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**Sustainable Rural Development with
Emphasis on Agriculture and Food
Security within the Climate Change
Setting
SARD-Climate Final Report**

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Sustainable Rural Development with Emphasis on Agriculture and Food Security within the Climate Change Setting (SARD-Climate)

This final report comprises of research carried out by the SARG research group of the Department of Economics and Management. The title of the research project is entitled Sustainable Rural Development with Emphasis on Agriculture and Food Security within the Climate Change Setting (SARD-CLIMATE) by the Finnish Ministry of Foreign Affairs. The research focuses on a wide range of topics and countries, but mainly within the areas of sustainable agriculture, food security and climate change. The research reports focus on Kenya, Zambia, Ethiopia, Namibia, Mozambique and Bangladesh. All of the enlisted countries, except Bangladesh, are long-term Finnish Development Cooperation partners.

The SARD-Climate research project provides reports containing analyses and policy recommendations considered instrumental in development policy. These recommendations are particularly related to sustainable agriculture and rural development. They also cover quite extensively the probable role of climate change and suggest how it influences agriculture and food security. While it does not answer all the questions about the effect of climate change on sustainable agriculture and food security, it contributes to the ongoing discussions on the subject.

The project has been coordinated by Professor John Sumelius of the Department of Economics and Management, University of Helsinki. He was assisted to Dr. Stefan Bäckman, who coordinated the project research team and ensured smooth progress and delivery of the reports. The climate change portion of the research was carried out by Dr. Reimund Rötter and Dr. Helena Kahiluoto, both of MTT Agrifood Research Finland.

The following reports have been issued:

1. General theoretical framework (John Sumelius, Stefan Bäckman, Reimund Rötter, Helena Kahiluoto)
2. Start-up document (John Sumelius, Stefan Bäckman)
3. Investigation on the effects of increases in agricultural productivity with regard to food security, employment and rural development in general (Newton Nyairo, Tuulikki Parviainen, K.M. Zahidul Islam and Stefan Bäckman)
4. Analysis of the relation between rural poverty, malnutrition and hunger, and their link to agricultural production growth and productivity growth with special reference to Mozambique and Bangladesh (Rose A. Ingutia, K. M. Zahidul Islam and Md. Motaher Hossain)
5. Effects of land tenure and property rights on agricultural productivity in Ethiopia, Namibia and Bangladesh (Shimelles Tenaw, K.M. Zahidul Islam and Tuulikki Parviainen)
6. Effects of developing country policies on agricultural services, extension, rural infrastructure and energy, health care, water and sanitation (Md. Motaher Hossain and Shimelles Tenaw)
7. Identifying the driving forces behind price fluctuations and potential food crisis (Stefan Bäckman and John Sumelius)
8. Analysis factors affecting supply of agricultural products: market liberalization, agricultural policies, bioenergy policies, population growth, input price development, trade policies and other relevant factors (Newton Nyairo and Stefan Bäckman)
9. Rural financial services and effects of microfinance on agricultural productivity and on poverty (Shimelles Tenaw and K.M. Zahidul Islam)
10. Fair Trade coffee certification. A tool for rural development and environmental protection in Nicaragua? (Joni Valkila)
11. Implications of and possible responses to climate change (Helena Kahiluoto and Reimund Rötter)

The SARD-Climate reports can be downloaded without charge from the Department of Economics and Management Discussion Paper series website, <http://www.mm.helsinki.fi/mmtal/julkaisut.html>



**Sustainable Rural Development with Emphasis on
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ting SARD-Climate**

Final Report

John Sumelius, Stefan Bäckman, Helena Kahiluoto, Reimund Rötter

Preface

This report is a draft Final Report containing a synthesis of findings, conclusions and policy recommendations of the project, Sustainable Rural Development with Emphasis on Agriculture and Food Security within the Climate Change Setting (SARD-Climate). The report also provides information on the implementation of those recommendations in the countries under the research study. This interim document is based on 11 deliverables reports that have been elaborated according to the various themes and provides examples and case studies from the studies countries. The different reports as well as their execution are tabulated in Annex I/Table2. The structure of the integral elements of the core elements of the project is provided in Annex I/Table1. The separate full deliverables are not included in this report, but they may be downloaded from the Discussion Papers publication series of the Department of Economics and Management, UH, <http://www.mm.helsinki.fi/mmtal/julkaisut.html>

Detailed recommendations on the various partner countries covered in this research project (reports 3-11) should be consulted from the detailed country analyses. The separate country reports, which provide deeper and specific recommendations, can provide country dynamics that may benefit country desk officers or other officers working in the relevant countries. Annex II, which is prepared in Finnish, consists of the project budget and provides a breakdown of how the funds were utilized. Short term impacts are listed in Annex III.

The research project is collaboration between researchers from the SARG (Sustainable Agriculture and Rural Development) group based at the Department of Economics and Management, University of Helsinki and MTT Agrifood Research, Mikkeli, Finland. The SARG team consisted of: Tuulikki Parviainen, Shimelles Tenaw, Newton Nyairo, Dr. Stefan Beckman, K.M. Zahidul Islam, Motaher Hossain, Rose Ingutia & Joni Valkila. The group is headed by John Sumelius, Professor of the Department of Economics and Management. The MTT Agrifood Research team consist of Dr. Reimund Rötter and Dr. Helena Kahiluoto. The variance in expertise of the entire research team is greatly reflected in the depth of the reported analyses of the countries and their comprehensive expertise on developing country issues.

Helsinki 23 November 2009

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Professor in Agricultural Economics

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We are grateful to the Foreign Ministry for the permission to reproduce the copyright material (the separate reports). We also acknowledge the tireless effort made by the SARG and Mikkeli research teams in ensuring timely delivery of reports on the assigned topics and the countries covered. Newton Nyairo has helped with revision of the English language. However, any errors or shortcomings in this report are my responsibility.

John Sumelius

Abbreviations

ATVET	Agricultural Technical and Vocational Education
BCCSAP	Bangladesh's Climate Change Strategy and Action Plan
CCX	Chicago Climate Exchange
CDM	Clean Development Mechanism
CO ₂ e	Carbon Dioxide Equivalents
CSI	Coping Strategy Index
DRFN	Desert Research Foundation of Namibia
ET	Emission Trade
EU	European Union
FAO	Food and Agriculture Organization
FFW	Food-For-Work
FTC	Farming Training Centres
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GM	Genetically Modified
IAASTD	International Assessment of Agricultural Knowledge, Science and Technology for Development
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IPCC	Intergovernmental Panel on Climate Change
HIV/AIDS	Human Immunodeficiency Virus/ Acquired Immune Deficiency Syndrome
HOORC	Harry Oppenheimer Okavango Research Centre
MAWF	Ministry of Agriculture, Water and Forestry
MDG	Millennium Development Goal
MET	Ministry of Environment and Tourism
MFCAL	Multi-Functional Character of Agriculture and Land use
MtCO ₂ e	Megatonnes Carbon Dioxide Equivalents
NAU	Namibia Agricultural Union
NEWFIU	National Early Warning and Food Information Unit
NGO	Non-Governmental Organization
OECD	Organisation for Economic Co-operation and Development
PRSP	Poverty Reduction Strategy Papers
SADC	Southern African Development Community
SARD	Sustainable Agricultural and Rural Development
SRES	Special Report on Emission Scenarios
SSA	Sub-Saharan Africa
tCO ₂ e	tonnes Carbon Dioxide Equivalents
UNFCCC	United Nations Framework Convention on Climate Change
UN	United Nations
UNAM	University of Namibia
UNICEF	United Nations Children's Fund
USD	United States Dollars
VHF	Vulnerable Group Feeding
WBCFU	World Bank Carbon Finance Unit

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Executive Summary

Sustainable Agricultural and Rural Development (SARD) is considered an essential step toward achieving the first Millennium Development Goal (MDG) of eradicating extreme hunger and poverty. In order to achieve this important goal, first it is important to find ways of increasing the incomes of the rural poor, who mostly depend on upon agriculture for their livelihoods. This means improving development, cooperation, trade and agricultural policy to improve agriculture's contribution to economic development and poverty reduction. Current projects estimate that 1.02 billion people will go hungry in 2009 alone; an indication that if efforts are not directed at reversing this trend it would most likely continue. The most common causes of hunger and poverty range from high population growth, high prices of energy and requisites which translate into high food prices. Additional causes of hunger and poverty are lack of water, crop failures and calamities, low productivity growth, lack of infrastructure and institutions that provide easy access to markets, credits, education and extension. In addition to the foregoing factors, the threat of climate change and global warming is a compelling factor effects have become pertinent to agriculture and food security in recent years. Based on finds from the Intergovernmental Panel for Climate Change, climate change is anticipated to have severe effects on food security, environmental sustainability and equity, possibly increasing the number of hungry people from 100million to 380 million according to IPCC by 2080 (Easter ling et al. 2007). The estimated rise in temperature, according to Meehl et al. (2007), is estimated to lie in the range of 2°C to 4.5°C, with a most likely value of about 3°C. More recent findings suggest that climate sensitivity ranges from 2.5 to 6.0°C (Monastersky 2009). Sub-Saharan Africa (SSA) is especially vulnerable to these climatic changes and resulting agricultural production response to temperature changes. According to projections, climate change impacts on SSA are considerable; even a 1°C to 2°C warming would lead to high yield losses in arid and semi-arid areas (30-50% by 2050). Projections related to climate change are subject to huge uncertainties, especially for smaller geographical areas, so effects may vary by region.

The major strategies to reduce the potentially harmful effects of global changes, especially climate change are; 1) adapting of food and farming systems to climate change; 2) enhancing the adaptive capacity to changes in climate variability and extremes that are difficult to predict, and to global change more generally (including socio-economic changes), and 3) mitigation of climate change. Because of inertia in the system, climate change seems unavoidable; warming will take place even if greenhouse gas emissions will be substantially reduced. The vulnerability of poor rural households can be reduced by enhancing adaptation through new water and soil management practices. Adaptive capacity on the other hand means the whole of capabilities, resources and institutions of a country or region to implement effective adaptation measures to varied changes. Enhancing systems resilience is closely related to increasing its adaptive capacity. Through mitigation of GHG emissions over the coming decades, long term effects can be reduced. Mitigation implies technological change and substitution that reduce resource inputs and emissions per unit of output. Apparently a regulatory framework is needed to reduce GHG emissions. The earlier and stronger the reduction in emissions, the quicker the concentrations will approach stabilization. It has been claimed that the earlier mitigation measures are implemented the lower the economic and social costs will be. However, since further changes in the climate are inevitable, adaptation is also imperative. Decision-making has to be based on a set of uncertainties concerning climate, population and technological change. Carbon trading through market-based transactions offers, to industrial countries, additional time for changes required to reduce emissions and to low-income countries one possibility to finance adaptation and build adaptive capacity. The latter approach can be achieved through carbon sequestration (afforestation, avoidance of deforestation) or emission reduction (biological N-fixation to replace fossil-energy based fertilizers, improved livestock management) while simultaneously enhancing productivity. Through carbon trade, industrial countries pay low-income countries for GHG emission

reductions or for the right to release a given amount of GHG emissions. The Clean Development Mechanism (CDM) of the Kyoto-protocol offers such possibility. Currently Africa, excluding North African countries and South Africa, represent only 1% of global carbon markets. According to IPCC (2007a, p. 36), agriculture contributed 13.5% of total anthropogenic GHG-emissions in 2004. Therefore, it is necessary to implement the following improvements: 1) Develop the international carbon trading framework to respond to the needs and potential of SSA. This implies, e.g. revising and simplifying the CDM rules and standards to get agriculture and avoidance of deforestation included in the CDM mechanism; 2) Create international, national and regional participatory interlinkages in the value network for effective integration, from the global governance of carbon trading to the sectoral and micro-level design of products, markets and contracts; 3) Affiliate the multiple carbon markets and create a supportive institutional structure to enhance voluntary carbon markets. This implies e.g., to create a third party organ with competence and credibility to standardize and certify voluntary carbon offsets; 4) Develop appropriate climate change policies to unleash the potential for pro-poor mitigation in SSA. Such policies should focus on increasing the profitability of environmentally sustainable practices that generate income for small producers and create food security and investment flows for rural communities; 5) Empirical research on impacts of mitigation options on carbon balance, adaptation and resilience in terms of food security, and related competence and capacity building.

It is estimated that the world population will continue to rise, but less rapidly. That growth will average 1.1 percent per year until 2030; compared to 1.7 percent per year over the past 30 years. Still that will mean a population increase from the current 6.7 billion to more than 8.5 billion by 2050 (UN World population prospects: the 2006 revision) and to 9.35 billion people in the mid 2050s (Population Reference Bureau, 2008). Agricultural productivity growth is necessary in increasing agricultural production in order to match the growth in world population. A major share of increased agricultural production has to be accomplished through sustainable productivity growth rather than area expansion in order to meet the increasing demand. At the same time, productivity needs to be increased in more sustainable ways than in the past in order to protect the natural resource base and ecological provisioning of agricultural systems. There is clear evidence that many countries that have had high rates of productivity growth have succeeded to reduce poverty. Increased productivity does not necessarily imply equity, which can be achieved by other means.

The research on climate change effect on productivity and rural development is scarce. The high uncertainty of climate change effects and the implications on agriculture is based on extrapolations and scenarios. Our knowledge on local environmental issues and agriculture is insufficient and local agricultural research data do mostly not exist. However, according to the some Special Reports on Emissions Scenarios (SRES), climate change scenarios by IPCC (2007a) suggest that climate change will aggravate both agricultural productivity and food security in many developing countries. Therefore, in order to prevent crop failures arising from natural disasters, which renders rural poor people vulnerable, it is recommended that adaptive measures through increasing disaster preparedness must be improved. Early warning systems to detect natural disasters should be developed.

Sustained negative rates of per capital agricultural growth may be contributing to food insecurity. Hunger is caused by many factors including crop failures because of weather and natural calamities, war and violence, insufficient means to production and high costs of inputs and requisites. Some empirical results on malnutrition show a strong relationship between mother's education and malnutrition. Improving female education for all calls for geographical targeting of the poorest rural areas. In addition to this, there is need to attend to the specific needs of girls and women. Lack of enough trained human resources have led to inadequate formulation of food, agricultural and environmental policies. Effective communication, including the use of new information technology and mobile telephones, can facilitate communication in rural communities and decrease dependency

on outside information. Access to these technologies can reduce the risk of farmers relying on information provided by middlemen.

Secure land tenure and property rights are a necessary condition for successful adaptation measures. Farmers with insecure property rights are reluctant to make investments for periods longer than a cropping season. Therefore, some of the conclusions drawn in some of the countries of the study suggest that land should be privatized. Privatization of land creates optimal patterns of land of different sizes through market transactions and that in turn increases productivity. Cooperatives, autonomous associations of persons united voluntarily to meet their common needs through a jointly owned and controlled enterprise, offer a good organisational solution as to how small and middle size farmers could fully participate in marketing and agricultural food processing. Reform policies giving landless access to land are needed to ensure that farmers feel emotionally attached to the land they cultivate and are ready to make investments in it. Landholding institutions should be strengthened through good governance. It should be possible to use land as collateral for loans. For agriculture to become sustainable and income distribution among the small-scale farmers economically viable, incomes should be distributed evenly.

Food and product prices fluctuate because of demand and supply factors. On the demand side, energy prices, population growth and consumer habits are the most important factors. On the supply side, the following factors affect prices: input factors and prices, lack of water, soil quality, weather, climate, technological development, policies and institutions, product prices and trade. Eventually, changes in these factors may lead to sharp increases or drops in food and producer prices.

The agricultural sector requires investments and incentives that can guarantee sustainable development. The impact of climate change cannot be ignored while assessing those impacts. The general indication of it is that there are negative impacts that have the potential to adversely affect the sustainability of the agricultural sector. Collective effort is necessary in order to mitigate both short and long terms effects on the livelihoods of people in Finland's partner countries. Agricultural policies need to be structured so as to provide support to small-scale farmers through projects that can improve, diversify and market agricultural products

Farmers need credit possibilities in order to buy input, to make investments and to finance adaptation measures. However, financial constraints are more common in agriculture and related activities than in other sectors, because of the small size of farms, the nature of activities and transaction costs (costs of seeking information, negotiating the outcome or travelling) (World Bank, 2008). Access to rural financial services has a potential to improve these constraints and improve productivity, food security, reduce poverty reduction and enhance adaptive capacity. Micro-credit institutions and cooperatives offer possibilities to come out of the deeply rooted poverty trap and are significant for improvements of productivity. In order to improve rural financial services, credit providers should improve their information and risk management strategies and develop weather-based risk management products. Rural micro-financial institutions focusing upon smallholders should be established. Grassroots marketing cooperatives may be in a position to compete with private traders. Governments in developing countries may facilitate financial services by establishing information systems and overhauling required legislation.

Fair Trade certification offers one way to guarantee minimum prices for farmers. Based on a field study in Nicaragua, it was concluded that the Fair Trade system of minimum prices guaranteed a higher price in times on very low producer prices: However, during other times the price of certified products were not necessarily higher than other market prices. Workers on Fair Trade coffee farms did not enjoy better working conditions. The Fair Trade farms provided various environmental services and resilience in terms of climate change but the price premium did not enable farmers to earn as much as they would earn using more intensive methods of coffee production. Further compensations for the environmental services provided would be needed in order to realize adaptation measures.

Yhteenveto

Kestävän maatalouden ja maaseutukehityksen nähdään olevan avainasemassa vuosituhatvuotteen 1 saavuttamiseksi eli äärimmäisen nälän ja köyhyyden poistamiseksi. Tämä tarkoittaa kehityksen, yhteistyön, kaupan ja maatalouspolitiikan edistämistä niin, että maatalous myötävaikuttaa talouskehitykseen ja köyhyyden vähenemiseen. Tällä hetkellä arvioidaan 1 020 miljoonan ihmisen näkevän nälkää vuonna 2009. Köyhyyttä ja nälkää aiheuttavat mm. nopea väestön kasvu, korkeisiin elintarvikehintoihin johtavat energian ja panosten hinnat, veden puute, kadot ja luonnonmullistukset, alhainen tuottavuuden kasvu, infrastruktuurin puute sekä puute instituutioista, jotka mahdollistaisivat markkinoille pääsyä, luoton saantia, koulutusta ja neuvontaa. Tämän lisäksi on noussut uusi huoli *ilmastonmuutoksesta*. Ilmastonmuutoksella on ennakoitu olevan vakavia seurauksia ruokaturvalle, ympäristökestävyydelle ja oikeudenmukaisuudelle. IPCC:n mukaan ilmastonmuutos saattaa lisätä nälkää näkevien lukumäärää 100–380 miljoonalla (Easterling 2007). Arvioitu lämpötilan nousu on Meehl et al. (2007) mukaan 2 °C – 4.5 °C, todennäköisimmin noin 3 °C. Tuoreimmat tiedot viittaavat kuitenkin siihen, että ilmaston lämpeneminen asettuisi 2 °C – 6 °C:een (Monastersky 2009). Saharan eteläpuoleinen Afrikka on erityisen haavoittuvainen. Ilmastonmuutoksen vaikutusten on arvioitu olevan huomattavia jo 1 °C – 2°C lämpenemisen johdosta erityisesti kuivilla ja puolikuivilla alueilla, joille ennustetaan 30–50 %:n sadonmenetyksiä. Ilmastonmuutosta kuvaaviin ennusteisiin liittyy suuria epävarmuuksia erityisesti pienemmillä maantieteellisillä alueilla, joten vaikutukset voivat alueittain vaihdella.

Päästrategiat globaalin muutoksen, erityisesti ilmastonmuutoksen, haitallisten vaikutusten vähentämiseksi ovat 1) ruoka- ja tuotantojärjestelmien sopeutuminen todennäköiseen ilmastonmuutokseen, 2) sopeutumiskyvyn parantaminen vaikeasti ennustettaviin globaaliinmuutoksiin (ml. sosio-ekonomiset muutokset) sekä lisääntyvään vaihteluun ja ääri-ilmiöihin varautumiseksi ja 3) ilmastonmuutoksen hillintä. Järjestelmän hitaudesta (inertia) johtuen ilmastonmuutos vaikuttaa väistämättömältä; ilmasto lämpenee, vaikka päästöjä vähennettäisiinkin huomattavasti. Köyhien maaseutuasukkaiden haavoittuvuutta voidaan vähentää edistämällä sopeutumista, esim. uusin vedenhallinta- ja maanhoitokäytännöin. Sopeutumiskyky tarkoittaa valmiuksia, resursseja ja instituutioita tehokkaiden sopeutumistoimenpiteiden toteuttamiseksi erilaisia muutoksia kohdattaessa. Systeemin palautuvuuden (Eng. resilience) edistäminen on läheisessä yhteydessä sopeutumiskyvyn parantamiseen. Kasvihuonekaasupäästöjä tulevana vuosikymmeninä hillitsemällä voidaan vähentää pitkän aikavälin vaikutuksia. Hillintä merkitsee teknologista muutosta, joka vähentää tuotantopanosten käyttöä ja päästöjä tuoteyksikköä kohti. On ilmeistä, että kasvihuonekaasupäästöjen vähentämiseksi tarvitaan säätelyä. Mitä aikaisemmin ja enemmän päästöt vähenevät, sitä nopeammin pitoisuudet lähestyvät tasapainoa. On myös esitetty, että mitä aiemmin hillintätoimenpiteitä toteutetaan, sitä pienemmiksi taloudelliset ja sosiaaliset kustannukset jäävät. Mutta koska ilmastonmuutosta ei enää kokonaan voida estää, myös sopeutuminen on välttämätöntä. Päätöksenteon täytyy ottaa huomioon ilmasto, väestö ja teknologista muutosta koskeva epävarmuus. Markkinaperusteinen hiilikauppa (Eng. carbon trading) tarjoaa teollisuudelle lisäaikaa emissiovähennysten vaatimiin muutoksiin ja matalan tulotason maille yhden mahdollisuuden sopeutumisen rahoittamiseen ja sopeutumiskyvyn rakentamiseen mm. hiilen varastoinnin (metsittäminen, metsätuhojen estäminen) ja päästöjen vähentämisen (biologinen typensidonta keinolannoitteiden korvaamiseksi, kotieläinpäästöjen hallintakeinot) avulla samalla tuottavuuttakin nostaen. Hiilikaupan kautta teolliset maat voivat maksaa matalan tulotason maille kasvihuonekaasupäästöjen vähentämisestä tai ostaa niiltä kasvihuonekaasujen päästöoikeuksia. Mm. Kioton pöytäkirjan mukainen puhtaan kehityksen mekanismi (Eng. Clean Development Mechanism, CDM) tarjoaa tällaisen mahdollisuuden. Tällä hetkellä Afrikka (Pohjois-Afrikan maita ja Etelä-Afrikkaa lukuun ottamatta) edustaa ainoastaan 1 % globaaleista hiilimarkkinoista. IPCC:n (2007a, p. 36) mukaan maatalous itse edusti 13,5 % kaikista ihmisen aiheuttamista

kasvihuonepäästöistä v. 2004, ja SSA:n maatalouteen liittyvät hillintäoptiot edustavat 17% maailman maatalouden hillintäoptioista. Siksi on välttämätöntä toteuttaa seuraavat toimenpiteet: 1) kansainvälisen hiilikaupan säännöstön kehittäminen Saharan eteläpuoleisen Afrikan tarpeita ja mahdollisuuksia vastaaviksi mm. yksinkertaistamalla CDM-sääntöjä ja hyväksymällä maatalous ja metsien hävityksen estäminen tämän mekanismin piiriin, 2) kansainvälisten, kansallisten ja alueellisten arvoketjujen ja niiden toimijoiden integrointi tuotteiden, markkinoiden ja sopimusten kehittämiseksi, 3) eri markkinamekanismeihin kytkeytyminen ja myös vapaaehtoisten hiilimarkkinoiden kehittäminen mm. riippumattoman verifiointi- ja standardointielimen perustamisen avulla, 4) köyhyyttä vähentäviä hillintätoimia tukeva ilmastopolitiikka, joka parantaa köyhille lisätuloja kanavoivien hillintätoimien kannattavuutta ja 5) empiirinen tutkimus hillintämahdollisuuksien vaikutuksista hiilitaseeseen ja kykyyn sopeutua ilmastonmuutokseen ja siihen liittyvän osaamisen kehittäminen. Väestöennusteiden mukaan maailman väestö jatkaa kasvuaan mutta hitaammin kuin aikaisemmin, keskimäärin 1,1 % vuodessa vuoteen 2030 saakka, kun viimeisen 30 vuoden kasvuvauhti on ollut 1,7 % vuodessa. Tämä merkitsee sitä, että väestö kasvaa nykyisestä 6,7 miljardista yli 8,5 miljardiin v. 2050 (UN World population prospects: the 2006 revision) ja 9,4 miljardiin 2050-luvun puolissa välissä (Population Reference Bureau 2008). Maatalouden tuottavuuden kasvua tarvitaan tämän väestömäärän elintarvikekysynnän tyydyttämiseksi. Pääosa tuotannon lisäyksestä on aikaansaattava pikemminkin tuottavuuden kasvun kuin tuotantoalan laajentamisen avulla, mutta ei panoksia lisäämällä. Luonnonvarapohjan ja ekosysteemipalveluiden säilymisestä huolehtiminen on tärkeää. On selvää näyttöä, että monet tuottavuutta merkittävästi kohottaneet maat ovat onnistuneet vähentämään köyhyyttä. Tuottavuuden kasvun hyöty ei kuitenkaan välttämättä jakaudu oikeudenmukaisesti, vaan siitä on huolehdittava muilla tavoin.

Ilmastonmuutoksen vaikutuksista tuottavuuteen ja maaseutukehitykseen on niukasti tutkimusta. Ilmastonmuutokseen ja sen seurauksiin maataloudelle sisältyy suurta epävarmuutta, mikä perustuu ekstrapolointiin ja skenaarioihin. Tieto paikallisista ympäristöongelmista on riittämätöntä ja useimmiten paikallista tulosaineistoa ei ole käytettävissä. Kuitenkin IPCC:n ilmastonmuutoskenaarioiden mukaan maatalouden tuottavuus ja ruokaturva tulee vaarantumaan monessa kehitysmaassa. On tarpeen estää luonnonmullistusten aiheuttamia katoja vähentämällä maaseudun köyhien haavoittuvuutta sekä sopeutumistoimenpitein ja sopeutumiskykyä edistäen että valmistautumalla onnettomuuksiin ennalta. Aikaisia hälytysjärjestelmiä (Eng. early warning systems) on tärkeää kehittää luonnonmullistusten havaitsemiseksi.

Jatkuva maataloustuotannon väheneminen henkeä kohti saattaa myötävaikuttaa ruokaturvamuuteen. Näлкä johtuu monista tekijöistä, kuten poikkeuksellisten sääolosuhteiden aiheuttamista kadoista, sodista ja väkivallasta, riittämättömistä tuotantopanoksista ja panosten sekä tarvikkeiden korkeista kustannuksista. On osoitettu, että äidin koulutuksen ja aliravitsemuksen välillä vallitsee vahva riippuvuussuhde. Kaikkien naisten koulutuksen parantaminen merkitsee mm. sitä, että toimenpiteet pitäisi kohdistaa köyhimmille alueille. Lisäksi tyttöjen erityistarpeista on huolehdittava. Koulutuksen ja osaamisen puute heikentää elintarvike-, maatalous- ja ympäristöpolitiikan tasoa. Tehokas viestintä ja myös uuden tieto- ja viestintäteknologian (TVT) kuten matkapuhelimien käyttö voi helpottaa yhteydenpitoa maaseutuyhdyskunnissa ja vähentää riippuvuutta muualta tulevista tiedoista. Tämä teknologia vähentää viljelijöiden riippuvuutta välikäsien toimittamasta informaatiosta.

Turvallisuutta luovat maan hallintaoikeudet ja maanomistusoikeudet ovat välttämätön ehto sopeutumiseen tähtävien toimenpiteiden toteuttamiselle. Maanomistusoikeuksien epävarmuus vähentää valmiutta sijoittaa maahan pitemmällä kuin yhden kasvukauden tähtäimellä. Maan yksityistäminen mahdollistaa tilakokojakauman kehittymisen tarkoituksenmukaiseksi maakauppojen kautta nostaen tuottavuutta. Osuuskunta - itsenäinen, vapaaehtoisesti yhteen liittyneiden henkilöiden muodostama yhteisömisteinen yritys, jota sen jäsenet hallitsevat - tarjoaa hyvän organisatorisen ratkaisun pienten ja keskisuurten tilojen markkinointiin ja raaka-aineiden jalostukseen. Maareformit takaavat maattomille viljelijöille mahdollisuuden kiintyä maahan ja kannustimen siihen sijoittamiseen

tuottavuuden lisäämiseksi ja ilmastonmuutokseen sopeutumiseksi. Maanomistusinstituutioita tulisi vahvistaa hyvän hallinnoinnin keinoin. Mahdollisuus käyttää maata lainan vakuutena lieventäisi puutetta tuotantopanoksista. Tasainen tulonjako edistäisi maatalouden kestävyyttä ja pienviljelijöiden maanomistusrakenteen kehittymistä elinkelpoiseksi.

Elintarvike- ja tuottajahinnat vaihtelevat kysyntään ja tarjontaan vaikuttavien tekijöiden mukaan. Tärkeimmät kysyntätekijät ovat energian hinta, väestön kasvu ja kulutustottumukset, tarjontatekijöistä hintoihin vaikuttavat panosten hinnat, veden puute, maaperän laatu, sää, ilmasto, teknologinen kehitys, harjoitettu politiikka ja instituutiot sekä tuotteiden hinnat ja kauppa. Muutokset näissä tekijöissä voivat johtaa jyrkkiin elintarvikkeiden ja tuottajahintojen nousuihin tai laskuihin.

Maataloussektori edellyttää investointeja ja kannustimia, jotka mahdollistavat kestävä kehityksen myös muuttuvassa ilmastossa. Negatiivisilla kannustimilla on taipumus heikentää maatalouden kestävyttä. Kollektiiviset toimenpiteet ovat välttämättömiä maaseudun toimeentulolähteiden heikkenemisen hillitsemiseksi yhteistyömaissa sekä lyhyellä että pitkällä aikavälillä. Maatalouspolitiikan tulisi edistää pienviljelijöiden mahdollisuuksia kehittää ja monipuolistaa tuotantoaan ja markkinoida tuotteitaan.

Maanviljelijät tarvitsevat luottomahdollisuuksia panosten ostamiseksi, investointien tekemiseksi ja sopeutumistoimenpiteiden rahoittamiseksi. Rahoitukselliset rajoitukset ovat kuitenkin tavallisempia maataloudessa ja sen sivuelinkeinoissa kuin muilla sektoreilla johtuen pienestä yrityskoosta, toiminnan luonteesta ja transaktiokustannuksista (informaation hankinta-, neuvottelu-, matkustamiskustannukset jne.) (World Bank 2008). Maaseudun rahoituksellisten palvelujen saatavuudella on potentiaalia vähentää näitä rajoituksia ja edistää tuottavuutta ja ruokaturvaa, vähentää köyhyyttä ja parantaa sopeutumiskykyä. Mikrolainoja antavat laitokset ja osuuskunnat tarjoavat pienviljelijöille mahdollisuuksia irrottautua köyhyysloukusta ja ovat tärkeitä tuottavuuden parantamisessa. Maaseudun rahoituksellisten palvelujen edistämisessä luoton antajien tiedotus ja riskien hallitsemisen strategiat ovat avainasemassa, ja tuotteita sääriskien hallitsemiseen on tarpeen kehittää. Paikalliset osuuskunnat voivat tuoda yksityisten kauppiaiden hallitsemille markkinoille tasapainottavaa kilpailua. Kehitysmaiden hallitukset voivat helpottaa rahoituksellisia palveluja perustamalla TVT- informaatiojärjestelmiä ja tarvittavaa lainsäädäntöä.

Reilun kaupan sertifiointi tarjoaa yhden tavan taata viljelijöille minimihinnan heidän tuotteilleen. Kenttätutkimukset Nicaraguassa osoittivat, että reilun kaupan järjestelmä takaa korkeamman hinnan silloin, kun tuottajahinnat ovat hyvin alhaiset. Muina ajanjaksoina tarjottu tuottajahinta ei kuitenkaan välttämättä ollut maailmanmarkkinahintoja korkeampi, eivätkä työolosuhteet reilun kaupan kahvituloilla paremmat kuin tavallisilla tiloilla. Reilun kaupan kahviviljelmät tuottivat erilaisia ekosysteemipalveluja, jotka myös edistivät palautuvuutta (Eng. resilience) ilmaston muuttuessa, mutta hintamarginaalit eivät mahdollistaneet viljelijöille yhtä hyviä ansioita kuin voimaperäisessä kahvinviljelyssä. Korvaus tuotetuista ekosysteemipalveluista edistäisi ilmastonmuutokseen sopeutumiseksi tarvittavien toimenpiteiden rahoitusta.

Sammandrag

Ett uthålligt lantbruk och landsbygdsutveckling anses som nyckeln till att uppnå millennium målen (MDG1) som syftar till att utrota hunger och fattigdom. Detta innebär förbättrat utvecklingssamarbete, handel och lantbrukspolitik för att förstärka lantbrukets betydelse för ekonomisk utveckling och för att minska på fattigdomen. Idag finns det en projektion på 1020 millioner personer som är hungriga 2009. Fattigdom och hunger förorsakas av ett antal olika faktorer som befolkningstillväxt, höga energipriser och insatsfaktorer som överförs till höga matpriser, brist på vatten, missväxt, låg produktivitet, brister i infrastrukturen och i institutioner som ger marknadstillträde, låneomöjligheter samt utbildning och rådgivning. Utöver dessa faktorer har det tillkommit en ny oro över klimatförändring och global uppvärmning. Klimatförändringen antas ha allvarliga påverkan på mat produktionen, miljöns hållbarhet och jämställdheten, möjligen öka antalet hungrande med 100-380 millioner människor enligt IPCC (Easterling 2007). Den estimerade temperaturökningen är 2 till 4,5°C, sannolikt över 3°C. En färskare rapport (Monastersky 2009) föreslår att klimatet ändrar från 2,5 till 6,0°C. De afrikanska områdena söder om Sahara är speciellt utsatta även en moderat uppvärmning på 1 till 2°C kan medföra stora skördeförstärkluster för de torra och halv-torra områdena (30-50% till 2050). Projektionerna av klimat förändringar är mycket osäkra samt lokala variationer kan vara ännu osäkrare.

De huvudsakliga strategierna för att reducera potentiellt skadliga effekter av globala förändringar är 1) anpassning av mat och jordbrukssystemen till klimat förändring, 2) förbättring av anpassningsförmågan till förändringar i klimatvariationer och extrema situationer som är svåra att förutse och till globala förändringar generellt (inkluderande sociala och ekonomiska förändringar), 3) förmildring av klimatförändringen. På grund av systemets interna orsaker ser klimatförändringar ut att vara oundvikliga, uppvärmning kommer att inträffa även om växthusgasutsläppen minskar avsevärt. Utsattheten hos fattiga landsbygdshushåll kan reduceras genom att stärka anpassningsförmågan, t ex. genom förbättrade vatten och jord hushållning. Anpassningskapaciteten och andra sidan är hela kapabiliteten, resurser och institutioner för ett område eller ett land för att implementera effektiv anpassning till varierande förhållanden. Förstärkningen av ett systems återhämtningsförmåga är minst lika viktigt som att öka dess anpassningskapacitet. Genom en minskning av växthusgasutsläpp över nästa decennier, kan långtidseffekterna minskas. Minskningen innebär teknologiska förändringar och substitution som reducerar resursinsats och emission per producerad enhet. Det existerar ett behov av regelverk för reducering av växthusgaser. Ju tidigare och kraftigare reduceringen av emissioner görs desto snabbare når koncentrationerna stabilitet. Det påstås att desto tidigare utsläppsregler införs desto lägre blir de ekonomiska och sociala kostnaderna. Dessvärre, eftersom klimatförändringar är oundvikliga är anpassning nödvändig. Beslutsfattandet måste baseras på osäkerhet beträffande klimatet, befolkningen och teknologiska utvecklingen. Kolutsläppshandel via marknadstransaktioner ger en möjlighet att förstärka anpassningskapaciteten i låg-inkomstländer genom koldioxidkonfiskering (skogsodling, undvikande av avskogning, biologisk N-fixering för ersättandet av fossil energi, förbättrad djurhushållning). Genom koldioxidutsläppshandeln betalar den industrialiserade länder låginkomstländer för växthusgasreduktion eller för rättigheter till utsläpp. Mekanismen för ren utveckling eller Clean Development Mechanism, CDM som är ett delprojekt under Kyotoprotokollet erbjuder en möjlighet. Idag representerar Afrika (förutom de nordafrikanska länderna och Sydafrika) endast 1 % av den globala utsläppshandeln för koldioxid. Enligt IPCC (2007a, p. 36) är jordbruket ansvarig för 13,5% av de totala antropogena växthusgasemissionerna år 2004. Därför är det nödvändigt att implementera följande förbättringar: 1) Utveckla den internationella kolutsläppshandeln med tanke på behov och potential för afrikanska länder söder om Sahara. Detta innebär en omskrivning och förenkling av CDM regler och standarder för att få jordbruket och undvikande av avskogning med i CDM mekanismen; 2) Skapa internationella, nationella och regionala medverkande sammanlänkningar i värde nätverk för effektiv integrering, från global ledning av kolutsläppshandel till

sektoriella och mikronivå designade produkter, marknader och kontrakt; 3) Föreninga multipla koldioxidutsläppsmarknader och skapa en stödande infrastruktur för att öka frivillig koldioxidutsläppshandel. Detta innebär att skapa ett organ med kunskap och trovärdighet att standardisera och certifiera frivilliga kolutsläppsminskningar; 4) Utveckla lämplig politik för klimatförändring för att utnyttja potentialen för att stödja pro-fattig mildring i afrikanska länder söder om Sahara. En sådan politik borde fokusera på att öka lönsamheten på miljömässigt hållbar produktion som ger inkomst åt små företagare och skapar livsmedelssäkerhet och investeringsflöde för rurala områden; 5) Empirisk forskning om effekten av minskningsmöjligheter i kolbalanser, anpassning och återhämtningsförmåga med tanke på livsmedelssäkerhet, och relaterad kompetens och kapacitetsutbyggnad.

Det har estimerats att världens befolkning kommer att fortsätta växa, men långsammare, med en tillväxt på i medeltal 1,1 procent per år tills år 2030, jämfört med 1,7 procent under de senaste 30 åren. Detta medför en befolkningsökning från 6,7 miljarder till mer än 8,5 miljarder år 2050 (UN World population prospekt: 2006 utgåva) och till 9,35 miljarder i mitten av 2050 talet (Population Reference Bureau 2008). Jordbrukets produktivitetstillväxt behövs för att föda den växande världsbefolkningen. En stor del av ökningen i jordbruksproduktionen måste uppnås genom hållbar produktivitetstillväxt snarare än genom ökad areal användning för att uppnå den ökande efterfrågan. Samtidigt måste produktiviteten öka i mera hållbar riktning som skyddar naturresurser och ekologisk utbudande av lantbrukssystem. Det finns klara bevis på att många länder vilka haft hög produktivitetstillväxt har lyckats minska på fattigdomen. Ökad produktivitet innebär inte ökad jämlikhet, som bör uppnås på andra sätt.

Forskning om klimatförändringens effekter på produktiviteten och rurala utvecklingen är ringa. Den höga osäkerheten beträffande klimatförändringen och dess betydelse för jordbruket är baserat på extrapoleringar och scenarier. Existerande kunskap om lokala miljöfrågor och jordbruk data saknas för det mesta. Emellertid, enligt SRES klimatförändringsscenarioer av IPCC (2007a) klimatförändringen försvårar både jordbrukets produktivitet och livsmedelssäkerhet i många utvecklingsländer. Det rekommenderas att för att undvika missväxt förorsakade av naturliga Det rekommenderas att föröka undvika missväxt orsakade av naturkatastrofer genom att minska sårbarheten hos de fattiga på landsbygden delvis med hjälp av anpassningsåtgärder och förbättra förmågan till anpassning, dels genom ökad katastrofberedskap. Tidiga varningssystem för att upptäcka naturkatastrofer bör utvecklas. Ihållande negativa jordbrukstillväxt resultat per invånare kan bidra till livsmedelsbrist.

Hunger orsakas av många faktorer, bl.a. missväxt på grund av väder och katastrofer, krig och våld, otillräckliga resurser till produktion och höga kostnader för insatsvaror och förutsättningar. Empiriska resultat visar starka samband mellan moderns utbildning och undernäring. Förbättrad utbildning av kvinnor för alla innebär att man borde geografisk fokusera på de fattigaste på landsbygden. Utöver detta finns det ett behov av att sköta de specifika behoven hos flickor. Brist på tillräckligt utbildade mänskliga resurser har lett till dålig utformning av livsmedels-, jordbruks- och miljöpolitik. Effektiv kommunikation, inklusive användning av ny informationsteknik och mobiltelefoner kan underlätta kommunikationen på landsbygden och minska beroendet av extern information. Denna teknik minskar risken för jordbrukarna att lita på den information som mellanhänder ger.

Säker besittningsrätt eller äganderätt är en nödvändig förutsättning för att anpassningsåtgärderna skall lyckas. Jordbrukare med osäker äganderätt är ovilliga att göra investeringar för längre perioder än en växtsäsong. Därför bör i allmänhet land privatiseras. Privatisering av mark skapar optimala mönster av mark i olika storlekar genom marknadsoperationer och ökar produktiviteten. Andelslaget eller kooperativet, dvs. en självständig sammanslutning av personer som frivilligt tillgodoser sina gemensamma behov genom ett gemensamt ägt och kontrollerat företag, erbjuder en bra organisatorisk lösning hur små och medelstora bönder kunde delta fullt ut i marknadsföring och jordbrukets livsmedelsindustri. En reformpolitik som ger de jordlösa tillgång till mark är nödvändigt att se till att jordbrukarna känner sig emotionellt fästa vid den mark som de odlar och är beredda att investera i

det. Institutioner som säkrar ägandet av mark bör stärkas genom god förvaltning. Det bör vara möjligt att använda mark som säkerhet för lån. För att jordbruket skall bli hållbart bör inkomstfördelningen mellan småbrukare vara jämn.

Mat- och producentpriserna varierar på grund av efterfrågan och utbudsfaktorer. På efterfrågesidan är energimarknadspriser, befolkningstillväxt och konsumtionsvanor de viktigaste faktorerna. På utbudssidan påverkar följande faktorer priserna: insatsfaktorer och priser, brist på vatten, mark kvalitet, väder, klimat, teknisk utveckling, politik och institutioner, produktpriser och handel. Förändringar i dessa faktorer kan leda till kraftiga ökningar eller nedgångar i priserna på livsmedel och producentpriser.

Jordbrukssektorn kräver investeringar och incitament som kan garantera en hållbar utveckling. Effekterna av klimatförändringarna kan inte ignoreras, när man bedömer dessa effekter. Den allmänna tecken på det är att det finns negativa konsekvenser som har potential att påverka hållbarheten i jordbrukssektorn. Kollektiva insatser är nödvändiga för att mildra konsekvenser på både kort och lång sikt för försörjningen av människor i samarbetsländerna. Jordbrukspolitik måste utformas så att den stöder småskaliga jordbrukare genom projekt för att förbättra, diversifiering och saluföring av jordbruksprodukter

Jordbrukarna behöver kreditmöjligheter för att köpa in, göra investeringar och för finansiering av anpassningsåtgärder. De ekonomiska begränsningarna är vanligare inom jordbruk och närliggande verksamheter än inom andra sektorer på grund av småföretagens storlek, typ av verksamhet och transaktionskostnader (kostnader för att söka information, förhandla resultatet, resor etc.) (World Bank 2008). Tillgång till stödet för finansiella tjänster har en potential att minska dessa begränsningar och förbättra produktiviteten, livsmedelssäkerhet, fattigdomsbekämpning och anpassningskapacitet. Mikro kreditinstitut och kooperativ erbjuder möjligheter att komma ut från djupt rotade fattigdomsfällan och har betydelse för förbättringar av produktiviteten. För att förbättra jordbrukets finansiella tjänster bör kreditgivare förbättra sin information och riskanalys och utveckla väderbaserade produkter för riskhantering. Rurala mikrofinansieringsinstitut fokuserade på småbrukare bör inrättas. Marknadsföringskooperativ på gräsrotsnivå kan vara i stånd att konkurrera med privata näringsidkare. Regeringarna i utvecklingsländerna kan underlätta finansiella tjänster genom att upprätta informationssystem och nödvändig lagstiftning.

Certifiering av rättvisemärkta produkter erbjuder ett sätt att erbjuda garanterade minimipriser för jordbrukarna. Baserat på en fältstudie i Nicaragua var det möjligt att dra slutsatsen att systemet för rättvisemärkta produkter med minimipriser garanterade ett högre pris i tider med mycket låga producentpriser: I övriga fall var priset inte nödvändigtvis högre än andra marknadspriser. Arbetstagare på rättvisemärkta kaffeodlingar erhöll inte bättre arbetsvillkor. Gårdar för rättvisemärkt handel som producerade olika miljötjänster som också var anpassningsbara till klimatförändringar uppnådde inte samma inkomster de skulle tjäna med intensivare metoder för kaffeproduktion eftersom prispremierna inte var tillräckliga. Ytterligare kompensation för miljötjänster skulle behövas för att förverkliga dylika anpassningsåtgärder.

Key messages

1. Climate change is expected to worsen the situation for many food-producing regions and seriously undermine rural development prospects. That would make it harder to achieve the Millennium Development Goals and to ensure a sustainable future beyond 2015. Findings from the recent 4th assessment report of IPCC, Working Group II indicate that towards the year 2050 food crop yield losses are projected between 10 percent and 30 percent in large parts of Africa, including Western, Eastern and Southern Africa. Climate change is likely to increase disparities between the developed and the developing world, while many uncertainties remain. It is, for instance, estimated that developing countries would need to bear 75-80% of the costs of damages caused by a changing climate.
2. The prevention of such threats cannot rely alone on economic growth, but requires climate policies that combine enhanced economic development with reductions in vulnerabilities and effective financing mechanisms that support transition to low-carbon economies. The major strategies to reduce the potentially harmful effects of global changes, especially climate change are 1) adaptation of food and farming systems to climate change, 2) enhancing their resilience and adaptive capacity to changes in climate variability and extremes that are difficult to predict, and to global change more generally (including socio-economic changes), and 3) mitigation of climate change and trading the options to mitigate in low-income countries on the global carbon markets to create a substantial financial flow from the North to the South.
3. Agricultural productivity growth is needed in order to increase agricultural production for a growing world population, projected at an additional 2 billion by 2050). A major share of increased agricultural production has to be accomplished through sustainable productivity growth rather than area expansion in order to generate sufficient food for a world population that is expected to rise to more than 8.5 billion people by 2050. Productivity needs to be increased in ways that are more sustainable: that is energy-saving, protecting the natural resource base and providing ecological services of agricultural systems. Countries with high rates of agricultural productivity growth have succeeded in reducing severe poverty. While in the past such productivity gains were often energy-intensive; in the future gains need to come from more sustainable, innovative agro-technologies and agrifood systems.
4. Secure land tenure and property rights are a necessary pre-condition for successful adaptation measures. Farmers with insecure property right are reluctant to make investments for periods longer than a cropping season. Therefore, in general land should be privatized and landholding institutions strengthened.
5. Farmers need access to credit in order to purchase inputs, to make investments and to finance adaptation measures. Access to rural financial services has the potential to improve these constraints and improve productivity, food security, reduce poverty and enhance adaptive capacity. Micro credit institutions and cooperatives offer possibilities to escape the deeply rooted poverty trap and enter a development process that, among others, leads to improvements in productivity. More rural microfinancial institutions focusing on smallholders should be established.

Further detailed recommendations are found in the end of most subchapters.

1 Introduction

Sustainable Agricultural and Rural Development (SARD) is considered key to achieving the first Millennium Development Goal (MDG1) aimed at eradicating extreme hunger and poverty. One of the MDG1 targets is to reduce by half the proportion of people living on less than a dollar per day by 2015 (using 1990 as the reference year) and to reduce by the same proportion the number of people that suffer from severe hunger. In order to achieve MDG1, it would be necessary to find ways of increasing the incomes of rural poor, who mostly depend on agriculture for food and for incomes. This would require an improvement in development, cooperation, trade and agricultural policy so as to raise agriculture's contribution to economic development and poverty reduction (OECD, 2009). Until recently, global rural poverty as a whole, declined as a percentage, mostly because of China's success in reducing the number of poor people. However, still 75 per cent of the poor in the world live in rural areas and poverty remains dangerously high, particularly in Sub-Saharan Africa and South Asia (World Bank 2008, p. 45). Recently the UN Secretary-General, Ban Ki-moon, stated that the pace of attaining the MDGs, including MDG1, have been too slow for most of the targets to be met by 2015. The prevalence of hunger in the developing regions is again on the rise, from about 850 million or 16 per cent of the world population in 2006 to 17 per cent in 2008. A fall in international food prices in the second half of 2008 failed to translate into more affordable food for most people around the world (UN Report, 2009). FAO (2009) even estimates that people at risk from hunger will exceed 1 billion in 2010.

Poverty and hunger are caused by a number of factors such as high population growth, high energy prices and requisites which translate into high food prices. Other causes include lack of water and fertile soil, crop failures and calamities (such as floods and insect swarms), low productivity growth, lack of infrastructure and institutions that could provide easy access to markets, credits, education and extension. In addition to these factors there is a new concern of *global warming and climate change*, which is anticipated to have severe effects on food security, environmental sustainability and equity. Agro-ecosystems in the tropical world are estimated to suffer most because of reduced water availability and low capacity to adapt to changes in climatic and socio-economic conditions. Climate change is projected to affect food directly by changing agro-ecological conditions like hotter seasonal growing temperatures, water stress, rainfall distribution and by shifts in agro-ecological zones (IPCC, 2007; ref. Kahiluoto and Rötter task 11-12; and Battisti and Naylor, 2009). Declining crop yields, especially in Africa, is likely to increase the number of people suffering from hunger and leave hundreds of millions of people without possibilities of producing their own food or purchasing sufficient food particularly if the CO₂ fertilisation effect is weaker than previously thought (Stern, 2007, p. 56). Currently, 25 per cent of the African population or about 200 million inhabitants suffer from water stress. This number is expected to increase by 75 per cent to 250 million more (Boko et al., 2007. p. 444). Africa is considered to be the region most susceptible to climate change and to rising food insecurity. In most climate scenarios, SSA is estimated to account for between 40 per cent and 50 per cent of global hunger by 2080 (Tubiello & Fischer, 2007). The IPCC Special Report on Emissions Scenarios (SRES) estimated that without climate change the number of the undernourished can be reduced by between 100 million and 230 million people by the year 2080 as opposed to an estimate of between 100 million and 380 million people under a climate change scenario. Climate change alone is estimated to increase the number of undernourished people in sub-Saharan Africa from 40 million to 170 million. The possible effects of unfavourable socio-economic development pathways suggest that several hundred millions of people would be at risk from hunger (Easterling et al., 2007)¹

¹ The FAO reports that the number of hungry "is projected to reach a historic high in 2009-10 with 1 020 million people going hungry every day", according to FAO 2009, June 19.

It is estimated that the world population will continue to rise, but less rapidly, at an average of 1.1 percent a year until the year 2030, compared with a 1.7 percent a year over the past 30 years. That implies a population increase from the current 6.7 billion to more than 8.5 billion by the year 2050 (UN World population prospects: the 2006 revision). According to FAO (2008a), the projected population and socio-economic growth will double food demand by the year 2050. In order to be able to meet this increasing demand, cereal yields need to increase by 40 per cent net irrigation water by 40-50 per cent and additional land of 100-200 million hectares may be needed mainly in Africa and Latin America (FAO, 2008a). Although climate change may result in some opportunities for agriculture in developing countries, like payment for ecosystem services such as carbon sequestration through new carbon trading schemes, the threats will clearly increase and are likely to overrule the opportunities. The groups most likely to be hit hardest are smallholders, subsistence farmers, pastoralists and fishermen because of their low adaptive capacity.

The purpose of this report is to formulate an analysis and policy recommendations for a set of topics related to climate change, food security, sustainable agriculture and rural development. These reports are prepared for the Ministry of Foreign Affairs. The analyses consist of thirteen different tasks and deliverables as specified in the work plan, including a start-up document. The reports are listed on the inside cover of this report. In this summary report the main conclusions and recommendations are presented.

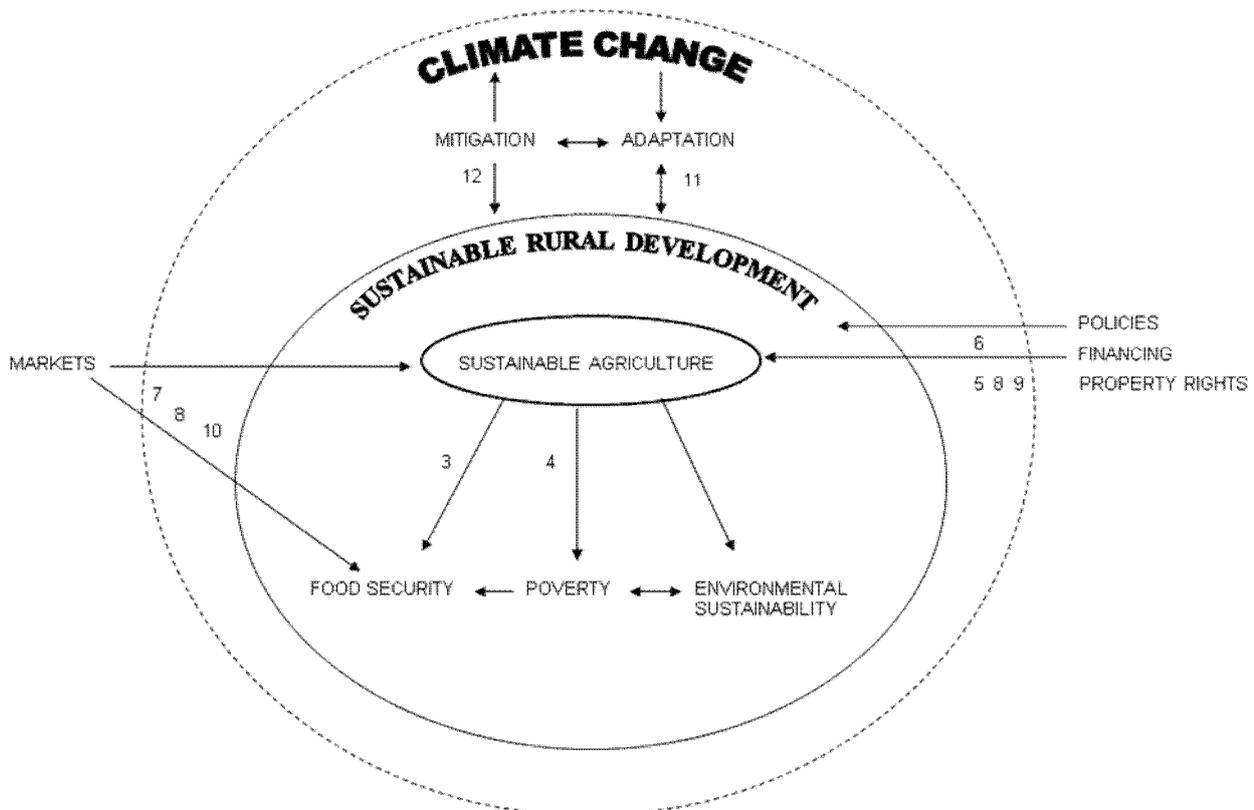
2 Theoretical framework

A theoretical framework has been prepared as a mapping strategy for the presentation of the research study. The term *Sustainable Agricultural and Rural Development (SARD)* is here defined as a process, which entails the following elements. First, it ensures that the basic nutritional requirements of present and future generations are met, while providing a number of other agricultural products. Second, such process provides durable employment and sufficient income for all those engaged in agricultural production. Third, that process maintains and, where possible, enhances the productive capacity of the natural resource base as a whole, and the regenerative capacity of renewable resources, without disrupting the functioning of basic ecological cycles and natural balances, destroying the socio-cultural attributes of rural communities, or causing contamination of the environment. Finally, that process is presumed to reduce the vulnerability of the agricultural sector to adverse natural and socio-economic factors and other risks, and strengthens self-reliance (FAO 1995). We also noted that the SARD approach has been further elaborated and operationalized, by other scholars such as Rabbinge (1995); Bouma et al. (2007), Roetter et al. (2007), and in the International Assessment of Agricultural Science and Technology for Development (IAASTD, 2009; www.agassessment.org), including for instance, equity aspects. The multi-functional character of agriculture and land use (commonly referred to MFCAL framework) also builds on SARD (FAO, 1999).

The theoretical framework of the link between climate change, rural development, sustainable agriculture, poverty, and food security that the research team adopted is presented in Figure 1 below. According to Hegerl et al. (2007), *climate change* refers to a change in the state of the climate measured by changes in the mean and in the variability of certain properties (such as temperature and precipitation) that persist over decades and that can be detected by statistical tests. Changes in climate occur as a result of natural variability and as a consequence of anthropogenic activity.

Climate change, according to the understanding of the scientific community, or as formulated by the IPCC (2007a), "*refers to a change in the state of the climate that can be identified (by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for*

an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity. This usage differs from that in the United Nations Framework Convention on Climate Change (UNFCCC), where climate change refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods". In other words, emissions of greenhouse gases (GHG) and aerosols may cause a temperature change that leads to changes in precipitation patterns, rising sea levels and extreme weather events. These changes interact and cause changes to water resources, natural ecosystems, agriculture and forestry. These changes in natural resources and sectors, on the other hand, cause further changes socio-economic system, for instance due to direct impacts in production and consumption patterns, or by triggering changes in technology, policies and trade. These impacts can be modified by adaptation measures, whereas the causes can be tackled by mitigation measures.



The cases of SARD Climate within the framework:

- 3 Impact of productivity
- 4 Interlinks of hunger, poverty and productivity
- 5 Impact of property rights on productivity
- 6 Impact of policies on rural development
- 7 Drivers of price fluctuations
- 8 Impact of market and policies on food availability
- 9 Impact of micro-finance on productivity
- 10 Impact of fair trade on food security
- 11 Enhancement of adaptive capacity
- 12 Mitigation options

Figure 1. Theoretical framework of the relation between rural development, sustainable agriculture, climate change, poverty, and food security

According to the IPCC global projections, “An expert assessment based on the combination of available constraints from observations and the strength of known feedbacks simulated in the models used to produce the climate change projections in this chapter indicates that the equilibrium global mean (surface air temperature (SAT)) warming for a doubling of atmospheric carbon dioxide (CO₂), or ‘equilibrium climate sensitivity’, is likely to lie in the range of 2°C to 4.5°C, with a most likely value of about 3°C” (Meehl et al., 2007, p. 749). More recent findings suggest that the climate sensitivity range is even wider, from 2.5 to 6.0°C (see Monastersky, 2009). Although the scenarios of IPCC include a lot of uncertainty, in terms of the magnitude, spatial and temporal patterns of changes in temperature and precipitation, the consequences in large parts of the world, particularly developing countries, may be severe.

The complex causes of hunger and poverty are connected to an increasingly important human-induced variable, climate change. Battisti and Naylor (2009) note that higher growing season temperatures may result in dramatic impacts on agricultural productivity, farm incomes and food security. Their simulations indicate that with very high confidence, by the end of the century the summer average temperatures will exceed the hottest summer records in the tropics and the subtropics. Since the tropical and the subtropical regions are the homes of approximately half of the world's population, the human consequences could be enormous.

Watson (2009) notes that climate change has the potential to irreversibly damage the natural resource base on which agriculture depends, and in general adversely affect agricultural productivity. Moderate increases may have some minor beneficial advantages in mid to high-level latitudes (Easterling et al., 2007). In lower latitudes even small increases in temperature are likely to have negative effects on yield because of water scarcity, invasive species, pests and disease vectors which adversely affect agricultural productivity. Local variation may complicate the picture, but the overall effects are adverse. Therefore, advances in agricultural knowledge and technology are required in order to develop improved crop traits, that are temperature, drought, pest and salt-tolerant. Furthermore, new knowledge is also required to more effectively reduce greenhouse gas emissions from the agricultural sector – methane from livestock and rice and nitrous oxide from the use of fertilizers.

Strategies to reduce harmful effects

The major strategies to reduce the harmful effects of global change are; 1) *adaptation* of food and farming systems to climate change, 2) enhancing the *adaptive capacity* of the agricultural sector and rural communities to changes in climate variability and extremes that are difficult to predict, and to global change more generally (including socio-economic changes), and 3) *mitigation* of climate change.

Adaptation implies initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects, both in the short and in the long run. The adaptation measures are of various types, both private and public, and autonomous and planned ones. Examples are the rise of river or coastal dikes, substitution of temperature-sensitive plants by more resistant ones, etc. (Bates et al., 2008, appendix 2). As a concrete example, Kato et al. (2009) mention soil bunds, stone bunds, grass strips, waterways, tree planting, contours and irrigation as typical soil and water conservation measures that may be used for Ethiopian farmers in order to adapt to climate change by reducing production risk. Assuming relatively stable market prices, Seo and Mendelsohn (2008) found that African livestock farmers could switch species and move away from beef cattle, dairy cattle and chicken to goats and sheep (the damages of global warming to African livestock in the next 20 years were estimated to be between USD 9 and USD 12 billion).

Enhancement of adaptive capacity reduces vulnerability. Vulnerability (of socio-ecological systems) depends on the exposure and sensitivity to changes, and on the ability of the system to

manage these changes, such as their capacity to adapt (adaptive capacity, adaptability, coping ability) (IPCC, 2001; Smit and Pilifosova, 2003; Metzger and Schröter, 2006). Adaptive capacity on the other hand refers to the whole of capabilities, resources and institutions of a country or region to implement effective adaptation measures to varied changes. Enhancing resilience increases adaptive capacity (see Yohe and Schlesinger, 2002; Smit et al., 2003). Through the mitigation of GHG emissions over the coming decades long run effects can be reduced.

Mitigation implies technological change and substitution that reduce resource inputs and emissions per unit of output. Although several social, economic and technological policies would produce emissions reduction, with respect to climate change, mitigation means implementing policies that reduce greenhouse gas emissions and enhance sinks (Bates et al., 2008, Appendix 2). The earlier mitigation measures are implemented, the lower the (social) costs will be. However, since further changes in the climate are inevitable adaptation is also imperative. Beach et al. (2008) estimated the cost of global greenhouse gas mitigation in 36 world agricultural regions for the 2000-2020 period and found that marginal abatement costs for rice cultivation to be about USD 10/CO₂ equivalent to 20 per cent of total global mitigation. After that level the costs rise very rapidly. Corresponding marginal abatement costs for mitigating greenhouse gases through livestock management were estimated to be about USD 50/CO₂ equivalent to 10-12% of total global mitigation, rising rapidly after this level

Policy effects

We do observe that the policies addressing climate change are already affecting agriculture and rural development globally through international conventions, regulations, effects on prices of oil, prices of bioenergy crops and through mechanisms to enhance the cost efficiency of regulation and mitigation, such as the Joint Implementation, Clean Development Mechanism (CDM) and Emission Trade (ET) arranged under the Kyoto Protocol. Therefore climate change, rather than being a phenomenon of a distant future, is already affecting agriculture. From that perspective, it is, therefore possible to also analyse the effects on and opportunities for agriculture and rural development in the short run.

Food security is a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2001). Food security consists of: 1) food availability 2. food stability 3) food utilisation; and 4). access to food (Schmidhuber & Tubiello, 2007). *Food insecurity* is, on the other hand, a situation that when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active, healthy life. It may be caused by the unavailability of food, insufficient purchasing power or the inappropriate distribution or inadequate use of food at the household level. Food insecurity may be chronic, seasonal or transitory (FAO, 2001).

Poverty

Poverty can be defined in many ways. Ingutia (2009) defines poverty in the following way: "*Poverty can be understood as a condition in which a person or community is deprived of, and or lacks the essentials for a minimum standard of well-being and life. These essentials may be material resources such as food, safe drinking water, clothing and shelter, or they may be social resources such as access to information, education, healthcare, social status, political power or the opportunity to develop meaningful connections with other people in the society. Poverty has many facets; child poverty is widely perceived as a particularly problematic and disturbing facet of poverty, as the innocence of youth and helplessness of children to change their situation generates a particular social*".

A commonly used measure for poverty has been income; a person earning less than 1 USD per day is considered as poor. Chen and Ravallion (2008) argue that one should use an international poverty line of USD 1.25 per day in 2005 prices for measuring poverty. They tested the robustness of this poverty line and gave results for poverty lines spanning between USD 1.00 to USD 2.50 per day. Using the measure of USD 1.25, they estimated that the number of the poor in the world in 2005 was 1.4 billion persons. Alternatively, a 2 USD per day is a common measure used to delimit the poverty line (OECD, 2009). Based on these poverty line measures, one may calculate a head count index indicating the proportion of populations regarded as poor. However, it is also possible to construct a poverty gap index to measure the depth of poverty or a squared poverty gap index measuring the severity of the index (Hussain et al., 2006).

Productivity is usually defined as the ratio of output per inputs. When production involves only one input, the calculation is easy. But when production involves many inputs, which is the normal case, all the inputs need to be aggregated into a single index which is used to obtain a ratio that measures productivity (Coelli et al., 1998). OECD (2009) has investigated the effects of agricultural productivity growth on poverty (measured in terms of income of 2 USD per day). Out of 192 countries, 12 were chosen based on a criterion of a minimum 2 per cent increase in GDP per worker and a second criterion that food production per capita had increased at least 1,5 per cent (countries passing these criteria but being island states, resource dependent states or too small to be meaningful were dropped). The remaining 12 developing countries quite well representing different part of the developing world were studied. Although the countries were success stories in terms of agricultural production they were quite diverse. However, they shared the following characteristics: In all of them the incidence of poverty fell faster than in other countries in their region. The poverty rate systematically and negatively correlated with agricultural GDP per worker but not so much with food per capita. Thus it may be concluded that there is clear evidence that an increase in agricultural productivity reduces poverty measured as a rate of persons living below the poverty line of USD 2 per day. That does, of course, not take into account possible long term effects of such growth on the environment and the quality of the natural resource base and their feed-back effects on the growth rates of GDP and food production

3 Implications of and possible responses to Climate Change

3.1 The implications of and responses to climate change for promoting sustainable agrifood systems in Sub-Saharan Africa

Climate change is expected to bring in a worsening situation of many food producing regions. For example, findings from the recent 4th assessment report of IPCC, Working Group II indicate that towards 2050 with respect to food crops yield losses from 10 to 30% as compared to current conditions can be expected in large parts of Africa, including Eastern and Southern Africa (IPCC, 2007; IAASTD, 2009). Parry et al. (2004) found for most Special Report on Emission Scenarios (SRES) a negative impact on simulated world cereal yields from slight to moderate (0-5 %). However, according to the same source climate change is very likely to increase disparities between developed and the developing world.

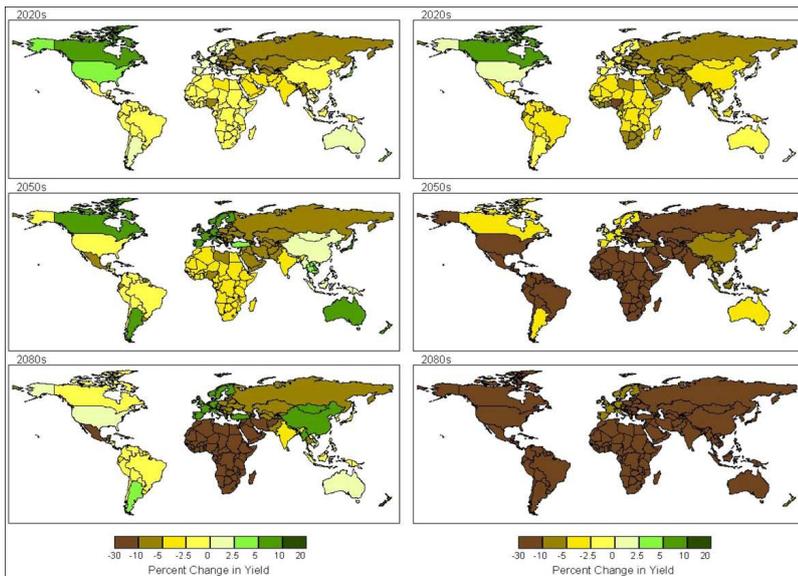


Figure 2. Potential changes (%) in national cereal yields for the 2020s, 2050s and 2080s (compared with 1990) with (left) and without (right) CO₂ effects (Parry et al. 2004).

According to Tubiello and Fischer (2007), in most climate scenarios SSA is estimated to account for 40-50 % of global hunger by 2080. Battisti and Naylor (2009) found that tropical countries will be the first to experience unprecedented heat stress because of climate change. They conclude that "ignoring climate projections at this stage will result in the worst form of triage".

The fragile ecosystems and communities of Sub-Saharan Africa are already burdened by poverty, high population growth rate, social and political unrests, weak institutions and unfavourable, highly variable climatic conditions, the combination of which incurs food insecurity, epidemics, and environmental problems. While several factors are responsible, the consensus is that high food prices are driving millions into food insecurity, and worsen conditions for many who were already food-insecure. The impacts of projected climate change during the first half of this century will add considerable burdens to those who are already poor and vulnerable and pose also a serious problem for development to regions in Sub-Saharan Africa that are now less affected.

Traditional *adaptation practices* have included changes in cropping and planting practices, reduction of consumption levels, collection of wild foods, inter-household transfers and loans, migration in search of employment, grain storage, sale of assets (livestock, tools), mortgaging of land, credit from merchants and money lenders, use of early warning system and food aid (NAPA, 2007). However, these measures may become insufficient in the face of accelerating climate change. A longer-term planned approach for adaptation is therefore needed. It has to incorporate additional information, technologies and investments, infrastructures and institutions and integrate them with the decision-making environment. Insurances, safety nets and cash transfers to reduce vulnerability to shocks are also part of the solution. In terms of technical options, the planned approach has to include many forms of land use and land use change, new cultivation practices, new seed varieties, etc. It must include an appropriate incentive structure, such as targeted payment for environmental services.

Enhancement of adaptive capacity reduces vulnerability. Through mitigation of GHG emissions over the coming decades long run effects can be reduced. More generally, it can be concluded that means for enhancing adaptive capacity of agrifood systems include *policy measures* that lead to:

- Poverty reduction
- Diversification of livelihoods
- Protection of natural resources

- Better education and (collective) learning
- Better infrastructure
- Strengthening of collective action.

Policy recommendations with respect to adaptation options and enhancement of adaptive capacity

- To African partner countries: Engage in mapping of ecological and socio-economic vulnerability (to understand its distribution and identify hot spots), resilience, adaptive capacity and carry out regional case studies to better understand causes that shape vulnerability (is in *line with several initiatives of the World Bank and proposed CGIAR Challenge Programme on Climate Change, Agriculture and Food Security*)
- Concentrate investments on most vulnerable regions and on effective means (infrastructure, R&E programmes) to adapt to climate change
- Carefully consider two-way relationship of climate change and agrifood systems: highly sensitive, but also high mitigation and adaptation potential
- Support development of scientific-technical means and policy measures that support more diversified agroecosystems, livelihoods (and in agreement with recommendations, see 3.2) low-carbon economy and utilize its opportunities (e.g. offered by carbon trading see 3.2)

Strategies and concrete measures to reduce the actual impacts by adapting to anticipated climate change or enhancing the adaptive capacity of systems to be able to better respond to uncertain future climate, are given by Kahiluoto and Rötter (2009).

3.2 Opportunities offered by carbon trading and integration of food and bioenergy systems in Sub-Saharan Africa

Currently the industrialized world is mainly responsible for Greenhouse Gas (GHG) Emissions and resulting climate change, but according to most scenarios the poor people in tropics will be hit most, especially in Sub-Saharan Africa and South Asia. Trading opportunities for ecosystem services offer one possibility for a win-win opportunity for Africa in terms of food security and preserving the natural resource base.

There is a global framework emerging and increasingly available for trade of ecosystem services. So far it is most developed for carbon trading. The global emission market is a concrete regulatory effort to mitigate climate change, hugely expanded since Kyoto protocol's entry into force and the launch of the European Union's Emission Trading Scheme in 2005 (Capoor and Ambrosi, 2006). It offers perhaps the only realistic option to still keep the global emissions below the catastrophic limits (Figures 3 and 4) (Schellnhuber, 2009), thus providing a direct benefit to the areas worst hit, such as SSA.

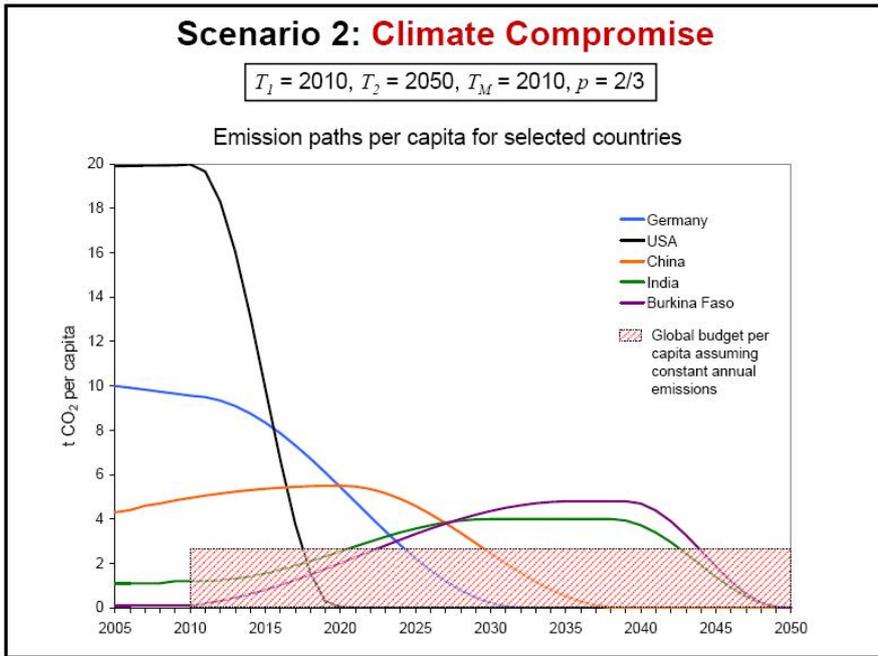


Figure 3. The requirement to reduce GHG emissions per capita in industrialised countries quickly enough to a safe level might be too challenging without emission trading. Examples of emission paths of CO₂ according to the WBGU budget approach without emission trading for countries with high (mainly industrialised countries), moderate (many newly industrialised countries) and low emissions (mainly developing countries) per capita. Source: WBGU, 2009.

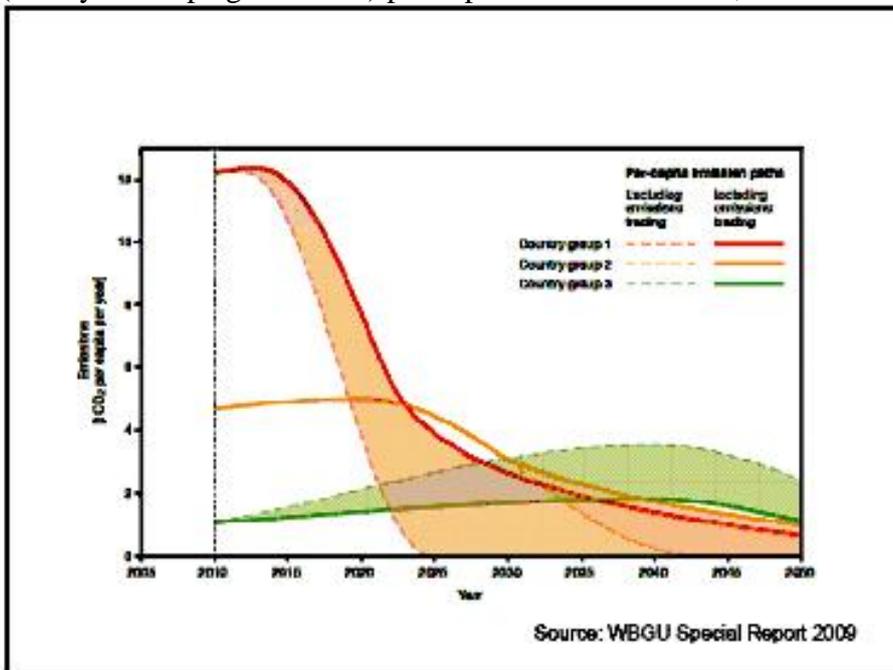


Figure 4. Emission trading between the industrialized and developing world would make the target realistic, and would imply an unequalled financial flow from the North to the South. The country groups see Figure 3. Source: WBGU, 2009.

The compliance (or regulatory) markets are based on international and regional agreements. The Kyoto protocol ratified by 163 countries underpins in some way most of these markets, even if it is directly concerned only with the biggest one. In addition to these regulated frameworks there are voluntary carbon markets. In recent years the emerging carbon market has doubled its volume and

value. Restrictions on the GHG emissions have expanded market value to USD 64 billion (euro 47 billion) in 2007. (Capoor and Ambrosi, 2008). Carbon markets, including the voluntary ones, have a great unexplored development potential (Bayon et al., 2008).

Within the dramatically extending carbon markets, developing countries and especially Sub-Saharan Africa (SSA) have still a marginal share. Africa (excluding North African countries and South Africa) represents a share below 1%. The share is roughly a tenth of SSA's global share of emissions. Consequently, SSA has potential for a greater role in global carbon market. The current mitigation potential through African agriculture is estimated at 17 % (economic potential 10%) and forestry 14 % of the global total mitigation potential of these sectors, and it is likely to increase (Bryan et al., 2008a). The potential to avoid deforestation in SSA accounts for 29% of the global total. SSA has a high projected growth rate in agriculture-related emissions, due to expected growing wealth and rising demand for livestock products in the long run.

Smith et al. (2008) estimate that by 2030 the technical potential for mitigation through world agriculture is 5,500 to 6,000 MtCO₂e. They further estimate that 89 percent of this is from carbon sequestration in agricultural soils and 9 percent and 2 percent are from mitigation of CH₄ and N₂O, respectively. Replacing fossil fuels by, e.g., crop residues, dung, and dedicated energy crops would further reduce GHG emissions. The full biophysical potential offset by agriculture is even 30% of total annual CO₂ emissions, with economic offset potentials of approximately 8 percent and 20 percent. However, the mitigation potential of land use change and forestry is multiple to that of agriculture.

For Africa, according to Smith et al. (2008), the technical potential for mitigation through agriculture is 970 MtCO₂e per year by 2030, and the economic potential (assuming prices of up to US\$20 per tCO₂e) is 265 MtCO₂e. For land use change and forestry, the total economic potential in Africa is estimated to be roughly triple to that of the estimated agricultural options, avoided forestation having drastically higher potential than afforestation or forest management. Taking into consideration the combined mitigation and food security benefits, the significance of agriculture is strongly emphasized.

Thus, the options with most potential for mitigation in SSA would be cropland and grazing land management and restoration of organic soils, together with avoided deforestation. Replacement of burning dung and crop residues for energy by anaerobic digestion and recycling is management option. Of particular relevance to smallholder agriculturalists is the potential of agro-forestry in mitigation (Rahman, 2008). The potential of individual mitigation options depends on regional and local conditions, including the features of agricultural and food systems. The fair trade framework and private labels implying carbon foot print are examples of other options for global carbon trading.

The mitigation options of agriculture, land use and forestry are closely related. E.g., increasing demand for food production triggers deforestation, and better cropland management to increase the productivity of agricultural lands will reduce the conversion of forest to agricultural land. The carbon stock in biomass is in Africa the second largest of all the continents, after South America, and its management is therefore of high importance. Low cost mitigation options based on enhancing carbon sequestration in grasslands are available. These practices generate additional important co-benefits in the form of food security, biodiversity and water conservation, and improved resilience and thus adaptation to climate change (FAO, 2005).

Present situation and obstacles

As the largest project-based market with a focus on developing countries, the CDM provides the largest market for carbon offset projects in SSA countries. Africa's share of the CDM market increased from 3 percent in 2005 and 2006 to 5 percent in 2007 (Capoor and Ambrosi, 2008).

The low utilisation degree of the mitigation and carbon trading options of SSA agriculture, land use and forestry reflects several major obstacles. These obstacles are related to difficulties at least in

1) developing and implementing the mitigation options, 2) verifying their mitigation impacts, 3) access to the carbon market, and 4) distribution of benefits which is not efficient in terms of food security and poverty reduction. These difficulties are all interlinked. Based on a survey for key regional stakeholders in an especially vulnerable case region of Central Rift Valley of Ethiopia in the autumn 2009, the primary obstacle to utilise the mitigation and carbon trading options turned out to be full unawareness of the carbon trading frameworks. They considered, however, themselves as appropriate responsible actors to coordinate the activity.

Development and implementation of mitigation options is knowledge-intensive, and especially so concerning the options with most significance in SSA. Implementation of these options suffers from lacking training and empirical data to rely on. For example, low cost mitigation options based on enhancing carbon sequestration in grasslands are available. There are, however, important methodological issues to be addressed (carbon monitoring, permanence, leakage) (FAO, 2005). For many countries in SSA, a lack of technical training and support in setting benchmarks as well as poor data availability and quality are obstacles to defining an adequate baseline.

There is also lack of awareness of available and optional trading frameworks, and the necessary institutional framework for verifying multiple mitigation options for voluntary carbon markets is not in place. The interlinkages between the potential clients in industrial countries on the other hand, and the local suppliers and supporting actors suffer from infrastructural and institutional deficiencies also. The situation is aggravated by the fact that CDM excludes the options with most potential for SSA and for many low-income countries more generally: agriculture and avoidance of deforestation. Also, the transaction costs, relatively high in CDM (Bayon et al., 2008), cause a bias against small-holders' access to carbon markets and thus hinder pro-poor mechanisms. The small-holders tend not to be competitive in terms of costs in producing carbon sequestration services in comparison with plantations (Rahman, 2008). Finally, property regimes such as ownership of forest or fields play a major role for the feasibility of option implementation and distribution of benefits from carbon trading.

Recommendations:

To develop the carbon trading in Sub-Saharan Africa it is necessary to implement the following improvements:

- 1) Develop the international carbon trading framework to respond the needs and potential of SSA. This implies, e.g., revising and simplifying the CDM rules and standards to get agriculture and avoidance of deforestation included in the CDM mechanism and to reduce the transaction costs of establishing a carbon trading project and verifying the impact lower.
- 2) Create international, national and regional participatory interlinkages in the value network for effective integration, from the global governance of carbon trading to the sectoral and micro-level design of products, markets and contracts. Here farmers' cooperatives could have a role. Local perspectives should be permanently linked in the governance, development and assessment of carbon trading.
- 3) Affiliate the multiple carbon markets and create a supportive institutional structure to enhance voluntary carbon markets. This implies, e.g., to create a third party organ with competence and credibility to standardize and certify voluntary carbon offsets. Here the following major issues should guide the offset quality: Additionality (has to add to the business as usual scenario; requires specific solutions to take into account the inequity in the baseline), permanence (GHG mitigation over the stated time period, e.g., for carbon sequestration), leakage (mitigation here may not cause emissions somewhere else), double counting (has to be avoided through transparent inventories), ex-ante vs. ex-post accounting (the former requires stringent guarantees), co-benefits (has to be clear, which have been parcelled off) (Bayon et al., 2008).

- 4) Develop appropriate climate change policies to unleash the potential for pro-poor mitigation in SSA. Such policies should focus on increasing the profitability of environmentally sustainable practices that generate income for small producers and create food security and investment flows for rural communities. Clarifying the proprietary regimes and take them into account when developing climate policies and carbon trading with synergy for food security is important.
- 5) Empirical research on impacts of mitigation options on carbon balance, adaptation and resilience in terms of food security, and related competence and capacity building.

Options for the Ministry of Foreign Affairs of Finland

The Ministry of Foreign Affairs can promote the above-mentioned actions

- through the development collaboration, e.g., funding CDM projects and projects for the voluntary markets, linked with agriculture
- contributing to establishment of the required institutional framework and building partnership for access to carbon market
- initiating and supporting construction of local and national institutional frameworks in SSA to connect to varied carbon markets
- supporting appropriate R&D and local to national capacity building
- influencing and integrating Finnish, Nordic, EU and UN climate, food and development policies, e.g., *to take care that development of pro-poor CDM will be on the agenda and proceed in the UN Climate Change Conference in Copenhagen, December 2009*

The opportunities in SSA for trading of ecosystem services have been outlined in more detail by Kahiluoto and Rötter (2009).

4 Agriculture and Rural Development

Between 1960 and 2000 the population of the world doubled, yet the average level of human nutrition improved remarkably. World agriculture was successful in producing larger quantities and in improving food security. However, this reduction of hunger was not even. Hunger was reduced in Asia and the Pacific and Latin America and the Caribbean, whereas SSA and South Asia was falling behind in hunger and poverty reduction (FAO 2008b). Population growth will make the eradication of hunger even harder in the future. It is estimated that world population will go on rising, but less rapidly, growing at an average of 1.1 percent a year up to 2030, compared with 1.7 percent a year over the past 30 years. Still that will mean a population increase from the current 6.7 billion to more than 8.5 billion by 2050 (UN World population prospects: the 2006 revision). The world population is estimated to rise to 9.35 billion people in the mid 2050s (Population Reference Bureau, 2008). Given this condition the challenge to increase agricultural production in ways that are environmentally, economically and socially sustainable is not easy.

A change of climate will make the task even more challenging. In this chapter we will analyse more closely various considerations required for a sustainable agricultural development under a climate change setting and motivate what is required to change the course.

First, the possibilities to expand arable land in the developing world are to a large degree restricted to Africa and Latin America, and even this often results in deforestation, avoidance of which is crucial for climate. Therefore, a major share of increasing production has to be accomplished through sustainable productivity growth rather than area expansion. In the past agriculture's performance has been impressive, from 1980 to 2004 the gross domestic product of agriculture increased on average by 2 percent a year while population growth was 1.6 percent a year (World Bank, 2008: p. 50). The challenge is now to accomplish an agricultural productivity growth so that the stock of natural resources and biodiversity do not decline. According to IAASTD (2009), systems are needed that enhance sustainability while maintaining productivity in ways that protect the natural resource base and ecological provisioning of agricultural systems. Different options include *“improving nutrient, energy, water and land use efficiency; improving the understanding of soil-plant-water dynamics; increasing farm diversification; supporting agroecological systems, and enhancing biodiversity conservation and use at both field and landscape scales; promoting the sustainable management of livestock, forest and fisheries; improving understanding of the agroecological functioning of mosaics of crop production areas and natural habitats; countering the effects of agriculture on climate change and mitigating the negative impacts of climate change on agriculture”*.

Second, other common reasons for lack of agricultural per capita growth are lack of infrastructure and institutions that provide access to markets, credits, education and extension. Roads and storage possibilities are missing in many places, and organisations that provide input, assistance with marketing and loans are missing. In many cases agricultural education and extension systems are weak.

Third, providing landowners with secure land rights against eviction is a precondition for long-term investments in land, including adaptation measures. Tenure need to be recognized, access to land by landless need to be given and landholding institutions, including the right to sell and buy land need to be strengthened in order provide a basis for using land as collateral for loans (World Bank, 2008).

Fourth, the changing trend in the factors affecting the agricultural sector requires dynamic investments and incentives that would warrant sustainable development. The impact of climate change cannot be ignored while assessing those impacts. The general indication of it is that there are negative impacts that have the potential to adversely affect the sustainability of the agricultural sector. Collective effort is necessary in order to mitigate both short and long terms effects on the livelihoods

of people in partner countries. Agricultural policies need to be structured so as to provide support to small-scale farmers through projects to improve, diversify and market agricultural products.

Fifth, farmers need credit possibilities in order to buy inputs, to make investments and to finance adaptation measures. However, financial constraints are more common in agriculture and related activities than in other sectors, because of the small farm sizes, the nature of activities and the transaction costs (costs of seeking information, negotiating the outcome or travelling.) (World Bank, 2008). Access to rural financial services has a potential to improve these constraints and improve productivity, food security, poverty reduction and adaptive capacity. Despite the rapid development of financial services, a majority of smallholders around the world remain without access to financial services that are essential in improving their livelihoods. Microcredit institutions and cooperatives offer possibilities to come out of the deeply rooted poverty trap and are essential in improving productivity.

Sixth, Fair Trade certification provides a means of guaranteeing minimum producer prices for agricultural producers and agricultural workers, especially when prices are low or fluctuate. The higher prices can be tied to requirements of environmentally sound production methods, which may contribute to an environmentally and socially sustainable rural development.

Every one of the factors described above have been analysed in the reports listed on page 2 and have been summarized in subsequent chapters.

4.1 Effect of an increase in agricultural productivity with regard to food security, employment and rural development²

According to a general perception among researchers and policymakers, agricultural growth benefits the poor and reduces poverty. Agricultural growth can be accomplished by increasing inputs or by increasing productivity. When inputs like land or energy are scarce, productivity growth may be a more feasible option. Sources of productivity growth that are commonly referred to are technical change and innovations, the technical and allocative efficiency of production, economics of scale and institutional innovation. According to Bäckman et al. (2009), agricultural productivity growth benefits rural resource scarce households through increased production; greater employment, reduced consumer prices and thereby ensuring improved food security and reducing vulnerability through asset accumulation. Agricultural productivity growth on the one hand lifts up the whole rural economy and on the other hand reduces poverty but it may also depress producer prices. Although the characteristics of productivity growth are basically positive they do not necessarily imply greater equity. However, access to food depends on purchasing power of the poor and given that agricultural growth leads to increased income through on-farm and off-farm activities. Like noted earlier, OECD (2009) reported clear empirical evidences between agricultural productivity growth and reduction of poverty and mentioned among others China, Vietnam, Chile and Burkina Faso as good performers in poverty reduction. Agricultural productivity is affected by climate change but agriculture is itself a major driver of GHGs. The World Bank (2008, p. 53) notes that countries with high growth rates of agricultural value added per capita of agricultural production. In this chapter we will look more closely on Kenya, Zambia, Namibia and Bangladesh

Research on climate change effect on productivity and rural development is scarce. The high uncertainty of climate change effects and its implications on agriculture is based on extrapolations and projection scenarios. Existing knowledge on local environmental issues and agriculture is simply insufficient and local agricultural data do mostly not exist.

² Detailed recommendation can be found in Bäckman et al. 2009

In general there is a positive trend in agricultural productivity in Namibia, Zambia, Kenya and Bangladesh. The increase in productivity is due to slightly different reasons in each of these countries. In Namibia, the government supported Green Scheme that started in 2003, has led to increased production in agriculture and horticulture in particular. The Green Scheme target is to triple the utilization of irrigation, and increase labour opportunities. The increased employment in agriculture is calculated to be 10 000 full time employment and 35 000 season workers. The green scheme is a governmental and donor backed scheme, and increases the utilization of national resources as well as improves farming skills. In the last two years, heavy rainfalls causing severe flooding have hit Namibia. However, even without climate change Namibia is projected to face absolute water shortage by the year 2020 (less than 1000 m³ per capita and year) (NPC, 2002: p. 37).

In Zambia there is a general increase in yields in agriculture and especially in the western parts of the country where the government has supported production through irrigation. The importance of agriculture has increased during the 1990s, particular because of the decline in the mining industry. Some improvements in the mining sector have been experienced during the last ten years. In Kenya there has been a declining trend in agricultural productivity. However, there has been an increase in the population growth rate. In both countries there is a need for more research on food security issues and on climate effects on the agriculture production as well as agricultures effect on the change in the climate. In arid and semi-arid areas agricultural activities may have an impact on the environment and also on the local microclimate. Even a small change in climate can have drastic effects on rural livelihood.

In Bangladesh there has been a successful introduction of new rice varieties and an increase in Boro rice production, which has led to an overall increase in agriculture productivity. At the same time there has been a negative trend in jute production especially due to low prices for raw jute. Early warning systems have been developed and it has been successful in decreasing human injuries in for example the 2008 Sidor cyclone. Bangladesh Rice Research Institute has also been successful in introducing flood prone rice varieties.

In all these countries there is a concern for the eventual changes in rainfalls. Higher variations in rainfall affect both agriculture and overall rural livelihood. Several steps have been taken to adapt to these changes, especially increases in storage capacity and improvement in water regulations has been taken. However, much more development and improvement is required particularly in the water and agricultural sectors.

4.2 Rural poverty, malnutrition and hunger and the interlinks with agricultural production growth and productivity growth

Given the definition of poverty in chapter 2, it can be generally inferred that hunger and malnutrition are often closely connected to poverty. The MDG1 states that the number of people living in extreme poverty and hunger should be halved by the year 2015 (UNDP). Hunger is caused by many factors including crop failures because of weather and calamities, war and violence, insufficient means to production and high costs of inputs and requisites. According to the climate change scenarios climate change will aggravate both agricultural productivity and food security in many developing countries.

The relation between rural poverty, malnutrition and hanger and the connection to agricultural productivity was investigated more closely in two case study countries: Mozambique and Bangladesh. The high rural population in Mozambique and in Bangladesh reveal a high concentration of poverty in the rural areas of the two countries. In the comprehensive study, special attention is given to the overall role of women.

Mozambique

Mozambique's independence from Portugal in 1975 was followed by almost two decades of civil war. In Mozambique the determinants of child malnutrition and poverty, as measured by the mortality rate of children less than five years old per 1,000 live births, was studied. Twelve different provinces were analysed based on data obtained from the World Bank and FAO. Regressions were carried out using Mozambican national poverty line and child mortality under five as dependent variables. The findings suggest that there are several factors explaining child poverty: Public expenditure for information on family planning and health care, female literacy and radio (information) decreases child poverty, high fertility rates increases it

Bangladesh

Malnutrition is a serious problem among women and children in Bangladesh. UNICEF (2008) estimated that 46 per cent of children aged less than five years of age are underweight. Bangladesh is the 7th most populous country in the world and one of the most densely populated countries in the world. Low intake of nutrients and nutrition, food taboos, traditional food habits, excessive processing and cooking and illnesses cause poor nutritional status for most of the people. Malnutrition is caused by poor diet, infection and interaction of the two. The key causes of nutrition relate to: inability of women to claim key rights (age of marriage, control of fertility, food education and healthcare), food insecurity, and too low care for infants insufficient resources allocated to primary health. Still Bangladesh has made impressive improvements in reducing poverty and malnutrition compared with other Asian countries.

Five recommendations³

1. Natural disasters and natural calamities.

Bangladesh and Mozambique are among the most vulnerable countries to natural disasters like floods, droughts, cyclones and these disasters cause crop failures and have adverse effects on wellbeing, especially on the poor. There is need to divert funds by donor sectors from disaster relief to disaster preparedness, by investing in the most vulnerable communities. It is recommended to prevent crop failures caused by natural disasters by decreasing the vulnerability of rural poor partly through adaptation measures and improving the adaptive capacity. This also means strengthening the long term decision-making systems of farmers. More scientific and technical research should be conducted on proactive measures to handle these natural disasters and vulnerability of the poor. Improving soil and water management systems is an example of measures that reduce soil erosion, increase resilience of the cropping systems and improve the possibilities for the rural smallholders to cope with drought. Early warning systems to detect natural disasters should be developed. A special disaster management fund could be created and disbursed instantly to mitigate the adverse consequences of disaster. Funding for emergencies and preparedness should be provided by rich nations according to their contribution to climate change and their capacity to assist. Aid should be used to build and protect the livelihoods and assets of poor people. Providing essential services like water, sanitation, health and education and long term social protection systems; form the foundations for timely emergency scale-up when required.

³ Detailed recommendations can be found in Ingutia et al. (2009):

2. *Human factor*

Empirical results show a strong relationship between mother's education and malnutrition in both Bangladesh and Mozambique. Investment in primary and secondary education as well as in adult education and special training programs for mothers and caregivers like instigating nutrition education should be initiated. Improving female education for all calls for geographical targeting of the poorest rural areas in both countries. In addition to this there is a need to attend to the specific needs of girls. Lack of sufficiently trained human resource has led to poorly designed food, agricultural and environmental policies, therefore grants and scholarships to promote higher education would be helpful.

3. *Agricultural productivity*

Further agricultural research should be carried out to target an increase in productivity and competitiveness in the production, distribution and processing of agricultural products. Policies must be put in place with the objective of reducing market imperfections, increasing incentives to participate in markets, and obtaining maximum benefits from regional and international markets. Research should focus more on technologies relevant and appropriate for women's enterprises, with consideration of the relevance, affordability and accessibility of such technologies. Both Bangladesh and Mozambique are well endowed with fish, for example in Bangladesh 60 per cent of the protein comes from the consumption of different species of fish. However, most of the rivers in both countries are being silted, as a consequence fish species are highly endangered, availability of irrigation water is reduced which negatively affects agricultural productivity and also rivers cannot carry much water and floods is the ultimate consequence in the rainy season. Dredging of rivers can be a solution, except is very expensive and requires technical expertise that requires donors' intervention and cooperation.

4. *Child focused issues*

There is great diversity among the various provinces in Mozambique; some are severely deprived of child rights while others such as Maputo city and Maputo province fare well on most child right indicators. Thus the criteria for planning, budgeting, and allocation of programmes has to be based on the conditions of the provinces in terms of child rights deprivation approach. Life-skill education is essential in internalising information on HIV/AIDS prevention and care and also in training youths in livelihood skills. This calls for supporting volunteers such as teachers in informal schools, traditional birth attendants, community organisations and households that provide home based care. Help directed to households does not reach homeless children; therefore programmes should device ways of reaching out to this set of vulnerable children. Special emphasis should be placed on food and cash transfers to child-headed households. Orphans and vulnerable children require increased access to basic services and social protection especially in provinces hit the most by HIV/AIDS. This can be done by strengthening the capacity of civil society organisations at grass-root level to reach households headed by children, women and the elderly with psychosocial, educational, health and nutritional support as well as assistance with birth registration.

5. *Communication*

Effectively using communication to reduce poverty, develop rural areas and improve food security in Mozambique and Bangladesh would first require an understanding of the needs of farmers and rural people and then the application of appropriate communication strategies, media and messages. Governments require advice on communication as part of rural development policy and help in establishing national communication systems that can support food production initiatives. Improved communication technology can facilitate communication in rural communities. Mobile telephones are an effective means to relay information. It reduces the risk of farmer's reliance on information provided by middlemen.

4.3 Effects of land tenure and property rights on agricultural productivity

Land tenure and property right structures are very important for agricultural productivity, investments in land and land management in general. Property rights affect application of technologies and adaptation measures. Farmers with insecure property rights are reluctant to make investment for longer time than the cropping season. Secure property rights will increase incentives of farmers to increase their efficiency and their incentives to carry out long-term adaptation measures. Secure property rights also facilitate transfer of land through rental or sales thereby improving the allocation of land and at the same time improving the development of financial markets (Deininger, 2003). An unequal distribution of land also seems to reduce productivity (Vollrath, 2007)

Adaptation to climate change in many cases means adopting soil and water conservation technologies that include long term land investments like stone and soil bunds, tree plantations or irrigations (Kato et al., 2009). Secure land tenure and property rights are therefore a necessary condition for successful adaptation measures. In this project land tenure and property rights, particularly in Ethiopia, in Namibia and in Bangladesh were analysed.

Ethiopia

The historical property schemes in Ethiopia during three different regimes since the beginning of the 20th century have varied much, namely; the imperial, the Derg and the current regimes. In this project the situation in the Amhara National Regional State in north-west Ethiopia was analysed in more detail. As a general problem from the viewpoint of land policy in Ethiopia, land belongs to the state. Farmers may use the land but they have no right to sell or lease the land legally. Tenure and ownership are therefore not secure and land and soil degradation are abundant since farmers do not choose soil and water conserving technologies because of this land insecurity. Increasing population pressure has decreased plot size (EEA/EEPRI, 2002). This has resulted in loss of fertility, degradation and ecological imbalances especially in the northern and central highlands.

Namibia

The agriculture in Namibia is based on a dual system, on the one hand large commercial farms that consist of less than one percent of the population and on the other hand a large number of small farms, which to a large degree are subsistence farmers, who have customary land rights. Although the constitution states that all individuals are equal, women may lack rights to land. Namibian agriculture is very vulnerable to drought, making it very vulnerable to climate change. Farmers have been encouraged to adopt adaptation measures like diversified crops, locally adapted indigenous breeds, local animal feeds, water conservation measures, improvement of soil fertility and water retention through agroforestry. Due to climatic conditions, cattle production is more important in the country than crop production.

Bangladesh

Tenaw et al. (2009) note that the pattern of land ownership affects net output. They note that farmers in Bangladesh can be classified into following four groups according to tenure system:

- (1) Farmers cultivating their own land. They do not rent in or rent out any land as well as any labour.
- (2) Farmers cultivating privately owned land as well as hired labour and also rent out part of the land.
- (3) Farmers cultivating their own land and also rented lands
- (4) Farmers cultivating lands of others only either on the basis of sharecropping or cash annual rental contracts.

According to APO (2000) one may note that 58% of the land is operated by owners (i.e., who do not rent out any land), 40% by owner-tenants, and just 2% by pure tenants (APO, 2000).

Five recommendations

1. Improving land policy

If agricultural development is ever to bring betterment for the lives of farmers and improve the national economy in poor developing countries land should be privatized. Privatization of land creates optimal patterns of land of different sizes through market transactions and increases productivity.

2. Developing Agricultural Co-operatives

Smallholders in developing countries represent a vast majority of the farmers. One of the recent rural development strategies in many developing countries has been the active promotion of marketing cooperatives as a means of commercialising smallholder agriculture. Certainly, without cooperatives smallholders would be out of the market. It has been argued that the liberalization of the agricultural marketing and the breaking up of the monopolies was a positive measure challenges and potential for cooperatives. Cooperatives need to play the role of increasing agricultural production while fully promoting marketing and agro-processing alongside other types of enterprises. There are plenty of community based informal types of cooperative societies particularly in rural areas which have the potential to play an important role in socio-economic development and poverty alleviation.

3. Improving rural tenure security

A key factor behind growing poverty is the increasingly insecure relationship between people and the land. Land is the most important resource in rural and agricultural areas in developing countries. For instance, in Bangladesh without owning or having access to land, people cannot sustain themselves. Over the past 30 years, the dispossession of small peasant producers from their land has increased dramatically. Today at least 60 per cent of rural families are landless. These people are turned into seasonal labourers, working or sharecropping on land belonging to others. So, the government should formulate and implement economically viable land reforms policies to ensure that the farmers feel emotional attachment to the land they cultivate.

4. Ensuring good governance in tenure system and property rights

Property rights reforms particularly those aiming to strengthen the marketability of land rights may not attain the goals given the imperfect nature of rural credit markets. The traditional land system in developing countries offers much security and certainty provided that the traditional landholders have legal authority over their land. The policy implication is that governments should strengthen the traditional landholding institutions by supporting and empowering them rather replacing them. This is an issue of good governance and much depends upon the political will of the governments.

5. Improving small-scale farmers' income

In developing countries, the population group that would suffer most from agricultural crisis and undernourishment is the poor segment of the rural population, which means the small-scale farmers. One of the most significant reasons for this is the unequal share of food crop and cash crop products by the small-scale farmers. In order for agriculture to become sustainable and income distribution among the small-scale farmers economically viable, incomes should be distributed evenly.

4.4 Effects of developing country policies on agricultural services, extension, rural infrastructure and energy, health care, water and sanitation

Extension services are important. Small-scale farmers need access to inputs, land and water and need information how to handle inputs and technologies in an appropriate way. Farmers need assistance in planning adaptation measures as well as soil and water conservation technologies. Farmers need assistance with marketing activities, with post harvest handling, with planning production and investments. One target related to the MDG goal 7 to ensure environmental sustainability is to, "Halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation". Improved safe drinking water and sanitation are clearly one aspect of rural infrastructure needed to improve to achieve this goal. Road and health care are other aspects of rural services that need to be improved.

In Bangladesh government, non-government and international organizations provide extension support. Bangladesh has made good progress in improving drinking water for the population and 98 percent of the population have access to improved water sources (BBS, 2007). Still a significant share of the rural and urban population drinks water that is naturally contaminated with arsenic. Access to public health service is rather difficult for the poor.

In Ethiopia the government through local level offices of agriculture and rural development almost exclusively funds extension. The Amhara Regional State is classified into two extension areas in which a team of extension specialists work. According to Hossain and Tenaw (2009) it has been a problem that extension is only provided by a single provider. The approach has been top-down driven and lacks a long-term strategic vision. Extension is oriented to crop production whereas other sectors like livestock have received little attention. Energy questions have been an issue of national interest for some time. It has been claimed that development of energy from available renewable sources such as dung, crop residues, and woody biomass is one of the components relating to food security. Health services are scarce. Access to water and sanitation is among the lowest in the world.

Five Recommendations:

1. Infrastructure and rural development

Rural farmers do not get the actual price of the commodities they produce. The middlemen take the major share of the price of an agricultural produce paid by consumers. Market access for the rural farmers should be increased through improved infrastructure and communication. Therefore, development aid for rural development, agriculture and trade infrastructure should be increased to help poor countries.

2. Agricultural Extension

Creating alternatives to avoid top-down and the supply-driven nature of the extension services that have limited the identification of development alternatives based on the biophysical and socio-economic realities at all levels. Identifying development alternatives at the local level or farmers' organizations levels will be better done by the farmers themselves with the assistance of Development Agents (DA).

3. Water in food security and poverty alleviation

In the past, the crucial role played by water in food security and employment has been given too little attention in poor developing countries. Thus, developing countries should implement the Poverty Reduction Strategy Papers (PRSP) giving due importance to water considering irrigation projects, fisheries, sanitation, industrial use, hydropower energy, ecology, and disaster management. In

particular, building water reservoirs (collect and save sufficient water during good rainy seasons to provide supplies in the dry season) and dredging rivers may improve the flooding problems common in some developing countries. More opportunities in income generation and employment might be created especially in rural areas through water storage techniques and methods.

4. Sanitation

Attention should be given to sanitation and water facilities in public spaces – religious and educational establishments, markets and workplaces, railway stations and bus depots. Most of these places already have the facilities but are left locked or are so ill-maintained as to turn away potential users. There should be clean and adequate facilities. Menstrual hygiene should be provided in the secondary schools.

5. Development cooperation

Bangladesh is one of the most affected developing countries by the climate change setting. At present, Finland is financing some NGO-projects in Bangladesh. Financing to projects in Bangladesh is also given through EU. Bangladeshi experts residing in Finland could be involved in these types of developments projects in order to ensure more fruitful implementation.

4.5 The driving forces behind price fluctuations and potential food crisis

While in theory the price fluctuations should gain the producer, the practice might be different considering investments and risk awareness. For developing countries, it might be even more important to reduce the risk of price fluctuations due to the relative importance of agricultural food products.

Long-term actions to reduce price fluctuations are to secure production possibilities by improvements in institutions. Clear definitions on property rights are required for production of long-term agricultural production to develop. It is also important to create stable institutions that would deal with income distribution as a means of enhancing social sustainability. Access to inputs should be improved particularly for those factors that might require infrastructure investments such as water for irrigation and roads for transportations. At the same time, it is important to avoid negative impacts from irrigation.

Storage capacities should be increased to reduce the impacts of price fluctuations and state trading institutions should be avoided. Measures hampering long-term development and increasing price fluctuations, such as supports of temporary character should not be used. Management skills in agriculture should be improved in order to increase productivity in the long run

4.6 Factors affecting supply of agricultural products

The changing trend in the factors affecting the agricultural sector requires dynamic investments and incentives that would warrant sustainable development. The impact of climate change cannot be ignored in assessing those impacts. While some of the climate change scenarios put forward by climate change 'worst-case-scenario' proponents do not provide hard evidence, the general indication of it is that there are negative impacts that have the potential to adversely affect the sustainability of the agricultural sector. Collective effort is necessary in order to mitigate both short and long term effects on livelihoods of people in Finland's development partner countries.

Agricultural policies need to be structured so as to provide support to small-scale farmers through projects to improve, diversify and market agricultural products. For the case of Kenya the existing Kenya Joint Assistance Strategy (KJAS) should be maintained, improved and expanded to cover more

rural producers. Improving the delivery of services to the poor can be done through other public, private sector and civil society channels. Delivery improvements are important in enabling producers to improve agricultural productivity and increase production for the market as well as for consumption.

With regard to Zambia, agriculture, which is evidently dependent on rainfall and climatic conditions for its survival, would need improvement in order to strengthen irrigation capacity. The country is richly endowed in ground water, a major source that can facilitate expansion of more irrigated land, particularly during periods of sporadic rains. The Congo/Zaire and Zambezi river basins have abundant ground water resources that can service around 523,000 ha of land of which current capacity is only 9 per cent and mostly by large-scale farmers.

Agriculture and forestry significantly contribute to climate change in ways that are sometimes difficult to quantify. However, governments and the relevant sectors should support agriculture by promoting safer production techniques and educating farmers about the inputs that are not harmful to the environment. However, further emphasis and support on capacity building through increased training and monitoring farm progress would be used as a means of supporting safe agricultural practices.

4.7 Rural financial services and effects of micro-finance on agricultural productivity and on poverty

Rural financial services are important in reducing poverty. Through financial intermediaries funds can be mobilized for poor to buy means of production and inputs (such as seeds and fertilizer), to realize strategies for adaptation measures to climate change and to reduce vulnerability and risks. However, financial constraints are more common in agriculture and related activities than in other sectors, because of the small size of farms, the nature of activities and transaction costs (costs of seeking information, negotiating the outcome or travelling) Despite the rapid development of financial services, smallholders around the world lack credit possibilities. Promoting, improving and even creating rural institutions that supply credit possibilities remain a challenge for the developing world (World Bank, 2008).

The financial intermediaries involve, on the one hand, formal ones (like banks and some cooperative banks) and, on the other hand, more informal ones like loans from local intermediaries or relatives. Formal institutions have, according to the World Bank (2003, p. 6), largely avoided rural areas. It has been hard for the rural poor to obtain loans, even very small loans, partly because of lack of collateral. Credit institutions or insurance companies are typically reluctant to serve rural areas. Most loans provided by informal sources, especially moneylenders are too expensive to be profitable and they attract high interest (Islam and Tenaw, 2009).

According to the Inter-American Development Bank (2001), the development of the financial sector can be viewed as an important catalyst for three reasons: First, financial sector development ensures the acceleration of economic growth through efficient intermediation and risk management. Countries with developed financial markets, or with greater financial depth, enjoy higher economic growth than those with less developed financial markets. Second, lack of adequate financial services hinder the formation of new enterprises and the modernization of existing ones. Third, improved financial intermediation could directly reduce vulnerability and alleviate poverty. Micro-finance as a tool of rural financial services has a clear impact on poverty by positively affecting the household economic development, ensuring Income Generating Activities (IGA), sources of income, reducing vulnerability, housing tenure and enterprise growth.

In order to enable rural poor to obtain small loans, various micro-credit institutions, have been established, (a prominent example is the Grameen Seed Bank in Bangladesh). If possibilities to credits

are scarce the rural smallholders are usually dependent on local sources that demand high interest levels. Another possible way to overcome these problems is through utilization of farmer-controlled cooperatives, sometimes alternatively called producer organizations (Sumelius et al., 2008).

Five recommendations

1. Risk in agriculture and rural financial services

To deal with the complexity and risk in agriculture, rural financial service providers have to innovate on their product design; improve their information and risk management strategies, develop price risk management instruments like weather-based risk management products, backing credit with technical services.

2. Improving micro-finance facilities

Appropriate government policy to ensure marketable land rights (for collateral in obtaining credit) and linking commercial banks with NGOs in providing maximum loans to the farmers. Special care should be taken for the small and marginal farmers who constitute the economic backbone of the country. Since micro-finance enables farm households to smooth their cash flows to access to productivity enhancing techniques, commercial banks may work with micro-finance institutions in reducing poverty and hunger, thereby facilitating the achievement of MDGs.

3. Price stabilization

To enhance agricultural output performance and alleviate poverty farmers need to increase their farm size; thus, an increase in micro-credit is advocated to enable farmers to pay for additional mechanization required by the use of additional land. To reduce risks and unstable production and income, there should be a policy of price stabilization that would help increase income and assets on a sustained basis.

4. Cooperatives as a tool for market promotion

Grassroot marketing cooperatives which have an active member involvement and present economies of scale in their operations, may be in a position to compete with private traders, provided they have mobilized sufficient own capital and savings and are well managed. Assistance to cooperatives should aim principally at strengthening the business character of these organizations by providing adequate training, marketing, financial management, accounting and auditing. Provision of bank funding to cooperatives should only be increased track records.

5. Role of government

Governments in developing countries have an essential role to play in agricultural marketing and financial policy formulation, coordination of marketing and financial operations of the different actors, establishing information systems (production information and market intelligence), required legislation (business laws, bank regulation and supervision, loan collateral requirements, safeguarding of savings, warehouse acts), and training (in storage and grading techniques or in cooperative business operations).

The community rooted informal types of cooperative societies have an immense role to play in promoting rural financial services at the local level. Therefore, governments in developing countries should take the responsibility of shifting the operation of informal cooperatives to formal cooperatives so that they will stand the chance of equal status and financial support.

4.8 Fair Trade coffee certification

Through Fair Trade certification schemes minimum prices for agricultural products are established. The main idea is that agricultural producers can be granted an economic return that is not minimal but can be considered fair from a social point of view. Also requirements for environmentally sound production methods can be connected to fair trade. In the end the consumers pay a higher consumer price for these products well aware of the social or environmental justification for a higher price. In this case study the Fair Trade minimum price for Arabica coffee obtained by Nicaraguan coffee producers and paid by cooperatives was studied. The possibilities of Fair Trade to protect the environment in the case of coffee production in Nicaragua were also analysed, based on fieldwork in 2005-2008. The question whether Fair Trade builds the adaptive capacity of farmers to climate change was also addressed (Valkila and Nygren, 2009; Valkila, 2009a; Valkila 2009 b).

Five key messages from that study:

1. Fair Trade system of *minimum prices guarantees a higher price for producer organizations in times of extremely low market prices*. This was the case with coffee in years 2000–2004. Fair Trade can be argued to support or favour cooperatives of small-scale coffee farmers.
2. For a number of reasons discussed in Valkila (2009a), when Fair Trade certified producer organizations pay their members for coffee, *the price is not always higher than what other markets in Nicaragua would offer*.
3. Hired workers on Fair Trade certified coffee farms and cooperative owned coffee processing facilities *did not enjoy better working conditions* compared with working conditions in rural Nicaragua in general. Poor working conditions in coffee production in general need to be addressed. As a major coffee consumer, Finland has a responsibility in raising that issue at a county-to-country level.
4. Practically all the coffee produced by small-scale farmers is shade-grown in Nicaragua. The yields are typically low, but the farms produce not only coffee, but also many other agricultural products and they provide a number of environmental services. *This type of diverse agricultural production can be resilient to changes such as those caused by climate change*.
5. Fair Trade and organic certifications can add income to low-intensity small-scale farmers slightly, but the price premiums do not enable farmers to earn as much as they would earn using more intensive methods of coffee production. *Further compensations for the environmental services provided would be needed*.

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Annexes I. Implementation of work

The implementation of work is described in Table 1 below. The name of the task is given in the first column; and the output in the fifth column

The plans for the rest of the project is given in Table 2

Table1/AnnexI: Progress of work

Phase 1. Analysis	State of work October 15	Work to be done by	Work input	Output
<i>Task 1.</i> General theoretical framework stating the interrelations between ecologically, economically and socially sustainable agriculture, climate change and poverty reduction. Definition of sustainable agriculture, rural development, food security, food crisis and climate change will follow generally accepted international definitions.	Ready.	Prof. John Sumelius, Dr Stefan Bäckman, Dr Reimund Rötter, Dr. Helena Kahiluoto	1 month	D1. Description of the analytical framework
<i>Task 2.</i> Kick-off meeting directing implementation of work plan	Ready	Prof. John Sumelius, Dr Stefan Bäckman	1 day	D2 Start-up document to be submitted April 28 to Min of Foreign affairs
<i>I .Agriculture and Rural Development issues</i>				
<i>Task 3.</i> Investigations of the effects of increases in agricultural productivity with regard to food security, employment and rural development in general	Ready	Dr. Stefan Bäckman, M.Sc. Newton Nyairo, M.BA. K.M. Zahidul Islam, M.Sc. Tuulikki Parviainen	2 months	D3 Report
<i>Task 4.</i> Analysis of relation between rural poverty, malnutrition and hunger and the interlinks with agricultural production growth and productivity growth	Ready	M.BA. K.M. Zahidul Islam, Lic. Rose Anyiko Ingutia, M.BA. Motaher Hossain	2 month	D4 Report
<i>Task 5.</i> Effects of land tenure and property rights on agricultural productivity	Ready	M.Sc. Shimelles Tenaw, M.BA. K.M. Zahidul Islam, M.Sc. Tuulikki Parviainen	2 months	D5 Report
<i>Task 6.</i> Effects of developing country	Ready	M.BA. Motaher Hossain.	1 month	D6

policies on agricultural services, extension, rural infrastructure and energy, health care, water and sanitation		M.Sc. Shimelles Tenaw		Report
<i>II. Food security issues</i>				
<i>Task 7.</i> Identifying the driving forces behind price fluctuations and potential food crisis	Ready	Dr Stefan Bäckman, Prof. John Sumelius	Two weeks	D7 Report
<i>Task 8.</i> Analysis factors affecting supply of agricultural products: market liberalization, agricultural policies, bioenergy policies, population growth, input price development, trade policies and other relevant factors	Ready	M.Sc. Newton Nyairo, Dr Stefan Bäckman	2 months	D8 Report
<i>Task 9.</i> Rural financial services and effects of microfinance on agricultural productivity and on poverty	Ready	M.Sc. Shimelles Tenaw, M.BA. K.M. Zahidul Islam	2 month	D9 Report
<i>Task 10.</i> How Fair Trade affects different actors in the food chain	Ready	M.Sc. Joni Valkila	1 month	D10 Report
<i>III Climate change issues</i>				
<i>Task 11.</i> The framework and implications set by climate change for all the other tasks; Main elements to enhance adaptive capacity of agrifood systems in two case countries in Sub-Saharan Africa	Ready	Dr Reimund Rötter, Dr Helena Kahiluoto	4 months	D11
<i>Task 12.</i> Opportunities offered by carbon trade and integration of food and bioenergy systems in two case countries in Sub-Saharan Africa	Ready	Dr Helena Kahiluoto, Dr. Reimund Rötter, in collaboration of economists of the group		D11 Report
<i>Task 13.</i> Mid term seminar integrating the analysis and results	Completed August 12	Prof. J Sumelius, Dr S Bäckman, Dr H Kahiluoto, and Dr R Rötter	1 day	Draft interim report
An Interim Report has been submitted to the Ministry containing preliminary findings, as well as information on progress, use of funds and plans for the rest of the research project period. An interim progress meeting has been held with the steering group September 16 in conjunction with the submission of this report.		Mid term report completed	D12 Interim Report	
A draft final has been submitted October 16			D13 Final strategy report	

ANNEX II. Use of funds and future use of funds

Future use of funds.

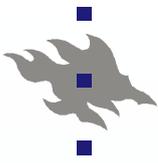
Of total funding, 99,960;00 euro, by 2 November we have used 94 135 euro and 5 825 are left. The remaining money will be used as salaries for the researchers at Department of Economics and Management according to the original research plan. The multipliers recommended by the Ministry of Foreign Affairs have been used (this includes a 7% total overhead which goes to the Rector of University of Helsinki).

The use of funds will be sent in beginning of December as a separate pdf file

Annex III Short term impacts

The short term impacts of the project are:

- a) It is difficult to judge what kind of effects the recommendations provided to the Foreign Ministry will have, but it gives some guidelines in which way to proceed for building a sustainable development cooperation in agriculture and rural issues, which hopefully affects development work in the short and the long run.
- b) A documentation of sustainable rural development, agricultural and food security issues within a climate change setting that can be used for teaching, research as well as practical implementation in development cooperation work, hopefully also to be used by the country desk offices of respective countries. This documentation has been made in the form of eleven deliverables and a final report.
- c) Recommendations for Finnish authorities of issues to take into account in climate change negotiations, and in practical implementation of development cooperation work.
- d) A summarized view of climate change and rural development and agricultural issues for those who read this and the other reports
- e) A vitalization of agricultural socio-economic research related to climate change, capacity building and a higher awareness of climate change issues among researchers at University of Helsinki and MTT.



Discussion Papers:

No.

13. Chen Quizhen & John Sumelius (2006). Comparative Study on Chinese and Finnish Experts' Opinion of Multifunctional Agriculture. *Agricultural Economics*.
14. Hervé Guyomard, Jussi Lankoski & Markku Ollikainen (2006). Impacts of Agri-environmental Policies on Land Allocation and Land Prices. *Environmental Economics*.
15. Kyösti Arovuori & Jukka Kola (2006). Farmers' choice on multifunctionality targeted policy measures. *Agricultural Economics*.
16. Seppo Vehkamäki & Stefan Bäckman (2006). Evaluation of economic activities and poverty in the region close to the National Park of Río Abiseo in Peru.
17. Jussi Lankoski & Markku Ollikainen (2006). Bioenergy crop production and climate policies: A von Thunen model and case of reed canary grass in Finland. *Environmental Economics*.
18. Heini Ahtiainen (2007). The willingness to pay for reducing the harm from future oil spills in the Gulf of Finland – an application of the contingent valuation method. *Environmental Economics*
19. Andrea Cattaneo, Jussi Lankoski & Markku Ollikainen (2007). Green auctions with joint environmental benefits. *Environmental Economics*.
20. Chen Qiuzhen, Kyösti Arovuori & John Sumelius (2007). Evolution and Implementation of Multifunctionality-Related Policies in China and Finland. *Agricultural Economics*.
21. Antti Iho & Jaakko Heikkilä (2008). Has selling tickets in advance increased attendance in the Finnish football league? *Environmental Economics*.
22. Soile Kulmala, Polina Levontin, Marko Lindroos, Catherine Michielsens, Tapani Pakarinen & Sakari Kuikka (2008). International Management of the Atlantic Salmon Fishery in the Baltic Sea. *Environmental Economics*.
23. Stefan Hellstrand, John Sumelius & Stefan Bäckman (2008). Ekonomiska och miljöeffekter för olika åtgärder att begränsa Östersjöns övergödning - kan den gröna marknadskraften bidra? *Agricultural Economics*.
24. Anna-Kaisa Kosenius (2008). Heterogeneous Preferences for Water Quality Attributes: the case of Eutrophication of the Gulf of Finland, Baltic Sea. *Environmental Economics*.
25. Antti Iho (2008). Spatially Optimal Steady State Phosphorus Policies in Crop Production. *Environmental Economics*.
26. Leena Lankoski (2008). Multiobjective firms and the management of trade-offs. *Food Economics*.
27. Mika Rahikainen, Marko Lindroos & V. Kaitala (2008). Stability of international fisheries agreements using precautionary bioeconomic harvesting strategies. *Environmental Economics*.
28. Jaakko Rinne, J. Lankoski, Markku Ollikainen & H. Mikkola (2009). Ethanol production under endogenous crop prices: Theoretical analysis and application to barley. *Environmental Economics*.
29. Anna-Kaisa Kosenius (2009). Causes of Response uncertainty and its Implications for WTP Estimation in Choice Experiment. *Environmental Economic*