



## Information Flash No. 1

# CLIMATE-RESILIENT SMALL-SCALE AGRICULTURE

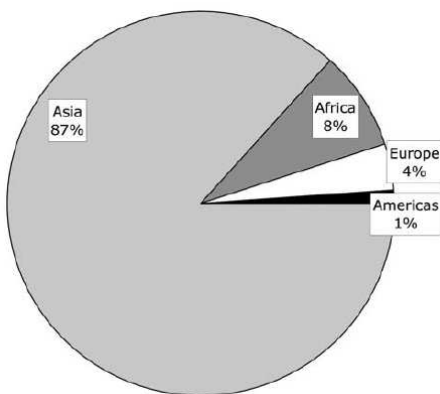
## Introduction

The small-scale agricultural sector is facing unprecedented challenges arising from the impacts of changing global climate patterns. Understanding both the small-scale agricultural sector and projected climate change impacts facing the sector is a prerequisite to designing responses.

### 1. Characteristics of small-scale agriculture

FAO estimates that 525 million farms exist worldwide, providing a livelihood for about 40% of the global population (IAASTD 2009). Nearly 404 million of these farms are small-scale farms, defined as having less than 2 ha of land. Small-scale farms occupy about 60% of the world's arable land. Figure 1 provides a regional breakdown. The large proportion of small-scale farms in Asia is mainly accounted for by China and India. The comparably low proportion of small farms in Africa may be underestimated due to the 2 ha threshold in the definition, as African farms tend to have larger areas, but of less fertile land.

Due to the weak socio-economic position of many small-scale farmers, the land they farm is rarely prime land. When a country's land reserves come under pressure, it is often small-scale farmers who are forced to move onto more marginal lands. This development frequently takes place in the context of unclear land tenure as well as low levels of service provision and a severe lack of energy available to the sector. The high percentage of people who depend on small-scale agriculture, their social and political marginalisation, and the system's 'subsistence' orientation contribute to the relatively high vulnerability of small-scale agriculture.



**Figure 1.** Regional distribution of small-scale farms. 87% of the world's small-scale farms are in Asia, 8% in Africa, 4% in Europe, and 1% in the Americas. (Source: IAASTD 2009)

### Outlook:

- Small-scale agriculture, particularly in developing countries, will remain an important sector for decades to come.
- Small-scale agriculture depends to a large extent on natural resources.
- The disparities between small-scale agriculture and industrial-type agriculture will increase as the former will continue to depend on metabolic energy sources while the latter has access to cheap fossil energy.

- Missing market stimuli result in low levels of innovation and stagnation within the subsistence context.
- Climate change is an additional risk factor which adds to existing challenges such as climate variability, water stress, scarce and fragile land resources, and rapid population growth.
- The direct dependence of small-scale agriculture on ecosystem services has led to a considerable level of adaptive capacity among farmers for handling uncertainties. This can be an opportunity in facing future climate-related changes.

## 2. Impact of climate change on agriculture

The greenhouse effect is triggered by increasing greenhouse gas concentrations in the atmosphere. They trap an increasing part of the sun's energy within the earth's atmosphere, thus disturbing the inflow / outflow balance of solar radiation.

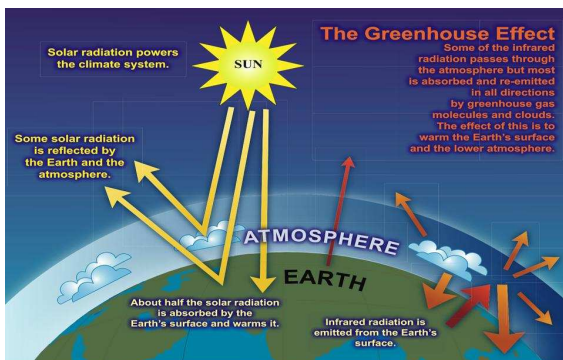


Figure 2. The greenhouse effect. (Source: IPCC 2007)

The greenhouse effect itself is not disputed. What is still debated is its impact on human well-being.

Primary aspects of climate change that impact agriculture are:

- Temperature rise
- Changes in precipitation patterns
- Frequency of extreme weather events
- Sea level rise
- Changes in river flows

## 3. What are the possible impacts of climate change on small-scale agriculture?

Overall, agriculture is estimated to be one of the sectors most severely affected by climate change, in developed as well as developing countries. Small-scale agriculture may prove particularly vulnerable, since many small-scale farmers live in areas with a fragile resource base which are already heavily affected by climate variability, water scarcity, and temperature stress. Predicted negative effects of climate change include:

- Temperature increases that will negatively affect harvests in tropical and sub-tropical regions. Many crops are sensitive to high temperatures. Regions like the Sahel are expected to be particularly heavily affected.
- Changes in the amounts and distribution of precipitation will exacerbate the water stress already prevalent in many regions. Southern Africa may face yield losses of 20-50% by 2050 (IPCC 2007).
- More frequent and more extreme events such as droughts, floods, and hurricanes are likely to damage crops. Many developing countries are prone to these climate-related disaster risks.
- Lower availability of glacial water and snowmelt will aggravate water stress in irrigated agriculture, affecting irrigation systems in India, Pakistan, Central Asia, and Latin America.

- A higher sea level and salt water intrusion will damage fertile agricultural land in areas such as Bangladesh and the Mekong Delta.

Climate change is confronting small-scale agriculture to a challenge of a magnitude to which it has not been exposed to before. Impacts are of a regional or even global nature and are therefore difficult to understand and also to counteract through adaptation. Local coping mechanisms might no longer suffice.

More information about the impact of climate change on agriculture can be found in the following presentations:

The Challenge of Climate Change for Agriculture and Food Security. Facts and Figures. Prof. Jürg Fuhrer. 2010. Dialogue on Food and Agriculture.

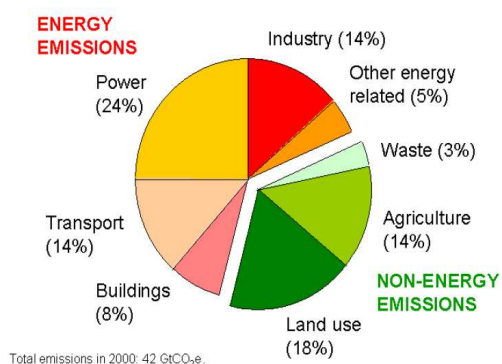
[http://www.world-food-dialogue.ch/documents/10\\_04/presentation\\_fuhrer.pdf](http://www.world-food-dialogue.ch/documents/10_04/presentation_fuhrer.pdf)

In French: Adaptation et sécurité alimentaire. Markus Giger, 2009. Atelier Régional Burkina Faso.

[http://www.sdc-](http://www.sdc-climateandenvironment.net/en/Home_Who_we_are/SDC_Climate_DRR_Check_Training/Training_on_Climate_Change_and_Development/Training_Material_Burkina_Faso)

[climateandenvironment.net/en/Home\\_Who\\_we\\_are/SDC\\_Climate\\_DRR\\_Check\\_Training/Training\\_on\\_Climate\\_Change\\_and\\_Development/Training\\_Material\\_Burkina\\_Faso](http://www.sdc-climateandenvironment.net/en/Home_Who_we_are/SDC_Climate_DRR_Check_Training/Training_on_Climate_Change_and_Development/Training_Material_Burkina_Faso)

### 3. How is small-scale agriculture linked to greenhouse gas emissions?



All in all, the agriculture sector is responsible for roughly a third of the global annual greenhouse emissions (Figure 3). Agriculture directly contributes 14% of the global annual greenhouse gas emissions. In addition, land use changes such as deforestation, which often take place to make space for agricultural production, contribute another 18% of the global annual greenhouse gas emissions.

Figure 3. Global greenhouse gas emissions by sector. (Source: Stern 2006)

Carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), and nitrous oxides (N<sub>2</sub>O) are the three most important greenhouse gases, with carbon dioxide in the lead. Land-use change (deforestation and forest degradation) results mainly in emissions of carbon dioxide, whereas agriculture as a direct source causes emissions mainly of methane and nitrous oxide.

Small-scale agriculture contributes to climate change through various activities:

**Land use changes:** Although small-scale agriculture does not use much fossil energy, it does contribute significant amounts of CO<sub>2</sub> through land use changes. Consumption pressure on land induces small-scale farmers to destroy native vegetation and forests for crop cultivation and fuel production. In the short term, these practices release CO<sub>2</sub> through the burning processes involved in clearing the forest. In the long term, they expose the soil to erosion, degrading its ability to build soil organic matter and sequester carbon for years to come.

**Livestock:** The majority of global livestock is kept in the smallholder sector. Livestock serves a variety of purposes, from milk and meat production to drawing agricultural implements and accumulating economic securities. The productivity of the majority of livestock in smallholder contexts is very low. Experience shows that there is a tendency

to increase livestock numbers in situations of change and uncertainty, such as the current context of climate change. Ruminants contribute considerably to methane emissions by way of enteric fermentation. The rougher the fodder – and rough fodder is prevalent in many smallholder contexts – the stronger the enteric fermentation.

**Irrigated rice** cultivation secures a large share of global nutrition. Population growth calls for increasing rice production. This is achieved by increasing the area as well as productivity. Wetland rice cultivation, like livestock production, is responsible for a major share of anthropogenic methane emissions.

**Fertiliser application:** Agricultural production releases nitrous oxides mainly by way of nitrogen fertiliser application and various agricultural techniques. Although in many developing countries fertiliser is not heavily used, certain countries subsidise the use of fertilisers, leading to their excessive application.

Although not intensive in nature, small-scale agriculture thus contributes to global greenhouse emissions. Ninety per cent of African farms are small. Hence, while Africa has few large-scale emitters, it is the sheer number of small farms that contribute to climate change. The same is true for the agricultural sector in Asia. Table 1 shows the shares of agriculture-related greenhouse gas emissions in various global regions.

Region	Total GHG emissions (Mt CO <sub>2</sub> e)	Share from agriculture	Share from land-use change and forestry
Europe	7,600	9.1	0.4
North America	7,208	7.1	-4.7
South America	3,979	23.6	51.6
Sub-Saharan Africa	543	12.7	60.4
Asia	14,754	14.4	26.8
Developing countries*	22,186	15.7	35.6
World	40,809	14	18.7

**Table 1.** Regional share of emissions from agriculture and land use change. (Source: Nelson 2009, citing WRI-CAIT 2009)

While total greenhouse gas emissions from South America and sub-Saharan Africa are low compared to European and North American levels, the share of emissions from agriculture and land use change is higher in South America and sub-Saharan Africa than in Europe and North America. This share originates to a large extent from small-scale farming.

More information about the interlinkages between agriculture and the greenhouse effect can be found in the following presentation: Introduction to climate change, greenhouse gases and land management. Presentation at Forum SLM. 2009. Markus Giger. [http://www.cde.unibe.ch/Research/pdf/Forum\\_slm\\_2009/2-Introduction1\\_MG.pdf](http://www.cde.unibe.ch/Research/pdf/Forum_slm_2009/2-Introduction1_MG.pdf)

## References

IAASTD [International Assessment of Agricultural Knowledge, Science and Technology for Development]. 2009. Agriculture at a Crossroads. Global Report. Washington, D.C.: Island Press.

IPCC [Intergovernmental Panel on Climate Change]. 2007. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK: Cambridge University Press.

Stern N. 2006. The Economics of Climate Change: The Stern Review. HM Treasury. [http://webarchive.nationalarchives.gov.uk/http://www.hm-treasury.gov.uk/stern\\_review\\_climate\\_change.htm](http://webarchive.nationalarchives.gov.uk/http://www.hm-treasury.gov.uk/stern_review_climate_change.htm); accessed on 12 April 2011.

Nelson G. 2009. Agriculture and the Climate Change Negotiations. IFPRI. Powerpoint Presentation. Available at: [www.donorplatform.org/load/1370](http://www.donorplatform.org/load/1370); accessed on 26 April 2011.

**The next Information Flash will focus on adaption needs and options.**

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