

Climate-smart agriculture and food security

Dr. Hamdani Mehieddine - Medea University

Received: 03/05/2018

Accepted: 24/06/2018

Published: : 24/06/2018

Abstract :

Climate-smart agriculture (CSA) is an approach for transforming and reorienting agricultural systems to support food security under the new realities of climate change through the adoption to a new practices of sustainable land management. It focuses on agricultural productivity with emphasis on the integrated management of natural resources and on resilience. Widespread changes in rainfall and temperature patterns threaten agricultural production and increase the vulnerability of people dependent on agriculture for their livelihoods, which includes most of the world's poor. Climate change disrupts food markets, posing population -wide risks to food supply. Climate-smart agriculture encourages agricultural development through approaches that improve food security with low emissions and increase producer incomes. CSA promotes coordinated actions by farmers, researchers, private sector, civil society and policymakers towards climate-resilient pathways through building evidence, increasing local institutional effectiveness;and fostering coherence between climate and agricultural policies.

Key words: Agriculture, Climate change, food security ; climate-smart agriculture

Resume:

L'agriculture intelligente face au climat (CSA) est une approche pour transformer et réorienter les systèmes agricoles afin de soutenir la sécurité alimentaire dans les nouvelles réalités du changement climatique à travers l'adoption de nouvelles pratiques de gestion durable des terres. Il se concentre sur la productivité agricole en mettant l'accent sur la gestion intégrée des ressources naturelles et sur la résilience. Les changements généralisés des régimes de précipitations et de températures menacent la production agricole et accroissent la vulnérabilité des personnes dépendantes de l'agriculture pour leurs moyens de subsistance, ce qui inclut la plupart des pauvres dans le monde. Les changements climatiques perturbent les marchés alimentaires et posent des risques à l'échelle de la population pour l'approvisionnement alimentaire. L'agriculture intelligente face au climat encourage le développement agricole à travers des approches qui améliorent la sécurité alimentaire avec de faibles émissions et augmentent les revenus des producteurs. L'agriculture intelligente face au climat encourage les actions coordonnées des agriculteurs, des chercheurs, du secteur privé, de la société civile et des décideurs en faveur de voies résilientes au changement climatique en renforçant les preuves, en renforçant l'efficacité institutionnelle locale et en favorisant la cohérence entre les politiques climatiques et agricoles.

Mots clés: Agriculture, Changement climatique, sécurité alimentaire; agriculture intelligente face au climat.

Introduction:

The agricultural sector is a key sector of both the global economy and many national economies. It provides livelihoods and basic subsistence needs for millions of people, and contributes to the achievement of food security in both developing and developed countries.

Climate change is emerging as a major threat on agriculture, food security and livelihood of millions of people in many places of the world. Several studies indicate that agriculture production could be significantly impacted due to increase in temperature ; changes in rainfall patterns and variations in frequency and intensity of extreme climatic events such as floods and droughts. Worldwide agricultural production is expected to decrease under climate change projections, posing a threat to global food security

The evolution of agriculture in the future will be shaped by its response to climate change. Farmers need to adapt their practices to accommodate climatic conditions, and agricultural activities will need to be modified to reduce greenhouse-gas (GHG) emissions. But climate change is only one of the major forces that will change the future of agriculture. It is also important to note that agriculture contributes a significant amount of global emissions annually, which would increase with the intensification or expansion of production to meet higher demand

The challenges associated with CSA will require integrated multi-disciplinary approaches, which build upon social, natural and technological sciences. The key questions we pose for this workshop include:

1. What concepts, approaches or actions are available for production and consumption dimensions for the advancement of CSA?
2. What are the program's goals and objectives?
3. How is the program trying to achieve those goals and objectives?
4. How might climate change influence the effectiveness of program strategies and actions?
5. How might strategies and actions affect future vulnerability to climate change?
6. How can the program be adjusted to increase the likelihood of success and avoid mal adaptation, given the answers to the above questions?
7. What role should policy play in furthering CSA?

This article aims to meet the following specific objectives:

1. To create awareness to the stakeholders on the impact of and vulnerability of agriculture and food security to Climate Change.
2. To provide a simple and a quick field reference on Climate Change and its potential impact on agriculture, food.
3. To introduce the concept of CSA to the national stakeholders associated with Climate Change adaptation programs and to promote CSA as one of the options for adaptation to Climate Change.
4. To introduce, promote and popularize CSA approaches and interventions validated and adapted by the CSA project

Objective

The objectives of the Workshop are to share knowledge and experience on implementing Climate-Smart Agriculture among public, civil society and development agencies, and promote the mainstreaming and up-scaling of CSA

1. Concepts :

1.1 : Climate-smart' agriculture concepts

Climate-smart agriculture is being discussed as a strategy to respond to climate change on the global level because climate-smart agricultural practices do not focus on providing mitigation or adaptation benefits in isolation. These types of practices are said to have the potential to provide 'triple wins':

1. increased resilience to climate change,
2. reduced GHG emissions, and
3. improved food security¹

The concept of CSA was developed by the Food and Agriculture Organization of the UN (FAO) in 2010 as an integrated approach towards addressing the interlinked challenges of food security and climate change².

The FAO defines 'climate-smart agriculture' as "agriculture that sustainably increases productivity, resilience (adaptation), reduces/removes GHGs (mitigation), and enhances achievement of national food security and development goals."³ This simply means that different, more climate-friendly farming techniques could be used to grow agricultural products (including food crops, livestock, fuel,

1 Elizabeth Dooley+ Dr Sophie Chapman: Climate-smart agriculture and ;REDD+ implementation in Kenya,2014;p13

2 Dóchas Working Group on Livelihoods, Food and Nutrition Security:Climate smart agriculture;2015;p3

3 Lipper, L. et al., "Climate-Smart" Agriculture: Policies, Practices and Financing for Food Security, Adaptation and Mitigation, Report for the FAO (2010), at ii, n.1

fibre, and raw materials).⁴ Another way of understanding climate-smart agriculture as “an approach to developing the technical, policy and investment conditions to achieve sustainable agricultural development for food security under climate change⁵.”

CSA is about integrating climate considerations into food security efforts in order to maximize the chances of increasing food security levels in a changing world. At the highest level, there is general agreement that CSA focuses on three interlinked objectives:

1. Sustainably increasing agricultural income and productivity
2. Building resilience to climate change (adaptation)
3. Reducing or removing greenhouse gas emissions (mitigation)

These objectives serve as a guide for developing and selecting actions needed to transform agricultural systems to meet development and food security goals in a changing climate⁶

CSA will:

1. sustainably intensify production systems to achieve productivity increases thereby supporting the achievement of national food security and development goals;
2. increase the resilience of production systems and rural livelihoods (adaptation),
3. reduce agriculture's GHGs emissions (including through increased production efficiency) and increase carbon sequestration (mitigation)⁷.

Climate smart agriculture is not a new agricultural system, nor is it a set of practices. It is a new approach, a way to guide the needed changes of agricultural systems, given the necessity to jointly address food security and climate change.

Climate-smart agriculture seeks to increase sustainable productivity, strengthen farmers' resilience, reduce agriculture's GHG emissions and increase carbon sequestration. By doing so, it strengthens food security and delivers environmental benefits⁸

⁴ Climate-smart Agriculture, Climate-Smart Practices, at <http://www.climatesmartagriculture.org/72612/en/>, last accessed 24 June 2013

⁵ FAO, Climate-smart agriculture for development. www.fao.org/climatechange/climatesmart/en.

⁶ Food security and nutrition network; Climate-Smart Agriculture in USAID Office of Food for Peace Funded Programs; 2015, p2

⁷ FAO & World Bank Final report: Identifying Opportunities for Climate-Smart Agriculture Investments in Africa; 2011; p10

⁸ World Bank. 2011. Climate-Smart Agriculture: A Call to Action.; climatechange.worldbank.org/sites/default/files/documents/CSA_Brochure_web.pdf

Climate-smart agriculture should be seen as a pathway towards development and food security⁹

The integration of CSA into FTF (feed the future) programs, which builds on previous adaptation efforts, should focus on the following five areas:

1. Use sound climate data and science. Country, Regional operating units are working
2. Develop and deploy climate smart technologies and innovations.
3. Strengthen human and institutional capacity in ways that foster adoption of CSA by Smallholders.
4. Build and maintain partnerships for impact.
5. Support policies and an enabling environment that facilitates climate-smart agriculture.¹⁰ Smart agriculture

1.2 :Key characteristics and Evolution of the CSA Concept :

One of the main features of the recently FAO published a new set of guidelines and approach to achieving sustainable agriculture and food systems(SFA) as ones which meet the following criteria

1. improving the efficiency of resource use,
2. conserving, protecting and enhancing natural resources,
3. protecting and improving rural livelihoods,
4. enhancing resilience of people, ecosystems and communities and
5. responsible and effective governance mechanisms¹¹.

It characterized by :

1. **addressing climate change:** CSA systematically integrates climate change into the planning and development of sustainable agricultural systems (Lipper et al. 2014).
2. **integrating multiple goals and manages trade-offs:** CSA produces triple-win outcomes: increased productivity, enhanced resilience and reduced emissions.
3. **maintaining ecosystems services:** Ecosystems provide farmers with essential services, including clean air, water, food and materials. It is imperative that CSA interventions do not contribute to their degradation.
4. **Hqving multiple entry points at different levels:** CSA has multiple entry points, ranging from the development of

9 Climate-smart agriculture: managing ecosystems for sustainablilivelihoods.<http://www.fao.org/docrep/015/an177e/an177e00.pdf>

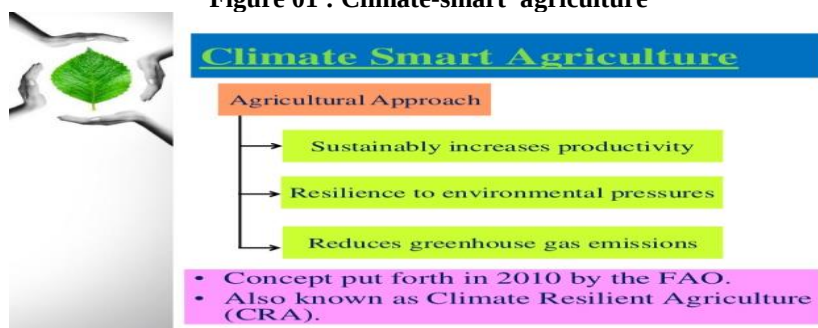
USAID. Climate smart agriculture in feed the future programs. February 2016 .P8

11 Natural Resource Management and Policy/Climate Smart Agriculture Building Resilience to Climate Change.volume 52;Fao;2018;p24

technologies and practices to the elaboration of climate change models and scenarios, information technologies, insurance schemes, value chains and the strengthening of institutional and political enabling environments.

5. **It is context specific:** What is climate-smart in one-place may not be climate-smart in another.. Interventions must take into account how different elements interact at the landscape level, within or among ecosystems and as a part of different institutional arrangements and political realities.
6. **engaging women and marginalised groups:** To achieve food security goals and enhance resilience, CSA approaches must involve the poorest and most vulnerable groups. Gender is another central aspect of CSA. Women typically have less access and legal right to the land which they farm, or to other productive and economic resources which could help build their adaptive capacity to cope with events like droughts and floods (Huyer et al. 2015)¹².

Figure 01 : Climate-smart' agriculture



1.3 : climate-smart agriculture importance :

Climate change threatens to undo years of progress achieved in agricultural development towards enhancing livelihoods and food security, with the most severe consequences falling on developing countries and the poor.

Reducing this threat requires that agriculture must be practiced in climate-smart ways so that the goal of achieving agricultural development and national food security is not compromised¹³.

To overcome the impact of climate change, an array of interventions for adaptation and mitigation have been tested. Specific adaptation

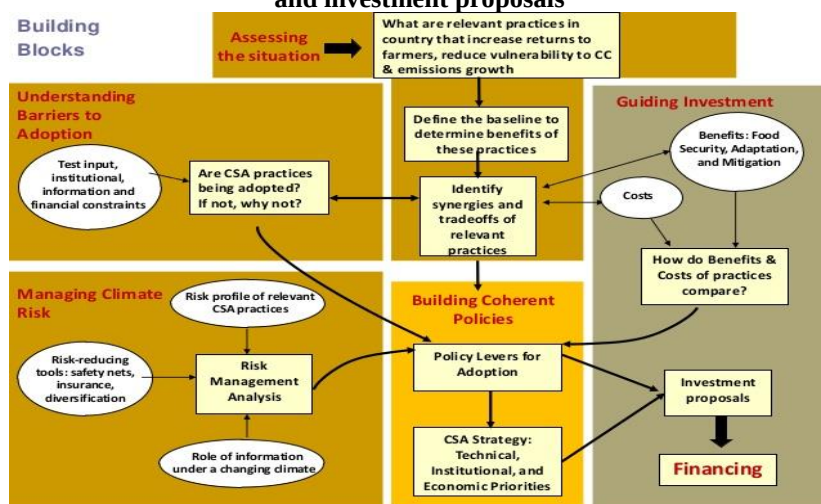
¹² <https://csa.guide/csa/what-is-climate-smart-agriculture>; April 21st 2018

¹³ Fao; Climate-Smart Agriculture: A call for action; Synthesis of the Asia-Pacific Regional Workshop Bangkok, Thailand, 18 to 20 June 2015. :p32

measures include: improved crop varieties and livestock and fish breeds, simple adjustments to land, crop and livestock management, more efficient use of water and energy for food production, better weather forecasts and timely provision of such data to farmers, and sustaining ecosystem services of forests and water sources.

Further, it is important to consider climate-smart management of agriculture within a broad socioecological context, recognizing that climate change is one of the many drivers of change influencing the agricultural sector¹⁴

Figure 02: A Framework for developing a CSA strategy and investment proposals



Source : FAO :Developing a climate-smart agriculture strategy :the country level:lessons from recent experience ;Background Paper for theSecond Global Conference on Agriculture, Food Securityand Climate ChangeHanoi, Vietnam, 3-7 September 2012 ;p6

Between now and 2050, the world's population will increase by one-third. Most of these additional 2 billion people will live in developing countries. At the same time, more people will be living in cities. If current income and consumption growth trends continue, FAO estimates that agricultural production will have to increase by 60 percent by 2050 to satisfy the expected demands for food and feed. Agriculture must therefore transform itself if it is to feed a growing global population and provide the basis for economic growth and poverty reduction. Climate change will make this task more difficult

¹⁴ Fao To overcome the impact of climate change, an array of interventions for adaptation and mitigation have been tested. 2015/04;p5

under a business-as-usual scenario, due to adverse impacts on agriculture, requiring spiralling adaptation and related costs

1. World's population will increase by one-third by 2050
2. FAO estimates that agricultural production will have to increase by 60% by then
3. Agriculture in developing countries should undergo a significant transformation to feed the growing global population
4. Climate change adds extra challenges in reaching this goal

To achieve food security and agricultural development goals, adaptation to climate change and lower emission intensities per output will be necessary

1.4 : :CSA Objectives:

CSA concept is that it calls for meeting three objectives:

1. sustainably increasing food security through increases in productivity and incomes,
2. Building resilience and adapting to climate change,
3. reducing greenhouse gas emissions compared to a business as usual or baseline scenario¹⁵

Climate-smart agriculture (CSA) as a global development goal was introduced to guide the transformation of agricultural systems integrating adaptation, mitigation and food security Alleviating vulnerability and fostering resilience of agricultural systems to climate change to secure the sustainable provisioning of food while reducing greenhouse gas (GHG) emissions are the major objectives of CSA¹⁶

These objectives serve as a guide for developing and selecting actions needed to transform agricultural systems to meet development and food security goals in a changing climate¹⁷.

CSA invites us to consider these three objectives together but at different scales - from farm to landscape - and at different levels - from local to global - over both short and long time horizons, taking into account national and local priorities.

It focuses on agricultural productivity with emphasis on the integrated management of natural resources and on resilience. management plans, and increased efforts to improve productivity in rain-fed development strategies, including CSA, must be tailored to increase communities response to three capacities:

15 Natural Resource Management and Policy/Climate Smart Agriculture Building Resilience to Climate Change. volume 52;Fao;2018;p20

16 Patric Brandt and others: How to target climate-smart agriculture? Concept and application of the consensus-driven decision support framework "targetCSA" Agricultural Systems;151(2017)pp234-245

17 The TOPS Program. Climate-Smart Agriculture in USAID Office of Food for Peace Funded Programs;2015;p2

absorptive – the ability to minimise exposure to shock; adaptive – the ability to quickly and effectively respond and adjust to changing conditions; and transformative – the ability to move beyond chronic poverty and insecurity through systemic change by building stronger support structures and creating more enabling environments¹⁸

CSA approaches entail greater investment in:

1. managing climate risks;
2. understanding and planning for adaptive transitions that may be needed, - for example, into new farming systems or livelihoods; and
3. exploring opportunities for reducing or removing greenhouse gas emissions, where feasible. (FAO, 2014)¹⁹.

1.5 :CSA pillars: CSA is based on three pillars:

1. **Productivity:** CSA aims to sustainably increase agricultural productivity and incomes from crops, livestock and fish, without having a negative impact on the environment. This will raise food and nutritional security.
2. **Adaptation:** CSA aims to reduce the exposure of farmers to short-term risks, while also strengthening their resilience by building their capacity to adapt and prosper in the face of shocks and longer-term stresses. Particular attention is given to protecting the ecosystem services which ecosystems provide to farmers and others.
3. **Mitigation:** Wherever and whenever possible, CSA should help to reduce and/or remove greenhouse gas (GHG) emissions. This implies that we reduce emissions for each calorie or kilo of food, fiber and fuel that we produce. That we avoid deforestation from agriculture. And that we manage soils and trees in ways that maximizes their potential to acts as car on sinks and a sor CO2 from the atmosphere²⁰.

Increasing the productivity, resource efficiency and sustainability of livestock systems includes following principles such as :

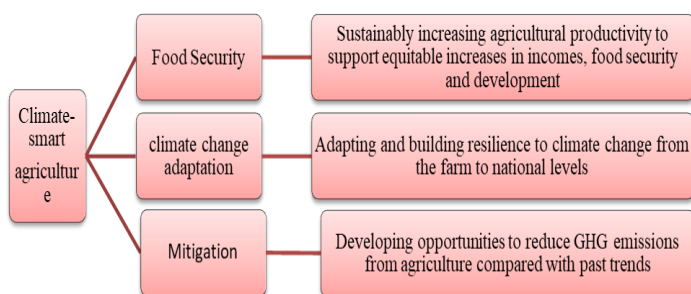
1. Adopting management practices that improve animal health and welfare

18 Béné et al. 2012. Resilience: New Utopia or New Tyranny? Reflection about the Potentials and Limits of the Concept of Resilience in Relation to Vulnerability Reduction Programmes. IDS Working Paper, Volume 2012 Number 405. CSP Working Paper Number 006. Institute of Development Studies (IDS) and Centre for Social Protection (CSP).

19 Dóchas Working Group on Livelihoods, Food and Nutrition Security:Climate smart agriculture;2015;op3

20 Netherland enterprise agency:Climate smart agriculture;2017;p9

2. Increasing animal productivity and efficiency through genetic improvements and better feeding, including adoption of age--specific, balanced feed rations
3. Decreasing pollution by optimizing critical metabolic and nutrient cycles.
4. Enhancing diversity within animal production systems to strengthen their resilience
5. Improving rangeland productivity, diversity and grazing management
6. Adapting management practices that preserve biological diversity in livestock agroecosystems
7. Using manure within comprehensive nutrient management systems while recognizing and mitigating its associated health and contamination risks²¹

Figure 03:

1.6 : CSA Approaches

Climate-smart agriculture (CSA) is an approach for transforming and reorienting agricultural systems to support food security under the new realities of climate change. Widespread changes in rainfall and temperature patterns threaten agricultural production and increase the vulnerability of people dependent on agriculture for their livelihoods, which includes most of the world's poor

CSA promotes coordinated actions towards climate-resilient pathways through four main action areas:

²¹ Source : The Sustainable Development Solutions Network : Solutions for Sustainable Agriculture and Food Systems ;2013 ;p22

1. building evidence (identify set of viable options, enabling “tools” to assess different technologies)
2. increasing local institutional effectiveness
3. fostering coherence between climate (energy) and agricultural policies
4. linking climate and agricultural financing

An approach not a new concept: reduce vulnerabilities, increase adaptive capacity, technically feasible & economically viable

The Global Alliance on Climate Smart Agriculture group, in a working paper on climate smart approach proposes following elements as core elements of a climate smart approach:

1. Emphasis on adaptation and resilience for food producers
2. Mitigation focus, in line with historical responsibility and the principle of Common but Differentiated Responsibility
3. Meaningful climate, environmental and social safeguards
4. Emphasis on smallholder.
5. Emphasis on productivity and sustainability
6. An analysis of farming systems at a landscape level.
7. Accent on farming systems that promote agroecological principles
8. Promotion of diversified farming systems
9. Reference to the need for adaptation and mitigation at all stages of the food chain .
10. Reference to the food-energy-water nexus
11. Reference to sustainable agriculture, understood as approaches aimed at: increasing agricultural productivity per units
12. Emphasis on community-based organisations (village-level institutions, by-laws etc.)
13. Acknowledgment of the role of soil and ecosystem health
14. Risk mitigation and adaptation strategies
15. Reference to the creation of an enabling policy environment²²

1.7 : What is needed for effective implementation of CSA?

Urgent action from public, private and civil society stakeholders at the international to local levels is required in four areas:

1. building evidence and assessment tools;
2. strengthening national and local institutions;
3. developing coordinated and evidence-based policies;

²² Dóchas Working Group on Livelihoods, Food and Nutrition Security: Climate smart agriculture; 2015; p4

4. increasing financing and its effectiveness²³

1.8 : Climate-Smart Agriculture and development

“Climate-Smart Agriculture” (CSA) addresses the challenges of building synergies among climate change mitigation, adaptation and food security that are closely related within agriculture, and minimizing their potential negative trade-offs. It seeks to enhance the capacity of the agricultural sector to sustainably support food security, incorporating the need for adaptation and the potential for mitigation into development strategies. The specific conditions, circumstances, and capacities within countries will define opportunities and barriers to implementation, and hence policy choices.

CSA will:

1. sustainably intensify production systems to achieve productivity increases thereby supporting the achievement of national food security and development goals;
2. increase the resilience of production systems and rural livelihoods (adaptation),
3. reduce agriculture’s GHGs emissions (including through increased production efficiency) and increase carbon sequestration (mitigation).

There is no blueprint for climate-smart agriculture and the specific contexts of countries and communities would need to shape how it is ultimately implemented. Climate-smart agricultural production technologies are therefore aimed at maximizing food security benefits and, at the same time, they can deliver significant climate change mitigation and adaptation co-benefits (Branca et al, 2011).²⁴

2 :What is food security?

Providing sufficient, safe and nutritious food to all people is one of the major global concerns historically and in the twenty-first century. Food security is usually framed in four dimensions : food availability, access to food, food use/utilization and food stability (FAO, 2016a).

These dimensions build the overall framework of the definition established by the Food and Agriculture Organization of the United Nations (FAO): “Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences

²³ Leslie Lipper et al: Climate-smart agriculture for food security; Nature Climate ;2014;April20th 2018

²⁴ Giacomo Branca, Timm Tennigkeit, Wendy Mann, Leslie Lipper : Identifying Opportunities for Climate-Smart Agriculture Investments in Africa ;2011 :p10

for an active and healthy life” (FAO, 2016b). For each of these dimensions, a series of indicators has been defined in order to assess progress in improving food security²⁵

Agriculture and the worldwide food system are challenged to feed an estimated global population of 9.7 billion people by 2050 with diminishing land and water resources. Agricultural land areas can no longer be expanded because most global arable lands have already been put into production²⁶

2.1 : Food security and climate change: three intertwined challenges

Agriculture and food systems must improve and ensure food security, and to do so they need to adapt to climate change and natural resource pressures, and contribute to mitigating climate change. These challenges, being interconnected, have to be addressed simultaneously

2.1.1 : Ensuring food security

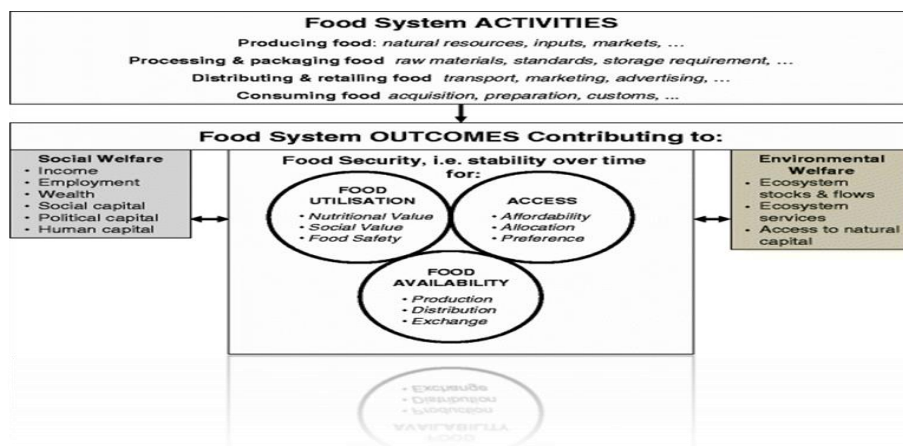
Between now and 2050, the world's population will increase by one-third. Most of the additional 2 billion people will live in developing countries. At the same time, more people will be living in cities (70 percent against the current 50 percent). Urbanization and rising incomes in developing countries are driving increases in the consumption of animal products (FAO, 2009a). The objective is to ensure food and nutrition security, worldwide. Ensuring availability of calories and sufficient global production is not enough; we also need to make sure that enough food is accessible to everyone, everywhere, physically and economically²⁷.

Figure 04 :

25 Unctad: The role of science, technology and innovation in ensuring food security by 2030; 2017; p4

26 Harold Vanes and Joshua Woodard: Innovation in Agriculture and Food Systems in the Digital Age; The Global Innovation Index 2017; p97

27 FAO: climate-smart agriculture; Sourcebook; 2013; p1X



2.1.2 : Impacts of climate change on agriculture

Climate change has already significantly impacted agriculture (Lobell et al, 2011) and is expected to further impact directly and indirectly food production. Increase of mean temperature; changes in rain patterns; increased variability both in temperature and rain patterns; changes in water availability; the frequency and intensity of ‘extreme events’; sea level rise and salinization; perturbations in ecosystems, all will have profound impacts on agriculture, forestry and fisheries. The extent of these impacts will depend not only on the intensity and timing (periodicity) of the changes but also on their combination, which are more uncertain, and on local conditions.

The climate change impact will have major effects on agricultural production, with a decrease of production in certain areas and increased variability of production to the extent that important changes may need to be made in the geographic area where crops are cultivated²⁸

2.1.3 : Agriculture’s impact on climate change

The agriculture sector has to produce more food and it will be certainly impacted by climate change. As an integral part of the economy, it has also been called upon to contribute to mitigate climate change. Agriculture is not only affected by climate change, it is also contributing to the emission of greenhouse gases²⁹

Increasing efficiency in the use of resources is also one of the driving principles of CSA. GHG emissions from agriculture are linked to its use of resources. Agriculture is a major driver of deforestation, which

²⁸ Fao: climate-smart agriculture; Sourcebook; 2013; p5

²⁹ Fao: Climate-Smart Agriculture: A call for action; Synthesis of the Asia-Pacific Regional Workshop Bangkok, Thailand, 18 to 20 June 2015; p28

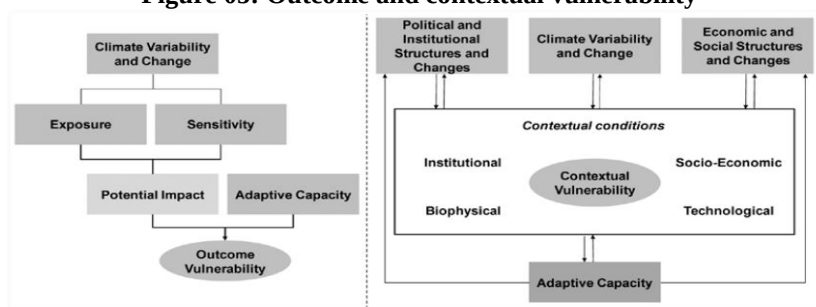
roughly accounts for an additional 17 percent of global GHG emissions. The main direct sources of GHG emissions in the agricultural sector are not only carbon dioxide Agriculture is a source of nitrous oxide (N₂O), accounting for 58 percent of total emissions, mostly by soils and through the application of fertilizers, and of methane (CH₄). There are two ways by which agricultural production can contribute to mitigate climate change that are in line with the 'food security first' objective.

1. To improve efficiency by decoupling production growth from emissions growth
2. to enhance soil carbon sinks³⁰

Climate change is expected to introduce new risks for agricultural production and to modify existing ones. Climatic models cannot predict future risks with a sufficient precision to enable decision-makers at local level to exactly address them.

The impact of a risk on a system depends on the shock itself and on the vulnerability and resilience of the system³¹

Figure 05: Outcome and contextual vulnerability



Source: Building resilience for adaptation to climate change in the agriculture sector; a Proceedings of a Joint FAO/OECD Workshop 23–24 April 2012.P43

Towards more efficient and resilient systems

They have to become more efficient in resource use: use less land, water and inputs to produce more food sustainably, and be more resilient to changes and shocks through :

More efficient : Increase efficiency in resource use as one of the driving principles of CSA through :(1)Increase resource efficiency in plant production ;(2)Increase resource efficiency in livestock

³⁰ Fao:climate-smart agriculture;Sourcebook;2013; pp7-8

³¹ Building resilience for adaptation to climate change in agriculture sector.A Proceedings of a Joint FAO/OECD Workshop 23–24 April 2012.P35

production ;(3)Integrated systems ;(4)Reduce food losses and waste,(5)System efficiency ;

More resilient systems

Climate change will profoundly affect the conditions under which agricultural activities are undertaken. It will affect existing risks and add new risks and uncertainties. Resilience is an essential condition for achieving our goal to sustainably reduce global hunger, malnutrition, and poverty as well as to reduce reliance upon emergency food assistance. resilience capacities need to be strengthened at the individual, household, community, national, and systems levels.³².

One of the most effective approaches to be prepared for uncertainty and new risks is to reduce vulnerability and increase resilience of a given system

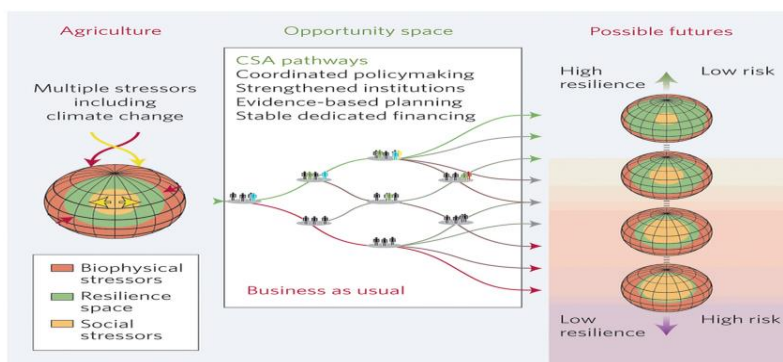
Vulnerabilities: The net impact of a shock depends not only on the intensity of the shock itself but also on the vulnerability of the system to this particular type of shock.

Resilience

Resilience can be described as the capacity of systems, communities, households or individuals to prevent, mitigate or cope with risk and recover from shocks

Figure 06: Climate-resilient transformation pathways for agriculture

³² U.S. Government Global Food Security Strategy fy2017-2021;2016;p17



Source: Leslie Lipper et al : Climate-smart agriculture for food security ;2014 ;p3 .

Resilience is often limited to increasing 'efficiency' and productivity, or calling for the expansion of industrialised food systems in developing countries, thus failing to take the depletion of natural resources such as oil into account

Three ways to build resilience

Increasing resilience can be achieved by reducing exposure, reducing sensitivity and increasing adaptive capacity, for every type of risk. we can identify the following three ways to build resilience (1) Reduce exposure, (2) Reduce the sensitivity of systems to shocks, (3) Increase adaptive capacity³³.

Efficiency and resilience

Efficiency and resilience should be pursued together and at various scales in different agricultural systems and food chains. Increasing diversity of production at farm and landscape level is an important way to improve the resilience of agricultural systems. Specialized systems are often presented as being more efficient from an economic point of view, as they generate more income. Diversifying production can also improve efficiency in the use of land, as is the case in agroforestry systems for instance and of nutrients with the introduction of legumes in the rotation or in integrated crop/livestock or rice/aquaculture systems

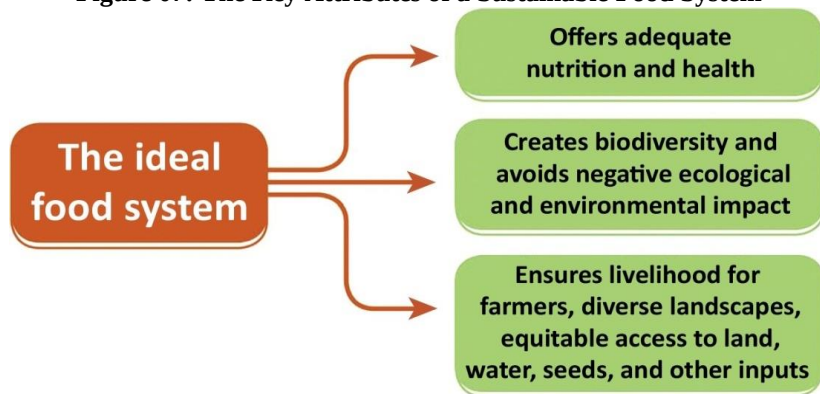
3 :Link between climate change, food policies and food security

Climate-smart agriculture involves the use of different 'climate-smart' farming techniques to produce crops or livestock, which could help

33 Vincent Gitz and Alexandre Meybeck: Risks, vulnerabilities and resilience in a context of climate change; www.fao.org/fileadmin/templates/agphome/documents/.../gitz.pdf April 19th 2018

reduce pressure on forests for agricultural use as well as potentially maintain or enhance productivity, build resilience to climate change and mitigate the sector's high emissions

Figure 07: The Key Attributes of a Sustainable Food System



Trends in Plant Science

Source: Diversifying Food Systems in the Pursuit of Sustainable Food Production and Healthy Diets, Trends in Plant Science, October 2017, Vol. 22, No. 10p851

Climate is one of the most important variables in world food production, affecting Product quality and quantity, farming locations, soil types, application of management and technologies, input costs, food prices and natural resource. Impacts of climate change include:

1. Changes in planting and harvesting times
2. Modification to crop, cultivar and animal types suitable for particular temperature zones and other farming practices, such as crop rotations as a result of higher temperatures and/or a reduction in average rainfall
3. Reduced water run-off and consequently water availability for irrigation
4. Increase in extreme weather events, for example, heatwaves and bushfires, tropical cyclones, and drought and excessive rainfall.
5. Changes in water storage
6. Potential need for some farmers to relocate
7. Business flexibility on-farm

8. Regulatory reform for native vegetation management and genetic modification technology
9. More efficient use of nitrogen fertilisers, improvements in productivity and reduction of emissions
10. Changes in global trading patterns
11. Changes to production costs due to government greenhouse gas emission policy
12. Potential opportunities for carbon sequestration³⁴

A sustainable food system is a collaborative network that integrates several components in order to enhance a community's environmental, economic and social well-being. It is built on principles that further the ecological, social and economic values of a community and region. Characteristics of a sustainable food system are outline below³⁵ :

1. is secure, and therefore reliable and resilient to change and accessible and affordable to all members of society;
2. is energy efficient'
3. is an economic generator for farmers, whole communities and regions'
4. is healthy and safe;
5. is environmentally beneficial or benign'
6. uses creative water reclamation and conservation strategies for agricultural irrigation;
7. balances food imports with local capacity'
8. adopts regionally-appropriate agricultural practices and crop choices'
9. works towards organic farming;
10. contributes to both community and ecological health;
11. builds soil quality and farmland through the recycling of organic waste;
12. supports multiple forms of urban as well as rural food production'

34 Christine Slade+Angela Wardell-Johnson: Creating climate for food security ; Governance and policy in Australia ;2013 ;pp16-17

35 Kameshwari Pothukuchi+Jerome L. Kaufman ; Placing the food system on the urban agenda: The role of municipal institutions in food systems planning; [Agriculture and Human Values](#) 1999;volume 16 ;pp213-224

13. ensures that food processing facilities are available to farmers and processors;
14. is celebrated through community events, markets, restaurants, etc;
15. preserves biodiversity in agro-ecosystems as well as in the crop selection;
16. has a strong educational focus to create awareness of food and agricultural issues, and
17. is fairly traded by providing a fair wage to producers and

Conclusion

Climate change alters agricultural production and food systems, and thus the approach to transforming agricultural systems to support global food security and poverty reduction. Climate change introduces greater uncertainty and risk among farmers and policy-makers, but

need not lead to analysis paralysis. An integrated, evidence-based and transformative approach to addressing food and climate security at all levels requires coordinated actions from the global to local levels, from research to policies and investments, and across private, public and civil society sectors to achieve the scale and rate of change. CSA is not a single specific agricultural technology or practice that can be universally applied. It is an approach that requires site-specific assessments to identify suitable agricultural production technologies and practices. It is an approach that:

- addresses the complex interrelated challenges of food security, development and climate change, and identifies integrated options that create synergies and benefits and reduce trade-offs;
- assesses the interactions between sectors and the needs of different involved stakeholders;
- identifies barriers to adoption and provides appropriate solutions in terms of policies, strategies, actions and incentives;
- seeks to create enabling environments through a greater alignment of policies, financial investments and institutional arrangements.
- prioritize the strengthening of livelihoods, especially those of smallholders, by improving access to services, knowledge, resources ; financial products and markets;
- addresses adaptation and builds resilience to shocks, especially those related to climate change, as the magnitude of the impacts of climate change has major implications for agricultural and rural development;
- considers climate change mitigation as a potential secondary co-benefit, especially in low-income, agricultural-based populations;
- seeks to identify opportunities to access climate-related financing and integrate it with traditional sources of agricultural investment finance.

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