

→ Climate change conditions

Agriculture, forests and land-use under changing climatic conditions



The issue at stake

Around the world, increases in temperature and the frequency of floods, droughts and storms, and an aggravation of water scarcity are being observed, causing severe pressures on mankind and the environment and affecting both urban and rural infrastructures. It has become clear – as evidenced by scientific studies – that we will face a new dimension of challenges arising from human-induced changes in climatic conditions caused by the greenhouse effect. The most affected regions around the globe are the tropical and sub-tropical climate zones with high population densities and difficult institutional and socio-economic conditions. Climate change has the potential to jeopardize the livelihoods of many small-scale farmers and forest-dependent communities. Adapting to climate change can be of key importance to securing households' well-being. Applied research can help identify the impacts of climate change and devise solution strategies, but this calls for new approaches and methodological proceedings.

Over the last five years, a number of developments and results of scientific work at the *School of Agricultural, Forest and Food Sciences HAFL* have led to elements of climate change being incorporated into the BSc and MSc programmes in Agriculture, Forestry and Food Sciences. Moreover, a number of research projects and consulting services have deepened and broadened the competence of the School's academic staff in analyzing issues and producing smart applied solutions for some of the climate change challenges in Switzerland and abroad with a focus on developing and transition countries.

The HAFL approach

HAFL's main comparative advantage is the fact that it unites under one roof the expertise to deal simultaneously with technical issues relating to agriculture, forestry and food sciences and with most types of land and natural resource uses. Furthermore, HAFL has the expertise and capacity to deal with the interactions between resource uses that are manifested in cross-sectoral challenges and opportunities existing in the Swiss and European context and in developing countries and countries in economic transition.

The focus of HAFL's research work and consulting services is on applied solutions for the agricultural, forest and food sectors to face current and expected challenges. The aim is to improve crop, livestock and forest in such a way that they are environmentally safe, economically viable and responsive to the above-mentioned changing conditions. Such approaches cannot be developed by HAFL in isolation, but through collaboration with local organizations and with a range of research institutes and other public or private agencies in Switzerland and abroad with the overall goal of sharing knowledge, technology and resources for an integrated innovation process. In this process, HAFL is able to provide multidisciplinary competencies with regard to the identification of potentials for increased production, improved sustainability and enhanced resilience to climate change. Improved access to farm inputs as well as food markets by integrating stakeholders into local and global value chains are also part of the strategic approach when confronted with climatic change. Moreover, and with respect to climate



change, HAFL has solid and up-to-date expertise in consulting on international forest and climate change policy design, in particular in the development of *Reducing Emissions from Deforestation and forest Degradation (REDD+)* and of *Land Use, Land-Use Change and Forestry (LULUCF)*.

Based on its research and development experience, HAFL acts for or assists governmental and non-governmental agencies, private enterprises and local interest groups in devising concepts, strategies, plans and best practices that facilitate adaptation to changed climatic conditions, increase resilience and reduce negative climate change impacts of agriculture and forestry. Some of HAFL's interventions also target mitigation aspects through specific land management practices which reduce greenhouse gas emissions and/or increase carbon sequestration on farming land, grassland and forest areas.

HAFL competencies and services

In recent years, some climate change related conducive approaches and methods have been developed in close collaboration with local partners which have shown tangible results. Their effects on adaptation to or mitigation of climate change are correlated with practice-oriented knowledge transfer such as applied skills and capacity development, advisory services and communication. Some of them deal with *conservation agriculture, soil (fertility and organic matter) management, crop rotation, diversification, mulching, intercropping, integrated crop-livestock management, drought- or flood- tolerant crop development, pest and disease management, agro-forestry or agro-silvo-pastoral techniques, optimized livestock and manure management, improved grazing and pasture management to increase carbon sequestration, improved water management and water saving irrigation, sustainable forest management (natural and man-made forests), collaborative forest management, forest policy analysis, forestry impact analysis (wind, fire, landslides and avalanches), biochar utilization and production technology, degradation of ecosystem functions, plant invasions, grassland management for biodiversity, and knowledge sharing and transfer methodologies to enable local groups to become their own managers of change and adaptation.*

To create effective output, close contacts and links to other areas such as novel types of communication, weather forecasting, early warning systems, micro insurance schemes, dendrochronology, soil carbon analysis are possible through the HAFL's interdisciplinary structure and its broad partner network.

HAFL experience and references: a selection

Crop production ⇔ Climate change

- Introduction and overview of concepts, approaches and technologies to increase resilience in agriculture systems with a focus on climate change and other natural hazards, for staff of the *Swiss Agency for De-*

velopment and Cooperation SDC from the *Humanitarian Aid* and *Global Program Food Security units* (course title: *Food Security and Disaster Risk Reduction DRR / Climate Change Adaptation*, 5-8 September 2011).

- Information of communities and Helvetas staff in Afghanistan about possible ways to reduce the threat of devastating flash floods and regaining the production potential of watersheds, and development of a concept note for a corresponding project with a particular view to climate change (planning mission for Helvetas in Kahmard, Bamyán province, Afghanistan, 2008).
- Increasing income and resilience of small-scale farmers through irrigated vegetable/horticulture production and input/produce market chain development. Various feasibility studies and development of project ideas for clients in Africa.
- Increasing income from agricultural activities and production stability through water-efficient practices, including small-scale irrigation, in order to alleviate poverty and reduce production risks due to increasing climate variability. Development of a tool for small-scale farmers that allows farming operations to be optimized in terms of income and water productivity under rain-fed and irrigated conditions (ongoing research project).
- Production and use of biochar for increased soil fertility, food security and biodiversity, and to sequester carbon and reduce carbon emissions. Focus on biochar production technologies adapted for small-scale farmers in developing countries and the effects of biochar on agricultural productivity. Slash-and-char as a triple-win approach for livelihoods, environment and climate (several term papers and BSc theses).



- Adapting basic food crops to changing rainfall patterns: study of the seed system, breeding strategy and post-harvest technology to respond to climate change in Mozambique and Bolivia. HAFL provided scientific backstopping to *Helvetas Swiss Intercooperation (Mozambique)*, *World Vision (Bolivia)* and the *International Potato Center CIP (Peru)*. Period: 2010-2012.



- Supplemental low-cost drip irrigation in Nicaragua: adapting the novel low-pressure drip irrigation system developed in India to the hillsides of Central America following a participatory approach. A GIS-based tool to assess the sustainability of supplemental irrigation was developed. HAFL collaborated with *Exportadora Atlantic (Nicaragua)*, *IDE (India and USA)*, *Nestlé (CH)* and *msd-consulting (CH)*. Period: 2009-2013. An MSc thesis, entitled *Sustainability of supplemental micro-irrigation in coffee plantations – Nicaragua*, was written on this topic, 2012.
- Scaling-out of alternative wet-and-dry irrigation of rice in the Mekong Delta, Vietnam: survey to assess the benefits of wet-and-dry irrigation regarding water saving and rice yield as well as to identify challenges for adoption, to assess climate change mitigation through reduced methane emission, and to identify limitations of this technology. The results were fed into a farmer training programme. HAFL conducted the study together with the *International Rice Research Institute IRRI, Philippines*, and the *Plant Protection Department of the Ministry of Agriculture and Rural Development MARD, Vietnam*. Period: 2008-2009.

Livestock ↔ Climate change

- The *Global Agenda of Action in Support of Sustainable Livestock Sector Development* aims to build consensus among key stakeholders in the livestock sector for a subsequent operational phase. The *Agenda of Action* is focusing on the improvement of resource-use efficiency in the livestock sector to support livelihoods, long-term food security and economic growth while safeguarding other environmental and public health outcomes. It is also building a stakeholder platform with special focus on important private sector stakeholders. The three identified focus areas to be developed for the initial operational phase are: *bridging the efficiency gap in agricultural production, towards zero discharge in livestock production system and restoring degraded grasslands*. HAFL is mandated by the Swiss Federal Office of Agriculture FOAG to support the Agenda of Action. Ongoing.
- In Mongolia, SDC mandated HAFL to conduct a research study under the title *Linking Herders to Carbon Markets*. The hypothesis of the study was that “improved livestock and pasture management, including reduced stocking rate, leads to better fed and healthier animals, to higher livestock productivity, and thus to improved income and livelihood for herders, and to carbon sequestration in the soil and biomass. In addition to access to the international carbon credit market, improved market opportunities compensate for reduced stocking rates.” Five sub-studies were conducted in the district of Tariat by researchers of HAFL and Mongolian partner institutions on the following subjects: livestock, economics, value chains, institutions & livelihood, and policy. The analysis listed favorable and unfavorable factors influencing the feasibility of a rangeland carbon project and identified challenges which need to be addressed. In

terms of sustainability, a carbon project would definitely improve the ecological situation in Tariat (rangeland) and globally (carbon sequestration). However, the economic situation of herders is negatively affected both at the household and the district level. Ongoing.



- Optimisation of livestock and manure management: in the framework of projects coordinated by the *FAO*, national teams in Thailand, Vietnam, China and Mexico were supported in analysing intensive livestock production systems and in developing and implementing manure recycling strategies which reduce the impact of livestock production on the environment and make optimal use of manure as a local resource.
- Nutrient flux modelling: approaches to assess nutrient and heavy metal fluxes (mainly N, P, K, Cu and Zn) were studied. Recommendations and models to assess the nutrient balance of livestock production systems or the carrying capacity of crop land for livestock production were developed for regions in Asia and Switzerland.
- Gaseous emissions from livestock production and manure management: in the framework of emission inventory work, a model was developed to estimate ammonia emissions at the farm and at regional level, taking a wide range of influencing factors into account. It is planned to expand the model to other gases, mainly CH₄ and N₂O. A by-product of these activities is the *European Agricultural Gaseous Emissions Inventory Researches Network EAGER*.
- Historical development of management practice to assess the recent development of emissions from livestock production and manure management: regular representative questionnaire surveys were performed in Switzerland (2002, 2007, 2010) to assess the development of emissions and emission mitigation strategies.

Forestry / Agroforestry ↔ Climate change

- *Quesungual* – an alternative to slash-and-burn agriculture in the hillsides of Central America: this project measured the adaptation and mitigation effects of *Quesungual* (a slash-and-mulch system developed by



farmers in Lempira, Honduras) as a response to increasingly erratic rainfall and studied its spread to neighbouring countries. HAFL collaborated with the *International Center for Tropical Agriculture CIAT (Honduras, Nicaragua)* and the *Instituto Nicaraguense de Tecnología Agropecuaria INTA*. Period: 2008-2011.



- Revision of the *ITTO Guidelines on sustainable management of tropical forests*. Preparation of draft for consideration by the International Tropical Timber Council. Ongoing.
- Strategic evaluation of the work of the *FAO* in forests and forestry. Global evaluation conducted for the Governing Council of the *FAO*. HAFL staff acted as coordinator and team leader. Period November 2011 to Dec 2012.
- Collaboration in the evaluation of *Beech Genetic Resources for Sustainable Forestry*. The main objective of this *COST Action (European Cooperation in Science and Technology, FP0703 ECHOES – Expected Climate Change and Options for European Silviculture)* is to forecast the future distribution range of beech forest ecosystems under the assumption of certain scenarios of climate change, based on the analysis of the reaction pattern of European beech populations of defined origin (progenies of natural beech stands) under changed climate situations in sets of pan-European field trials. Ongoing.

- Scientific collaboration with the *Global Programme Climate Change division* of the *Swiss Agency for Development and Cooperation SDC*, including senior advisory services to the development of an innovative programme of forests and climate change at global level. In this function, one member of HAFL staff is a member of the Swiss delegation to the climate change conferences (COP of UNFCCC). Since 2011. Ongoing.
- Accompanying the work of the *Forest Carbon Partnership Facility (FCPF)*, a multi-country partnership administered by *The World Bank*. The FCPF is the largest pilot in the world to introduce REDD+ as a strategy at country level. HAFL supports both the *Swiss State Secretariat for Economic Affairs SECO* in its FCPF policy work and the FCPF itself through working with the Technical Advisory Panel and the various technical and scientific working groups, e.g. the working group on methodological and pricing approach. Since 2011; ongoing.
- Chaired the expert panel of the *Forest Investment Program (FIP)* of *The World Bank*. The FIP works in seven countries to foreground forests in the national climate change agenda. HAFL staff were instrumental in the selection of countries and the approach to scientific work. Development of the FIP proposal for Burkina Faso. Period: 2010-2012.
- Development of the role of forests and forestry in a green economy. Preparation and implementation of an international workshop for countries in economic transition. Preparation of publication. Period: 2011/2012.
- Development of the *Criteria and Indicator Set for Sustainable Forest Management (C&I)* of the *International Tropical Timber Organization ITTO*. This set of C&I is used now throughout the tropics as a main tool to assess the progress towards sustainable forest management. Ongoing.

Biodiversity ↔ Climate change

- Monitoring of wetland plant species in areas of national importance on the shore of Lake Thun to test the effects of lake-level regulation in times of high flood risk over 10 years, 2013-2022. Collaboration with *Infraconsult Bern* in commission of the *Amt für Wasser und Abfall of the Canton of Bern, Switzerland*. Ongoing.
- Scientific research on the invasibility of Swiss grasslands. Plant ecological field experiment on interactive effects of extreme drought, management, origin and propagule pressure of invader species on grassland. Swiss NSF-Project 2010-2013.
- Collaboration in an innovative pan-European experimental research activity in grassland ecosystems, linking pressures from extreme weather events and non-indigenous invasive plant species with buffers such as within- and between-species diversity of plants, and mowing techniques, aiming at regionally differentiated policy decision support. *Project SIGNAL - European gradients of resilience in the face of climate extremes, BiodivERSA network*, 2013-2015.
- Technical advising agency in the development of the nature conservation and climate change strategy of Macedonia in collaboration with *Helvetas Swiss Inter-cooperation and SDC*. Since late 2012. Ongoing.





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