Module 2: Concepts: gender and climate change issues in agriculture and food security

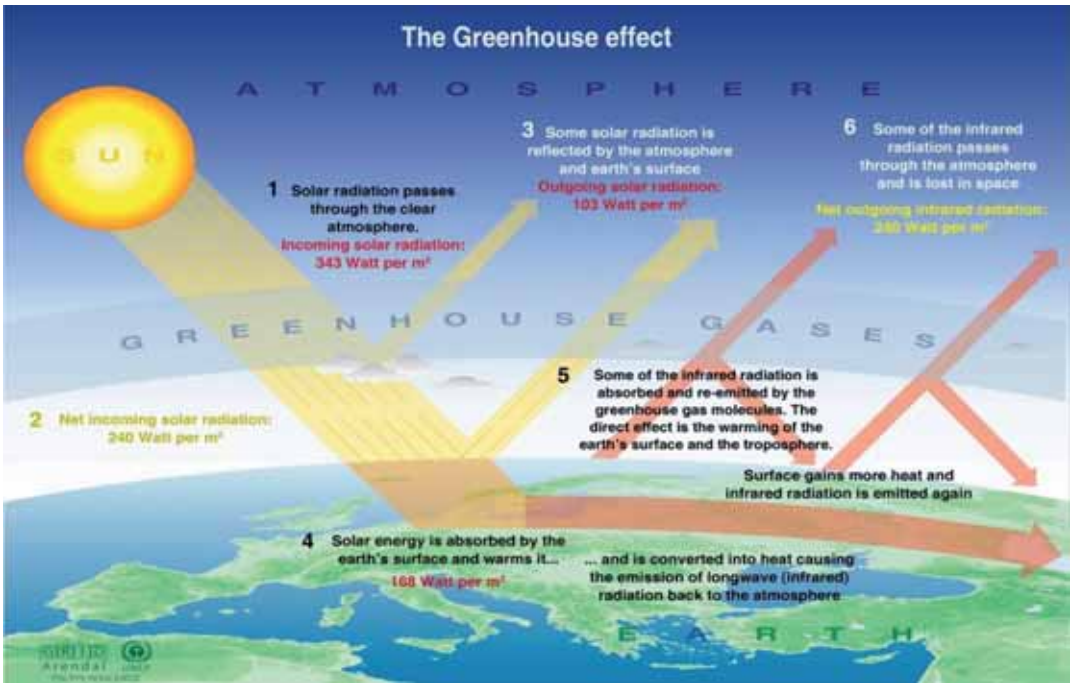
In this module you will:

- review the key concepts of climate change;
- explore climate-smart practices from a gender perspective; and
- understand the importance of researching and addressing gender issues in the context of agriculture, food security and climate change.

A. What is climate change?[1]

You are probably already familiar with the environmental explanation of global climate change, as well as some of the policy responses; here is a brief summary. You are encouraged to consult additional resources depending on your level of familiarity with these issues (see Annex 1 for glossary and Annex 2 for additional resources).

Figure 1: The greenhouse effect mechanism



(GRIDA, 2011.)

1. The Enhanced greenhouse effect

The Earth's atmosphere naturally contains greenhouse gases (primarily carbon dioxide, methane and nitrous oxides) that allow solar radiation to pass through and trap heat reradiated from the Earth after it has been heated by the sun in a manner similar to a greenhouse (see Figure 1).

[1] Section 1 is based substantially on FAO 2011d.

The greenhouse effect created by these gases maintains the Earth's surface temperature at about 14°C on average; without this, the Earth's global average temperature would be closer to -19°C. The greenhouse effect is therefore essential for keeping the world warm enough for human habitation.

However, since the Industrial Revolution started in the midst 18th Century human activities that produce greenhouse gases have altered the composition of the atmosphere, leading to an enhanced greenhouse effect. The human activities that lead to greenhouse gas emissions include burning of fossil fuels for transport and energy consumption, as well as agriculture and forestry. In the agriculture sector, emissions of greenhouse gases arise from fertilizer production and use, cattle, rice production, biomass burning and other activities. Agriculture and land conversion, combined, contribute up to **one-third** of emissions leading to the enhanced greenhouse effect. Thus, the agricultural sector contributes significantly to climate change through its emissions of greenhouse gases. Consequently, there is a high potential in agriculture for climate change mitigation.

The enhanced greenhouse effect has led to an increase in the overall mean global temperature as well as changes in precipitation patterns (see box 2.1). While climate varies naturally, these significant changes cannot be attributed to natural variability alone and the role of humans in changing the climate has been determined with confidence.

Box 2.1. Scientific evidence of global climate change

Eleven of the twelve years from 1995 to 2006 rank among the twelve **warmest years in the instrumental record** of global surface temperature (since 1850).

Global mean temperature has increased at the rate of **0.74°C for the last 100 years**.

The temperature increase is **widespread over the globe** and is greater at northern latitudes.

From 1900 to 2005, precipitation **increased** significantly in eastern parts of North and South America, northern Europe and northern and central Asia but **declined** in the Sahel, the Mediterranean, southern Africa and parts of southern Asia. Globally, the area affected by **drought** has likely increased since the 1970s.

(IPCC in FAO, 2010b.)

2. Bio-physical Impacts of climate change

The implications of these changes are and will be numerous and will vary from place to place; there will be more and more intense extreme weather events and increased unpredictability globally. In summary there will be:

Increase in temperature

- Overall, the mean temperature is increasing and will continue to increase. This suggests that the coldest days will become warmer, and the hottest days will become even hotter.
- The frequency of cold days will decrease, and the frequency of hot days will increase.
- In some areas the frequency of warm spells and heat waves will increase.
- Number and intensity of wildfires will increase.

Rainfall

- Over many areas the frequency of heavy rain will increase.
- There will be an increase in number and intensity of floods and landslides.
- Drought risk will increase in many areas.

Sea level rise

- The global sea level rise is estimated to be up to 60cm by 2100; however, some important processes are not well understood yet.

These bio-physical impacts will differ in time and place , but the impacts will hit the hardest in the agricultural and fisheries sectors especially among already poor and vulnerable populations, as the resources they have access to are often marginal and already under stress. These impacts include reductions in crop yields, heat stress for people, livestock and plants: changes related to the crops, varieties and animal species and races that thrive locally; stressed water resources; and increases in agricultural prices. In essence, for people whose livelihood depends on agriculture, climate change will alter what they can do, as well as their ability to manage natural resources and access traditional safety nets. Climate change impacts also limit access to basic resources, such as water and agrobiodiversity. The impacts of climate change on all four dimensions of food security are also potentially severe as adaptive capacity and resilience diminish (see Box 2.2 Climate Change Impacts on the Four Dimensions of Food Security below).

Box 2.2. Climate change impacts on the four dimensions of food security

	Climate impacts	Gendered differences in impacts
Availability	The most direct impact of climate change on food security is through changes in food production. Short-term variations are likely to be influenced by extreme weather events that disrupt production cycles and change seasonality. Climate change impacts on the availability of food will vary geographically – temperate regions in the high latitudes will see a slight increase in productivity. However South Asia and southern Africa will suffer negative impacts on food crops, livestock, forest produce and fisheries.	Although availability has consequences for both men and women, each attaches importance to different issues. For example, men tend to focus on there being less fodder for animals; whereas women are more likely than men to focus on the implications for the well-being of their families.
Stability	Weather extremes and climate variability are the main drivers of food production instability, especially in rain-fed farming systems with limited irrigation. More research is needed especially on this issue.	A shortage of water affects both men and women, but men tend to focus on there being less water for farming and production whereas women tend to focus more on lack of drinking water and its implications on the health of their families.
Utilization	Increases are projected in weather-related disasters, such as flooding , caused by rising sea level and increased precipitation especially for coastal settlements. This is likely to lead to an increase in the number of men and women exposed to vector-borne (e.g. malaria) and water-borne (e.g. cholera) diseases. This, in turn, lowers people's capacity to utilize food effectively, which compromises their food security status.	With farming systems changing there is a risk that traditional crops for food will not be available. As women tend to be responsible for the households, food preparation and food security this is felt especially strongly by them.
Access	Access to food by all members of the population is arguably as important as food availability. Access to food is likely to be influenced by complex secondary impacts of climate change including conflict, human insecurity, migration and soaring food prices.	Women are often more vulnerable than men in conflict situations and will thus be affected more than men when access to food is threatened. Both men and women migrate in order to secure income, but women tend to be less flexible in the distances they can travel from their homes. Men travel farther away while women stay closer to home.

(FAO, 2008a & Lambrou & Nelson, 2010.)

3. Solutions – climate-smart agriculture

Definition of climate-smart agriculture: agriculture that sustainably increases productivity, resilience (adaptation), reduces or removes greenhouse gases (mitigation) and enhances achievement of national food security and development goals (FAO, 2010b).

Responding to the challenge of climate change has become a global priority. At the international policy level, the major response has been institutionalized in the United Nations Framework Convention on Climate Change (UNFCCC). Within the UNFCCC, two major approaches to addressing climate change have been established, which have also shaped the way climate change responses have been designed outside of the UNFCCC. These two approaches are mitigation (addressing the causes of climate change by lowering greenhouse gas emissions) and adaptation (responding to the impacts of climate change by reducing vulnerability). However, the end result of climate change negotiations is not the main issue in the nexus between climate change, agriculture and food security. We must start to produce food in a climate-friendly way, adopting practices that will increase productivity on existing land areas, increase resilience, reduce risks and reduce GHG emissions regardless of the progress of the negotiations, in order to reach the global development goals of peace and prosperity.

While adaptation and mitigation have been developed as distinct communities of practice in reality, we do not necessarily do only one of these at a time when responding to climate change. Especially in the agricultural and food security sectors, a strategy that may help farmers adapt to climate change impacts may also reduce greenhouse gas emissions or sequester carbon, and therefore it can also be considered mitigation. Strategies that can solve multiple climate-related purposes are increasingly recognized as an effective approach to both addressing climate change and reducing poverty. That is why agencies like FAO and the World Bank are mobilizing around the concept of Climate-smart agriculture

The idea is to promote the notion of addressing multiple goals simultaneously. In fact, by aiming to reduce poverty, address climate change and reduce food insecurity at the same time, it is possible to make more efficient use of resources. For this to happen, climate change considerations must be included in agricultural policies, investments and development activities of agriculture, extension messages and school and university curricula. Fortunately, we already know a lot of practices which are climate-smart, such as managing natural resources, soil, water and biodiversity sustainably, diversifying incomes of households, introducing more trees to the farming landscape and improving the productivity of livestock in environmentally sustainable manner. For more examples, see Box 2.3 Examples of climate-smart activities of small holder farmers.

All production systems and household livelihood strategies have to adapt to the diverse impacts of climate change. We must also manage and curb global warming. If we are unable to do this, it will not be possible to adapt satisfactorily. Hence, it is in the best interest of all farmers to adopt farming systems that help them adapt to the changing conditions and contribute to mitigation of climate change. However, this must not compromise household food security or livelihoods.

Food security is typically equated with food production. However, food security, which is an outcome of a food system, is made up of several components see Figure 1 below (Ericksen et al. 2010). The first component is food **availability**, which is the amount, type and quality of food. Food may be available through production, distribution, and exchange. The second component is **access** that can depend on the affordability, allocation, and social preferences. The third component is food **utilization**, which refers to the nutritional value of food, social value placed upon food, and food safety. These three components of food security are influenced by social and environmental welfare, which includes drivers of change, such as demographics, economics, land cover and water availability. The diagram below provides a helpful way to understand food security and what influences availability, access, and utilization.

Box 2.3. Examples of climate-smart activities of small holder farmers

Increasing use of weather and climate forecasting to reduce production risk.

Increased productivity and resilience through altering inputs, varieties and species for increased resistance to heat shock and drought, flooding and salinization; increased soil carbon content, optimizing organic and inorganic fertilizer rates to maintain production levels and grain or fruit quality while minimizing greenhouse gas emissions emissions; altering amounts and timing of irrigation and other forms of water management for stable yields and maximum biomass production and altering the timing or location of cropping activities and local seed storage (seed banks).

Managing river basins for more efficient delivery of irrigation services and prevent water logging, erosion and nutrient leaching, making wider use of technologies to "harvest" water to maximize "crop by drop" and conserve soil moisture, use and transport water more effectively.

Improving livestock management practices for increased productivity per animal while decreasing emissions.

Matching livestock stocking rates with pasture production, altered pasture rotation, modification of grazing times, alteration of forage and animal species/breeds, integration within livestock/crop systems including the use of adapted forage crops, re-assessing fertilizer applications and the use of supplementary feeds and concentrates for increased productivity and increased carbon sequestration.

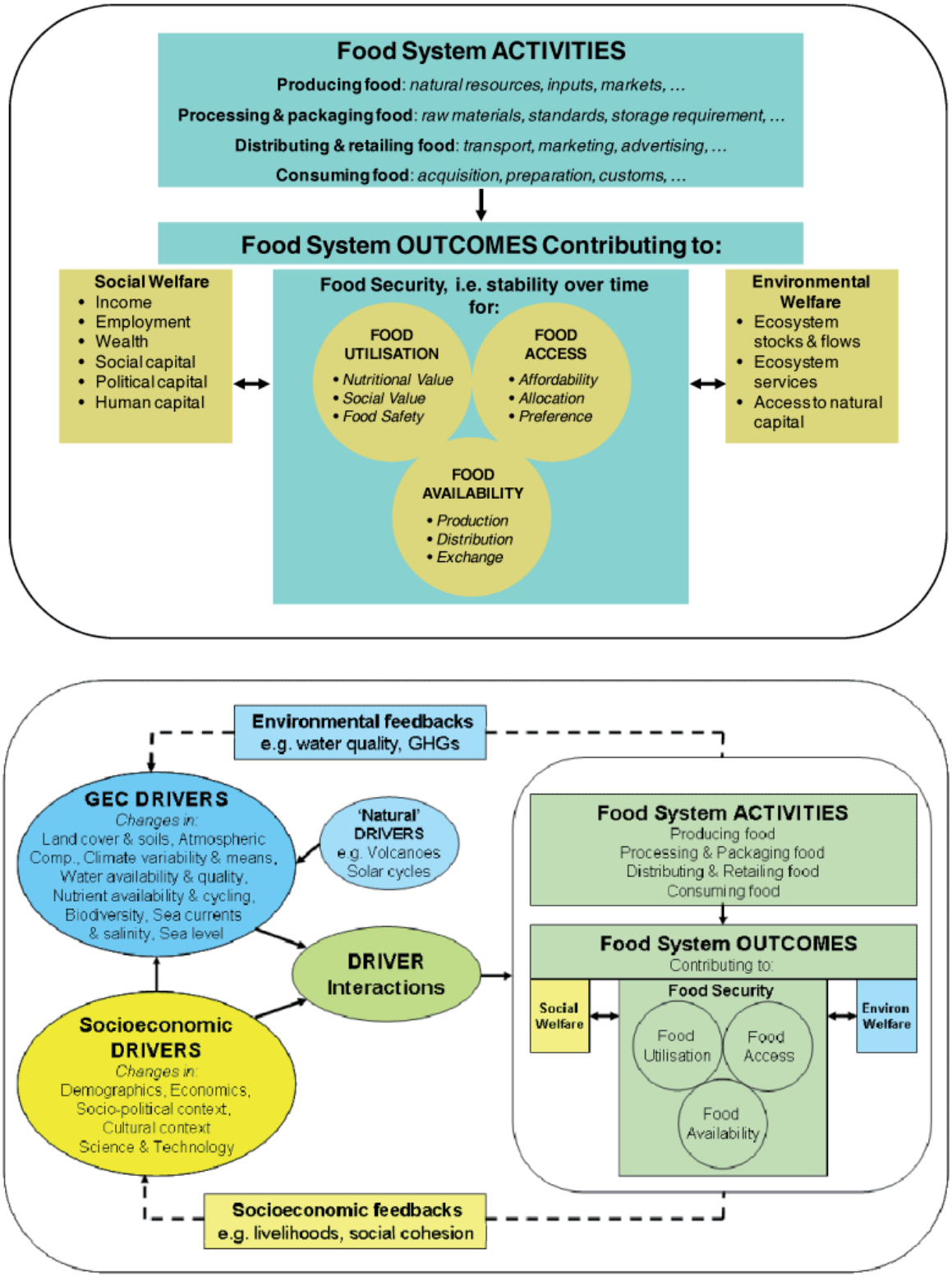
Diversifying income through the integration of activities such as marketable crops, livestock raising, fish production in rice paddies, bee-keeping and non-timber forest products.

Introducing forest conservation, agroforestry and forest-based enterprises for diversification of rural incomes, increased resilience and carbon sequestration.

Making wider use of integrated pest and pathogen management, developing and using varieties and species resistant to pests and diseases increasing productivity per used inputs; improving quarantine capabilities and monitoring programmes.

(Howden*, et al*., 2007 in FAO, 2008b & FAO, 2010b.)

Figure 2: Food system



(Ericksen et al. 2010.)

The following will describe the gender dimensions of climate-smart agriculture and food security, drawing on the gender concepts and gender analysis frameworks presented in Module 1: Conceptual framework: gender issues and gender analysis approaches.

B. The Gender dimensions of climate-smart agriculture in the context of rural livelihoods

Adaptation

Adaptation to climate change requires making adjustments to prepare for climate variability and changing average climate conditions, in order to moderate harm and exploit beneficial opportunities (IPCC, 2007a). Adaptation can also take place in response to climate change impacts.

Most ecological and social systems have built-in **adaptive capacity**. However, the current climate variability and rapid rate of climate change are imposing new pressures that have the potential to overwhelm existing coping capacity[2]. The indigenous knowledge of women and men farmers, forest-dependent people and fishers can be a valuable entry point for localized adaptation. The different knowledge of women and men must be acknowledged making sure that all local knowledge is gathered and treated equally. This means recognizing the advantages of and capitalizing on locally adapted crops, fish and livestock, farming systems, soil, water and nutrient management, agroforestry systems and wild fire management. It is important also to note that local knowledge about less obvious resources, such as small crops, forest food and medicinal plants is often held only by women. Nevertheless, in efforts to address complex and long-term problems caused by changing climate, indigenous knowledge often needs to be complemented by 'conventional' scientific know-how, recognizing that new scientific knowledge is also needed.

Adaptation efforts by households and communities must create the capacity to deal with increasingly difficult and more frequent conditions and gradual changes in climate, although it is often not possible to anticipate the precise nature of these. This requires a focus on capacity development at all levels recognizing the different needs and roles of men and women. The community level is, in practice, the level where most of the adaptation activities are carried out and gender conscious support actions are needed at this level. Furthermore, it is vital also to strengthen institutions dealing with monitoring, research and extension with appropriate recognition of gender perspectives, as well as social learning, innovation and development processes. If localized projections of climate change impacts are not available, it is necessary to take a precautionary approach, which means taking adaptive actions that are beneficial even if climate change threats do not occur exactly as anticipated (FAO, 2009b).

Both **risk management** and **change management** play roles in adaptation to climate change. Disaster risk management focuses on preventing, mitigating, preparing for and responding to shocks in short- and medium-term scales, while change management adds a strategic, long-term objectives to policy, legal and research frameworks. Both perspectives are interrelated and mutually complementary, providing incentives to modify behaviours and practices over the medium to long term.

When optimizing current conditions and minimizing the **vulnerability** of women and men to future changes, trade-offs, which may be gender specific, might need to be made. For example, converting

[2] It should be noted that coping is not equal to adaptive capacity. In fact coping strategies may even be negative from a gender or long-term perspective. But in the short term, people have no choice but to cope regardless of long-term perspectives.

mangroves into shrimp farms may increase incomes and food supply, but it might also increase vulnerability to climate extremes and climate change. Diversifying agriculture or rural livelihoods builds long-term **resilience**, but at the same time it might require new or different work input, and the control of new income is often gender specific. Another consequence might also be a decrease in income in the short-term. For people in developing countries, short-term challenges, including immediate decreases in income and climate risks, are often so important that long-term climate risks cannot be given sufficient attention. Designing responses that acknowledge both short- and long-term food security usually requires parallel processes, such as phased and iterative participatory and gender-sensitive planning alongside introduction of short- and long-term measures.

Adaptation is not accomplished in a single intervention. Rather, it is a continuum, requiring an overarching approach that incorporates interventions that range from those that address underlying drivers of vulnerability to those designed exclusively to respond to climate change impacts (ODI, 2010). The vulnerability of a system depends on its exposure and sensitivity to changes, and on its ability to manage these changes (IPCC, 2001). Climate change adaptation can thus be enhanced by i) altering exposure ii) reducing sensitivity of the system to climate change impacts and iii) increasing the adaptive capacity of the system while simultaneously explicitly recognizing genders specific consequences (OECD, 2010).

Adaptation processes need to be location-, gender- and context-specific, integrated and flexible. This is accomplished by basing the processes on climate monitoring and impact and vulnerability assessments, as well as concurrently engaging and working with both women and men stakeholders to develop institutional capacity and identify, evaluate, prioritize and select available adaptation options and tools.

Although adaptation and development are needed in both smallholder and commercial agricultural systems, the two systems present significant differences in priorities and capacities. Commercial systems are chiefly concerned with increasing resource efficiency and reducing emissions. In agriculture-based countries, where agriculture is critical for economic development, adaptation in smallholder systems is important for food security and poverty reduction, as well as for growth and structural change (FAO, 2010b).

Adaptation to variable climatic conditions is a process and has taken place for centuries. Women and men are continually modifying their agricultural practices to naturally varying climate conditions according to their specific needs, knowledge and access to resources.

Sometimes these modifications are called coping strategies, which can be described as shorter-term plans to overcome immediate challenges. These plans do not always take into account the longer term consequences. They may in fact have negative long-term impacts for users. Coping strategies help men and women to get by, but do not alter their long-term vulnerability. If they are exposed to the same climate conditions in the future (e.g. flood, drought) they will still likely be adversely affected. Conversely, adaptation suggests a more permanent shift in approach. See below Box 2.4 for examples of coping strategies of men and women.

Box 2.4. Examples of coping strategies local women and men apply

In case of harvest lost, due to drought for example, people, especially women, reduce the intake of food;

Reduce household expenditures – such as taking children out of school;

Sell assets;

Economize on the use of resources. A common strategy is, for example, shifting to other food products, such as wild food or food that needs less cooking time (these products are often less nutritious);

Use energy-saving or resource-saving devices. Many cases are known in which these technologies are introduced without adequately consulting women as users in their planning and implementation;

More time, effort and energy are put into work, particularly by local women;

Specific activities aimed at making available more natural resources and increasing their supply. Examples are women's initiatives in tree-planting and reforestation, as well as forest conservation activities;

Both women and men organize themselves. Women, who are already used to working together in the field or in the collection of natural resources, share the problems they face with each other and look into solutions together. Groups might be formed or pre-existing women's organizations take up the environmental issues in their livelihoods. Men, who are often more familiar with organized activities since they are often supported to do so for such events as village meetings, also organize themselves to tackle challenges.

Migrating to find work. Both women and men may choose to migrate to find work for example, but the distance they chose to migrate differs. Men are willing to migrate further away from home than women.

(Dankelman, 2010 and from Lambrou & Nelson, 2010.)

Experiences with past climate variability offer important lessons for understanding women's and men's vulnerability to climate variability. How and why they are exposed and sensitive to climate variability will give an idea of what may cause them to be vulnerable to climate change. In addition, understanding men's and women's past or current coping strategies can help develop longer-term adaptation plans and can be an entry point for adaptation projects. One way of approaching this is by using the Climate Analogue Approach, which is based on the idea of learning from the experience of others. See below Box 2.5 Climate analogue approach.

Box 2.5.Climate analogue approach

The Climate Analogue Approach is a new initiative developed by CCAFS with the aim of helping communities explore options for adaptation by learning from the experiences of other, 'analogous' communities. Exchanges have proved to be an important way of learning. The idea is to match a community that is likely to experience a change in climate conditions to a community that already experiences those climate conditions, allowing the community facing the change can learn from the community already coping with those conditions.

While this may seem like a highly technical approach, in essence, it is about people who are facing likely impacts of climate change exchanging ideas with other people who have already faced similar conditions. A gender-specific approach and equity in participation are key to making sure that all community members could benefit from this approach. Some of the key questions to ask are:

What do men and women, (adolescent) boys and girls want to learn from the analogue community? (needs/priorities)

Is it culturally appropriate for men and women to interact with members of another community? If there are restrictions, are there ways to overcome them so men and women can both participate in this exchange?

What is the likelihood that men and women would act on the information gained from the exchange of knowledge? (Socio-economic conditions may impact their ability to act.)

In what form will the exchange of information take place – written, verbal, or other? Do men and women have the same educational background to enable them to participate in the dialogue?

Are men and women able to travel? How far and when (both according to daily and seasonal schedules)?

The implementation of adaptation strategies can lead to changes in the social context. There can be an increase in migration, by both women and men, in search of alternative livelihood opportunities. The division of labour can shift. For example, women may take on more care giving work within the family if climate change causes negative health impacts, or women may take on new income-generating work, which could change their position in the household and increase in the number of female-headed households. Adaptation is often part of a coping strategy and not always planned, although it may be calculated to take long-term impacts into account. Conversely, the notion of mitigation, the complementary aspect of adaptation within the concept of climate-smart agriculture, does focus on long-term impacts.

Mitigation

Definition of mitigation : Climate change mitigation refers to an anthropogenic intervention to reduce the sources or enhance the sinks of greenhouse gases (FAO, 2011d). In other words, mitigation means taking action to reduce the causes of climate change by limiting the amount of heat-trapping gases that are emitted into the Earth's atmosphere.

For farmers in developing countries, the main aim of agriculture is to secure their livelihoods and to produce products that can be used directly or sold at the market. Mitigation is not the first activity consciously undertaken, but can be integrated into the current practices if it enhances their livelihoods. Thus, mitigation must be seen in the context of farmers' decision making. For most farmers, the emphasis will be on increasing agricultural productivity, entailing necessary adaptation to the changing climate. This could include the co-benefit of mitigation.

Projects that specifically aim to integrate mitigation activities into agricultural practices are termed carbon projects (see Box 2.6).

Box 2.6. Carbon projects in agriculture

In the agriculture sector a carbon project entails agricultural practices that mitigate climate change. These can be activities which either:

reduce emissions, for example by reducing methane emissions from livestock through the introduction of different feeds;

avoid emissions, for example by substituting fossil fuels with bioenergy produced from wood, agricultural feedstocks, residues, algae or fish waste; and

remove emissions, through agroforestry activities, for example, which can sequester carbon from the atmosphere.

When a project can account for the reduction or removal of greenhouse gas emissions, it can receive so-called carbon credits or payments for the delivery of this environmental service.

Mitigation of greenhouse gas emissions emissions in agriculture has several approaches: (i) emissions can be reduced; (ii) emissions can be avoided or displaced, or (iii) sinks can be created to remove emissions.

To **reduce emissions from farming systems** several means are available. In the livestock sector, for example, emissions can to some extent be regulated by increasing the productivity per animal unit or through the implementation of certain production practices and more efficient use of feeds. In crop and feed production, the use of (greenhouse gas emitting) inorganic fertilizer can be optimized, or in some cases, replaced by organic fertilizers to reduce emissions. Additionally, technical changes in production systems and practices, such as manure management and water management in rice farming provide options to reduce greenhouse gases (FAO, 2006).

To **avoid emissions in the agricultural sector** energy efficiency needs improving in many systems. There is a diversity of different greenhouse gas mitigation strategies, which are highly specific to location and management practice (Schneider and Smith, 2009). Through efficient household energy systems, greenhouse gas emissions can be displaced at a relatively low cost.

Box 2.7. CASE study on the Western Kenya sustainable agriculture land management project

The Western Kenya Sustainable Agriculture Land Management Project is supported and run by VI Agroforestry and the World Bank. The project currently works with 65 000 households, and will continue to do so with over the next 30 years. Before the initiation of the project soil erosion and nutrient mining were very common in the region, agricultural productivity was very low, and there was little knowledge on sustainable agricultural practices. However, the project is changing the situation.

The aim of the project is to support the removal of greenhouse gases by promoting sustainable agricultural practices such as terracing, use of cover, mulch and fodder crops, manure management and agroforestry practices.

(Vi Skogen 2011.)

According to the IPCC (2007), the main potential for mitigation lies in **enlarging carbon sinks,** which can be described as natural carbon storages capable of storing more carbon from the atmosphere than they emit. Forests are an example of carbon sinks. There are different approaches to enlarging these carbon sinks in agriculture, such as increasing biomass (and carbon) by incorporating trees and bushes into farming systems, as is done in silvo-pastoral or agroforestry systems for example. Great potential is assumed to exist in increasing the carbon content of soils and landscapes, although whether or not this can be achieved in practice at a large scale remains to be determined. By restoring degraded soils, especially in vast grassland and pasture areas, and regulating animal numbers and improving pastures, the soil **carbon sequestration** rate (the ability of the soil to absorb carbon) is improved. It is likely that significant mitigation potential can be tapped by adopting farming practices that increase the organic matter content of the soils.

The **benefits** that arise from adopting mitigation techniques can provide the basis for farmers to take up new practices. For example, by improving the organic matter content of soils, the water retention capacity and nutrient content can be improved. Agroforestry systems can diversify income sources and enhance productivity. Diversified production systems, such as integrated rice-livestock systems, can increase the resilience of farming systems. Practices are varied and often specific to regions. Consequently now systems and practices will have to be chosen accordingly. Moreover, agricultural mitigation options need to provide adaptation, food security and rural development in order to be sustainable for farmers in the long-term.

In farm decision-making and practices, the adaptation and mitigation measures are often the same agricultural practices that also benefit farmers by increasing productivity and resilience. However, there may be important trade-offs too. In these situations, where climate-smart practices entail costs for the farmers and these changes are deemed to bring substantial benefits to the society, the farmers facing extra costs should be compensated through different payment mechanisms, rewarding these farmers for the environmental service they provide.

Mitigation on a large scale is essential for slowing the pace of climate change and will require the engagement of smallholder farmers in mitigation activities. However, for all household members to engage in and benefit from the uptake of mitigation activities, it is important to examine key gender aspects.

Box 2.8. Mitigation activities of smallholder farmers – some insights from existing projects

A recent global survey undertaken by FAO, examined 50 agricultural mitigation projects involving agriculture activities that reduce, avoid or sequester GHG emissions through the agricultural, agroforestry, forestry or bioenergy activities.

The entry point for many projects was agricultural practices that prove to be unsustainable in the specific region, such as slash-and-burn, overharvesting, conventional/traditional agriculture, low input (rain-fed rice), intensive farming systems, as well as degraded land. The mitigation projects generally brought a shift to more sustainable agricultural practices, including conservation agriculture, compost production, organic agriculture, agroforestry, improved management (coffee, livestock, manure), as well as afforestation, reforestation, forest conservation and bioenergy production.

The predominant activities in the projects were restoration of degraded soils and agroforestry. Cropland management and ecolabelling were also relatively frequent activities, as were forest management activities (conservation, plantation, forest restoration, non-wood forest management or nurseries), mangroves, rain water harvesting, organic manure and composting.

The benefits generated through the agricultural projects were numerous. Farmers were the main recipients of benefits, either in the form of payments or as a result of increased agricultural productivity. In addition, the community benefited through the recognition of its land use rights and carbon rights. Among the socio-cultural impacts, the implemented projects provided both improved knowledge of practices and helped to strengthen community institutions. Other benefits mentioned were that the projects improved the local communities' livelihoods and made it possible to retain the subsistence and cash value of the ecosystem services.

(Seeberg-Elverfeldt and Tapio-Biström, 2010.)

Mitigation is a co-benefit, which might be remunerated in the future through different payment schemes. The experience today suggests that the economic benefits will in practice come from increased productivity due to climate-smart practices. Specific payments, including carbon market payments, would not be of great importance for small farmers in developing countries.

Gender roles and decision making within the household

Adoption of climate-smart practices involves a series of decisions based on multiple goals. Men and women often attach different weight to different goals, and adoption of new farming practices will have differentiated implications to men's and women's income, labour requirements and well-being. At the household level, the main incentives are securing livelihoods and food security, reducing risks and increasing income. To achieve this farming systems and coping strategies have to be changed to adapt to changing circumstances, be it due to extreme events or fundamental long-term changes with increasing incidence of warmer temperatures, less rain or raising sea level.

Decisions regarding adaptation at the household level revolve around preparing for or responding to climate risks. Climate risks do not only affect cash crops and large livestock (areas that men are usually responsible for). Climate risks also affect household water and energy resources, health, subsistence farming (crops/livestock) and kitchen gardens (areas that women are typically responsible for). Therefore, adaptation at the household level is a continuous negotiation of how to protect the different dimensions of the household's well-being and livelihoods that are at risk due to climate change. Due to their gender roles, tasks and responsibilities and gender-based division of labour, men and women may have different perspectives on and knowledge about what is at risk and how it can be protected. Therefore the participation of both men and women in adaptation activities and projects should be encouraged, and their distinct roles in decision making should be acknowledged and supported.

Box 2.9. Carbon markets

There are many efforts underway to reduce greenhouse gas emissions and promote activities which help decrease, avoid or store carbon and other greenhouse gases. This has made carbon a valuable economic commodity. Carbon markets work in a similar way to financial markets. The currency used on these markets is carbon credits.

There are two types of carbon markets: regulatory compliance and voluntary markets. The compliance market is used by companies and governments that by law have to account for their GHG emissions. It is regulated by mandatory national, regional or international carbon reduction regimes. On the voluntary market the trade of carbon credits is on a voluntarily basis. The size of the two markets differs considerably. In 2008, carbon credits worth US$119 billion were traded on the regulated market whereas on the voluntary market it was US$704 million's worth of carbon credits.

Regulatory market

One of the important (Kyoto Protocol) mechanisms for the regulatory market is that of the Clean Development Mechanism (CDM). Developing countries are not obliged to reduce their GHG emissions under the Kyoto Protocol, whereas industrialised countries must fulfil specified targets. They can achieve these by reducing GHG emissions in their own country, by implementing projects to reduce emissions in other countries or by trading. This means that countries that have satisfied their Kyoto obligations can sell their excess carbon credits to countries that are having difficulties or find it too expensive to meet their targets. The idea of the CDM is that an industrialised country implements an emission reduction project in a developing country. This can be an afforestation, an energy efficiency or a renewable energy project.

Examples of CDM projects

Methane avoidance: energy, and fertilizer enterprise from dumped cattle waste in Pakistan

Biogas: methane capture and combustion from poultry manure treatment at Lusakert Plant, Armenia

Biomass production: electricity generation from mustard crop residues in India

Reforestation programme: planting trees for timber, firewood and fodder production on degraded land in Bagepalli, India

Afforestation of grassland: establishment and management of forest plantations in Tanzania

The voluntary market

The voluntary market has become very important for agriculture and forestry projects. Voluntary carbon credits are mainly purchased by the private sector. Corporate social responsibility and public relations are the most common motivations for buying carbon credits. Other reasons are considerations such as certification, reputation and environmental and social benefits. There are a number of companies that offer clients the opportunity to neutralize their carbon emissions (e.g. some airline companies offer carbon neutral flights and global financial services companies provide the equivalent amount of carbon credits). The private sector can either purchase carbon credits directly from projects, companies (e.g. Ecosecurities) or from carbon funds (e.g. The World Bank BioCarbon Fund).

In general, the voluntary market is more interesting than the regulatory market for small-scale agriculture projects in developing countries, because the CDM market has rather complex procedures and methodologies for project registration.

(FAO, 2010a.)

Key questions to be addressed are:

- What role do men and women play with regards to food security of family members?
- Who in the household is vulnerable and how? How is this vulnerability differentiated according to gender, age and other social indicators?
- What do men and women perceive is at risk due to changes in climate?
- What do men and women currently do to deal with the risks?
- Who decides what adaptation strategy to implement? Who takes action and implements the strategy and is he/she involved in the decision making?
- What are the implications of a given adaptation strategy on men's and women's use of time and labour and on their health?

- What information is needed to decide which strategy to implement? Is this information shared in the household?
- How might household and individual food security be affected by the adaptation strategy?

Adopting climate-smart practices implies that the household will make a decision to change their practices, whether the change is a modification in farming practices to reduce emissions or sequester carbon or an alteration of the household energy system to reduce emissions. This decision making is likely to take place according to gender roles and has implications for men's and women's livelihoods. The following are questions that could be asked to clarify their respective roles:

- What are men's and women's roles in decision making about agricultural practices? Do they participate equally?
- How do men and women participate in carrying out the change in agricultural practice?
- Are the implications for labour time of men and women considered when agricultural practices change?
- How might a change in the household energy system affect men and women? Could it increase or decrease the amount of time ensuring the family's energy security? Do men and women have a voice in deciding how the family's energy security is ensured?
- Does land tenure of men and women differ and does it affect their decision making on which agricultural practices to employ?

Access to resources

Men's and women's access to and control over agricultural resources is often unequal. Many of these resources are essential for adaptation to climate change. Taking women's persistent lack of access to and control over resources into consideration is thus essential when supporting adaptation strategies to improve women's access to resources, and achieve gains in agriculture and food security in the context of climate change adaptation.

Key questions include:

- What are men's and women's resources for coping with climate change?
- Do women and men access climate information that they use in responding to climate risks? In what form? Do they use this information?
- What are the formal and informal institutions that supply men and women with the resources needed for adapting, such as information, financial support and technological inputs?
- Do men and women have access to labour markets for earning an income in times of need?
- Are men and women able to access the resources they need (e.g. cash and land) when they need them?
- Who owns and controls as opposite who uses the agricultural resources in the household? Specify land, seeds, manure, livestock, pest control systems and/or other resources.
- What are men's and women's individual food security status in times of crisis? Are they equally capable of accessing the resources they need to meet their food security requirements?

The adoption of climate-smart practices by a household is based in part on the household's and its individual members' access to resources. It is not a given that male- and female-headed households, nor men and women in the same household, will have the same capacity to take up better practices, given persistent gender inequalities in access to the resources needed for adoption of climate-smart practices, such as technology and information.

Key questions include:

- What information is available to men and women, male- and female-headed households, about the various climate-smart farming practices and farming systems?
- Do men and women, male- and female-headed households, have access to the agricultural inputs, like organic and inorganic fertilizers, seeds and seedlings and veterinary services, which are a part of the climate-smart farming strategy?
- Do men and women, male- and female-headed households, receive institutional support for implementing an agricultural practice that also has mitigation benefits?
- Do men and women, male- and female-headed households, receive or have access to the technology needed for implementing an agricultural practice that also has mitigation benefits?

Strategic and practical agricultural needs of men and women

Adapting to new environmental conditions can be an opportunity for creating new social conditions. By addressing the strategic and practical agricultural needs of men and women, adaptation can contribute to development and food security goals. Men and women may have different and sometimes conflicting needs, as may male- and female-headed households.

Key questions include:

- What are men's and women's priorities in terms of short-term and long-term adaptation needs?
- Can addressing adaptation priorities meet some of the educational or resource needs of men and women?
- Does meeting men's needs compromise women's needs or vice versa?
- Are women's groups active in the community and can they support a process of social change engaged in the adaptation process and adoption of climate-smart practices?
- Is a gender-differentiated vulnerability analysis available to assess the needs and constraints of men and women?
- Are gender-sensitive approaches adopted in adaptation and risk management support?
- Climate-smart farming systems including mitigation activities, by implying a modification or change in current practices, can be an opportunity for improving the well-being, food security and equality of men and women. It is important to assess whether climate-smart approaches meet the practical and strategic needs of women in order for new improved farming systems to contribute to social transformation.

Key questions include:

- How do the proposed mitigation activities meet the practical needs of men and women, boys and girls, e.g. in meeting needs for provision of adequate water energy, health care and employment?
- How do the proposed mitigation activities meet the food security needs of men and women, boys and girls?
- Do these mitigation activities entail changes that impact men and women? What kind of changes and within which sector?
- How are the financial needs and constraints of men and women considered, especially with regards to how benefits of the mitigation activity might be distributed to meet those needs?
- How are groups such as women's organizations who are not necessarily focused on mitigation a part of the process, helping to bring forward the needs of women?
- How are women empowered and how do they participate in the decision making regarding mitigation projects?

Climate-smart agriculture is thus an important approach to supporting men and women farmers in overcoming climate change related challenges to improve livelihoods, and food security by increasing productivity and resilience, while at the same time reducing greenhouse gas emissions. As we have seen from the above it is very important to include a gender perspective in carbon projects in agriculture due to the different roles, responsibilities and circumstances of men and women.