the island, in particular the rainfall regime. The first is the fact that Sri Lanka is a small island surrounded by the warm, tropical Indian Ocean with associated warm and humid air. The second is being closer to the equator influence of the Inter Tropical Convergence Zone (ITCZ) for its rainfall climatology is remarkable, especially during inter-monsoon periods The next is the existence of large mass of hills at the center of island which is perpendicular to two approaching moisture laden monsoon wind streams (the south-west monsoon in the middle of the calendar year and the north-east monsoon towards the end of the year). Another factor is the presence of the vast land mass of the Indian sub-continent to the immediate north and northwest of Sri Lanka, which has a large effect in driving the monsoon and its temperature regime. These four factors, directly or indirectly influence the rainfall regime of island. In general, the climate of Sri Lanka is considered as tropical monsoonal with a marked seasonal variation of rainfall. Of the major climatic parameters, rainfall, temperature, humidity and evaporation are of special significance to Sri Lankan agriculture, impacting substantially on the agricultural productivity of the country.

(c) Identification of adaptation measures, taking into account the diversity of the agricultural systems, indigenous knowledge systems and the differences in scale as well as possible co-benefits and sharing experiences in research and development and on the ground activities, including socioeconomic, environmental and gender aspects;

- Climate change, the harsh reality of modern civilization possesses an immediate, growing and grave threat to Sri Lanka cut-across all sectors of its economy, especially the agriculture. Climate of the island has undergone a change to such an extent that correct amount of rainfall does not come at the correct time of the respective rainfall seasons while the country's ambient temperature, especially the nighttime minimum temperature is slowly, yet significantly increasing while variability of both southwest and northeast monsoon rains and rains of convectional origin (inter-monsoons) has increased significantly during recent decades. As a result, both extremes, i.e., water scarcity and excess water, have become a recurrent problem in crop production and its entire value chain in Sri Lanka. Meanwhile recent climatological studies have revealed that cumulative annual or seasonal rainfall of major climatic zones in Sri Lanka during last few decades have not under gone a significant change. Nevertheless, occurrence of heavy rainfall events is on increase during recent times in most parts of the island with web of negative impacts especially on the agriculture sector. Meanwhile, increasing ambient temperature is also inflicting several direct and indirect negative impacts on the crop growth.

- However, it has been evident during recent decades that heritage of farming experiences and accumulated weather lore of centuries have become ineffective in agricultural planning process at all levels due to climate change. Therefore, it has become a timely need to produce reliable and effective early warnings with a reasonable lead time so that appropriate changes to farming practices could be undertaken to minimize the impacts of possible weather aberrations under a changing climate.

- The main food-related agricultural products in Sri Lanka are crops such as rice and other field crops, fruits and vegetables, and animal products such as milk, meat, eggs, and fish. All these sub-sectors of agriculture are highly vulnerable to climate change. Decreasing arable lands, increasing land degradation together with increasing population, renders these challenges more difficult to tackle. It has been now understood that among the crops grown in the country, coarse grain, legumes, vegetables and potato are likely to be adversely affected due to climate change. Changes in the seasonal rainfall pattern with very high variability and an increase in both minimum and maximum air temperature are likely to be the two key factors that will affect food production in principal growing regions. A positive feature is that the diverse agro-ecological conditions of the island have given rise to a wide range of crop species and land races that are suited for varied conditions of soils, rainfall and altitude as well as to diseases and insect pests. Farming systems and agronomic practices in most agricultural regions of Sri Lanka have evolved in a close harmony with the prevailing agro-ecological conditions of respective climatic regions of the island and thus, possess high genetic diversity particularly among rice, other cereals, cucurbits and vegetables such as tomato and eggplant, indicating potential for crop improvement as an adaptation measure to climate change.

- Being cognizant of the importance of adapting to climate change, the government of Sri Lanka has taken several initiatives at the policy level by developing the National Climate Change Policy (NCCP) of 2012 and the National Climate Change Adaptation Strategy (NCCAS) 2010-2016. While the three main policies that deal with the agriculture sector related to food security namely the National Agricultural Policy of 2007 (a new agriculture policy is currently being developed), National Livestock Development Policy of 2007, and the National Fisheries and Aquatic Resources Policy of 2006 do not explicitly address the climate change related issues, the NCCP and NCCAS has mainstreamed climate change adaptation into national planning and development.

- In terms of food security, self-sufficiency in rice production has been the major strategy of agricultural policy since Sri Lanka gained independence in 1948. This has supported generation of employment, and elimination of rural poverty. Sri Lanka reached the stated goal of self-sufficiency in rice, the staple food in the year 2010 mainly due to the investments in research and development, and expansion in extent of cultivation, and has been producing surplus of rice since then. The rice research outputs in Sri Lanka in the last half century further corroborates this contention in that on average, for every 1 % increase in rice research investment rice production increased by 0.37 % with an internal rate of return of 174 % in a tariff protected regime and a benefit cost ratio of over 2,300.

- Poverty, climate change, decreasing arable agricultural land, land degradation and increasing population pressure are the main issues that render achieving the national level food and nutrition security more challenging in Sri Lanka. Out of the total population of Sri Lanka, 12 % are severely food insecure, of which 82 % are in the Northern and Eastern Provinces. Extreme climate events, such as the severe drought that prevailed over a period of 5-6 months in the year 2012 and recurrent floods, have provided its own challenges to food security. Despite all these, the Global Food Security Index 2015 has ranked Sri Lanka 63rd out of 109 countries, placing the country at the highest position among all South Asian countries highlighting the approaches taken by Sri Lanka to adapt to climate change over the years.

Rice:

- Rice being the major staple of Sri Lankans, more efforts have been made by the scientific community to provide suitable materials resilient to changing and variable climatic conditions. A recent study has indicated that rice farmers in the Kurunegala district of Sri Lanka (Intermediate Zone) have lost 44% of the agriculture income every season due to drought. The awareness of climate change among the farmers is high but the adaptation is poor due to lack of knowledge on adaptation methods, unavailability of prior information on climate change, absence of suitable cultivars and lack of funding have been identified as factors hindering adaptation. A recent study has reported that the rice yield variability under the future climate scenarios in the Kurunegala district of Sri Lanka shows small increasing trends, averagely 1.7% and 2.4% under the A2 and B2 scenarios respectively. In order to achieve the future country rice requirement under the impacts of climate change more yield improving techniques are required.

- Several successful attempts have been made in the rice production sector in the technological front to meet the challenges of climate change. Development of rice varieties, which are of short duration, and suitable for short growing seasons, and suitable for high CO_2 concentration are in the forefront of technological innovations. The recent release of ultra-short duration rice varieties by the Sri Lanka Department of Agriculture such as Bg250 and Bg251 (maturing in 75-80 days) is a positive response by the Government of Sri Lanka to cope up with climate change. The potential for adoption of aerobic growing conditions for rice varieties minimizing the water use under changing climatic condition while assessing the competition for weeds has been reported.

- Studies carried out in Sri Lanka to identify the role of traditional paddy varieties and organic practices in adapting to climate change especially in the coastal belt have indicated that farmers have perceived climate change in rainfall patterns, intensity and timings, changes in the cloud formations and other indicators such as the behavior of animals. As the sustainability of food production through traditional farming patterns is being challenged, farmers have been following water conserving agronomic practices such as *Kekulama* or *Manawari* system and *Nava Kekulama*(dry sowing systems) . They are also making informed choices in species selection by combining local knowledge in species and varieties under the guidance of several NGOs. Paddy cultivation in the Dry and Intermediate zones in Sri Lanka under zero tillage condition has enabled a reduction in cost of production and enhanced water conservation without significantly affecting the yield. Breeding of salt-tolerant rice varieties is also a primary adaptation measure to maintain national rice production levels and ensuring food security in the face of expanding salinity due to sea level rice. In this regard, the rice variety At354 (three and half month age class) is a salt-tolerant rice variety developed by the Sri Lanka Department of Agriculture to meet food production challenges under saline conditions. Salinity in paddy fields could be also be overcome by a combination of agronomic measures including improved field drainage, application of organic manure, rice straw and burnt paddy husk and transplanting instead of direct seeding.

- With more frequent extreme rainfall events, the area under major irrigation reservoirs schemes (reservoirs with an irrigable area of more than 80 ha) in the Dry and Intermediate Zones that practice rice+rice annual cropping pattern would not be able to claim the usual share from the trans-basin diversion structures. This has forced the farming community to reduce the extent under cultivation or explore other adaptation options such as “shared cultivation” (*Bethma* System) but, at the expense of productivity of the system. Moreover, increased occurrence of extreme positive rainfall anomalies is likely to cause severe damages to existing irrigation infrastructures of major irrigation in addition partial or severe crop losses and thus, limiting the water availability for crop production systems under these tanks.

- Traditional agriculture practices coupled with endogenous paddy varieties have proven to be more successful in facing climate change events such as droughts and floods. There are many traditional paddy varieties in existence today in Sri Lanka, which have strong characteristics that help them survive climate change impacts such as droughts, heavy rains, and floods compared to newer varieties used in chemical intensive paddy cultivation. This vigor is based on certain characteristics unique to traditional paddy varieties. The traditional varieties are capable of surviving in the nursery until the field conditions are favourable for planting. Traditional varieties are tall with a strong stem compared to the new improved varieties, thus helping them to withstand heavy rains, winds, and droughts. The shell of the paddy seed of traditional varieties can withstand water logging and drought conditions. Traditional rice varieties such as ‘*Hata da vee*’ that survives long dry spells are being cultivated in selected areas in the Dry and Intermediate zones of the country. Farmers are being assisted by several NGOs to identify traditional paddy varieties such as *Pokkali*, *Kaluheenati* and *Madathawalu*, which can be grown in sandy and saline soil with appropriate management practices. To cope with shifting seasons due to unpredictable fluctuations in rain and temperature, short age traditional varieties such as '*Hata da vee*' (mature in 60-70 days) and the '*Maha ma vee*' (requires 6 months to mature) are cultivated by farming communities in different localities of Sri Lanka. Paddy farmers under the minor tank systems (less than 80 ha of command area in the Dry Zone of Sri Lanka are aligning farming activities with the recognized seasonal pattern of rainfall and managing rainwater harvested in the commonly owned village tanks. Changing planting date of rice according to the onset of rainfall can reduce the irrigation water requirement and risk of rice cultivation. Early onset and an early planting resulted higher yield and water productivity across different irrigation management options, while there was a higher variability in both water productivity and yield at a late onset and planting with subsistence irrigation. Advancing the rice planting date by 1 month for four different rice varieties tested is a non-cost climate change adaptation strategy for rice production in the Kurunegala district of Sri Lanka.

Coconut:

- Analysis of coconut production data from 1971-2001 have shown that that foregone income to the economy due to crop shortages from unfavorable climate has varied around US$ 32- 73 million, and the additional income to the economy from favorable climate years producing a crop glut was US$ 42-87 million. This implies the potential for significant economic benefits from investments in adaptation that would reduce variability in coconut production, caused by variation in climate. Some varieties such as Tall x Tall, Tall x San Ramon have been recommended for drought –prone area in Sri Lanka to meet the challenges of climate change. Furthermore, Dwarf Brown appears promising for plant breeders as an ideal parent material due to some characteristics such as non-seasonality, high yielding capacity (higher number of nuts per bunch and higher number of inflorescence per palm per year) and relatively higher tolerance to water stress conditions compared to those of other dwarf varieties.

Other food crops:

- Several strategies have been adopted in the other food crops sector (excluding rice) covering many food crops at national and household level to cope up with the changes in climate, such as (a) soil moisture conservation with mulching, soil erosion control under stormy weather conditions to minimize surface runoff and improving the water retention capacity of soil, (b) growing low water demanding crops such as mungbean (green gram), soybean, cowpea, ground-nut, finger millet and sesame and short age crops for mid seasons cultivation with appropriate agronomic management practices and (c) adjusting the cropping calendar according to changes in the rainfall pattern.

Animal production:

- Livestock and poultry form an important subsector in terms of social and economic context of the country, and hence strategies for adaptation and risk aversion to face the challenges brought by the changing and variable climatic conditions are crucial. Specific strategies for climate change adaptation have not been specifically highlighted in the National Livestock Development Plan – 2010, which is implemented at present. The livestock sector implement a strategic approach in animal breeding activities since 1994 according to the climatic regions and the level of adaptation of different livestock breeds and their crossbreds.

- A greater emphasis has been given for the dairy sub-sector in implementation of breeding strategies as the country's main strategy in terms of food and nutrition security in relation livestock production is to bring self-sufficiency in milk and milk products. The interim target has been set to achieve 50% self-sufficiency by the year 2015. However, there are no pasture development strategies or recommendation in place according to the climatic conditions due to various limitations that exists in the field level. Given the fact that Sri Lanka possesses a diverse climatic condition as well as the production environments, the benefit of development of climate resilience system for feed improvement is still pending.

- The sub-sectors other than dairy have breeding strategies specified for each sector considering the adaptability of different genotypes. In addition, sustainable utilization of indigenous animals has been specifically identified in the animal breeding guidelines. Many efforts have been taken in the past in developing locally adopted breeds suitable for different climatic regimes in the country. Kottukachchiya goat breed developed as a dual purpose breed suitable for the Dry Zone of Sri Lanka, CPRS poultry breed developed for local climatic conditions and feeding practices are a few examples of such attempts.

Homegardens:

- "Homegarden" (HG) is a complex but sustainable land use system that combines multiple farming components in the homestead and provides environmental services, household needs, and employment and income generation opportunities to the households. A study conducted to assess the vulnerability of Homegardens to climate change and its impact on household food security in Sri Lanka has identified four categories of climate change adaptation strategies of homegardeners namely, (1) changing planting date, (2) changing agronomic practices, (3) changing technology such as use of new varieties and irrigation equipment, and (4) use of soil and water conservation measures. Family size and perceptions on climate change positively affect the likelihood of adaption of new technologies in Sri Lanka. Male-headed households also tend to adopt more than that of the female-headed households. The factors that negatively affect adaptation in Sri Lankan study sites included ownership of animals, homegarden size, age of the head of the household head and plant diversity of the homegarden. Commercial orientation, perceptions on climate changes, years of experience of the homegardeners, and location of farming have significantly influenced the probability of adoption of adaptation strategies.

- The bio-physical responses in agriculture are from the impacts of rainfall, temperature and extreme climate events arising from climate change. The scope is determined by the temporal and spatial distribution of these variables on the vulnerable regions. Temperature affects the reproductive biology of the plant. This is important in plants where the harvested product is the reproductive part of the plant as in rice and other cereals and the plantation crop - coconut. In tea, temperature increase at the higher elevations affects the quality of the product. Temperature also affects the rate of evaporation, which depletes soil moisture and transpiration from crop plants. The spatial distribution of rainfall determines the extent of rain-fed agriculture in the Dry-zone, particularly paddy and other field crops. Temporal and quantitative changes affect the initiation of cultivation and harvesting of annual crops, particularly paddy cultivation, and also the recharge of surface and ground water resources for irrigated agriculture.

- The social consequences extends from the farming community whose livelihoods are affected from reduced farm income and in extreme cases from total crop failure or inability to cultivate at all due to insufficient storage of irrigation water in tanks. The impacts on national food security extends the social consequences to other vulnerable sectors of the population living close to the poverty line, particularly in the Dry zone and estate workers and small holders in the Wet and Intermediate zones of the country. To seek alternative employment, the affected communities would migrate to urban areas for employment resulting multi-faceted problems in the economy.

<u>Gender issues in adapting to climate change</u>:

- Rainwater harvesting techniques, crop diversification and livestock integration, mulching and thatching, and micro-irrigation are key CSA practices adopted in Sri Lankan homegardens. Such activities, predominantly undertaken by women, represent important entry points for advancing adaptation, mitigation, and productivity goals, but also for acknowledging and encouraging women's critical role as knowledge heirs, decision makers and environmental stewards.

- Studies carried out in the Kandyan homegardens of the Central province suggest the importance of acknowledging women's role in promoting and scaling out CSA, given their role as decision-makers and managers of homegardens. While men grow mainly tree crops and are engaged in marketing the products, women are usually in charge of growing secondary crops that aim to diversify production and provide for a healthy household diet, contributing to ensuring household resilience and food security

(d) Identification and assessment of agricultural practices and technologies to enhance productivity in a sustainable manner, food security and resilience, considering the differences in agro-ecological zones and farming systems, such as different grassland and cropland practices and systems;

- Sri Lanka has traditionally been generalized into three climatic zones namely, "Wet Zone" in the southwestern region including central hill country, "Dry Zone" covering predominantly, northern and eastern part of the country, and "Intermediate zone," skirting the central hills except in the south and the west. In differentiating these three climatic zones, annual rainfall, contribution of southwest monsoon rains, soil type, land use and vegetation have been widely used. The Wet zone receives relatively high mean annual rainfall over 2,500 mm without pronounced dry periods. The Dry zone receives a mean annual rainfall of less than 1,750 mm with a distinct dry season from May to September. The Intermediate zone receives a mean annual rainfall between 1,750 to 2,500 mm with a short and less prominent dry season. Sri Lanka has been further divided into 46 agro-ecological regions that take into account the monthly rainfall amount (at 75% probability) and distribution in addition to the parameters considered for identifying climate zones.

- An agro-ecological region represents a particular combination of the natural characteristics of climate, soil and relief. When an agro-climatic map, which can be considered as areas where the integrated effect of climate is uniform throughout the area for crop production, is superimposed on soil and terrain the resulting map identifies agro-ecological regions. Thus, each agro-ecological region represents a uniform agro-climate, soils and terrain conditions and as such would support a particular farming system where certain range of crops and farming practices find their best expression. The demarcation of the island into 46 agro-ecological sub-regions is shown in Figure 1.

i. The Wet Zone comprises of 15 agro-ecological sub-regions. Four sub-regions found in the Up-country wet zone show a distinct variation in the distribution of the South West Monsoon (SWM) rains. Being in the most effective area of the SWM rains, WM1a, WL1a and WU1a sub-regions receive the highest amount of rainfall in the country. Apart from the amount and distribution of SWM rains, relative effectiveness of North East Monsoon (NEM) rains has also played a vital role in distinguishing 6 sub-regions in the mid- country wet zone. The four months period from December to March is relatively "dry" in WM3a agro-ecological sub-region while there are two distinct dry periods in the WM3b due to reduced effectiveness of SWM rains over this sub-region. In the Low country Wet zone, amount and distribution of SWM as well as First Inter Monsoon (FIM) rains were important in identifying the 5 agro-ecological sub-regions. Meanwhile, the months July, August and December in WL3 agro-ecological region does not receive adequate amount of rainfall and hence cannot be considered as wet months. As such, 4 months period extending from December to March is relatively "dry" in this region.

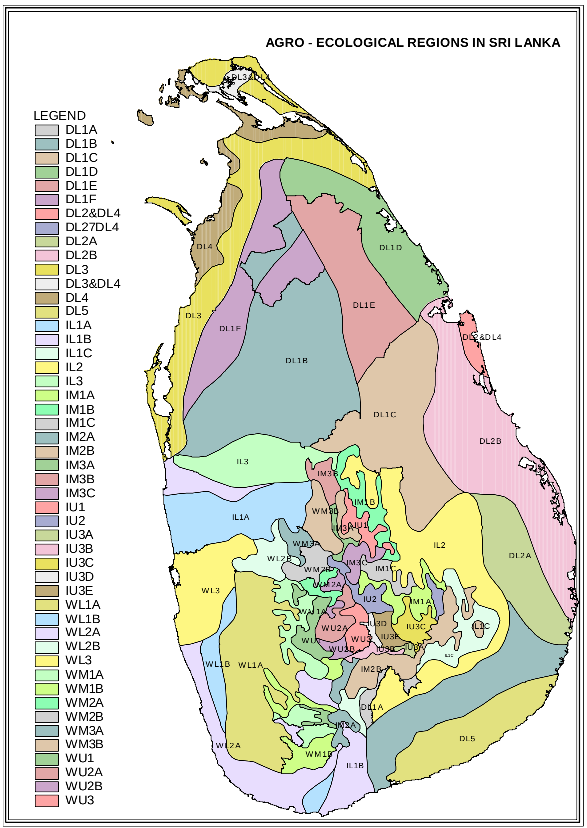

Figure 1. Agoecological regions of Sri Lanka

ii. The Intermediate Zone consists of 20 agro-ecological sub-regions out of which 15 sub-regions are in the central hills. Varying degree of effectiveness of different rainfall governing mechanisms across the central hills has caused variety of growing environments in this region. There are seven agro-ecological sub-regions in the Up country Intermediate zone out of which IU1 is reported to receive the highest annual rainfall among all sub-regions of the entire Intermediate zone. Being in the Knuckles range, this region receives ample amount of rains from NEM while the contribution from SWM rains is also substantial. Complex geographical settings of the IU3 agro-ecological region which encompasses almost whole of the so-called "Uva basin" have resulted five agro-ecological sub-regions due to high spatial variability of inter-monsoonal and NEM rains in this region. Meanwhile, being located in the rain shadow area of the SWM, this region does not receive adequate rains during June to September resulting in dry and windy environment. The Mid country Intermediate zone has seven agro-ecological sub-regions. Most of these sub-regions also do not receive adequate rains from SWM and, hence, 4-month period from June to September is relatively dry. Low country Intermediate zone consists of five agro-ecological sub-regions. Other than IL2, all other agro-ecological sub-regions in the Low country Intermediate zone resemble a bi-modal rainfall distribution. Since Second Inter Monsoon (SIM) and NEM rains are the only effective rainy seasons in the region, the IL2 agro-ecological region exhibits a distinctly uni-modal rainfall distribution along with a long and pronounced dry period from April to September.

iii. The Dry zone consists of 11 agro-ecological sub-regions with different rainfall distribution and edaphic features. The DL3, DL4 and DL5 agro-ecological regions of the Dry zone receive the lowest annual rainfall of the country in combination with some soil limitations that are found in these regions. Out of 11 agro-ecological sub-regions, only DL1a and DL1b are characterized by two discernible peaks in the rainfall distribution and thus, support crops in both *Maha* and *Yala* growing seasons. Those agro-ecological sub regions found in the eastern sector of the Dry zone, i.e., DL1c, DL1d, DL1e and DL2a and DL2b, exhibit a distinct uni-modal rainfall pattern, and support only the crops in *Maha* season. The rest of the agro-ecological sub-regions of the Dry zone also support only the *Maha* crop since *Yala* rains in those sub-regions are not adequate to meet the evapotranspiration requirements.

- Food security in Sri Lanka is determined by several factors including diverse food systems and farming systems. Food systems in Sri Lanka are affected to different degrees by natural disasters induced by the climate change with a larger spatial variation. Sri Lanka's traditional farming systems have developed over hundreds of years with farmers managing production systems in the agro-ecological regions to best suit local environmental conditions. This has led to a rich agro-biodiversity in the island in terms of food crops such as rice, cereals, pulses, vegetables, root and tuber crops, spices and fruits. Changes in climatic conditions may, however, change the conditions that define the agro-ecological regions, and reduce the productivity of crops and livestock that are adapted to them. Conversely, they might allow new options in some areas. Currently, more than two million hectares are under some form of agriculture in Sri Lanka. However, much of the agricultural lands are located in the water deficient Dry Zone where increased productivity of crops (other than paddy) depends entirely on seasonal rainfall.

Land uses in Sri Lanka

- The main agricultural land uses in Sri Lanka includes land under food crops (consisting of rice paddies, horticultural crops, other field crops and spices), plantation crops (comprising mainly tea, rubber, coconut and sugarcane), export agriculture crops (comprising cinnamon, clove, pepper and nutmeg), and other beverage crops such as coffee. The category termed other field crops (OFC) includes over 100 species. Among these are cereals, grain legumes, condiments and oilseeds, onion and potato. Crops such as onion, potato and vegetables generally remain a small farmer activity, though some of these crops are also grown on a semi-commercial scale. Fruits, vegetables (i.e. up-country and low-country vegetables), and ornamental plants also form an important component of agricultural export earnings as they contribute to ensuring food security and national income generation.

Farming systems in Sri Lanka:

- Traditional farming systems in Sri Lanka have developed over hundreds of years with farmers managing production systems in these regions to best suit local environmental conditions. This has led to a rich agro-biodiversity in the island in terms of rice, cereals, pulses, vegetables, root and tuber crops, spices and fruits. Changes in climatic conditions may, however, change the conditions that define the agro-ecological regions, and reduce the productivity of crops and livestock that are adapted to them. Currently, more than 2,000,000 ha are under some form of agriculture in Sri Lanka. However, much of the agricultural lands are located in the water deficient Dry Zone where increased productivity of crops (other than paddy) depends entirely on rainfall. A positive feature is that the varied climatic conditions in farming systems of the island have given rise to a wide range of crop species and land races that are suited for varied conditions of soils, rainfall and altitude as well as to diseases and insect pests. Genetic diversity is particularly high among rice, cereals, cucurbits, vegetables such as tomato and eggplant, indicating potential for crop improvement in the face of climate change as an adaptation measure.

- Adaptations can be autonomous or reactive. Autonomous adaptation is the reaction of a farmer to changing climatic patterns where changes of crops or use of different harvests and planting dates can be identified. Reactive adaptation measures are aimed at altering the adaptive capacity of the agriculture systems such as deliberate crop/variety selection, substitution of new crops with old crops, etc. Adaptation could also be Anticipatory or proactive. Those are the measures to reduce potential risks of future climate change such as crop and animal breeding for biotic & abiotic stresses and major investments on trans-basin diversion to improve the irrigation capacity

Agriculture Practices in Rice Paddies**:**

- Sri Lanka's paddy fields are both rainfed and irrigated from rainwater stored in tanks, built during the island's hydraulic civilization over almost 2,000 years ago, and large multi-purpose reservoirs built in recent times. Paddies in the Dry Zone are rainfed from the North-East monsoon during the *Maha* season and irrigated in the non-rainy period or *Yala* season. Paddy fields in the Wet Zone are rainfed and comprise terraced systems in hilly areas, and open systems in flat lowland areas, to suit the local terrain and rainfall. Paddy yields over the years have been drastically affected resulting from delay of the onset of seasonal rains, and the consequent delay in release of water for cultivation from ex-sluice. Sri Lanka has reached well above self-sufficiency in rice during the past five years due to an increase in the extent in cultivated and productivity supported by technology and favourable weather conditions, which underscores the importance of adopting adaptation measures to mitigate the impacts of adverse weather conditions to maintain consistency of paddy production. Further, the high genetic variation among indigenous rice varieties is an indicator of excellent potential for varietal improvement for adaptation to climate change.

- Many New Improved Varieties (NIV) with varying yield times (i.e. varied age groups) have been developed and adopted by paddy farmers across agro-ecological regions of Sri Lanka which had led to strategic climate change adaptation measures.About 98 per cent of the paddy cultivated extent in Sri Lanka is occupied by the NIVs.

- During *Maha* season the common farming system in the uplands of the Dry zone is rainfed agriculture which is a fairly low productive system due to frequent moisture stress, low fertilizer use efficiency and poor adoption of good agricultural practices. Decrease in the rainfall would further aggravate the low productivity of rainfed upland farming system in the Dry zone. The amount of rainfall received in the *Maha* season would decide the type and extent of both *Maha* and *Yala* cultivation. Consequently, less availability of water in minor and major irrigation tanks would limit cultivable land area under each tank. This has led to adoption of a *Bethma* cultivation system where cultivable extent for each individual farmer is reduced in proportion to the ownership allowing maximum use efficiency of available water in the reservoirs, thus making it an effective adaptation strategy.

- The *Walagambahuwa* concept that was developed to maximize the utilization of incidental rainfall for rice cultivation has been adopted to reduce the crop failures due to shortage of water at the tail end of the cropping season. The underlying principle was the utilization of incidental rainfall of *Maha* cultivation through advancing the timing of field operations for rice and save water for rice/OFC cultivation in subsequent *Yala* season. However, the rate of adoption of the concept by the farmers was not satisfactory due to technical (in some minor tanks, ratio between the catchment and command area was not sufficient), practical (with the onset of rains farmers give a priority on upland cultivation first *i.e.*chena. and subsequently they move on to the lowland) and attitudinal reasons where farmers had no assurance for cultivation until the tank is full.

- The long history of paddy cultivation in Sri Lanka that spans over two thousand years is closely linked with natural climatic variations in the region where rice is grown, resulting in a high varietal diversity of rice (*Oryza sativa*). Among these there are several indigenous rice varieties that can tolerate different climatic and soil conditions, and are highly resistant to pests and disease. For example, there are traditional upland varieties well known for their drought tolerance; varieties grown in the coastal areas and floodplains of rivers that possess tolerance of salinity, submergence and flash floods; a few rice varieties cultivated at higher elevations (over 1,000 m) that grow at low temperatures; and several varieties that show broad-based resistance to serious pests, high salinity and other adverse soil conditions. Sri Lanka also has five species of wild rice, including one with a rhizome (*Oryza rhizomatis*) which is perennial. Among the traditional varieties of rice many have characteristics that are important for varietal improvement. For example, *Podi wee* and *Murungakayan* are resistant to blast; *Dahanala* and *Kalubala wee* are resistant to thrips; *Rathu heeneti*, *Suduhanditan*, *Balama wee*, *Suduru samba*, and *Ma wee* and *Hondarawalu* are resistant to the brown plant hopper (BHP). Some new varietal lines such as LD 183 is expected to be resistant to drought, and LD 183-187 are resistant to high salinity; some New Improved Varieties (NIV) such as At 353 and At 354 also have high salinity tolerance+; BW 361, 363 and 364 are resistant to iron toxicity.

Agriculture Practices in Other Food Crops to Adapt to Climate Change

- Conservation farming practices have been introduced and adopted as a means of maximizing incidental rainfall and to mitigate the effects of periodic droughts on crop growth. The basic technology involved the cultivation of annual crops between leguminous tree species (Alley cropping). Soil moisture conservation with mulching, soil erosion control under intensive rainy conditions were expected under this system apart from other benefits such as nutrient recycling, weed control, improvement in bio-diversity as means of natural pest management systems.

- Organic farming approach is also useful in addressing the issues related to water shortages. Soil organic matter improves and stabilizes the soil structure so that the soils can absorb higher amounts of water without causing surface run off and improving the water retention capacity to mitigate the impacts of drought conditions. Low tillage, maintenance of permanent soil cover through crops, crop residues, cover crops and crop rotation increase the soil organic matter. Mulching and zero tillage are also appropriate where rainfall intensity is high.

- There are no locally released OFC varieties having appreciable tolerance to adverse moisture or temperature conditions. However, short age varieties have been developed as an escape mechanism to alleviate from drought situations. Examples for such shortage varieties include the maize variety *Aruna* (90 days), Black gram variety *Anuradha* (65-70days) Mung bean variety MI-6 (55-60 days), Soybean variety Pb 1 (80-85 days) and Ground nut variety *Tissa* (90 days).

- Cropping patterns and relevant management practices to maximum utilization of the available moisture have been introduced. For example, less water demanding crops such as finger millet and sesame are suitable for the rice based cropping systems and short age crops such as Mung bean for mid seasons cultivation with appropriate agronomic management practices.

- Crop diversification along with perennials has been a successful adaptation option to mitigate impacts from unexpected weather conditions with the increase of resilience of the agro-biodiversity to changing environmental conditions and stresses. In addition, benefits such as provision of wood and non-wood forest products, restoration of soil fertility, conservation of bio diversity, improvement to the micro-climate have be entertained

Agriculture Practices in Plantation Agriculture to Adapt to Climate Change

- The Plantation Sector comprises tea, rubber, coconut and sugarcane, which together with other export agriculture crops such as coffee, cocoa, spices (including cloves, cinnamon, nutmeg, mace, pepper, cardamom, etc.), cashew, arecanut, betel leaves, essential oils and un-manufactured tobacco are important in terms of export earnings. About 300,000 small scale growers are involved with the cultivation of export crops, of whom the majority are smallholders. Tea and rubber plantations are concentrated in the Central and Sabragamuwa Provinces; coconut plantations are mainly located in the Kurunegala, Puttalam and Gampaha Districts; cinnamon and citronella plantations are found mainly in the Southern Province. Research carried out at the respective Tea, Rubber and Coconut Research Institutions, as well as selection by growers, has resulted in considerable diversification of cash crops from the originally introduced germplasm.This has served to produce high-yielding varieties that are also resistant to pests and disease and adverse climatic conditions.

Agriculture Practices in Home Gardens and Horticultural Crops to Adapt to Climate Change

- Home gardens have made a substantial contribution to agricultural production in the country, and play a perceptible role in maintaining canopy cover in the island, ameliorating the micro-climate, and providing timber and wood products. Home gardens constitute a traditional system of perennial cropping for a wide range of valuable crops, and are known to be particularly important for providing construction and industrial wood and maintaining high species and genetic diversity of fruit, vegetables and spices that can be used to improve capacity of such crops to withstand climate change.

- Forest analogue home-gardens, such as the typical ‘Kandyan home gardens’ demonstrate diverse agricultural systems, and are the main agricultural holdings for horticultural crops. They are also repositories of indigenous traditional knowledge on agricultural practices that could be of value when formulating adaptation measures for climate change. Home gardens in the Wet Zone, particularly in the Western wet lowlands are, however, now being increasingly fragmented, with the decreasing land-man ratio in the region. This is leading to considerable localized loss of canopy cover and the erosion of indigenous horticultural crop diversity and soil as well.

- Chena, or rainfed upland farming in the current context, though environmentally destructive, is also a major source of cereals and vegetables that have been subject to selection by farmers over time. The Department of Agriculture is continually engaged in research and development projects, extension services, seed production and quality improvement programmes for development of the horticultural sector, headed mainly by the Horticulture Research and Development Institute (HORDI). These efforts include the release of several hybrid varieties that have qualities to withstand impacts of climate change. For example, two new hybrid varieties of tomato, '*Bhathiyaa* and *Maheshi*', and one variety, (*i.e.* KC-1) that have been released are tolerant to high ambient temperature coupled with a high yield.

<u>Agriculture Practices in Livestock to Adapt to Climate Change</u>

- Livestock is an important component of the agricultural sector. Most of the livestock comprise imported high yielding breeds to address the increase in livestock production. Sri Lanka also has several local breeds that are well adapted to the local environment and harsh conditions, but are relatively low yielding. These locally adapted breeds now show a significant drop in population size due to the move towards high yielding imported breeds and cross-breeding. This requires special measures to conserve the indigenous livestock breeds with traits that are useful to adapt to climate change.

- Among the existing indigenous breeds there are a few type of locally adapted native cattle (*Bosindicus varceylonicus*) or "*Batu Harak*" and the white cattle of Thamankaduwa that are reared for draught and milk, hardy indigenous goats including a locally adapted breed *Kottukachchiya*, and village back-yard chicken that are poor egg producers, but are highly adapted to a harsh environment. The locally adapted breeds show traits such as high adaptability to the environment, high resistance to tropical diseases, high fecundity, early maturity, good mothering ability, longevity and low cost of production.

Paper no. 7: United States of America

Issues Related to Agriculture

March 8, 2016

The United States welcomes the opportunity to submit its views and experiences, pursuant to UNFCCC/SBSTA/2014/L.14, on the following two areas: 1) Identification and assessment of agricultural practices and technologies to enhance productivity in a sustainable manner, food security and resilience, considering the differences in agroecological zones and farming systems, such as different grassland and cropland practices and systems and; 2) Identification of adaptation measures, taking into account the diversity of the agricultural systems, indigenous knowledge systems and the differences in scale as well as possible co-benefits and sharing experiences in research and development and on the ground activities, including socioeconomic, environmental and gender aspects.

Examples from the United States context can be found below.

1) Identification and assessment of agricultural practices and technologies to enhance productivity in a sustainable manner, food security and resilience, considering the differences in agroecological zones and farming systems, such as different grassland and cropland practices and systems.

BUILDING BLOCKS

In April 2015, the United States Department of Agriculture (USDA) announced the USDA Building Blocks for Climate Smart Agriculture and Forestry. This plan was designed to assist farmers, ranchers, forest land owners, and rural communities in responding to climate change. The framework consists of ten "building blocks"[1] spanning a range of technologies and practices that reduce greenhouse gas emissions, increase carbon storage, and generate clean renewable energy.

USDA has a long history of cooperative conservation and partnerships with farmers, ranchers, and forest land owners. The principles that have guided USDA's cooperative conservation efforts also apply to each of the ten building blocks. Actions taken through this initiative will be:

- **Voluntary and incentive-based:** Farmers, ranchers, and forest land owners are stewards of the land. USDA has a track record of successful conservation through voluntary programs designed to provide technical assistance for resource management. These efforts fit within USDA's approach of "cooperative conservation."

[1] Soil Health; Nitrogen Stewardship; Livestock Partnerships; Conservation of Sensitive Lands; Grazing and Pasture Lands; Private Forest Growth and Retention; Stewardship of Federal Forests; Promotion of Wood Products; Urban Forests; Energy Generation and Efficiency. See http://usda.gov/climate-smart.html

- **Focused on multiple economic and environmental benefits:** To be successful, the proposed actions should provide economic and environmental benefits through efficiency improvements, improved yields, or reduced risks.
- **Designed to meet the needs of producers:** This strategy is designed for working farms, ranches, forests, and production systems. USDA will encourage actions that enhance productivity and improve efficiency.
- **Cooperative and focused on building partnerships:** USDA will seek opportunities to leverage efforts by industry, farm groups, conservation organizations, municipalities, public and private investment products, Tribes, and states.
- **Measured to evaluate progress:** USDA is committed to establishing quantitative goals and objectives for each building block and will track and report progress.

Implementation Plans

USDA has embarked on an integrative approach for the development of implementation plans for each of the ten building blocks. These plans outline the execution of actions, deliverables, and guidance under the proper authorities. They include interagency collaborations, partnerships and metrics to accurately capture and monitor data. Actions under each of the building blocks may include, but are not limited to, the following:

1. Soil Health

- Develop national guidelines for cover crops to ensure their beneficial use in crop production.
- Provide cost-sharing to implement practices such as Residue and Tillage Management, No-Till, Residue and Tillage Management, Reduced Tillage, Contour Buffer Strips, Grassed Waterways, Filter Strips, Field Borders, Conservation Crop Rotation, Vegetative Barriers, Herbaceous Wind Barriers, and Cover Crops.
- Implement soil health awareness training for all stakeholders, and advanced level Soil Health Management Planning and Implementation Training to build capacity for a more effective work force.
- Use multimedia to convey the message of soil health by providing funding to develop videos, podcasts, and interactive online materials.
- Pursue standardized soil health assessments in collaboration with research entities, public/private labs, and other partners in order to make soil health testing publicly available, affordable, and commercially viable, while remaining science-based and standardized.
- Encourage soil carbon sequestration by promoting reduced tillage and appropriate use of increased organic inputs, deep rooting cover, and perennial crops.
- Develop and implement pilot project cost-sharing for Soil Health Assessment and Management Planning and integrate into current planning efforts.
- Implement the Soil Health Monitoring and Enhancement Network.

2. Nitrogen Stewardship

- Recruit and train additional Technical Service Providers (TSP) to assist producers and to develop and implement the “4Rs” of nutrient management: the *right* type of fertilizer, *right* application rate, *right* seasonal timing in the plant growth cycle, and the *right* location in or on the soil.

- Encourage farmers to apply to the Environmental Quality Incentives Program (EQIP), to hire a qualified TSP, and to develop a Nutrient Management Plan.
- Develop and maintain partnerships with agri-business professionals that are trained in nutrient management. Engage partners to help producers plan and implement nutrient management plans.
- Collaborate more closely with other industry-based initiatives to help producers implement nutrient management plans and receive both technical and financial assistance during the transition to a 4Rs nitrogen management plan.
- Leverage funding for conservation technical assistance to support the TSP and agri-business partnerships at the national and local levels.
- Prioritize the nutrient management practices in the Lake States—Michigan, Minnesota, Wisconsin—and Corn Belt States—Illinois, Indiana, Iowa, Missouri, and Ohio.

3. Livestock Partnerships

- Recruit and train the additional technical professionals and TSP needed to help producers install and operate anaerobic digesters (AD) and the associated electrical generation equipment.
- Prioritize AD technology and the associated electrical generation technology in the EQIP and Rural Energy for America Program (REAP) rankings.
- Develop and maintain partnerships with other Federal, state, and local agencies, agri-business organizations, and agri-professionals to promote AD for GHG reduction and profit potential.
- Work with dairy industry to implement *Biogas Roadmap* in cooperation with the Department of Energy and the Environmental Protection Agency as commitment to White House *Climate Action Plan: Strategy to Reduce Methane Emissions*

4. Conservation of Sensitive Lands

- Identify and target highly valued eligible land and encourage owners to enroll additional riparian buffers, wetlands, and other conservation practices with large greenhouse gas mitigation benefits into the Conservation Reserve Program (CRP).
- Encourage states and counties to develop partnerships to leverage CRP for multiple environmental benefits, including greenhouse gas reduction.
- Extend benefits from CRP conservation by enrolling lands into permanent or long-term easements within the Agricultural Conservation Easement Program (ACEP), with State easement programs under the Conservation Reserve Enhancement Program (CREP), and with private partners.
- Develop an effective outreach program to identify and encourage farmers with organic soils to adopt conservation systems that reduce carbon emissions from these soils.
- Enroll organic soils used for crop production into CRP or wetland restoration easements under ACEP.
- USDA will increase the conservation actions on highly erodible lands (HEL) and wetlands as a result of conservation compliance provisions included in the 2014 Farm Bill.

5. Grazing and Pasture Lands

- Increase the application of Prescribed Grazing (USDA Natural Resource Conservation Service Practice Code 528) to range and pasture lands grazed by domestic livestock. Prescribed Grazing requires the management of animal numbers, distribution, and season of use to meet conservation objectives, which may include soil carbon storage.
- Conduct conservation field trials to identify the potential of long-term uses of application of organic waste (compost) for carbon sequestration.
- Promote and monitor land treated with forage and biomass planting and ensure practices are maintained and managed, maximizing the land's carbon sequestration potential.

6. Private Forest Growth and Retention

Since the beginning of FY2015[2], the Forest Legacy Program has conserved 78,888 additional acres of forestland and the Community Forest Program has conserved 756 additional acres. Expected annual greenhouse gas reductions for the private forest retention building block stem from permanently conserving critical forest land, and the associated carbon benefits, that otherwise would have been converted and lost.

- The official guidance for the FY2017 Forest Legacy Program project selection process will guide the selection of projects at the state and national level to ensure the most environmentally significant forest land is conserved nationwide. Projects are evaluated for their importance (which includes economic and environmental criteria), threat of conversion and strategic contribution of the proposed acquisition to the landscape. This year's guidance also references the Administration's goals and objectives related to climate change.
- USDA announced $1.9 million in FY15 funding for six new Community Forest Program projects to preserve community forests in New Hampshire, Michigan, Massachusetts, Washington and Puerto Rico. These projects also support the Building Blocks for Climate Smart Agriculture and Forestry—a comprehensive effort to help farmers, ranchers, and forest land owners respond to climate change, create economic opportunity, reduce net greenhouse gas emissions and generate clean, renewable energy.

7. Stewardship of Federal Forests

USDA manages carbon through managing the health and adaptive capacity of our forests in the face of multiple impacts of climate change. The actions included within this building block are designed to recover, maintain, and enhance the resilience of the carbon sequestration associated with our National Forests. Efforts of the building blocks work plan will focus on restoration of resilience and reforestation. Reforestation refers to planting areas that are currently non-forested, but have been forested in the recent past and are non-forested as a result of stand-replacing wildfire, insects & disease, or other disturbances.

- USDA will focus on approximately 11.3 million acres for highest priority restoration treatments. Examples of restoration treatments include: stocking control through commercial and pre-commercial thinning; hazardous fuels reduction through mechanical treatments and prescribed burning; detection and rapid response to control insects, pathogens, and invasive

[2] FY refers to fiscal year and CY refers to calendar year.

species; sustainable levels of timber harvest; wildlife habitat improvement and other land management objectives.
- At the start of FY2015, the USDA identified 493,105 acres of post-disturbance planting needs. Over 97% of this need (482,730 acres) is due to wildland fire. These areas are at risk of either remaining non-forested or of sequestering carbon at a much slower rate than if they are planted.
- In FY2016, USDA plans to plant 32,000 acres of post-disturbance National Forest lands.
- USDA is in the early stages of assessing post-fire reforestation needs as a result of 2015 wildland fires. Initial estimates indicate more than 150,000 additional acres will need to be planted as a result of the 2015 fire season – primarily in the northwestern part of the United States. These fire areas will likely be planted beginning in 2017. USDA nurseries have already begun growing seedlings for FY2016 planting.

8. Promotion of Wood Products

In the second quarter of CY[2] 2015, USDA's Wood Innovation project partner WoodWorks influenced and converted 110 design projects to wood frame construction. This resulted in a 332,000 metric-ton carbon benefit to the environment (106,000 metric tons sequestered and 225,000 metric tons of emissions avoided). Additional contributions included providing 5,861 educational hours to 4,125 construction specifiers through 81 events.
- A FY2016 Request for Proposals for the Wood Innovations grant program is currently under review.
- A Presidential Proclamation for Forest Products Week recognizing the role of forest products in our society was released in the fall of 2015.
- USDA and The Softwood Lumber Board have begun the joint development of a publically available database of research literature regarding Cross Laminated Timber and related technologies known as "Mass Timber".

9. Urban Forests

- In the spring of 2015, the Energy Saving Trees program engaged homeowners and leveraged funds from electric utilities to plant more than 25,000 trees. In the fall of 2015, the Energy Saving Trees program engaged 6006 homeowners and leveraged $486,731 from electric utilities to plant more than 10,150 trees. Since July 2011, the program has engaged 24 utilities, 2 retail organizations, 1 state government and one city government across 27 states and the District of Columbia. These tree plantings have saved more than 294,000 MwH of power and just under 4,000,000 therms of natural gas, and sequestered more than 298,150 metric tons of carbon.

10. Energy Generation and Efficiency

USDA executed a Memorandum of Understanding that establishes a structure to coordinate energy efficiency activities which will:

- Support and offer interchangeable on-farm energy audits for Rural Energy for America Program (REAP), the Energy Efficiency and Conservation Loan Program (EECLP), and the Environmental Quality Incentives Program (EQIP).
- Support and advise clients to make energy efficiency upgrades and to install digesters and gasifiers.
- Coordinate training and outreach of rural development programs.
- Increase outreach to increase the exposure of programs and opportunities.
- Over the next 10 years expand the number of specific conservation practice standards for energy efficiency practices and increase staff capabilities.
- Collaborate with other partners using existing USDA programs and policy.
- Provided financing for 17 new anaerobic digesters in FY 2015. This is an increase from 2 digesters in FY 2014.
- Pursue an interagency agreement with the Environmental Protection Agency's AgStar Program to expand outreach to stakeholders.

Metrics

In establishing quantitative goals and objectives for each building block the USDA will:

- Work with other agencies and partners to support and improve the National Greenhouse Gas Inventory as a baseline metric for the building blocks.
- In FY 2016, prepare a report on national greenhouse gas-relevant agricultural indicators. The Indicators Report will contain national data on agricultural management activities that affect greenhouse gas emissions. The report will be produced at regular intervals (e.g., biennially).
- Integrate data collected from the 2006 Conservation Effects Assessment Project (CEAP) into the National Greenhouse Gas Inventory estimates for the agriculture sector. The CEAP data will be complemented by financial programs and technical assistance data compiled in FY2016.
- Identify additional survey questions that should be added to existing surveys of farmers and landowners to better track key building block measures.
- Review the need for a new survey or questionnaire to collect information on the rates of adoption for key conservation practices.
- Throughout FY2016, identify the most appropriate quantification metrics for each of the building blocks and identify the most appropriate pathway to integrating this data into the National Greenhouse Gas Inventory.

2) Identification of adaptation measures, taking into account the diversity of the agricultural systems, indigenous knowledge systems and the differences in scale as well as possible co-benefits and sharing experiences in research and development and on the ground activities, including socioeconomic, environmental and gender aspects

CLIMATE HUBS

Overview

The USDA Climate Hubs were established in February 2014 to deliver science-based knowledge, practical information, and program support to farmers, ranchers, forest landowners, and resource managers to support climate-informed decision-making in light of the increased risks and vulnerabilities associated with a changing climate. These activities further the mission of maintaining and strengthening agricultural production, natural resource management, and rural economic development under increasing climate variability.

The Climate Hubs add value by serving as a regional source of knowledge explicitly designed for hazard and adaptation planning for agriculture and natural resource management. Through the Climate Hubs, USDA will deliver science-based, proven solutions more efficiently to its stakeholders to enable them to maintain and increase productivity and resilience in light of climate change. The Climate Hubs allow USDA to coordinate effectively with other federal regional networks as well.

Key Partners

Key partners in this effort include the public universities, Cooperative Extension, USDA researchers, the private sector, state, local and regional governments, the National Oceanic and Atmospheric Administration, Department of Interior regional climate change experts, and non-profit organizations engaged in providing assistance to landowners.

The National Oceanic and Atmospheric Administration's Regional Integrated Sciences and Assessments Program, and the Department of Interior's Climate Science Centers and Landscape Conservation Cooperatives complement the U.S. Department of Agriculture's Climate Hubs by providing data, findings, tools, and forecasts to build integrated services for the agricultural and forestry sectors. In addition, all four regional climate networks are working together to coordinate stakeholder input into their programs.

The Climate Hubs are located at a USDA Agricultural Research Service or a USDA Forest Service location. The USDA Agricultural Research Service, Forest Service, and Natural Resource Conservation Service provide the primary science and technical support. Furthermore, additional program delivery specialists on topics of relevance to a region will come from other USDA agencies, including the Animal and Plant Health Inspection Service, Farm Service Agency, Rural Development, and the Risk Management Agency.

Activities

The Climate Hubs have completed eight regional vulnerability assessments, and hosted numerous workshops rolling out the Building Blocks for Climate Smart Agriculture. The Climate Hubs developed the "Tool Shed," a one-stop-shopping place to find available web-based tools to help farmers, ranchers, and forest land managers make climate-informed management decisions.

The Climate Hubs have produced numerous outreach materials to help land managers make climate-informed decisions including demonstration projects and videos (e.g. Northern Forests Adaptation Planning Demos, Caribbean ADAPTA Climate Change Demonstration Project, and the Southwest Water and Climate Change Education Module).[3] In addition, the Northern Forest's adaptation workbook is now being modified for the agriculture sector. The Climate Hubs have established mechanisms to coordinate with the USDA Cooperative Extension climate change efforts. Through eXtension, the Agriculture-Climate Change Learning network is underway and will provide Cooperative Extension and other trusted advisors a place to come for information, training, and interaction on important topics surrounding agriculture and climate change.

Stakeholders

The Climate Hubs provide benefits to the following stakeholders:

- ***Farmers, Ranchers, and Forest managers*** will benefit from regional vulnerability assessments through an improved understanding of climate change effects in their region and opportunities to adapt to and mitigate the effects of a changing climate.
- ***USDA Agencies and Field Staff*** will benefit from improved climate science and technical outreach (and in-reach) through the Hub's science synthesis and partnership building efforts. Agencies and field staff will benefit from regional scale opportunities provide by the Building Blocks for Climate Smart Agriculture and the availability of mitigation technologies to meet USDA's, and the United States', greenhouse gas emissions reductions targets.
- ***Conservation Partners such as State and local agencies and NGOs*** will benefit from better access to the latest USDA climate research translated by the Climate Hubs into a form that is easy to understand and implement.
- ***Taxpayers and the general public*** will ultimately benefit from climate-resilient working lands that will continue to provide the food, fuel, and fiber that our growing population requires, as well as a better understanding of which federal climate networks and programs can help them make and implement climate-informed decisions.

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[3] http://forestadaptation.org/demonstration-projects;
https://www.youtube.com/watch?v=_U1p3SlyWcA&feature=youtu.be;
http://swclimatehub.info/education/climate-change-and-water-cycle

Next Steps
In 2016, the Climate Hubs will:

- Collaborate to modify existing tools/resources across regions/sectors
  - The Northern Forests Adaptation workbook is being modified to accommodate the agricultural sector in the Midwest and may be expanded to other regions.
  - The Southwest's K-12 education module is being evaluated by other Hubs for modification and incorporation into their training tools, and NRCS will translate the current version into Spanish.

- Publish a Regional Vulnerability Assessments "Special Issue" in the Journal "Climatic Change" which will advance the usefulness of the existing information to our stakeholders and serve as a technical reference for policy makers.

- Improve USDA "In-reach" to build climate literacy and collaboration, this will include:
  - Cementing Regional Steering committees
    - Ensuring that each regional Climate Hub has a member of their regional USDA Sub agency partners as part of their steering committee.
  - Carrying out Building Blocks Workshops and other Agency directed Climate Training Opportunities
    - The Climate Hubs will carry out building blocks workshops in accordance with the USDA Climate Change Mitigation Strategy
    - The Climate Hubs will provide USDA agency personnel training in the field to build climate literacy.

- Connect with existing USDA stakeholder groups at the national, regional and state levels.

Paper no. 8: Uruguay

SUBMISSION BY

Uruguay

TO

The 44th Session of the Subsidiary Body for Scientific and Technological Advice of the UNFCCC

on issues related to agriculture in response to SBSTA decision FCC/SBSTA/2014/2. These are views on:

Identification of adaptation measures, taking into account the diversity of the agricultural systems, indigenous knowledge systems and the differences in scale as well as possible co-benefits and sharing experiences in research and development and on the ground activities, including socioeconomic, environmental and gender aspects. FCC/SBSTA/2014/2.

Identification and assessment of agricultural practices and technologies to enhance productivity in a sustainable manner, food security and resilience, considering the differences in agro-ecological zones and farming systems, such as different grassland and cropland practices and systems. FCC/SBSTA/2014/2.

1. Adaptation measures, practices and technologies in agricultural systems of Latin America

Food production systems are particularly vulnerable to the adverse effects of climate change as it is recognized in the Paris Agreement. In order to adapt to climate change and build more resilient agro-ecosystems, that enhance safeguard food security, as well as increase productivity and efficiency, countries need to identify and implement different measures, practices and technologies taking into account differences in agro-ecological zones and farming systems, such as scales, and integrating socio-economic, environmental and gender aspects.

Uruguay has built several relevant experiences in planned adaptation to climate change in agriculture and adaptation concerns have been included in the agricultural development agenda in recent years. Moreover, there is a wide range of examples of successful adaptation measures, practices and technologies, and lessons learned in agricultural sector, in Latin America and in other regions. In this context, learning from others is of utmost importance to Uruguay as well.

In this submission we summarize main experiences and identify main needs in Uruguay in relation to knowledge and capacity building for adaptation, in terms of measures, technologies and practices.

1.1 Adaptation measures in Agriculture in Uruguay

Adaptation measures refer to the wide range of actions and institutions that raise the adaptive capacity of agricultural systems. These measures provide an enabling environment for implementation of the agricultural practices and technologies as will be discussed in 1.2.

In agricultural systems, successful measures for adaptation are related to: climate risk management, governance, policy frameworks and readiness; national planning; local planning; finance, economic incentives; research and knowledge systems; extension, capacity building and technology transfer. In Uruguay main examples of adaptation measures across these categories are outlined in Table 1.

Table 1: Adaptation measures in Agriculture in Uruguay

Type of adaptation measures	Description of measure
Governance and readiness	Strengthening institutional arrangements. a) Creation of the *National System of Response to Climate Change*, recognizing the transversal nature of climate change. This systemic institutional approach ensures that different stakeholders of the public sector, research institutions, private sector and NGOs are involved in climate change responses. c) Strengthening of the Climate Change Unit of Ministry of Agriculture with main priority on adaptation and its co-benefits. d) Strengthening of farmers' organizations and creation of local rural development boards ("Mesas de Desarrollo Rural") with participation of relevant local stakeholders.
Policy frameworks, national and local planning	Formulate national policy frameworks a) Formulation of the *National Strategy of Response to Climate Change* b) Formulation of the *National Policy for Climate Change*, including Agriculture, has started in 2016. It will be a participatory and consultative process with relevant stakeholders from public, private and academic sectors. The process will cover national and subnational scales. c) Definition of adaptation to climate change as one of the five strategic priorities of the policies by the Ministry of Agriculture of Uruguay. d) Uruguay has developed *National Emergency System (SINAE)*, which must protect people, environment and relevant infrastructure from adverse events of natural and / or anthropogenic origin, from a risk management perspective. e) Uruguay is developing *National Water Plan*, to carry out the National Water Policy (2009). Considering variability and climate change the plan areas are: knowledge; planning and coordination; and integrated and participatory management. Lines of action focus shifts from emergency response to risk management. Formulate sectoral adaptation planning instruments. a) Uruguay is beginning formulation process of the *National Adaptation Plan (NAP) for Agriculture* in the framework of a global program including 7 other countries, with support from the German Government, FAO and UNDP. The formulation process will finish by the end of 2018. Though Uruguay is the only Latin-American

Type of adaptation measures	Description of measure
	country in the process, spill-over opportunities lessons learnt in the process can be shared with other regional countries.
Finance, economic incentives and value chain interventions	Provision of finance and technological packages to vulnerable small farmers. a) Economic incentives are offered to small farmers in the framework of the project "*Building Resilience to Climate Change and Variability in Vulnerable Smallholders*"[4], which reaches more than 1,000 beneficiaries. Identification and transfer of sound technological practices b) Project *"Development and Adaptation to Climate Change"* has a comprehensive approach which embraces promotion of good agricultural technologies and practices for adaptation, and the development of decision support systems for risk management.
Research, extension, capacity building and knowledge systems	Adaptation in agriculture is highly knowledge-intensive. Research agendas have to mainstream adaptation as a cross-cutting issue, involving aspects as diverse as plant and animal diseases, soil conservation, water management, and crops and livestock management. At the same time, adaptation is not a one-step action practice but a continuous innovation process. Provide dialogue between the scientific community, farmers and policymakers Uruguay is discussing how to strengthen its actions in research and technology transfer, linked to policy incentives in order to create an enabling environment for adaptation in its main agricultural value chains (beef, dairy, crops). Research and technical knowledge are the basis for policy design. Our experience states that without good dialogue among the scientific community, farmers and policy-makers it is difficult to design adaptation policies, which can answer relevant questions, such as what should be adapted, how, where, which is the cost/benefit ratio, etc. Participate in knowledge sharing networks. Uruguay, through its national institute for agricultural research (INIA) participates in the Global Research Alliance (GRA) which focuses on mitigation and on the creation of adaptive capacity and resilience of farming systems, while increasing productivity and efficiency. Uruguay is part of PROCISUR as well, a network and platform of the south countries of Latin America, that links research institutions in different issues, including sustainability and climate change. Provide with decision support tools regarding climate risks Since 2012 Uruguay develops a decision support system to facilitate risk management, implementation of public policies and decision making by the government and private sector (SNIA)[5] . This system will offer a set of tools that integrate climate, production, water, soil and economic data with different objectives such as reducing vulnerability, food safety, and ecosystem services, among others.

[4] The project is executed by the Ministry of Agriculture of Uruguay (MGAP) with a national implementation agency (ANII) and running from 2012 to 2017.

[5] The system is being developed in the framework of the project financed with a loan of the World Bank, and with the technical cooperation of the IRI Institute of the Columbia University (USA) and the national University, and will be launched in April 2016

1.2 Agricultural practices and technologies which enhance food security, resilience and productivity in a sustainable manner

Practices and technologies can help to respond to changes that affect food security, resilience and productivity of the agricultural sector due to climate change. Practices and technologies for livestock, fisheries, crops, trees, soil and water can be implemented across scales (Dinesh, 2016). These practices provide decision makers, from farmers to policy makers, options on how to deal with climate change challenges in the agricultural sector considering context-specific conditions but also addressing national development goals, sustainable development and gender issues. In Uruguay main examples of agricultural practices and technologies which enhance food security, resilience and productivity in a sustainable manner are outlined in Table 2.

Table 2: Main technologies and practices identified in Uruguay

Type of technology/practice	Description
Soil management	Soil Use and Management Plans: For crop production, Uruguay has developed the policy of "Soil Use and Management Plans" (2011). This policy regulates the use of soil under crops in order to promote the application of management practices that reduce soil erosion. At present, 1.5 million hectares of croplands (94% of all cropland) are managed under these plans. All farmers are obliged to present a midterm soil use plan that demonstrates, using the calibrated Universal Soil Losses Equation (USLE/RUSLE), that erosion is not expected to be above a determined tolerable value. Soil conservation, in particular conservation of soil organic matter, plays a key role for food security, sustainable development and adaptation, as organic matter is related to water storage capacity, fertility and erodibility. At the same time, increasing or maintaining soil organic carbon represents an important mitigation co-benefit. Soil conservation practices reduce erosion and degradation, that means minimizing losses or in some cases increasing the amount of carbon in soil. This is an example of how policies for natural resources conservation are closely interlinked with adaptation to and mitigation of climate change. Responses to climate change are many times part of broader policies and are co-benefits sustainable development policies and measures. Uruguay can share these experiences in different manners, including through the "4 X 1000" proposal by France, launched in the COP 21 of UNFCCC.
Livestock management	Improved grassland and cattle management in a climate smart approach Climate change severely impacts one of the key sectors for Uruguay`s economy, livestock production. For example, the 2008/09 drought caused losses estimated at USD 1.3 billion. Among small-scale farmers to overgraze natural grasslands is a common practice, which increases vulnerability to climate extreme events. Therefore, the adoption of innovative grasslands and grazing management practices to increase forage supply, productivity, famers income, and resilience is key. The technologies promoted have the potential to increase soil carbon sequestration in degraded lands and reduce non-CO_2 emissions intensity as relevant co-benefits. A project has been submitted to the GEF to give continuity to the process of assessing

Type of technology/practice	Description
	the impact of technologies and practices changes in an extended time horizon, to draw more robust lessons and promote scaling up of the co-benefits approach.
Forestry and agroforestry	Sustainable management of native forests Native forests cover a small proportion of the national territory (4.5%) but its ecosystem services, including carbon sequestration, are receiving increasing attention. Well-designed forestry, agroforestry, silvopastoral and revegetation systems can provide benefits for adaptation. E.g. providing shadow and shelter, protecting watersheds and river banks and regulating the hydrological and nutrients cycles to decrease floods and protect water fluxes and water quality. Through its REDD+ strategy Uruguay will improve the management of its native forests with mitigation benefits and, at the same time, with adaptation co-benefits. Provision of shelter and shadow to cattle Tree plantations have increased sharply in Uruguay in the last 25 years (760.000 ha), mostly in lands of low food productivity, which reduced pressure on native forests. Genetic improvement has increased adaptation to local conditions. These plantations are also providing shelter and shadow to cattle, reducing vulnerability to extreme events (heat and cold waves, storms, etc.). Nonetheless territorial planning must be included to minimize trade-offs with water availability at watershed scale.
Water management	Associative irrigation: Uruguay is developing a National strategy to promote irrigated agriculture in Uruguay with focus on the associative use of water for supplementary irrigation of summer and perennial crops. Promoting supplementary irrigation is part of the guidelines that arises in the context of production intensification with economic and environmental sustainability. The strategy's overall objective: "to promote and create favorable conditions for the development of irrigation conditions, taking advantage of the opportunities to increase the competitiveness of the domestic agricultural sector, ensuring sustainable use of natural resources and greater adaptation to current climate variability and future climate change.
Climate Information Services	Developing strong climatic and meteorological information systems is key for adaptation, including tools as early warning systems (EWS). But good climatic services require high quality data, with adequate geographical coverage and available on time. Public meteorological service (INUMET) need to be strengthened in Uruguay and a big effort needs to be done to improve and deploy climate services. Meteorological data (robust and consistent time series) is also needed to design index based insurance schemes. Using existing meteorological information, the national research institute (INIA) through its specialized unit (GRAS) offers several climatic services as water availability in soils and vegetation indexes. There is a great opportunity for collaborative work among countries on improving meteorological information and developing EWS, in particular among neighboring countries.
Crop and livestock insurance	Implement climate index insurances: Promotion of agricultural insurance is a key policy of Uruguay. Innovative index insurances have been developed in Uruguay with participation of private sector,

Type of technology/practice	Description
	which complements existing damage-based commercial insurance. The high frequency and increasing variability of adverse climate events affecting agricultural production has been a limiting factor for the expansion of commercial insurance without public participation. In that sense, Uruguay has put in place two climate index-based insurances to help cope with extreme events. One is for excess rainfall in horticulture and the other (still at pilot scale) for drought for beef production systems on natural pastures. Index insurances can tackle risks that cannot be covered by traditional insurance. A lesson learned is that this type of insurance is more successful if it is part of a wider insurance program with technical assistance to farmers. Implement emergency relief funds: Uruguay has also created the Agricultural Emergencies Fund (FEA) to finance extended and very severe disasters. This instrument aims to compensate farmers in extreme situations and is used in close coordination with the agricultural insurance systems to achieve a greater protection of farmers.

2. Key challenges and needs for Uruguay

While Uruguay is implementing a number of adaptation measures (Table 1) and agricultural practices and technologies (Table 2), these are not generally adopted or are insufficient to cope with projected climate impacts in the country. There is an urgent need to strength and scale up good practices and technologies across national boundaries to broad up the transition towards climate-resilient, and more productive and efficient agro-ecosystems. The main challenges which limit such scaling up for Uruguay are:

2.1 Knowledge needs (Including knowledge on diversity of agricultural systems and targeting interventions)

Approaches and tools that support decision making processes of farmers in the region to address climate change and variability challenges, considering agro-climatic and biophysical diversity are priorities. In addition, knowledge on practices and technologies that both increase efficiency of inputs and increase productivity contributing to global food security should also be shared.

2.2 Finance

Lack of finance to support initiatives regarding research on agricultural topics and development actions is a challenge. Innovative mechanisms for farmers in key value chains to access resources that enhance food security are needed. Incentives for private sector to invest in climate related topics in the agricultural sector are essential to build capacity that not only depends on national and multilateral organizations, but that could go beyond through markets and so on.

2.3 Capacity

A vast number of initiatives are conducted in different countries in the region, generating many experiences and lessons. Therefore creating links could be extremely enriching for all countries, including

Uruguay. Building on what is already developed and learned, and developing synergies are key to reduce funding demand and increase resilience and impact of adaptation.

2.4 Institutions

Institutional framework in Uruguay is diverse at national and sub-national levels. There is a need to enhance capacities and synergies of the Ministry of Agriculture in coordination with other Ministries (Environment, Finance, Planning), local governments, research institutions and farmers organizations, to facilitate implementation processes of practices and technologies that support the reduction of climate change impacts in the agricultural sector, the rural population and its food security. The creation in 2009 of the National System of Response to Climate Change has been a big step forward to cope with the transversal challenges of climate change. More recently (2015) a national Secretary for Environment, Climate Change and Water, has been created and it will enhance the coordination of efforts of public and private actors.

2.5 Associative irrigation and institutional arrangements

The country lacks experience on supplementary irrigation, and in particular on the associative use of water and the institutional aspects that are key for a successful implementation. Other countries have vast experience on these issues that would be very important to access.

2.6 Sustainable management of grasslands and native forests

Uruguay aims to develop conservation and restoration policies for the use and management of grasslands and has made general policy declarations at the highest level. However, as of yet, no implementation tools have been issued and no budget allocated.

Uruguay is in its way to strengthen its capacities for sustainable management of its native forests and needs access to knowledge and experiences from countries with a much stronger tradition on sustainable management of natural forests, in order to develop technologies and practices to maintain and increase carbon stocks and implement MRV systems. Funds to implement incentives for sustainable forest management and put in place regulations to protect the forests are also needed.

2.7 Foresight, scenarios and simulation models

Scenarios and simulation models contribute to guiding the planning process of adaptation, given the intrinsic uncertainty of climate. There is a need to link socioeconomic and climate scenarios to develop strategies that can cope with the most likely future conditions. There is a need to update and download the new generation of IPCC scenarios and reflect on how they could affect different farming systems and regions in Uruguay. Construction of these tools offers an opportunity for inclusive reflection on the future and the engagement of stakeholders in the process. Uruguay needs to develop and make available these tools and faces the challenge of strengthening its capacities though training. International cooperation could play a key role to facilitate the process.

2.8 Gender and social inclusion

In 2015, the Uruguayan Rural Women Association (AMRU) has updated its agenda of work, including access to training, productive rights, access to technical assistance, and increase in the participation of the views of women in the design and implementation of productive projects, including more resilient farming systems. AMRU considers that distribution of productive and domestic responsibilities between men and women is different, and that the consequences of climate change are perceived also differently. Climate change is a threat to the possibilities of families to continue in their farms and implement the generational change.

3. Mitigation and productivity co-benefits of adaptation

Many adaptation measures, technologies and practices represent co-benefits in terms of mitigation.

In case of Uruguay significant examples in the field are the following:

a) Soils conservation plans to reduce erosion and protect fertility, physical properties of soils and the water storage capacity, increase or maintain soil organic carbon. At present 94% of the cropland area of the country is managed with this legally obligatory use and management plans.
b) Adaptation of beef production in grazing systems through better forage supply management increases productivity, sequesters carbon in degraded lands and reduces emissions intensity of methane and nitrous oxide per unit of beef produced.
c) Promotion of planting trees for shadow and shelter in cattle and sheep faming systems can sequester carbon in biomass.

In the future, associative systems for supplementary irrigation of crops can produce benefits in terms of adaptation, and simultaneously reduce emissions intensity and, depending on site conditions, sequester carbon in soils.

4. Priority for action: a global/regional knowledge exchange/sharing and learning platform

In order to help overcome some of the relevant challenges identified, there is a pressing need to establish a global/regional knowledge and learning platform. Such a platform could address not only the knowledge sharing needs, but also contribute to build capacities for implementation. Through building capacity processes the platform could enhance mechanisms for Parties to know and share successful experiences and lessons learned on tools and practices. On top of that, Parties could also discuss how issues related to adaptation in agriculture will benefit from the creation of a space to share knowledge and experiences of countries on the issues of adaptation of agriculture to climate change. Adaptation of agriculture to climate change is rather new and there is a lot to learn and share. If countries can share their progress and learn from others, the process of adaptation can be much faster and effective. A global platform can also include sub-regional platforms interconnected.

4.1 Achieving synergies with on-going initiatives in the region

This platform can benefit from and impulse synergies with on-going initiatives, such as PROCISUR, IICA programs, South Cone Council of Ministries of Agriculture (CAS), CGIAR-CCAFS, and ECLAC, among others. A recent publication shows that the region developed several tools and platforms for agriculture risk assessment that could benefit from integrating efforts. (Basualdo, Adriana. Inventario y características principales de los mapas de riesgos para la agricultura disponibles en los países de América Latina y el Caribe / Adriana Basualdo, Mercedes Berterretche y Fernando Vila -- San José: C.R.: IICA, 2015).

5. Recommendations for SBSTA

Support the ***development of a platform*** for exchanging information on, inter alia, gained experience, good practices, support tools and models, databases, successful institutional developments, success stories and lessons learned on responding to climate change in agricultural systems. Activities and services such as online seminars, online information exchange and virtual discussion groups, and links to other platforms, could be included. This platform might be built under the UNFCCC Secretariat. ***SBSTA could request parties to submit their views on the development of such hub*** and SBSTA may request secretariat to prepare a synthesis paper based on these submissions by Parties.

Paper no. 9: Viet Nam on behalf of Brunei Darussalam, Cambodia, Indonesia, the Lao People's Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Viet Nam

These are views on Identification and assessment of agricultural practices and technologies to enhance productivity in a sustainable manner, food security and resilience, considering the differences in agroecological zones and farming systems, such as different grassland and cropland practices and systems*. FCC/SBSTA/2014/L.14 paragraph 3 (d).*

1. Introduction and scope of climate-resilient agriculture, forestry and fisheries

In the agricultural sector, practices and technologies which seek to enhance food security, resilience, and productivity in a sustainable manner, is applied both at on-farm and beyond-farm levels. At the farm level, specific management practices for livestock, fisheries, crops, trees or soil and water conservation, as well as household energy management maybe the focus. Beyond the farm level, adaptation interventions can includeinfrastructure, agricultural extension systems, meteorological services and crop and livestock insurance. Both types of interventions are implemented within rural landscapes and landscape level approaches are becoming increasingly relevant, as a better understanding on realizing synergies and minimizing trade-offs amongst interventions emerge. The ASEAN Member States are of the view that both on-farm and beyond-farm practices and technologies should be considered by the SBSTA, together with approaches for landscape level management. ASEAN Member States consider the interaction between sectors to be important for addressing the challenges faced by the region, and have recently formulated the Vision and Strategic Plan for the Food, Agriculture and Forestry Cooperation 2025 (FAF) to guide the priorities of the region in achieving its goal of economic integrity and resilience in the next 10 years.

2. Priorities for action

A number of agricultural practices and technologies are applied in crop production systems in South East Asia (SEA), ranging from indigenouspractices and field-tested crop management measures toknowledge-based options. These are welldocumented and have proven positive results to enhance food security, resilience and productivity in a sustainable manner. While the suitability of these practices is location- and situation-specific they may be modified or adjusted to be applicablein other areas with more or less similar conditions. While adopting these practices and technologies, in addition to technical issues, operational and institutional limitations should also be considered. Based on a prioritization and planning process, ASEAN Member States have identified rice, maize and cassava as the staple crops most vulnerable to climate change in South East Asia and prioritize a set of practices and technologies to address challenges faced by these sectors. The ASEAN Member States are of the view that the SBSTA should consider these practices and technologies to be a priority to South East Asia.

a. Stress Tolerant Maize Varieties

Adoption of stress tolerant (drought, flood, saline, pests and diseases) and short/medium duration varieties of maize is a crop management practiceof relevance to South East Asia. These improved varieties can potentially help farmers in the region to cope with adverse climate impacts. However, the unavailability of quality seeds of stress tolerant varieties, high seed input cost for the purchase of hybrid seeds, and inadequate access to improved seeds are barriers which deter widespread adoption.There is also a pressing need for training andknowledge transfer to resource-poor farmers. The ASEAN Climate Resilience Network (ASEAN-CRN) in partnership with the ASEAN Technical Working Group on Agricultural Research and Development (ATWGARD) willsupport theestablishment of the ASEAN Maize Seed Improvement and Supply System to address some of these challenges and needs.

b. Stress Tolerant Rice Varieties

Stress tolerant rice cultivars (STR), with greater tolerance to abiotic stresses (i.e. drought,heat, increasing risks from typhoon- and rainfall-induced floods, sea-level rise, and saltwaterintrusions) and biotic stresses like pest infestation problems are important to reduce risk and raise productivity in rice systemsaffected by these type of stresses. The International Rice Research Institute (IRRI) has developed and released several stress tolerant rice breeding lines, which have been validated withNational Agricultural Research and Extension Systems (NARES). While actions to scale-up and scale-out these varieties have been taken, a number of technical and institutional challenges limit these efforts. These challenges include: lack of a concerted regional research, development and extension (RD&E) strategy, lack of strong and vibrant seed industry in the region and a common policy on varietal release system from stress tolerant rice. In order to address these challenges, four areas for regional collaboration have emerged, these are a) financial support for development and deployment of new generation stress tolerant rice varieties, b) capacity building, both degree and non-degree training, c) information dissemination, and d) technical expert exchange.

c. Climate informed Agricultural Insurance (including use of Weather Indices)

Small-scale farmers in the region are often trapped in poverty because they are unable or unwilling to make investments in improved agricultural practices because of the weather-related risks associated with these investments. Well designed and targeted agricultural insurance can enable farmers to invest in inputs and technology that can increase their average yields and income, and protect them from suffering losses and slipping into debt. Therefore, the ASEAN Member States consider climate informed agricultural insurance (including use of weather indices) to be a priority in the region. Traditional crop insurance relies on direct assessment of the loss or damage suffered by farmers, and can often be costly and time consuming. Index-based insurance on the other hand relies on an objectively measured index that is correlated with farmers' losses, rather than actual losses. The ASEAN Member states are of the view that both types of insurance are important to help farmers cope with and prosper in the face of weather-related risks. However, for insurance mechanisms to find widespread application in the region, issues related to access to credible weather data, methodologies to calibrate data, underdevelopment of supporting infrastructure are important.

d. Alternate Wetting and Drying

Alternate Wetting and Drying (AWD), a rice cultivation practice which involves alternateflooding and draining of rice fields during the course of the production cycle is a viable practice for rice-producing countriesin South East Asia. AWD offers considerable savings inwater use during the rice-growing season without reducing crop yield. It is particularly relevant for farmers using pumped water for irrigationsince reduction in water use results in a reduction in costs associated with energy as well. It is estimated that AWD reduces water use by 30%, while also reducing methane emissions by 48%, representing a positive co-benefit. AWD is now being tested and promoted by the national agriculturalresearch systems (NARS) throughout most of the region. In order to scale up application of AWD, greater investments in capacity building as well as more research around its benefits and application is needed.

e. Cropping Calendar for Rice and Maize

Adjusting the planting calendar by synchronizing with the occurrence of precipitation is a practice which is highly relevant to South East Asia.Adjusting the planting calendar inline with the onset of rainfall will help farmers cope with increasing climatic variability and also reduce irrigation water requirement and improve crop yields. This practice is particularly relevant for rice and maize cultivation, since these are the two major crops commonly used for food consumption, feeds, and livelihood activities. The optimal cropping calendar maybe determined based on (1) analysis of precipitation data in an area; (2) analysis of crop yield probabilities; and (3) combined analysis of rainfall data and crop yields.

3. Addressing differences in agro-ecological zones and farming systems

It is important that agricultural practices and technologies are matched with suitable contexts including agro-ecological zones and farming systems, but also the social and institutional context. The ASEAN Climate Resilience Network has through national studies in all ASEAN Member States have identified practices and technologies most suited to their contexts, this is represented in the Figure 1. This is a starting point for addressing the differences in context, but needs to be further downscaled to assess the suitability of practices at the farm level.

Good Practices Identified in National Studies

		BN	KH	ID	LA	MY	MM	PH	TH	VN
1.	**Rice**									
-	*Alternate Wetting and Drying*						x	x	x	x
-	*System of Rice Intensification*				x		x			
-	*Integrated Crop Management*				x		x			
-	*Crop Insurance*			x					x	
-	*Cropping Calendar*	x		x		x			x	x
-	*Crop Diversification*				x		x			
-	*Optimal Row Spacing*			x						x
-	*Rice Shrimp Farming*									x
-	*Nutrient Management*	x				x				
-	*Stress Tolerant Varieties*	x	x	x	x	x	x	x		
-	*Short-duration Varieties*						x			x
2.	**Maize**									
-	*Improved Varieties*			x			x	x	x	x
-	*Site Specific Nutrient Management*						x	x		
-	*Cropping Pattern / Intercropping*			x	x		x			x
-	*Cropping Calendar*			x			x			
-	*Using Crop Residues*			x			x			
-	*Diversification*						x			
-	*Appropriate Row Spacing*			x						x
-	*Post-Harvest Handling*			x	x			x		
-	*GAP in Sloping Areas*							x		x
-	*Seed Production and Seeding*				x			x	x	
3.	**Cassava**									
-	*Healthy Planting Material*		x			x				
-	*GAP in Sloping Areas*		x			x				

Figure 1 Summary of identified and prioritized good practices employed by collaborating ASEAN Member States to enhance climate resilience of rice, maize and cassava

4. Roles for UNFCCC and international community

INDCs from all ASEAN Member States identify food security and increasing the resilience of the agricultural sector to be an adaptation priority. ASEAN Member States are of the view that UNFCCC can play an important role in facilitating the implementation and scaling up of agricultural practices and technologies in South East Asia region as well as in other regions facing similar issues in the agricultural sector. The Convention's role may include supporting cooperation and knowledge sharing amongst parties and relevant observer organizations. Leveraging on existing frameworks of the Convention for capacity enhancement and technology transfer in the agricultural sector. The Convention's financial mechanisms can play an important role by channeling finance to address challenges faced by parties in implementing and scaling up best practices.

ASEAN Member States are of the view that the international community, including the CGIAR Consortium of International Agricultural Research Centers and Food and Agriculture Organization of the United Nations play important roles in addressing the research and technical assistance needs of parties and efforts should be made to complement these. At the regional level, regional mechanisms for cooperation, particularly the ASEAN Climate Resilience Network has a role to support regional implementation needs.

These are views on Identification of adaptation measures, taking into account the diversity of the agricultural systems, indigenous knowledge systems and the differences in scale as well as possible co-benefits and sharing experiences in research and development and on the ground activities, including socioeconomic, environmental and gender aspects. FCC/SBSTA/2014/L.14 paragraph 3 (c).

1. Adaptation measures in the ASEAN region

Southeast Asia (SEA) is one of the world's most vulnerable regions to climate change, due to its longcoastlines, high concentration of population and economic activity in coastal areas, and heavy reliance on agriculture, fisheries, forestry and other natural resources. Climate hazards such astemperature increase,erratic rainfall patterns, extreme climatic events (such as strong typhoons andsevere droughts) cause adverse effects and impacts on ecosystems, livelihoods and on many otheraspects of human societies. In particular, climate change threatens agricultural production andindirectly food security, ecological stability, and sustainable development.INDCs from all ASEAN Member States identify food security and increasing the resilience of the agricultural sector to be an adaptation priority. Taking cognizance of the diverse challenges posed by climate change, ASEAN Member States have identified a range of adaptation measures, both national and regional, to increase the resilience of the region's agricultural sector. Building resiliency of the region is one of the priorities of ASEAN as reflected in its new 10 year guiding frameworks such as the ASEAN Economic Blueprint, where the Vision and Strategic Plan for ASEAN Cooperation in Food, Agriculture and Forestry 2016 – 2025 (FAF)is aligned with. These policy measures,however, need to be considered together with a range of practices and technologies which aim to increase resilience, enhance food security, and productivity in a sustainable manner (see submission in response to FCC/SBSTA/2014/L.14 paragraph 3 (d)).

2. Addressing diversity of agricultural systems through regional cooperation

Adaptation measures have varying impacts and environmental and economic costs, which change depending on place and time. Therefore, decision makers need frameworks and tools to assist in channeling adaptation investment in efficient, effective and equitable ways to address existing and future challenges. To address this need, the ASEAN Climate Resilience Network, through the ASEAN Technical Working Group on Agriculture Research and Development (ATWGARD), developed the "ASEAN Guidelines on Promoting Climate Smart Agriculture Practices", which was subsequently endorsed by the Ministers of Agriculture and Forestry of the 10 ASEAN Member States in its 37th Meeting, as the guiding framework to promote resiliency of agriculture in the region. This came after a process that included a vulnerability index assessment of food crops critical to the region's food security, and an assessment that allowed for the identification of practices and technologies with potential for scaling-up in the region.

This important guiding document is divided into two parts: Guidelines on Knowledge Exchange and South-South cooperation, including accessing climate finance in support of scaling up initiatives; and Technical Guidelines on the promotion of particular climate-resilient practices such as Crops Insurance, Cropping Calendar, Promotion of Stress Tolerant Varieties for Maize and Rice.

3. Practices and technologies to underpin adaptation measures in agriculture

The ASEAN Member States view adaptation measures to include interventions relating to policy and planning, finance, achieving scale through innovative approaches, improving gender equity and social inclusion, and research and knowledge systems. However, these measures need to be underpinned by agricultural practices and technologies. The ASEAN Member States views in relation to agricultural practices and technologies are expressed in our submission in response to FCC/SBSTA/2014/L.14 paragraph 3 (d). However, it is important to recognize the link between adaptation measures and practices and technologies in agricultural systems. In South East Asia, adaptation measures are underpinned by the following practices and technologies:

1. **Stress Tolerant Maize Varieties:** Maize varieties tolerant to drought, floods, salinity, pests and diseases, and maturing in short/medium durations.
2. **Stress Tolerant Rice Varieties:** Rice varieties tolerant to drought, heat, floods, salinity, pests and diseases.
3. **Climate informed Agricultural Insurance (including use of Weather Indices):** Insurance mechanisms which protect farmers from weather related risks.
4. **Alternate Wetting and Drying:** Practice of rice cultivation which reduced water use, increases resilience and reduces methane emissions.
5. **Cropping Calendar for Rice and Maize:** Matching planting calendars with the occurrence of precipitation.

4. Key priorities and needs for adaptation measures in agricultural systems

The ASEAN Member States are of the view that the following are key priorities for South East Asia, to be scaled up through UNFCCC processes.

a. **Creating the evidence base:** Invest in pilot Implementation of climate-resilient agricultural practices and generation of an evidence base regarding benefits
b. **Models for impact at scale:** Develop and share experiences on successful models to scale-up climate-resilient practices in particular to reach smallholder farmers
c. **Funding and Capacity Building:** Provide opportunity and funding for capacity building and technical exchange and assistance among participating countries in the ASEAN-CRNand working with existing alliances
d. **Climate Information Services for Smallholders:** Develop effective and efficient approaches to provide integrated, climate information based services to marginalized farmers whichincludeinterpretation and application of the information (e.g. through ICT, SMS, Radioand extension)
e. **Market Orientation:** Integrate marketability and other value chain aspects into research on stress tolerant varieties – consult with downstream players/ private sector toensurecompetitiveness of new varieties

5. Mechanisms to support implementation

ASEAN Member States have respective country level mechanisms to implement adaptation measures. A range of regional initiatives support these efforts, and the ASEAN Member States are of the view that the UNFCCC needs to take into account the role of these regional actors in supporting implementation in South East Asia.

a. ASEAN Climate Resilience Network

The ASEAN Climate Resilience Network (ASEAN-CRN) has been established to promote the implementation of the guidelines and to thereby contribute to the aim that ASEAN Member States are in a better position to adapt their agricultural sector to climate change and.It therefore aims to promote a commonunderstanding on climate change and the agriculture sector amongst ASEAN Member States. It also facilitates mutual learning and promotes resilience of agriculture within the region, through the scaling-up of identified good practices and policies. It also identifies common concerns and capacity needs, and propose regional support strategies and instruments to address these in a coherent manner; and to support ASEAN decision-making and implementation processes by providing inputs based on policy-oriented research results on climate change and agriculture..

b. Other key initiatives

Other key initiatives which play an important role in the region include the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), which brings together the research expertise across the 15 CGIAR centres to support policy and implementation processes. The CCAFS regional program for Southeast Asia, together with key CGIAR centres in the region such as CIAT, CIMMYT, ICRAF, IRRI etc., play a key role in supporting implementation in the region. UN agencies in the region, notably the FAO arealso key to providing technical assistance to countries and the ASEAN CRN. In addition to these initiatives, the Asia Pacific Advanced Network (APAN) on climate change, Asia Pacific Association ofAgricultural Research Institutions (APAARI) and SEARCA networks are key initiatives in the region.

c. Recommendations for UNFCCC based on experiences in the ASEAN region

The ASEAN Member States are of the view that UNFCCC should consider the following recommendations based on experiences in the ASEAN region.

- **Promote regional cooperation and collaboration**. Regional cooperation and collaboration, notably through the ASEAN Climate Resilience Network plays an important role in South East Asia. Continued support to regional initiatives and leveraging on these initiatives for implementation is key.
- **Support inclusive planning mechanisms.**In the ASEAN, an inclusive planning process bringing together various stakeholders emerged successful, and helped identify priorities and actions for the region. Similar science-based inclusive planning mechanisms should be considered in different planning contexts.
- **Increase investment in research and development for technologies and management systems to support climate-resilient agriculture, land use and fishery.** As climates change, consistent long-

term investment in research at national level – and collaboratively across countries – will pay off for adaptation at farm, agriculture sector and national food security levels.
- **Increase financial support to adaptation measures in agriculture.** Lack of sufficient financial resources limits the capacity to develop climate-resilient agricultural systems.

6. Gender and social inclusion

Research by the CGIAR research program on Climate Change, Agriculture and Food Security show that women and men farmers in developing countries have different vulnerabilities and capacities to adapt to climate change. Women experience greater financial and resource constraints as well as less access to information and extension services in agriculture. The ASEAN Member States are of the view that gender and social inclusion needs to be incorporated within adaptation measures in agriculture. Mechanisms to guarantee women's involvement in developing and implementing adaptation strategies and financing and the development of principles and procedures to protect and encourage women's access to national adaptation programs and projects are important.