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Climate Change and Gender

What role for agricultural research among smallholder farmers in Africa?

by

Valerie Nelson
Natural Resources Institute
University of Greenwich, UK

June 2010

CIAT
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ECABREN includes member countries of: Burundi, Democratic Republic of Congo (DRC-the eastern and western parts), Ethiopia, Kenya, Madagascar, Rwanda, Sudan, Tanzania (the northern part) and Uganda.

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WECABREN includes member countries of Central African Republic, Cameroon, Togo, Congo Brazzaville, Burkina Faso, Guinea-Conakry, Senegal, Sierra Leone, Mali and Ghana.

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Executive Summary

Rapid changes to the climate are predicted over the next few years, and these present challenges for women's empowerment, gender equality and smallholder agriculture on a completely new scale. In many sub-Saharan African countries, poverty and food insecurity are linked to low agricultural productivity which accelerating climate change (CC) threatens to worsen. Despite the uncertainties of climate change impacts it is clear that there are many smallholder and subsistence farming households in developing countries who will be affected. This paper explores how these impacts on smallholder and subsistence farmers will not be felt equally, but will be overlaid upon existing patterns of gender and social inequality, potentially making them worse.

Women face specific vulnerabilities, because they are disproportionately represented in poorer sections of society. Because of traditional gender roles, they tend to be reliant on more climate sensitive activities and are also likely to have fewer resources with which to adapt. Development and climate change responses can only be *equitable* if they place women's empowerment and the tackling of gender inequality centre-stage – it is not an optional extra to consider the gender and social difference dimensions.

Climate change will affect smallholder agriculture in different ways. The scientific projections are for increased extreme events, greater climate variability and changing means (e.g. in average temperatures and precipitation). These changes will have direct effects upon agriculture and natural resources at organism, farm and broader landscape levels, as well as direct impacts on human health, infrastructure and non-agricultural livelihoods. Moreover, there will be indirect, secondary impacts of autonomous adaptations elsewhere and flowing from all the new climate-related policies, programs, funding and projects that are being put into place (covering both adaptation and mitigation). There are also a range of non-climate stressors affecting smallholders and the interactions between climatic and non-climatic (including other environmental) stressors will also be important as effects may be compounded and amplified.

As well as being affected by these diverse stressors, smallholder and subsistence farming systems are also inherently complex and location-specific, making prediction and modeling of impacts difficult. Moreover, the impacts will be mediated by existing inequitable, gendered power relations and cultural norms. Gender inequalities translate into weaker natural resource entitlements for women compared to men, a gender division of labor and roles, gender-differentiated knowledge systems and skills, gender differentiated perceptions of risk and climate and gendered power relations which are embedded in formal and informal institutions. Gender also intersects with other forms of social difference, such as age, class, poverty, ethnicity, caste, etc to produce differentiated impacts. Thus gender relations and inequalities mean that women tend to be more vulnerable to climate change than men, both in the playing out of its direct impacts (e.g. on women's health) and in the indirect impacts (e.g. of gender blind adaptation planning, limited participation of women in international negotiations etc).

More evidence of the gender- and socially-differentiated impacts of climate change on smallholders is needed. There is information that can be gleaned from existing coping and adaptive strategies, from the existing gender and agriculture literature and from on-going gender and disaster work. Some studies are beginning to be conducted which specifically focus on this topic, and others which are more generic in outlook but which throw up insights into gender, climate change and smallholder agriculture. But, more action research is needed for double mainstreaming – integration of both climate and gender imperatives in agricultural research and innovation. Diverse farming environments and socio-cultural contexts suggest a need for localized adaptation processes engaging women as well as male farmers, but also policy-makers and innovation system actors, with greater gender awareness, to enhance and sustain productivity – in an equitable manner. For this to be achieved we will require scaling up of existing priorities, knowledge and action on gender, women's empowerment and agricultural development, but also *new* knowledge, partnerships, approaches to learning and attitudes.

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1. Introduction

This study has been commissioned to inform future research strategic thinking with awareness of the gender dimensions of smallholder agriculture and climate change. Scientific projections and scenarios, previous experience and recent local observations indicate that smallholder and subsistence farmers across sub-Saharan Africa especially those in semi-arid regions will be particularly affected by climate change, yet the impacts of climate change will not be felt equally - they will reflect existing gender and social inequalities. The differentiated nature of these impacts remains fairly invisible in climate change activities. It is critical to understand how the impacts of climate change will be differentiated and how to avoid responses to climate change which lead to an exacerbation of existing inequalities. Instead, climate mitigation and adaptation activities should seek positive, equitable and empowering outcomes for disadvantaged and less powerful groups.

This paper sets out a conceptual framework for understanding the complex impacts of climate change on smallholder and subsistence farming (section 2). The direct, indirect and aggregate impacts of climate change and non-climate stressors are distinguished. The ways in which these impacts are gendered is then fleshed out in section 3, in relation to longer-term impacts and also climate hazards. The report unpacks the concepts underlying the terms `vulnerability' and `resilience' and presents a conceptual framework for understanding the gender dimensions of climate change and smallholder agriculture in sub-Saharan Africa. The intersections between gender and other forms of social difference are noted, such as class, ethnicity and age, and the specific vulnerabilities of children and older people in relation to climate change in particular are discussed. Some of the issues relating to gender and mitigation, as well as differences between coping and adaptation strategies are also explored in section 3 as well as the limits to adaptation, migration issues and women's participation in climate policy spaces. Section 4 assesses the available evidence of gendered climate change impacts in farming systems. Section 5 identifies some of the issues and priorities in agricultural research in the light of both climate change and gender imperatives.

2. Understanding smallholder agriculture and climate change

To understand how climate, gender and agriculture are interlinked it is first necessary to unpack how climate change is thought likely to have an impact upon smallholder and subsistence agriculture. Climate change is expected to have significant impacts upon developing country populations, particularly amongst subsistence or smallholder farmers, who have limited adaptive capacity because of socio-economic, demographic and policy factors.

2.1 Climate change modeling, trends and knowledge

Climate change science projects unparalleled changes in the climate, but to predict the likely impacts in a particular place requires a next phase of modeling (and uncertainty) using physical and socio-economic models to translate a 'climate future' (e.g. changes in temperature, rainfall and growing season) into human impacts (e.g. health impacts, floods, food supply) (Ensor and Berger, 2009). For modeling how crops will respond to climate change, the known responses of specific crops to temperature, CO_2 and moisture are used as well as models of land-use changes. However, there is significant uncertainty in these models, a lack of downscaled data below national level, with some models producing contradictory findings. On top of this, smallholder livelihood systems are by their nature complex, diverse, locally specific, risky, exposed to a range of stressors, and dependent on on-going adaptive strategies making site specific predictions very difficult (Morton, 2010). A lack of standardized definitions of smallholder farming systems complicates modeling and quantification, as does the vulnerability to a range of stressors of smallholders (Morton, 2007). As a result, climate change adaptation usually begins with climate variability and emerging climate trends and information dissemination commonly covers weather and seasonal forecasts as well as climate change models.

A number of key trends are expected as a result of climate change, although these are not mutually exclusive. A recent NRI (National Resource Institute) study identifies them as follows (these are not mutually exclusive): general increase in temperature; increased average rainfall; decreased average rainfall; increased frequency/severity of drought; increased frequency/severity of heavy rainfall events; more frequent occurrence of high winds (Nelson et al, *forthcoming*).

The clarity of knowledge (of different actors) about a specific climate-related hazard may vary due to uncertainties that remain in the projections and models, and because of differential access to information, entitlements (Ensor and Berger, 2009) and diverse cultural interpretations of what the climate is and how and why it changes. Climate knowledge depends upon the availability of projections, but also upon access to this knowledge in an accessible format. To improve clarity may require external support to firstly improve climate modeling and smallholder capacity building to access this information. In situations of high levels of clarity of climate knowledge, combined with high vulnerability then this analysis will inform specific responses and demand action.

2.2 Types of impacts on smallholder agriculture

Climate change impacts will be both direct and indirect. The direct impacts will comprise: biological processes at organism or farm level; environmental and physical processes at production and landscape level; impacts of climate change on human health and non-agricultural livelihoods. Indirect impacts will comprise: distant, off-site impacts; climate change policy and program secondary impacts (Morton, 2007). Table 1 below provides more detail of the different types of impacts already occurring and to be expected in the light of climate change.

The characteristics of smallholder livelihood systems (i.e. that they are complex, diverse, locally specific, contain inherent riskiness, involve exposure to other stressors, and feature dependence on continuous coping and adaptation) mean that predicting impacts on agriculture in any particular place is complex - as these systems are already characterized by constant adaptation to climate variability. This is perhaps a matter of time-scale, however, as over longer timescales the changes in average means caused by climate change will become clearer. This complexity means that differentiation of the gender aspects is also correspondingly difficult.

2.3 Vulnerability to climate change

Vulnerability is a long-standing concept emerging from work on disasters, with a focus on vulnerability to a specific risk evolving with work on political economy which demonstrated the social determinants of vulnerability (Eakins and Luers, 2006). Initially, vulnerability was thought of in terms of exposure to a disaster risk—a function of geography and nothing more. Later work on political economy demonstrated the social determinants of vulnerability, showing that not everyone is affected by a hazard in the same way. In recent years, drawing on ecological expertise and systems thinking, a growing group of academics are emphasizing the complex dynamics of adaptive systems to explore how and why (inter-linked) societies and ecologies change often in surprising and unpredictable ways. This body of work is often referred to as 'resilience thinking' and it provides a number of insights for climate change adaptation work as it encourages a broader view over longer time periods, with greater analysis of how disturbances (a variety of shocks and stresses) affect populations and ecosystems, ultimately asking 'can they cope with and recover from shocks and stresses' and what can be done to help them do so (Eakins and Luers, 2006). Certain principles have been identified (Walker and Salt, 2006) for resilience, which are relevant in reviewing adaptation options: for example, building social capital, spreading risk, maximizing ecological variability, increasing modularity etc.

Table 1: Climate change direct and indirect impacts on smallholder and subsistence agriculture (Adapted from Morton, 2007; Morton, 2010)

Direct climate change impacts upon smallholder livelihoods:	Biological processes affecting crops and animals at the levels of individual organisms or fields	Direct impacts of changes in temperature, carbon dioxide, and precipitation on yields of specific food and cash crops and productivity and health of livestock.
	Environmental and physical processes affecting production at a landscape, watershed or community level	Smallholder agriculture will be affected by direct impacts at the level of communities, landscapes, and watersheds (some overlaps with studies on extreme events). E.g. decreased flow of River Nile affecting irrigation systems for many smallholders, also experiencing increasing water scarcity; impacts on soil processes from complex global warming impacts and associated hydrological changes (accelerated decomposition of organic matter, depression of nitrogen-fixing activity). Soil fertility and water holding properties may be affected Combined with increased erosivity of rainfall and other factors this may increase overall soil erosion.
	Impacts of climate change on human health	The above impacts on agriculture will be combined with impacts on human health and the ability to provide labor for agriculture, such as increased malaria risk.
	Impacts of climate change on non-agricultural livelihoods.	Impacts on important secondary non-farm livelihood strategies for many rural people in developing countries.
Indirect impacts climate change	Distant, off-site impacts of climate change on a particular smallholder	Impacts of climate change in other distant areas of may create changes which affect a smallholder system. For example, increased system demand for grain in one location might affect pastoralists in another area as the latter are net grain buyers.
	Impacts of climate change adaptation and mitigation policies, programs and funds	The secondary impacts of climate change occur as governments, civil society, the private sector etc gear up to respond to climate change and institute new policies, programs, and funds- all of which may impact upon smallholders (positively or negatively).

Vulnerability to climate change can be thought of as comprising three things: exposure, sensitivity and adaptive capacity (Eakins and Luers, 2006). The ways in which the terms exposure, climate sensitivity and adaptive capacity are used in development literature can vary, but the essential elements are laid out in table 2 appearing on the following page.

Smallholders are not just vulnerable to climate stresses, but also to many other non-climate stressors. Broader scale trends affect the vulnerability of famers, households and communities at the local level[1],

1. Other examples include:
   - regionalized and globalized markets, and regulatory regimes, increasingly concerned with issues of food quality and food safety;
   - market failures in product marketing and input supply, following withdrawal of governments, leading to decreased market access for smallholders;
   - protectionist agricultural policies in developed countries, declines and unpredictability in the world prices of many major agricultural commodities, macro-economic shocks;
   - HIV/AIDS pandemic, reducing household labour supply, eroding household assets, disrupting knowledge transmission and agricultural services;
   - threats of panzootics (e.g. avian influenza) attacking livelihoods and increasing trade;
   - state fragility and armed conflicts in some regions.

Table 2: Unpacking climate change vulnerability

Component	Details
Exposure	Climate change impacts vary by geographical location. In addition poverty has spatial dimensions with poor people more likely to have to farm and live on steep slopes and marginal lands in rural and urban areas.
Climate sensitivity	Some livelihood activities and countries are more climate sensitive than others, and because of prevailing gender roles, women are more likely to be reliant on these climate sensitive livelihoods and resources.
Adaptive capacity	Adaptive capacity to actively engage in adaptation processes depends upon access to and control over livelihood resources to be able to cope, adapt and transform. Adaptive capacity, or the ability to adjust to climate change, is also socially determined and reflects societal inequalities.

such as population increase leading to fragmentation of landholdings, and environmental degradation caused by population, poverty and ill-defined and insecure property rights, including widespread soil degradation (Morton, 2007). The compound effects of these stresses at the local level are not yet well understood, but could be significant for poor rural populations. Tackling the general underlying drivers of vulnerability is a key part of responses to climate change - for example, through improving access to education, economic opportunities and reproductive health and family planning for women in poor populations. The management of non-climate stressors should also be recognized as a key adaptation response (Morton, 2007). For example, many of the policies affecting population trends, such as educational opportunities for girls, greater economic opportunities for women and expanded access to reproductive health and family planning may also build resilience to climate change – in a gender sensitive manner. Building up social and ecological resilience provides a greater buffer to climatic shocks and stresses.

The term vulnerability has negative connotations and it has been widely noted by gender specialists that the term deflects attention from the capabilities and agency of rural and urban communities in developing countries to respond to climate change and so there has been increased emphasis on capabilities and resilience in recent years in the adaptation literature. The term resilience tends to be used in relation to the ability of individuals, households and communities to cope with and respond to

Box 1: Interaction between rural stressors including climate

The interaction between stressors is leading to high vulnerability and limited adaptive capacity in sub-Saharan Africa. Adaptive capacity (the ability to actively engage in processes of adaptation) is constrained by these broader scale trends and pressures of poverty, conflict, etc. Millions of smallholder and subsistence farming households in the dryland tropics are expected to be affected by temperature-induced declines in crop yields, and increasing frequency and severity of drought leading to increased likelihood of crop failure, increased diseases and mortality of livestock and/or forced sales of livestock at disadvantageous prices, livelihood impacts including sale of other assets, indebtedness, out-migration and dependency on food relief, possible feedbacks through unsustainable adaptation strategies into environmental degradation including loss of biodiversity, eventual impacts on human development indicators such as health and education (Morton, 2007).

shocks and stresses, but resilience thinking has more specific applications referring to the ability of an inter-linked socio-ecological system to analyze complex processes of change in socio-ecological systems[2].

2.4 Adaptation

Adaptation to climate change has been defined by the IPCC as: 'Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation' (Adger, et al, 2007**).** Other interpretations emphasize the active engagement of people in adaptation processes (Ensor and Berger, 2009). To build adaptive capacity means increasing access to and control of key livelihood resources such as land, labor, information, etc. Having greater access to and control of these resources will enable local communities to adapt to the changing climate and to other stressors. Adaptation is not only about active engagement, it is also about tackling vulnerability to ensure that adaptations lead to equitable outcomes, rather than exacerbating inequality, and it should also strengthen resilience (the ability to withstand shocks and stresses).

A continuum for adaptation activities (from development to climate change) is a useful guide for clarifying what is different about climate change adaptation activities compared to traditional development interventions. On the left hand side there are the development activities which are undertaken to tackle the underlying drivers of vulnerability (e.g. literacy classes, vaccination programs, HIV/AIDS projects) and which do not specifically address climate change concerns. The second column includes activities which aim to build response capacity to climate change (e.g. building robust systems for problem solving and capacity for targeted responses). Examples include developing robust communication and planning processes, improving mapping and also weather monitoring and natural resources management practices (e.g. Participatory reforestation on flood prone slopes). The third column – 'managing climate risk' indicates actions that integrate climate information into decision-making and reduce the negative impacts on livelihoods and resources. These climate effects are not easily distinguishable from hazards effects in the historic range of climate variability. Examples include developing drought resistant crops, disaster risk management activities, and efforts to climate proof infrastructure. In the final column are activities which clearly address climate changes which are human-induced (e.g. measures in response to increasing glacial lake outburst risks, or managing coral reefs where bleaching is widespread, or building sea dykes to cope with sea level rise. These are highly specialized activities, which can be costly and require political will (McGray et al, 2007). By undertaking this latter category of activities to confront climate change, it may be possible to achieve 'high adaptedness' now and thus protect future generations, but there are likely to be trade-offs with support for current vulnerable populations in terms of dividing up resources for investment (Nelson, Adger and Brown, 2007).

2. Ecosystem resilience is the capacity of an ecosystem to tolerate disturbance without collapsing into a qualitatively different state that is controlled by a different set of processes. A resilient ecosystem can withstand shocks and rebuild itself when necessary. Resilience in social systems has the added capacity of humans to anticipate and plan for the future. Humans are part of the natural world. We depend on ecological systems for our survival and we continuously impact the ecosystems in which we live from the local to global scale. Resilience is a property of these linked social-ecological systems (SES). "Resilience" as applied to ecosystems, or to integrated systems of people and the natural environment, has three defining characteristics: the amount of change the system can undergo and still retain the same controls on function and structure; the degree to which the system is capable of self-organization; the ability to build and increase the capacity for learning and adaptation' Resilience Alliance definition at: http://www.resalliance.org/576.php, accessed on 15.06.10.

Diagram 1: A continuum of adaptation activities: from development to climate change

	Addressing drivers of vulnerability	Building response capacity	Managing climate risk	Confronting climate change
Features	Overlaps a lot with development practice. Activities take little or no account of specific cc impacts. Examples include livelihood diversification, literacy projects, women's rights, HIV.AIDS projects.	Building robust systems for problem solving & capacity for more targeted actions. Overlaps with institution building & technological approaches familiar in planned development. Examples include developing robust communications & planning processes, improvement of mapping, weather monitoring, & NR management practices.	Climate information integrated in decisions to reduce negative effects on resources & livelihoods (CC effects not easily distinguished from hazards effects within the historic range of climate variability). Disaster response planning activities, drought-resistant crops, & efforts to "climate-proof" physical infrastructure.	Highly specialized activities exclusively target distinct cc impacts, falling outside the realm of (current) development. Benefits felt only in the event of cc. Communities that relocate in response to sea level rise, and responses to glacial melting.
Examples	Crossbred goats & graze free feeding training with women (Karamoja Agropastoral programme, Uganda. Diversifying livelihood strategies in flood prone areas (Bangladesh, SSN).	Participatory reforestation, Rio de Janeiro hillside favelas, to combat flood-induced landslides (City authorities, Brazil). Reinstating pastoral networks in arid regions for appropriate rangeland management (National University of Mongolia).	Monitoring salinization of drinking water & drilling new wells (Tanzania, SSN). Teaching farmers to collect climate data & integrate it in planting decisions (Gov. of Mali & Swiss Agency for Development & Cooperation).	Managing coral reefs where widespread bleaching (WWF, Indonesia). Reducing the risk of glacial lake outburst floods from Tsho Rolpa Lake (Gov. of Nepal).
Vulnerability Focus ◄——————————► Impact Focus				

Source: McGray et al, 2007, p18.

A range of investments, policies, planning and information will be needed for holistic and people-centered approaches to climate change adaptation. According to a recent Oxfam study (Petengell, 2010) adaptation should:

a. respond to climate related hazards through disaster risk reduction
b. build adapted livelihoods (e.g. provision of forecast information as traditional farming calendars become less reliable, access to appropriate technologies such as development of seeds for crops that are more salt, flood and drought tolerant, involving farmers at all stages, and making these accessible to farmers and support for wise management practices and tackling existing conditions that limit adaptive capacity (e.g. social exclusion, political conditions, etc
c. strengthen natural resources management practices, entitlements and policies. Climate change will increase resource scarcity, yet healthy ecosystems are important as a buffer against climate shocks (e.g. increasing the soil's organic content improves water retention and drainage, which can help crops where rain becomes more concentrated during heavy downpours).

2.5 Agricultural adaptation

As well as new approaches and social learning, smallholder agricultural adaptation to climate change can be thought of comprising a) changes in farming practices to *maintain* existing system. At the management unit level in cropping, livestock, forestry or marine systems to maintain the existing system, including changes in varieties, planting times and use of conservation tillage will be needed; b) wider

institutional and policy changes which may be more significant and *systemic* in nature. More systemic changes may be required via policy reform to encourage behavioral and institutional change amongst enterprises and farmers. Systemic changes in resource allocations could increase the benefits achieved by the marginal technological and agronomic management practices outlined above especially where these include alternative livelihood and land use options (Howden et al, 2007).

It is important to emphasize that smallholder farmers are *already* responding to climate variability – many farmers spread risk by planting on different terrains, inter-cropping different varieties and species, etc. There is thus a great deal that smallholder farmers can do to respond to increasing climate variability and emerging climate trends. But there is also likely to be a great deal of external support required from researchers and development agencies to provide farmers with technical advice, capacity building and finances to enable them to respond to new climate risks and pressures, particularly when the scale of climate change challenges existing knowledge and adaptive strategies.

Agricultural development has traditionally focused on technological innovation, such as varieties and breeds, types of equipment and methods used, to increase growth or cut costs, reduce risks, enhance quality, etc. However, in recent years there has been increasing recognition that social and institutional innovations can be as important as technical ones. Examples include innovations amongst producers (formal or informal, such as the development of co-operatives, farmer groups and self-help groups) or development of new linkages and networks between producers and service providers (Conroy in Snapp and Pound, 2008). In agricultural adaptation there will be a need not only for technological developments, but social innovations as well and this will be required not only at farm level but in broader policy and governance processes. It is important to recognize the skills and capabilities of farmers. Farmer learning should be supported through financial, technical, capacity building etc, but some changes may require broader institutional change or multi-stakeholder collaborations.

2.6 Adaptation pathways and narratives

It is important to note that there are many different (agricultural) development pathways which may be followed, but these may be more or less sustainable and equitable. The desired outcomes are likely to be different amongst diverse social groups (Nelson, Lamboll and Arendse, 2008) and the narratives about sustainability processes vary with some being more dominant than others (Leach, Scoones and Stirling, 2010). Building up local voices (the 'demand side of governance') is critical if adaptation choices on policies, types of institutional arrangements and types of innovation that are needed are to take into account alternative pathway options which may be more socially and environmentally just.

3. Gender and social difference in climate change

3.1 Gender and climate change

Gender and social difference shapes the outcomes of climate change for smallholder and subsistence farmers. Following a slow start in recognizing that there are gender dimensions to climate change, this picture is now rapidly starting to change (Masika, ed. 2002; Nelson et al, 2002; Lambrou and Grazia, 2006). The global agenda and negotiations on climate change have largely focused on scientific, technological and market-based measures to tackle climate change without due consideration to the social implications for poor women and men (Masika ed, 2002; Boyd, 2002; Dankelman, 2008b). Although climate science and technology are indispensable, the political and socio-economic issues of climate change require greater attention (Denton, 2002).

The early literature on gender and climate change largely focuses on making the case for consideration of gender, namely that the impacts of climate change will not be felt equally – because of prevailing

gender inequalities and socio-cultural norms and greater participation of women in international and national climate policy spaces is necessary (Nelson et al, 2002; Skutsch, 2002; Cannon, 2002; Denton, 2004; FAO, 2006). The risk that climate change impacts will be laid onto existing patterns of inequality and vulnerability, and that they may make these differences more pronounced, is also a common thread in the literature. Lately, there has been more empirical evidence emerging upon which to explore gender and climate change (e.g. Nelson and Stathers, 2009; Terry, 2009; Neefjes, et al, 2009; FAO, 2010 etc).

Several recurring contentions appear in the gender and climate change literature:

- Women will be disproportionately affected by climate change compared to men, yet the gender-differentiated nature of the impacts has only belatedly been recognized. Women and female headed households are *disproportionately* represented in groups experiencing poverty and discrimination and thus have fewer resources to cope with and adapt to climate change.
- The reason for the gender-differentiated impact is the widespread existence of *entrenched and deep gender inequalities*. These inequalities mean that women have differing roles, resources, rights and time with which to cope with climate change compared to men.
- The gender division of labor means that women and men may be responsible for different tasks, and women's roles in household reproduction (e.g. collecting fuel and water) means that they are relatively more reliant on climate-sensitive livelihoods.
- The failure to tackle poverty and inequality will undermine climate adaptation efforts, because of the underlying social determinants of poverty and limitations on adaptive capacity;
- There is a lack of representation of women and gender issues in climate change policy and decision-making across the scales, from the local to the international levels.

It is vitally important that there is a move beyond a discourse framing women as 'vulnerable, passive victims', to a framing instead of women as 'active agents', with important and relevant skills, knowledge and experiences which should be employed in climate change adaptation and mitigation. If women are given appropriate support, they can be successful protagonists in action on climate change at all levels. Support for their involvement should begin from a rights-based perspective, not just an instrumentalist perspective (Roy and Venema, 2002; Aguilar, L., Araujo, A. and Quesada-Aguilar, A. 2007; Nelson and Stathers, 2009).

Gender inequalities are embedded in formal and informal institutions in society and power relations and this means that climate change will tend to have different and sometimes disproportionate impacts upon women as compared to men – although whole communities will be affected by climate change and men can be disadvantaged too.

It is also important always to remember that gender intersects with other forms of social exclusion and gender dynamics, thus are context-specific. Action to challenge gender inequalities have to therefore focus on the relationships between women and men, and between different groups in society. Table 2 details how resource rights, responsibilities and identities, knowledge systems and power relations are gendered and how this shapes climate change processes.

Gender roles are not fixed and will shift and change in response to a whole range of climate and non-climate stressors (Nelson et al, 2002). In the Hawai'i islands, gendered livelihood activities and resource patterns are shifting as economies gradually move from subsistence to cash economies and from rural to urban settings (Anderson, 2009). In South Africa, unemployment, HIV/AIDs, poverty and a changing climate are reshaping gender roles with women engaging in more income generating activities than before to sustain the household and sometimes having more opportunities and power to decide on the use of that income. However, women's workloads are being affected by climate-related stresses and

Table 3: Gender inequalities and climate change

Gender Inequalities	Gender & Climate Change
Resource rights are gendered Women & female headed households tend to have less well defined or secure land/natural resource rights than men and male headed households (e.g. *de facto* and *de jure* ownership/ use/inheritance rights). Also gendered access to and control of farming inputs, fuel, labor, etc.	Women & female headed households tend to have fewer resources with which to adapt to climate change challenges.
Responsibilities and identities are gendered	
Women & men are ascribed different responsibilities within the household & community. The gender division of labor means that women tend to have much higher workloads than men, because of their responsibilities in domestic production & reproduction and often have lesser control of household income due to more limited power in household & community decision-making.	Women have more domestic reproductive responsibilities e.g. collecting firewood and water – resources likely to be affected by climate change. Women's higher work burden means they may have less time & energy to adapt to a changing climate and fewer resources to diversify their activities. Men may also migrate more than women, potentially increasing the work burden of women who remain behind.
Knowledge systems are gendered	
Whilst some knowledge & skills are shared at a local community level, the gender division of labor also means some differences in the knowledge and skills held by women and men (or different social groups). Also differential access to education, modern media and information is common along gender lines.	Specific social groups may also have specific occupational skills and knowledge sets (e.g. in seed selection) or traditional weather forecasting roles – although the latter are challenged by increasing climate variability. Lesser access to information & media can constrain women's capacity to adapt; but with appropriate support they can take the lead and build upon their own knowledge and capacities.
Power relations and participation are gendered	
Power relations are shaped by gender norms and vice versa. How far women and men can participate in decision-making and have their interests represented - at intra-household, inter-household, community level and beyond - is shaped by prevailing gender norms.	Women's participation in climate change decision-making is inadequate at all levels. Despite gains in some countries regarding gender awareness or equality, more needs to be done to take up opportunities in new climate policy spaces and ensure that gender is mainstreamed and women can participate.

there are negative psychological impacts on men who lose their jobs in terms of loss of identity and confidence (Babagura, 2010). Understanding that such roles are not fixed and can be changed is a key part of participatory learning processes in which women and men are supported in enquiry and have the chance to read the world in a different way.

3.2 Gendered vulnerability and resilience

Vulnerability to climate change is gendered: Exposure to climate change is a function of geography, but poverty has spatial dimensions with the poorest (of which women are often a majority) forced onto marginal lands. There may also be differences in adaptive capacity shaped by location – where there are new climate risks; local communities may have limited experience of managing that risk. For example,

in Viet Nam communities with more experience of disasters and who had worked with NGOs in disaster risk reduction were better prepared for future hazards compared to those who are newly facing climate hazards (Neefjes et al, 2009). In Hawai'i, gendered impacts of climate change are being observed along spatial lines: there is often a division of labor along gender lines in fishing in Hawai'i with women fishing in the shallower waters, whilst men tend to fish in deeper waters, but the shallower fish stocks are being most affected by warming seas (Anderson, Copenhagen presentation, 2009). Thus the exposure of communities to climate change will vary, but differences in ability to respond within the household, within communities and between communities is socially determined.

Climate sensitivity has been noted for poorer, rural communities as well as whole countries. The gender aspects of this have been less explored, but it has been argued that women's subsistence and domestic responsibilities, which depend upon natural resources, might make them more vulnerable to climate change (FAO, 2007). However, generalizations should be avoided and care taken to understand gender and poverty in each location. Women may also have key roles beyond subsistence and reproduction in trading, for example, or non-agricultural livelihood activities.

Poorer people have fewer resources with which to respond to climate change (FAO, 2007). Gender inequalities mean women tend to have lesser access to key livelihood resources, although men can also face discrimination. For example, male members of female headed households may also suffer from a lack of access to and control over livelihood resources because of gender norms. Human capital assets important for adaptation include knowledge of climate risks, conservation agriculture skills, and good health to enable labor. Social capital assets include women's savings and loans groups, and farmer-based organizations. Examples of physical capital assets important for adaptation are irrigation infrastructure, and seed and grain storage facilities. Natural capital assets include reliable water sources and productive land. Finally, financial capital assets of importance in adaptation are micro-insurance, diversified income sources, etc (Care, 2009). For each of these, the gender dimensions should be identified and explored in specialist studies and attention paid in policy-making and adaptation program design.

Table 4: Key elements of vulnerability to climate hazards

Component	Gender dimensions
Exposure	Some communities might be affected in climate change hotspots compared to those in other locations (e.g. whole coastal communities may be more at risk from sea level rise than inland communities (see Viet Nam study for example Neefjes et al, 2008), the extent of exposure has a spatial dimension that is socially determined. Those pushed onto marginal fields or risky slopes in cities tend to be the poorest and women are disproportionately represented.
Climate sensitivity	Women are traditionally responsible for domestic production and reproduction, and generally have higher work burdens than male household members. Women are often responsible for collecting fuel, water, and edible wild plants for household subsistence, and these resources may be less readily available in some locations as climate change impacts begin to bite, although men may be affected too. Women and men may also work in other roles e.g. cash cropping, transport, marketing etc., and the ways in which climate change, in concert with other stressors and opportunities, should be explored.
Adaptive capacity	The ability to actively engage in adaptation depends upon access to, and control of, key ivelihood resources – with access and control usually differentiated along lines of gender and social difference (e.g. age, caste, class). Examples of livelihood resources important for adaptation are land, water, climate information, decision-making influence at household and community levels, social networks etc).

Source: own work

It is also important not only to over-emphasize, however, the vulnerabilities of women and marginalized groups in rural climate change adaptation. Instead, adaptation programs need to build upon the existing skills, capabilities and agency through participatory, localized processes of adaptation, promoting participation and decision-making power of women and building resilience through diversification, social learning, maximizing ecological variability, etc.

The processes by which the impacts of climate change may be gendered are represented visually in **Diagram 1**. Climate change and non-climate change stressors affect rural populations, in which gender inequalities shape starting point vulnerability and adaptive capacity (e.g. access to and control of land, labor and capital is gendered). Climate knowledge, however, varies: in some locations there is a lack of downscaled data and uncertainties within the projections: different stakeholder groups may have different levels of access to climate science and local observations and interpretations of climate, which have political, social and cultural dimensions. The direct and indirect impacts of climate change are thus gendered and socially differentiated potentially leading to worse outcomes for women and marginalized groups – although there are also potential opportunities in new climate policy spaces to support women's empowerment and gender mainstreaming.

3.3 Gendered adaptation pathways & policy spaces

Gender and power inequalities constrain many women's (and other marginalized groups') abilities to participate in decision-making from the household to the international level. Discrimination is embedded in formal and informal institutions (e.g. in both state and customary land tenure systems there are often rules and practices which mean women and female headed households have less well defined or secure access to land than men). Wealth, social group and network membership can provide resilience for some, but may at the same time undermine the resilience of others. The well-known risks of community-based approaches (elite capture of benefits, increased internal tensions, and risks of reprisals once development agencies disappear) must be explicitly recognized in climate change adaptation with an unpacking of the *changing incentives* which connect people in particular places (Cannon, 2008). Action to engender climate change adaptation will require pressure to explicitly challenge constrictive norms and awareness raising on the importance of gender equality as an integral part of successful adaptation rather than as an optional extra.

There is a great deal of experience amongst development agencies in terms of gender mainstreaming, and gender toolkits and approaches which can be drawn upon to engender climate adaptation. However, gender fatigue has to be battled with and greater recognition given to the essentially political nature of such processes and support for/leadership in the articulation of normative aims such as women's empowerment. This is far from easy given the need to conduct what is essentially double mainstreaming – i.e. gender and climate change awareness raising, - but potentially there is a new opportunity as new climate policy spaces open up. Climate policy spaces may be invited by states and development agencies seeking the participation of civil society groups, or they can be claimed by active civil society groups demanding influence through pressure and collective action. Alliance building, collective action and leadership amongst women should be supported to assist women's movements to generate new narratives and framings of adaptation pathways that are more equitable.

3.4 Disasters and gender

Because extreme events will be felt much more quickly than longer term shifts in temperature and rainfall, it is perhaps unsurprising that many adaptation interventions begin with climate variability and emergent trends and with intensifying climate hazards. The gender and climate change literature reflects this situation, and there has been analysis of the gendered impacts of disasters for some time (see Enarson, Fothergill and Peek, 2006).

Natural hazards lead to a whole range of impacts - many of which have gendered outcomes. Whilst disasters can affect whole populations, often the most serious impacts usually fall upon the poorest and most disadvantaged. Women may be less likely to learn to swim or be involved in disaster risk reduction processes (e.g. Cannon, 2002). Also, post-disasters violence against women has been shown to increase (UN/ISDR, 2008). Resettlement and recovery processes may replicate or even reinforce gender inequalities rather than challenge inequalities (Quan, 2008).

Box 2: Gender, poverty and vulnerability to climate hazards in Bangladesh

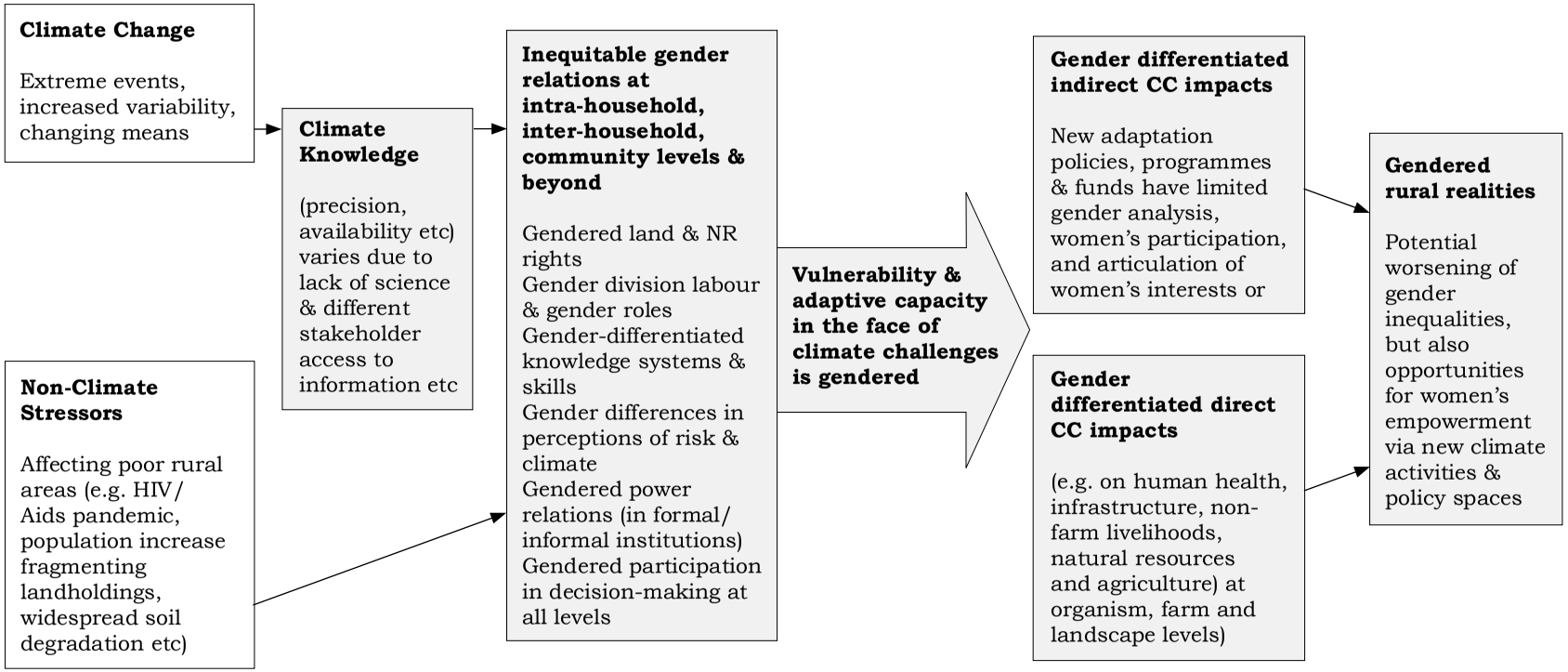
Women in female headed households in Bangladesh are more vulnerable to climate hazards such as cyclones and flooding. Many female headed households comprise divorced or widowed women and are disproportionately represented in the poorest sections of society. Women's poorer nutritional status, lesser access to healthcare, and domestic burden increases their vulnerability to climate hazards.

- the loss of utensils and household essentials disproportionately affects women in Bangladesh (and in Viet Nam, see Neefjes, 2009).
- women tend to find it harder to restore their livelihoods after a flood and are more affected by water-borne illnesses.
- In poorer, female-headed households, there are more constraints on women taking self-protection measures, (e.g. the quality of housing, finding higher food storage locations.
- cultural norms have been shown to delay women leaving the house and going to public cyclone shelters when cyclones approach
- women's mobility may be reduced by their childcare responsibilities and because they are less likely to be able to swim.
- NGO disaster risk reduction activities over the last ten years have led to improvements and there some gender equality indicators are improving in Bangladesh, but it is too early to tell if this will significantly alter the gendered differences in vulnerability to climate hazards.

Source: Cannon, 2002

Positive steps can be taken through gender-sensitive disaster risk reduction in reducing the vulnerabilities of less affluent women and men (Aguilar, 2004). In the La Masica communityb of the Honduras, no deaths occurred after Hurricane Mitch in 1998, for example, and this is thought to be due to a gender-sensitive community education initiative on early warning systems and hazard management which promoted women taking over responsibility for monitoring the early warning systems – a task which had been abandoned due to lack of interest from male members of the community. Many other positive experiences of grassroots initiatives in Bolivia, Mali, Sri Lanka, Tunisia, Brazil, India, Nepal and South Africa are outlined by UN /ISDR (2008), in which women's leadership has been encouraged in disaster risk reduction as a tool for adapting to climate change. Building upon women's knowledge and their capacity to participate in community decision-making, leadership and disaster risk reduction – as well as men - can thus reduce vulnerability of whole communities.

Diagram 2: Gender and climate change



3.5 Migration, climate change & gender

Migration has long represented an adaptive strategy to stresses and shocks particularly in semi-arid areas characterized by climatic uncertainty. Migration can be in-country or international, and it is the latter that is expected to be exacerbated by climate change. Rural to urban migration is well documented, but rural-rural population shifts are also occurring as people seek alternative sources of income. However, it is very difficult to identify 'climate' refugees as the decision to migrate is a complex one. Except in situations of resettlement following natural disasters, people tend to move for economic reasons, rather than solely climatic ones, although climate pressures can of course add to economic drivers. Analysis of broader economic drivers and socio-cultural change is a necessary part of understanding migration patterns and drivers.

Migration actually requires resources, social networks and health to move, and so the poorest may not be able to adapt in this way. In Viet Nam many rural households will have to move inland from low lying coastal areas of Quang Tri province, as climate change impacts are felt, but only those with most resources will be able to do so and those in receiving communities may also be (differentially) affected. These vulnerable groups will therefore require more assistance in resettlement (Neefjes, et al, 2009). Increasing male out-migration has meant that in some locations women already have to take on traditional male roles in disaster preparedness (Neefjes et al, 2009). Migration to urban areas may lead to problems where the destinations: urban areas are low-lying and vulnerable themselves to sea level rise (e.g. Dar es Salaam, cities in the mega-deltas of Viet Nam, Bangladesh etc).

Out-migration can lead to higher numbers of female headed households remaining in rural areas with higher workloads and limited access to key livelihood resources. In Dodoma, Tanzania, outmigration is predominantly male and it is increasing for a variety of reasons (climatic and non-climatic). Unpredictable rainfall, declining soil fertility and increased incidence of pest and disease problems are contributing to crop failures and increased yield variability. Voluntary seasonal migration is a long-standing coping strategy in this region, but it is increasing, straining family relationships, adding to women's workloads without concomitant increased access to resources and contributing to the spread of HIV – particularly affecting women's wellbeing and undermining young people's confidence in rural futures (Nelson and Stathers, 2009). Women remaining in rural areas may rely on remittances from men who have migrated away on a permanent or seasonal basis. Erosion has reportedly contributed to high levels of male out-migration in the Tambacounda region of Senegal, leaving women and children with tasks of land rehabilitation and food production, but at the same time they have fewer economic and human resources to rely upon (UNFPA, 2009).

There can be opportunities for women's empowerment where social structures and roles are changing. Sometimes, where women migrate, they can become more independent socially and financially, and those staying at home may gain greater autonomy in the household (UNFPA, 2009; Nelson and Stathers, 2009). However, there are often serious risks for migrant women, of: abuse, poor labor rights, isolation and dependence on men for women in urban settings (UNFPA, 2009). Local, regional and national level migration patterns are likely to show a need for policies to promote rural development, to facilitate movement, to engage in proactive urban planning and to address the needs of both locals and migrants (UNFPA, 2009).

3.6 Intersections with other forms of social difference

Whilst gender is the most widespread form of social discrimination, there are important intersections with other forms of inequality which perhaps are given less attention. Occupational or social groups, such as pastoralists and indigenous groups, people living with HIV/AIDS, etc are groups who commonly suffer discrimination and are likely to have lesser access to information, resources and services to adapt

Box 3: Caste, gender and climate change in India

A study in India (in the drought and flood prone villages of Sartanpur, Katpar, and Tarasara - in coastal south Gujarat) observed that women in all three of the focal villages were more vulnerable than men, but the experience of gender inequality is mediated by other aspects of social identity. Thus there are differences between women and between men in terms of vulnerability to climate change and other stressors because of differences in socio-economic status and access to entitlements. The caste system intersects with gender determining who is vulnerable, where they live, their access to resources, communication and information systems. In Sartanpar, poor tribal groups live in the low-lying, flood-prone areas on the outskirts of the village, making it difficult for them to access relief, or get information on impending disasters. The village temple provides the only safe sanctuary for people during floods and cyclones, but space is limited, and it is possible, though difficult to prove, that lower-caste groups are denied access because of social practices and beliefs about ritual pollution that discriminate against them. It is therefore critical that government and civil society actors integrate gender issues into their activities and engage women and men from *different* social groups to participate in priority setting and the development of relevant interventions.

Source: Ahmed and Fajber, (2009)

to climate change (Salick and Byg, 2007; Macchi, et al, 2008). Indigenous groups may also have significant knowledge of adaptive strategies which may be of relevance in adapting to climate change at least in the medium-term (McLean, 2009). A study from India provides an example of how caste intersects with gender to shape vulnerability to climate change. An FAO study from a different part of India, (Andrha Pradesh), concludes that gender, however, is still the greatest predictor of institutional support, more than caste or size of land holding, with women having lesser access to resources and options in selecting coping strategies (FAO, 2010).

In Viet Nam a UNDP-Oxfam study of gender and climate included dialogue with villagers in three different locations. These discussions included identification of resilience indicators for households and from this the least resilient to climate change were found to be female headed households, ethnic minority women and girls, the elderly and the poorest. Ethnic minority women and girls are particularly vulnerable, because have a lack of assets, and a high level of responsibilities for household needs, but the whole community in upland Avao village is also affected by having less previous experience of disasters and risk reduction measures (Neefjes et al, 2009).

The impacts of climate change are also differentiated along age lines. Both children and the elderly have *unique* vulnerabilities to climate change, with differences also between babies, infants and youth, and between the old and the very old. One of the largest groups to be affected by climate change will be children under the age of five (Baker, 2009). Children face immediate impacts such as increasing natural hazards, more water borne diseases, increasing hunger and malnutrition, as well as threats to health and social systems, access to water and sanitation, migration and population displacement, increased urbanization, increasingly fragile livelihoods and additional burdens on women (Baker, 2009).

Children are *already* being affected by increasing climate variability and more sudden onset events (Back and Cameron, 2008) for a number of reasons. Firstly, children represent a large percentage of those who are vulnerable to climate change, comprising between a third and a half of the population in the most affected areas (Bartlett, 2009 in Guzman et al, 2009). Urbanization means many of these children

will live in informal settlements and hazard prone parts of cities. Where children become ill, injured, malnourished or psychologically affected by disasters, famines, displacement or deepening poverty this increases the challenges faced by their communities. Secondly, the impacts of climate change on young children can be long-term because children have rapid metabolisms, immature organs and nervous systems, developing cognition, limited experience and behavioral characteristics, etc, and impacts on them may reduce their mental capacity and chances for learning and growth (Bartlett, 2009 in Guzman et al, 2009). Thirdly, perceptions of risk are gender and age-differentiated and reflect personal experiences. Children and youth have potential roles as informants within formal and informal risk communication networks, but these have been underestimated to date, and do also bring potential burdens (Mitchell et al, 2008).

Given so many other compelling priorities it may seem unrealistic to try and address children's concerns but there is a growing body of literature in which the synergies between children's needs and interests and the adaptations needed to respond to more general risks are identified (Bartlett, 2008). For example, adequate drainage, waste removal and good sanitation in urban areas not only protect children's health but help in reducing risks from potential disasters (Bartlett, 2008). Increased support is needed for children's participation – beyond tokenistic involvement - in international negotiations and in national adaptation and mitigation efforts and recognition and articulation of their interests.

Older people will also be disproportionately affected by climate change because of physical weaknesses, declining incomes, and because of health risks from extreme hot or cold weather and increased diseases (Beales, 2009). Reduced mobility, changes in physiology, more limited access to resources undermine older people's adaptive capacity (Filiberto et al, undated). Increasing numbers of older people may be displaced or remain behind when others migrate (Beales, 2009). Out-migration (temporary and permanent) by men of working age means many rural areas have disproportionate representation of older people, women and children. In some locations traditional family and community support mechanisms are being eroded for a variety of reasons, leading to reduced resilience to hazards and displacement. Rising rates of HIV/AIDS is also increasing the numbers of grandparent headed households, which strains their capacity to cope.

Older people may have useful knowledge of adaptive strategies plus they have the ability to compare past weather patterns with today - but it is also clear that social memory of climate is highly variable, and that increasingly local forecasting methods and associated social roles are becoming more unreliable as climate variability increases. In some places younger people have relatively more education, mobility and access to information about climate change and older people's valuable traditional adaptation knowledge is being lost or ignored by development agencies just when it is most needed. Older people are generally invisible in humanitarian discourse and practice, and their capabilities and experience overlooked and their needs (health, mobility and productive economic capacity) not appropriately met (Day et al, 2007).

Investment in age-friendly adaptation measures is needed including appropriate health care and social protection measures (HelpAge International 2007). In agriculture, support is needed for older farmers to diversify their crops, livestock and inland retention and use, and supporting older people to access funding (HelpAge International). Support for older farmers, including research on traditional knowledge of climate change, research on indigenous, drought resistant crops, facilitation of older peoples' issues in international policy dialogues, etc (Beales, 2009). Vulnerability assessments should be broken down by age and gender (HelpAge International 2007).

3.7 Men, masculinities & climate change

Neither women nor men form homogenous groups and men can also be disadvantaged with specific vulnerabilities linked to gender roles. The way in which prevailing ideas of masculinity are constructed

will shape the outcomes of climate hazards and trends (e.g. affecting their health and safety during and after disasters) (UNFPA, 2009). It is commonly stated that more women die during disasters than men, but more men died during Hurricane Mitch in 1985 than women because of societal expectations they should carry out high-risk activities (UNFPA, 2009). This was also reported by villages in Viet Nam (Neefjes et al, 2009) with more men reportedly dying as a result of undertaking search and rescue activities during cyclones. It is also quite possible that more women die in the aftermath of disasters, but that these are less well reported or linked to the disaster itself.

Some climate change impacts will affect men more than women because of gendered livelihood roles. For example, large scale liquid biofuel developments (in part driven by climate mitigation agendas) may have unintended impacts on access to fodder and access to grazing lands which could disproportionately affect men who tend to be responsible for the care of large ruminants (FAO, 2008). However, women tend to have greater responsibilities for small stock. Gender analysis is thus very important in planning and implementing small stock development and this should be integrated with identification of potential climate change impacts.

It is to be noted that livelihood activities can be gendered, and that there are also instances in which men will be more affected than women by climate change. The gender division of labor in Cameroon may mean that men are more affected by river blindness (the epidemiology of which will be changed by climate change) than women[3]. In the Arctic, where climate change impacts are already having a significant human cost, whole communities are being negatively affected, but male hunters are particularly hit by the increased difficulties and dangers they face from a shorter hunting season and inability to support the household creating social problems and tensions (Parbring, 2010). It is therefore critical that men need to be involved in gender equality work, including in adaptation to climate change.

3.8 Climate change, gender & indirect impacts

Adaptation and mitigation interventions are already underway and will have differentiated impacts on local communities, particularly where policies and programs are gender blind (Rossi and Lambrou, 2009; FAO, 2008; Karlsson and Banda, 2009; Nelson, forthcoming). Mitigation measures commonly rely on market-led instruments, but Alber (2009) notes that such approaches tend to disadvantage women because women commonly have lower incomes and limited access to markets and she argues that regulation would be a preferred option for this reason.

There could be benefits for social development where adaptation and mitigation interventions are well-designed and mainstream gender issues and women's empowerment. Synergies between adaptation and mitigation actions are also being sought: Neefjes et al. (2009) explore these synergies in Viet Nam, where the system of rice intensification (SRI) methodology is being promoted to boost rice production, income and sustainability. It can potentially reduce greenhouse gas emissions and costs (e.g. of seeds, water, fertilizers, agrochemicals) by promoting healthier, more resilient rice plants with stronger root structures and by fostering soil organic material and soil fertility. SRI can increase resistance to pests and diseases and make crops more resistant to stresses like drought and storm

3. The Cameroon NGO, the Yaounde Initiative Foundation (YIF), the Natural Resources Institute, University of Greenwich and Imperial College London, have developed a sustainable method of controlling Simulium blackflies, which transmit river blindness (onchocerciasis) and whose bites prevent people working. Instead of using helicopters to apply blackfly larvicide to rivers, small boats are used in a low cost method to more effectively disperse the larvicide across the river (the new Simulium Pirogue Application Technique (SPATE). Results on the Sanaga River in Cameroon have been dramatic with a reduction of 98% in blackfly numbers and biting. There is anecdotal evidence men are more affected by the disease, because they are the ones more likely to be fishing due to traditional gender roles. The elderly are more likely to have eyesight affected by the disease since it takes some years to cause eye damage – the majority of people over 40 in the villages visited had sight impairment (Hans Dobsen, NRI, pers comm..)

damage – important benefits in the light of climate change impacts in Viet Nam such as sea level rise, more frequent and intense droughts, cyclones and heat waves. However, the gender implications (e.g. changes in women's and men's workloads) of this new technology have not been analyzed in sufficient depth and require more attention.

The imperatives of greenhouse gas mitigation may spark renewed interest in rural energy and bioenergy schemes, but like any other new technological or social innovation, can create additional workloads or pressures for women, without increased decision-making power, if introduced without attention to gender relations. A study of the introduction of solar home systems in Bangladesh found that increasing women's visibility in technology committees is not sufficient to challenge gender stereotypes (Wong, 2009). Moreover, although increased lighting enabled women to do other income generating activities, they also felt pressure to work longer hours (Wong, 2009).

Similarly, the biofuels boom (partly driven by the desire to reduce greenhouse gas emissions), may create some rural employment through large-scale commercial schemes and may contribute to the national coffers, the social and gender impacts have been neglected by policy-makers and investors. Working conditions can be poor, particularly for women workers (unequal pay, fewer formal contracts etc), who tend to have lesser access to formal employment (because of less access to education and discrimination in recruitment) and fewer jobs may materialize than initially claimed by investors seeking land access from governments. Such developments also carry significant and serious social and environmental risks, (e.g. of community land and resource dispossession, especially in situations of weak land tenure security). In a number of cases, governments have allocated 'idle' lands to private investors dispossessing whole poorer, rural communities and leading to deforestation – but particularly negatively affecting women, who rely on communal property resources to collect wild edible plants, fuel-wood, and medicinal plants, because of traditional gender roles for women of domestic subsistence tasks (Rossi and Lambrou, 2008; Nelson, forthcoming). There are also many concerns regarding the indirect impacts on land values and food security of such schemes.

Smaller-scale, decentralized projects based on a technology called multi-functional platforms or MFPs (engines adapted to run on biofuels and powering activities such as milling) may significantly improve women's lives through reduced drudgery and time to generate income. These MFPs have been fairly successful in Mali and initiatives are spreading across West and Central Africa although impact assessment is limited. This technology, if implemented in a community based participatory (and gender-sensitive) manner, can provide improved access to energy for rural communities. Women, in particular, can benefit as they are often involved in women's groups collecting the seeds, making the oils and using the energy (Karlsson and Banda, 2009). Out-grower schemes, contract farming and other value chain roles and business models (e.g. management, shared equity) offer possibilities for smallholder farmers to gain better access to inputs, and technical advice, but there are also risks particularly for women who may find they have increased demands on their labor, without increased control over the resulting income or limited say in contract negotiations (Nelson, **forthcoming**).

3.9 Women's participation in climate change policy spaces

Participation in decision making is not always equal for men and women and this is already the case in relation to new climate policy spaces, programs and projects from local to international levels. Women's participation in climate change related policy-making has been limited to date, and there is an urgent need for gender mainstreaming in climate international and national policy-making (Skutsch, 2002; Dankelmann, 2008b). Alber (2009) calls for 'double mainstreaming', i.e. mainstreaming of both climate into all relevant sector policies and administrative procedures, *and* integrating gender at all stages.

Box 4: South Africa government smallholder biodiesel project

A government project in marginal Limpopo Province was set up in 2006 and has supported smallholders to intensively produce sunflowers and soya bean as feedstock for a biodiesel plant.

- The project provides technical extension, strategic business support services and free seeds for a three year period to male and female out-growers. Jobs may be created and multiplier effects on rural economies are possible. Women participants were positive about the income generated by the sale of jatropha seeds, bringing them greater influence in the household.
- Some women also noted, however, the added work burden involved in threshing and seed selection. They also said that meeting the contract targets for sunflower seed production can be difficult in situations of climate variability (especially in the driest parts of the river valley).
- Concerns abound about the water-intensity of energy cropping in a water-scarce country, and the possible risks of exacerbating hierarchical land and labor relations and effectively trapping farm workers, especially women, in continuing subordinate relationships without gaining benefits from the crops they grow.
- Some women said they would like a greater role in project management.
- They would also like to move beyond seed production. '*Women farmers said they did not know how seeds are converted into biodiesel, how much the biodiesel could be sold for, or where it is sold as an end product. They were convinced that others in the value chain are benefiting more than them*' (p32).
- Non-participating female farmers identified poor access to land as a key barrier to participation and argued for more land and water rights for women, as well as greater access to information through community radio and church meetings.
- Reform processes in the extension service have also limited farmers' access generally to information and support services on biofuels. The article does not state whether this specifically affects women farmers, but male bias in extension services is a well known issue

Source: Banda in Karlsson and Banda, 2009

Box 5: Gender and national adaptation planning

- In Senegal women were consulted in the process of developing the NAPA and some of the water efficiency and forestry projects target women specifically;
- In Malawi, women's NGOs were also consulted in developing the NAPA and gender is one of eight criteria for selecting projects. Access to micro-finance, water and energy sources, rural electrification, improved crop varieties and livestock breeds, improving crop and livestock management and improving early warning systems are proposed as projects with women, children, female-headed households and the elderly identified as the most vulnerable groups in rural communities.
- In Mauritania, despite a lack of consultation of women in the development process, the NAPA specifically recognizes the value of women's local and traditional knowledge and states that they should be incorporated as key stakeholders in decision-making. The first approved project aims to improve the lives of women and young people through the development of agricultural value chains.

Source: UNFPA, 2009

At the national level, the National Adaptation Plans for Action (NAPAs) generally do not explicitly address gender relations and issues in the identification and design of projects (Dankelman, 2008; Nelson and Stathers, 2009; Alber, 2009). Women have been identified as part of vulnerable groups in many of the NAPAs, which may provide a useful entry point and some women's groups have been consulted in NAPA processes (UNFPA, 2009, see box x below), but gender analysis is generally lacking. However, funding is still awaited for many of the projects and programs and so there may still be opportunities to adopt a more gender sensitive approach.

All the existing methods and tools which have been developed to address gender issues in development should be used and adapted for climate policy, such as gender impact assessments, gender budgeting, etc. To ensure that future NAPAs and adaptation plans are gender-sensitive it is proposed by UNFPA (2009) that:

- gender equality should be a guiding principle in guiding the process and in selecting activities for funding, and the specific vulnerabilities and impacts on women and men should be identified with project disaggregated data collected by sex and age
- the participation of women and men from affected communities should be facilitated, through use of targets for participation of women and women's groups and holding of separate meetings to overcome barriers to women speaking out
- gender sensitive capacity building programs at the community level should be designed and implemented to ensure both women's and men's roles, resources and priorities are taken into account and the agency, knowledge and skills of women recognized
- projects should include explicit and measurable quantitative and qualitative targets addressing gender issues, indicators are needed to track progress toward project goals, collection of gender-disaggregated data to evaluate impact, and develop gender-sensitive criteria for reporting at the international level, project budgets should be analyzed with a gender lens

In international negotiations civil society women's advocacy activities and networking has begun to increase the profile of gender issues in relation to climate change, but there is still much to be done (see Hemmati and Rohr, 2009 for a history).

Box 6: Mainstreaming gender in climate change policies

The UNFCCC (Rio in 1992) and the Kyoto Protocol (1997) conventions were not gender-sensitive; however, some progress is being made in later COP negotiations. Even though gender mainstreaming in climate change policies, mechanisms and actions can be beneficial to both men and women, and can enhance gender equality, at the same time gender participation is simply not enough. Most of the debates in this field mainly offer inadequate technical and economic solutions, rather than political and socio-economic solutions involving changes in development policy and practice. Women (and men) should be involved in official processes, such as the multi-stakeholder dialogues in the World Summit on Sustainable Development, in addressing climate change policies, mechanisms and actions.

Source: Dankelman (2008b)

4. Gender and climate change in smallholder farming systems

Although there is a great deal of generic literature on gender and agriculture (see for example, the 'Gender in Agriculture Sourcebook, World Bank, FAO and IFAD, 2009; Ogunlela and Mukhtar, 2009; Bezner-Kerr, 2008 in Snapp and Pound, 2008; FAO, 1997; Van Crowder, 1997; Martin and Nelson, 2008; Nelson, 2008), little of this explores the gender-climate change-agriculture nexus. The uncertainties of climate change projections combined with the invisible nature of gender inequalities and the context specificity of social dynamics and smallholder agriculture means that is it very difficult to say how climate change impacts will play out in specific locations and how these impacts will be gendered (Nelson et al, 2002). As a result climate change adaptation tends to begin with existing climate variability as the starting point for discussions with local communities and for which there may be existing local and scientific knowledge of possible coping and adaptive strategies.

4.1 Coping and adapting to climate change

A distinction is often drawn conceptually between coping strategies and adaptation. Coping strategies tend to be thought of as short-term and immediate, survival focused, discontinuous and reactive activities which are motivated by crisis and tend to involve degradation of the resource base and livelihoods (asset stripping) because of a lack of alternatives (Care, 2009). Conversely, adaptation is: oriented towards longer-term livelihoods security, involving a continuous process, results are sustained, resources are used efficiently and sustainably, involves planning, combines old and new strategies and knowledge and is focused on finding alternatives (Care, 2009). A slightly different distinction can be made as to when such strategies are used: In marginal, hazard-prone or high rainfall variability areas, coping strategies are employed by farmers and pastoralists *after*shocks and stresses whereas adaptive strategies are those that have evolved to reduce vulnerability *prior* to climate shocks (Morton, 2007, citing Davies, 1996). An example of a female smallholder in Uganda coping with increasing climate variability is outlined in the box on the following page.

However, the terms coping strategies and adaptation can be used interchangeably causing confusion and the distinctions may become extremely blurred in times of stress (Davies, 1996). Coping strategies, which may be employed in exceptional circumstances, can *become* adaptations for households and communities.

A core characteristic of dry land livelihoods is the adaptive strategies employed which have evolved in response to the uncertainty caused by climate variability (Morton, 2007)[4]. Coping strategies in rural Mali have evolved in response to the semi-arid conditions and climate hazards (droughts, lack of rainfall, and irregular rainfall) (ISDR, 2008). However, recent experiences of flooding in Mali indicate that there are no traditional coping strategies for responding to heavy rainfall and floods according to the study. Whilst existing drought coping strategies represent a starting point for action these communities face *new* climate hazards and climate challenges on a bigger scale, and so disaster risk reduction support is urgently required and should be embedded in local, national and regional planning. In discussing climate hazards over the past 30 years, villagers identified more frequent occurrence and intensity, and new phenomena such as strong Saharan winds and more heavy rainfall causing floods, and landslides, and there have been crop losses including large proportions of the annual harvest. Helping farmers to cope with *both* floods and droughts at the same time, through establishment of preventative measures and

4. Examples include spreading farm labour across the season following unpredictable, intra-season rainfall variations, promoting biodiversity in crops and wild plants, increasing the use of livestock in farming despite labour costs, increasing labour inputs per hectare, and diversifying livelihoods (Mortimore and Adams in Morton, 2007). Drought responses in rain-fed areas of Morocco include on-farm storage of food and feed, strategic use of fallow, and late planting of legume crops when cereals fail (Morton, 2007).

Box 7: A woman farmer in Uganda experiences increasing climate variability

In the foothills of the Rwenzori mountains limited access to land and poverty have contributed to environmental degradation, with cultivation of steep slopes and deforestation for firewood being particular problems. Dorothy Musoke, a subsistence farmer living in Kasese said that 'The seasons keep changing; the rains don't come when I expect them so then we have drought and it is so hard to grow anything. My maize is just about coping, but my beans won't grow.' She says that the rains have changed from being constant in the rainy season, to unpredictable and this leads to her crops failing. When the rains do come they are so heavy that the parched soil cannot absorb the water and soil and crops are washed down the hill. She has no option but to continue with the same crops despite continuing crop failures. The incidence of flash floods and drought periods has increased and so many in her community are turning to 'coping strategies' (taking out loans, food aid, eating less), but these are recognized as short-term fixes which undermine wellbeing and deplete the assets needed for recovery. Dorothy has received training as a 'model' farmer in a livelihood program supported by the international NGO Oxfam. The program aims to help local communities adapt to changing rainfall patterns, through the provision of agricultural extension and establishment of community nurseries for seedlings to replace crops lost to floods and drought and to try new crops more suited to the new conditions. Dorothy has dug trenches on her own fields and plans to dig more and/or plant vetiver grass in rows and aims to collect some of the heavy rainfall through water harvesting.

Source: Pettengell, 2010, p8

development of adapted seeds that can cope with both extremes is recommended (UN/ISDR, 2008). Access to and control of land is differentiated along gender lines in Mali[5]. Women do exclusively harvest shea nuts and extract the shea butter, providing them with income especially in hard times. Gender sensitive adaptation requires better intra-household collaboration so that the risks of production are shared, and action is needed to strengthen women's resource rights.

It should be pointed out that there are a number of potential drawbacks in approaches which focus on existing climate variability or recent local climate trends (measured or perceived) as proxies for future global climate change and for designing adaptation processes (Morton, 2010):

- Firstly, such approaches risk confounding perceived changes in environmental conditions or population well-being with climate change.
- Secondly, they may over-emphasize the role of variability and extreme events vis-à-vis shifting means.
- Thirdly, they may over-emphasize drought and drying over the increased rainfall that is in fact projected for many regions.

However, if these assumptions are recognized, then this work is still necessary to begin learning processes aimed at collective action, to build climate change awareness, monitoring of key climate risks, and to create greater build problem solving and communication capacity etc. Smallholders need external assistance because the pace of change may outstrip local adaptation processes, and

5. A limited, but increasing number of women in peri-urban areas try to form associations to gain access to land by renting or purchasing plots. Women will even buy land from their husbands for agricultural production, and try to get microloans from banks or micro-finance organizations (ISDR, 2008)

incremental changes in varieties and practices may become insufficient. Farmers and decision-makers need to look ahead beyond the next few years and current climate variability patterns. Farmers' adaptive capacity is limited by resource constraints and adverse policy environments which may need changing and external assistance can facilitate shared learning (Morton, 2010). As climate change impacts are felt more severely in some locations, the limits to adaptation may become more apparent as climate stresses undermine the feasibility of certain livelihood strategies. As these limits may be social as well as biological, technological or economic they are contingent upon ethics, perceptions of risk, and culture etc (Adger, et al, 2009).

4.2 Agro biodiversity, climate change and gender

Diversity is one of the key indicators of resilience to climate change shocks and stresses in wild and agricultural systems (Walker and Salt, 2007). The material within ecosystems (e.g. species complexes, soil biota and traditional varieties) possess differing levels of adaptability to climate (e.g. in temperature,

Box 8: Adaptation strategies at different levels

Ecosystem or landscape
Activities at the ecosystem and landscape level aim to mitigate and buffer the effects of climate change through ecosystem protection and restoration, landscape rehabilitation and the sustainable use of natural resources. Examples are:

- 3 Reforestation of tropical hillsides, riparian forests and mangroves.
- 3 Rangeland rehabilitation and improved pasture management.
- 3 Restoration of wetlands, peatlands, watersheds and coral reefs.
- 3 Re-vegetation in dry lands.

Agricultural systems
At the agricultural system level, the resilience of local food systems is enhanced through the diversification and sustainable management of water and soil. Commonly employed strategies are:

- Diversification of agricultural landscapes (agroforestry).
- Diversification of production systems (cultivation of a higher diversity of crops and varieties and crop-livestock-trees integration.
- Low-input agriculture, soil conservation and improved water management and use efficiency (mulching, cover crops, rainwater harvesting, re-vegetation, fallow, intercropping, crop rotation).
- Adjustments in crop and herd management (changes in crop cycle).

Intra- and inter-species diversity
Intra- and inter-species diversity is protected, used and redistributed to strengthen the resilience of agricultural systems and maintain production in stress-prone environments. The main adaptation measures are:

- Use of stress-tolerant and fast-maturing crop species and varieties; and stress tolerant species and breeds of cattle.
- Protection, reintroduction and distribution of traditional crops through community seed banks and on-farm conservation.
- Stress tolerance improvement through farmers' selection and participatory plant breeding

Source: PAR (2010)

rainfall, etc) and environmental changes (PAR, 2010). But humans influence the level of resilience in the agro-ecosystem - farmers and communities manage ecological and biological processes through their activities, (e.g. shaping micro-climates, regenerating the landscape and influencing gene flows). Social institutions, customary laws and cultural values shape these activities and generate traditional agro-ecological knowledge. Adaptation strategies can be identified functioning at different levels – ecosystem or landscape, agricultural system and inter- and intra-species diversity, with interactions between the scales contributing to overall system resilience through a) the links between natural and cultivated landscapes; b) the supportive role of agriculture in the protection and restoration of ecosystems; and c) the maintenance of species and genetic diversity (PAR, 2010).

Agro biodiversity management is not a separate activity undertaken with the explicit aim of conserving individual species, varieties or breeds, however, but is part of the day-to-day livelihood strategies of people throughout the world. Different components of agro biodiversity are used by different people at different times and in different places, contributing to the development of complex livelihood strategies (FAO, 2005). Women's role in agro biodiversity stewardship has gained greater recognition over recent years. An FAO study (2005) suggests that gender-differentiated roles in agro biodiversity management mean that women often have greater knowledge of indigenous plant varieties, with important nutritional and medicinal values. As the keepers of seeds, women often possess knowledge of a variety of genetic resources to adapt to varying climatic conditions such as resistance to drought or pests. On the remote Yap islands in Hawai'i women's knowledge of island hydrology helped them to find potable water and build new shallow wells during an ENSO-related drought (Anderson, 2009). Women are 'closer to nature' because of fixed, natural roles. If they have greater specialization in certain tasks, this is because of gender roles which are socially constructed and can change (Nelson et al, 2002). Unchallenged assumptions can lead to reinforcement of gender stereotypes and myths about the social appropriateness of different roles.

In an analysis of projects involving agro biodiversity and climate change adaptation (PAR, 2010) it was found that many are initiated and managed by local women's groups. For example, in India women's groups have been involved in the revival of traditional seeds and the establishment of community seed banks. In Sri Lanka, a women's-led project has been promoting the cultivation of indigenous roots and tuber crops, organic agriculture and integrated pest management and seed bank development. In Senegal, women's groups are involved in ecosystem protection and restoration projects (e.g. mangrove nurseries and reforestation). Women's collective action is a critically important route to women's empowerment as long as it addresses their strategic interests (e.g. their ability to claim their rights) as well as their practical needs, because otherwise their work demands may increase without concomitant changes in power in household and community level decision-making.

4.3 Climate change, livestock and gender

The literature on climate change and livestock (Thornton et al. 2009 is a good example) contains very little explicit discussion on gender and women's roles. Climate change is expected to impact upon livestock productivity directly, making breeds with greater heat or cold tolerance more attractive and indirectly through the impacts on feed and fodder availability and quality, as well as presence of disease and parasites, water availability etc (Thornton et al. 2007, and 2009) and complex patterns of spatial change and adaptations may affect the picture as well (Drucker *et al*, 2008). More understanding is needed of the gendered nature of climate change impacts on small stock and livestock in different farming systems in different parts of the world.

The literature is heavily biased towards cattle and away from small ruminants, pigs and poultry, especially in backyard or scavenging systems. Because these systems are particularly closely associated with women (Campbell et al. 2005) this species bias is also a form of gender bias. Much more understanding

Box 9: Gender and livestock

- Livestock represent one of the most important assets and sources of income for rural women in developing countries. Women in rural areas also invest a large part of their time, labor and expertise in agricultural and livestock production. Small stocks are particularly closely associated with women. While there is huge variation around the world, the day-to-day labor of caring for small stock is almost certainly mainly done by women (and to some extent children). It is therefore important to consider gender in any attempt to develop small stock production, and also to consider species differences in attempts to develop livestock production for women
- Women are also more likely to be considered the owners of small stock compared to larger livestock, and to have a say in the disposal and sale of small stock and small stock products, and in the use of income from this.
- However women may also contribute a lot of labor to intensive cattle production systems that take place in or near the home ("zero-grazing" or "cut and carry" systems). Their contribution here may involve gathering and processing fodder for cattle, as well as processing milk and managing manure for soil fertility

Source: Campbell et al, 2005.

is needed of the gendered nature of climate change impacts on small stock, and livestock in general, in different farming systems in different parts of the world.

In Morocco, under conditions of declining rainfall and increased urban demand for livestock products, cattle production is intensifying, while there is an increased trend to backyard fattening of sheep for religious festivals (Nassif, 2008) "Improved" dairy cattle breeds give more milk, but demand more labor from women in carrying fodder, feeding, watering, milking and cleaning stables. Sheep fattening is especially demanding in terms of drawing and fetching water, in some regions from distant deep wells, as well as greater needs, relative to extensive sheep production, to keep pens clean and prevent diseases. In both cases, women's work is seen as an extension of their reproductive role, both by their families and officialdom, and they continue to be excluded from information, education and training opportunities, and credit. The loss of certain livelihood activities may undermine traditional roles, undermining gender identities with risks of increased social tension and opportunities for positive social change in the form of women's empowerment.

4.4 Gender & agricultural adaptation: Case studies

The available evidence is minimal on gender and actual agricultural adaptation. A small number of case studies are emerging in which gender is being analyzed in adaptation processes.

Firstly, a case study of the gender dimensions of climate change, in relation to participation in decision-making, divisions of labor, access to resources, and knowledge systems is described in box 10. It draws on insights from an on-going, cutting-edge project of action research on agricultural adaptation to climate change in Tanzania conducted by the Institute of Resource Assessment, University of Dar es Salaam, with support from the Natural Resources Institute, University of Greenwich[6]. The project aims to support learning on how to strengthen capacity at individual, organizational and systems levels

6. This action research project covers both Tanzania and Malawi, is funded by the IDRC-DFID Climate Change Adaptation in Africa (CCAA) programme

Box 10: Gender and climate change - a situation analysis from semi-arid Tanzania

Farmers are already coping with climatic variability and non-climate stressors (endemic poverty, rapid population growth etc), which limits people's capacity to adapt. Agriculture will most likely be affected by climate change in a number of ways (e.g. reductions in crop yields, size of areas for crop production and grazing, increases in pests and diseases). Predictions for East Africa are uncertain, but crop production in Dodoma is thought to be likely to be negatively affected. Situation analyses conducted in Dodoma region were analyzed using a 'gender lens':

- The study found that a high degree of consensus in local observations of climate change across social groupings and these observations are consistent with scientific projections.
- Increasing unpredictability of the rainfall season has led to more people having to use oxen ploughs. Whilst the position of women varies, many said they were struggling with increases in demands on their labor combined with increased need to hire oxen ploughs to which they have lesser access generally than men.
- Unpredictable rainfall, declining soil fertility and increased incidence of some pest and disease problems are leading to more frequent crop failure and increased yield variability. To secure sufficient food farmers have to cultivate larger areas of land and these problems are contributing to the increase in seasonal (mainly male) outmigration.
- Voluntary seasonal migration is not a new coping strategy but it is increasing, straining family relationships and contributing to the spread of HIV – particularly affecting women's wellbeing and undermining the confidence of young people in rural futures. Male outmigration also adds to women's work burden in Dodoma.
- Children, women, elders, widows, widowers, orphans and the long-term sick were identified by villagers as being amongst the poorest and most vulnerable to climate change, because of their increasing inability to secure food in times of drought. Women with children are less likely to take up wage labor opportunities because of their childcare responsibilities and cultural constraints. Increased food shortages are reported to be affecting the health of women, because they eat fewer, poorer quality meals per day, so increasing climate variability is increasing existing inequalities.
- Farmers are changing the crops they are growing, with greater cultivation of drought-tolerant crops in response to government advice, market signals but also due to increased climate variability. Faster maturing sorghum varieties are being taken up because of the shortness of the rainy season nowadays. Changes in the balance of crops grown can lead to shifts in control of income and labor requirements for female and male farmers. The increasingly frequent need to replant annual crops is widely reported, because of rainfall unpredictability and undermining crop yields and quality –with mixed gender impacts.
- Prolonged extreme events (e.g. longer droughts) can lead to farmers having to sell off assets to get food. Collection of fuel wood and water tend to be seen as women's work but the availability of these resources (and the health of other ecosystem services) may be affected by climate change, especially where this is compounded by localized degradation. The specific impacts of climate change will depend on gendered entitlements to resources and gender norms.
- Adaptation strategies should build upon local and indigenous knowledge of agro biodiversity, but the limits to adaptation and the combined effect of stressors (climatic and non-climatic) must be kept in view.

Source: Nelson and Stathers, 2009

through a shared learning process. It involves farmer learning groups trying new practices on shared plots as well as the establishment of sub-national multi-stakeholder learning platforms and national consultation groups. A gender lens was used by NRI researchers to review the Tanzanian situation analyses to understand how female and male farmers are already coping with climate variability and non-climate stressors.

The adaptation strategies identified by farmers in the CCAA project include crop diversification, use of drought tolerant crops and varieties, adoption of ox-ploughing (for faster planting), planting in holes to save water, intensification of livestock production, access to credit, tree planting. The CCAA project outlined above is working with farmers – female and male - to implement new techniques: water harvesting/tillage; new implements; planting and thinning; new varieties; fertility management; pest management, raising of awareness among project farmers, neighbors, village leaders and extensionists, developing a new culture of learning and sharing (Morton, 2010). In the central zone of Tanzania, women in the learning group have adopted a spring jembe – a longer, narrower hoe than is normally used – because goes deeper than other hoes and helps trap rainwater and moisture in the soil. Women in the learning group interviewed say that it is more difficult to use, but does produce higher yields (T. Stathers, NRI, *pers.comm*).

Ziervogel, *et al*, (2008) provide a gender analysis of on-going work in Zambia on climate change adaptation. In some areas of southern Zambia the rains are starting a month later than in the past, and there has been a lengthening of the dry spell. All households reliant on rain fed agriculture may be vulnerable, but in some other areas, it may be necessary to work only with the most vulnerable, who may be women or children. Better vulnerability indicators are needed for monitoring of differential vulnerabilities, and how these change over time. In Mozambique loss of life in the 2000 and 2008 floods served as benchmarks, but it would be useful to have more nuanced indicators that enable post-disaster event responses to strengthen livelihoods where needed and address issues of social protection, risk management, economic losses, and risk transfer.

Thirdly, eight community case studies in four southern African countries were conducted assessing gender differentiated impacts of climate variability and change (Petrie, 2010). An overall conclusion relating to smallholder farming is that both women and men should receive training, improved climate resistant seeds and financial capital and that gender representation in a process of trade barrier reform is needed. Government officials and decision-makers should interact with rural communities, especially involving participation by women in decision-making. Sensitization programs should be implemented to challenge gender stereotypes, and early warning systems established providing information on timing, length and adequacy of rainfall to female and male farmers. Microfinance programs should be extended to smallholders, particularly women, as well as improved access to safe water and markets – again particularly for women (Petrie, 2010).

Fourthly, a study of the gender aspects of food security in the context of climate variability and change in Andhra Pradesh, India (FAO, 2010) is one of the few other studies to have conducted in-depth fieldwork with smallholders. This study had the explicit aim of understanding the gender dimensions of climate change in agriculture.

The FAO study (2010) confirms that women and men are being differently impacted by climate change, especially extreme events, and have different strategies for coping with longer-term increases in climate variability combined with differential access to institutional support for adaptation. Gender often determines who receives inputs for adaptation strategies, with gender being the biggest determinant (even more so than caste). Frequently new agricultural technologies bypass women farmers, despite women's knowledge. For example, extension personnel introducing new varieties intended for higher drought or heat tolerance rarely speak directly with women farmers.

Box 11: Climate adaptation and DRR in southern Africa

- Women can be vulnerable to low rainfall and drought because during these times they often have to fetch water and firewood from further away.
- When there is low crop yields and food insecurity, many people seek casual work and use the earnings to buy food and meet basic household needs. In rural areas people often mould bricks, do piece work on other people's farms and in town many do construction work. Both men and women engage in these activities, but men are more likely to search for wood to make charcoal and then have to travel far distances into town to sell it causing a shortage of labour in the fields resulting in women doing more of the work.
- In 2 adult households, both adults seek work and collectively they earn more money than single headed households, but in Malawi it was noted by some it can be easier for the woman in a female headed household to go out and try to find work without constraint whereas a woman with a husband first has to look after him first and ask his permission to work elsewhere.
- When yields are low and there is income insecurity, crime and prostitution often increases. Some men run away from their responsibilities, only returning when there is food in the house. Some women resort to prostitution to get food for the children in critical months (December to January) especially when male household members are absent with a resultant increase in the spread of HIV.
- Women play an important role in disaster responses, especially in the recovery process. Women should be explicitly engaged in developing DRR and adaptation strategies.
- Differential and dynamic vulnerabilities need to be assessed in order to prioritise, design and target adaptation responses, i.e. national vulnerability assessments may help to identify key areas to target, but effective responses will need to be based on a more nuanced understanding of intra-community and even intra-household vulnerabilities

Source: Ziervogel et al, 2008. Commissioned by Oxfam GB, Stockholm Environment Institute, Gina Ziervogel, Anna Taylor, Sepo Hachigonta and Juan Hoffmaister, July 15 2008. 'Climate adaptation in southern Africa: Addressing the needs of vulnerable communities'.

4.5 Beans, gender and climate change

Beans are important in African livelihoods and economies, yet they are widely undervalued by farmers and in local communities because they are seen as a women's crop. Robertson (1997) explores the history and significance of beans amongst Kikuyu and Kamba peoples in the Nairobi area. She argues that dried beans are a women's crop, a women's trade commodity and a pre-eminently a women's food, and under colonialism women struggled to control their own produce in resistance to agricultural imperialism (through the expropriation of land, labour, profits, plant genetic materials and the imposition of foreign priorities on farmers in central Kenya). Women asserted themselves through crop choices, selected multi-purpose hardy crops suitable to Kenyan conditions and rejecting some ill-judged export attempts. The British emphasized commercial agriculture and the introduction of new bean varieties leading to the dominance of imported *Phaseolus* varieties over and above indigenous ones such as *njahe*, which were marginalized alongside the Kikuyu religion that they symbolized. They have also had to given in as well, however, under the pressure of preferential pricing and high labour demand with negative impacts on their diet and wellbeing. The colonial emphasis on maize also displaced all beans to some extent. After independence discriminatory pricing continued but red varieties preferred by many Africans gained greater importance and became the focus of export efforts. Perhaps because most

Box 12: Gender, climate change and smallholder farming in Andhra Pradesh

An eighteen month study in six villages in the drought prone areas of Andhra Pradesh, explored how farmers reliant on rain-fed agriculture cope with extreme drought events and longer term changes and identified the adjustments they are making to their livelihoods and new food security coping strategies being adopted. These are:

- Participatory tools were used in focus group discussions including: a water resources map comparing thirty years ago and now; seasonal calendars of past and present typical rainfall patterns, farm activities and major livelihood opportunities, including migration; a web exercise on drought vulnerabilities and coping strategies to capture farmer perceptions on the causes and effects of a major past drought event, and the impacts and responses, especially with regard to food security; food security annual calendar to identify the availability and distribution of food in the household and in the community over the course of a year.
- A quantitative survey was also carried out with 200 male and female farmers (separately and together) to quantify the trends emerging from the focus group discussions.
- A meteorological analysis was also conducted for key indicators of the region to depict the climate variability and trends of the past 40 years to compare to farmer perceptions of change. Key persons from national and international institutions were interviewed.

The study finds include the following:

- Male and female farmers are facing multiple challenges (including deforestation, indebtedness, and chronic food insecurity), but farmer livelihoods are no longer based solely on agriculture.
- Both men and women farmers are observing weather changes over the past 30 years, but the impacts are viewed differently. Women report that the changes have affected health, and men are more likely to report impacts on farm production.
- There are gender differences in terms of who is impacted by extreme events (with higher numbers of women indicating that women are most affected by drought compared to the v iews of men).
- There are gender differences in preferred strategies for coping with long-term increases in climate variability, with men undertaking migration and women seeking wage labour.
- Men and women have different strategies for coping with food scarcity.
- Whilst both women and men farmers lack access to information on weather alerts and cropping patterns, this lack of access is more acute for the former.
- Gender is also the most important predictor of access to institutional support – more than caste or size of land holding.
- • Gender does make a difference to farmers' daily responses to climate shifts in South India and to policy-makers providing long-term institutional support and more understanding is need of gender differences in access to resources and in selecting coping strategies. Adaptation planning must be founded on men and women farmers' knowledge and experiences.

FAO, 2010

Box 13: Bean diversity, women, and religion in pre-colonial Kenya

Available evidence indicates that, in pre-colonial times, a large variety of different bean species was cultivated in the Kenyan uplands. Beans, moreover, constituted a critical element of the diet of rural people as they furnish a rich source of protein to complement maize consumption and other available foodstuffs. In particular, the varieties of indigenous black beans named *njahe* in Kikuyu (*Lablab niger* and *Dolichos lablab* by their scientific names) were cultivated by women, and made up a good proportion of the harvest. Njahe had, moreover, special meaning for women, as the bean was considered to increase fertility, and to have curative virtues for postpartum mothers. It was, at the same time, a quasi-sacred food as the beans grew on the Ol Donyo Sabuk mountain, which is the second most important dwelling place of the Creator in Kikuyu religion, and was widely used in divination ceremonies. Beans in Kenya are predominantly a small landholder crop, largely farmed by women to feed their families. Traditionally, women tended to grow multiple varieties on the same field – and saved multiple seed stocks – as a hedge against disease and unpredictable climate. Furthermore, local dishes, such as *githeri* and *irio*, were based on multiple types of beans.

Source: FAO, 2005

beans were consumed locally, however, local needs and preferences reasserted themselves but beans and women's labour are still widely undervalued in agricultural development and in local communities.

In Kenya women are using diverse bean varieties to achieve their livelihoods, growing different varieties on the same field and saving multiple seed stocks to spread risk against disease and climate variability. As the climate changes it is therefore clear that this knowledge will become even more essential, although new challenges may be presented (e.g. spread of existing bean diseases to new areas, greater heat stress, combined flooding and drought) requiring external assistance in joint innovation processes. The constraints on production for women flowing from gender inequalities – e.g. of unequal access to and control over land and labour in growing beans and for other livelihood activities – will remain or be exacerbated by climate change processes unless specific actions are taken to transform thinking, policies and practices.

In Tanzania, studies have shown that (mainly female) farmers are growing beans and are expert managers of *Phaseolus* bean mixtures, conserving and enhancing bean types through the process of selection and use. However, other stakeholders have alternative narratives which reflect the lack of value placed on beans and of the knowledge of women in managing bean mixes.

The focus on modern variety seeds and other inputs has two flaws for smallholder producers: firstly, commercial seed varieties may be less suited to farmers' specific agro-ecological environments, for which landraces may be more appropriate and secondly, the expansion of area cultivated with commercial seeds can accelerate crop diversity erosion. Governments therefore face two challenges: to ensure that commercial seed systems raise aggregate yields, but also benefit the most vulnerable and to support farmers' seed systems, for those farmers dependent upon them and for global long-term food security (Lamboll et al, 2010). Ideally, farmers would be able to choose between commercial protected seeds and seeds from alternative seed systems. Beyond seed-related issues many other factors contribute to the vulnerability of smallholders, such as access to land, declining soil fertility and access to markets – all of which have gender dimensions. Understanding seed systems in the context of broader

Box 14: Farmer management of *Phaseolus* beans: agro biodiversity conservation in the Southern Highlands of Tanzania

In the Southern Highlands of Tanzania, *Phaseolus* beans are widely grown for food and sometimes for cash. Many farmers, particularly women, are expert managers of bean mixtures manipulating the composition of different bean landraces or varieties according to a range of criteria and responding to changes in the broad environment over time and providing a valuable pool of genetic diversity. Key criteria are: biophysical (e.g. resistance to drought, pests or diseases); agronomic (e.g. suitability to be grown as an intercrop); socio-cultural (e.g. taste preference, use in ceremonies); and economic factors (e.g. high demand from buyers). ''Everybody has their own system" for selection according to one farmer, with the number of components reaching 25 in some cases, with the aim being to find all the required characteristics to cover seasonal and annual climate variability. Farmers have to balance home use and marketing with taste preferences. Beans that store well are likely to take longer to cook. Farmers need to store at least some beans, whereas urban consumers are better placed to buy as required, and emphasize shorter cooking times which reduce fuel costs. In most households beans are eaten at least once a day and diversity provides for a range of taste. Instead of growing different bean landraces or varieties on different plots, farmers mix the beans in the same plot, because then 'you can't miss' as one farmer said. A mixture containing disease-resistant and susceptible components means that, if disease pressure is high, there will still be a harvest. Resistant landraces or varieties can act as buffers to diseases spread by rain splash, and that if an infected plant dies, neighboring healthy plants can make use of the space and resources made available. Planting beans with different maturity periods spreads risk over a longer period of the season and the harvest period is longer, which may also be desirable.

Farmers are clearly planning for diversity, but there are also unplanned and negative aspects. For example, most farmers do not appear to be consciously making use of new genotypes resulting from out-crossing and often select them out from mixtures prior to planting. Small-seeded beans are often not considered useful and, if time is available, may be removed from a mixture prior to planting. Mixtures fetch a lower price at market than single bean types, and are time-consuming to separate. Agro biodiversity is valued, maintained and enhanced by farmers, and contributes to their livelihoods (e.g. food security and income). Crop management practices used by smallholders to produce bean mixtures are less destructive to the environment and the renewable natural resource base than the use of agrochemicals. The common bean as a rotation or intercrop contributes to nutrient recycling, pest and disease management and soil maintenance, benefiting other crops and vegetation. By growing a range of bean types the risk of total crop failure due to biotic and abiotic problems is reduced, with benefits for household food security.

Bean types are derived mainly through informal seed systems (relatives and markets) and come from within the Southern Highlands but also other parts of Tanzania and neighboring countries. There is little evidence of loss of bean types at the community level, and among individual farmers and communities there are many examples of gain. Farmers' strategies have achieved both conservation and enhancement through the process of utilization. Improving the above seed systems through the introduction of modern varieties is very challenging and likely to be incremental. Although farmers may incorporate a new variety into a mixture it would only be one of many components. A key point is the different perceptions of stakeholders as to why farmers grow beans in mixtures – one senior extensionist who had been working in the area for many years simply thought that farmers couldn't be bothered to sort out the different components of the mixtures.

Source: Bisanda (2000), Teverson (2000) in Lamboll, et al, 2002

cropping systems and livelihood systems is critical and to do this requires an in-depth understanding of how gender and social difference shapes the division of labor, crop decision-making, seed choices etc.

To improve seed systems firstly requires a better understanding of seed system dynamics in a particular locale including gender dynamics. Capacity building is needed in variety development with support provided to ensure women can participate and that extension advice is tailored to their interests, that there are sufficient numbers of female extension workers and that extension channels and media are gender sensitive. Participatory plant breeding and varietal selection should involve farmers and other stakeholders from the beginning to address farmer needs and to incorporate new varieties and genes into farmers existing seed systems. Given women's primary role in bean cultivation it is clearly very important that women's participation in participatory plant breeding is supported to produce appropriate technologies.

Small seed pack experiments are being undertaken to make seed and fertilizers more accessible to small farmers (e.g. in Kenya) combined with training on production constraints for farmers (e.g. using charts to distinguish between disease symptoms and soil deficiency symptoms) (R. Lamboll, *pers.comm*.). However, there are questions about the sustainability of community based seed projects after donors end funding, although they can be useful to achieve short-term objectives – but more impact assessment is required including gender disaggregated data gathering.

To improve farmer seed systems requires new strategic partnerships and investment to build farmer capacity in managing their own seeds (in-field selection, storage) and improving access to new genetic material. However, there appears to be limited knowledge, even within the public sector, of germplasm management and with interest in farmer saved seed (R. Lamboll, *pers.comm*). Understanding and challenging the dominant narratives and views of key secondary stakeholders which regularly undervalue, overlook and consequently marginalize women's work and knowledge is also an important part of supporting agricultural adaptation to climate change that is equitable and gender sensitive.

4.6 Localized, gender sensitive adaptation

Adaptation is likely to require protection and restoration of ecosystems, diversification of agricultural landscapes, and the protection and use of agro biodiversity, but the actual choice and design of specific strategies have to be based on *local* experiences of climate change, needs, resources, knowledge and agricultural traditions (PAR, 2010). Localized, participatory adaptation processes are urgently required. Building gender awareness and action is of critical importance amongst all stakeholders in this active process of adaptation and change otherwise the outcomes will only worsen the position of women and marginalized groups. The impact of climate change is likely to worsen the exclusion of women involved in agriculture, due to their lack of fertile land, and increased risks of, for example, *both* flooding and drought.

Support should be given to women not only to allow them to undertake preventative measures, gain access to adapted seeds, but to enable them to control decisions on the management of trees (e.g. multi-purpose tree species), i.e. meeting strategic adaptation interests of women and men, as well as meeting practical needs. Taking steps to strengthen women's land tenure rights is also a fundamental feature of equitable adaptation which responds to women's strategic interests. Project budgets should be analyzed to ensure that not just women's *practical* needs (drought-resistant crops, access to water) are met by adaptation interventions, but also their *strategic* needs (land ownership, participation in decision-making, reproductive health) are addressed (UNFPA, 2009).

5. Engendering agricultural adaptation research

More attention should be paid to the gender and social difference dimensions of climate change and adaptation processes. This paper has attempted to demonstrate how gender and power relations clearly shape vulnerability and ability to respond to climate change, although the dynamics vary from place to place. Work is still on-going to develop an understanding of what represents effective approaches to agricultural adaptation to climate change. Few studies explore the gender dimensions of agricultural adaptation.

The punitive timescales of climate change demand rapid action and the uncertainties and smallholder agriculture complexities require localized, learning processes. The need to respond to climate change challenges development researchers and practitioners alike to reflect upon whether approaches, methods and policies build adaptive capacity and resilience or if not, what changes are needed.

Climate change introduces *new challenges* (e.g. new climate risks or shifts in cropping zones) and presents challenges on a completely *new scale* with high levels of complexity (compound effects of climate change and other stressors). Incremental changes in varieties and practices may become insufficient as the rate of change becomes too fast for autonomous adaptation by farmers (Morton, 2007). Farmers (and local decision-makers) will need assistance in looking beyond the next few years and current patterns of climate variability to longer term timeframes (Morton, 2007) and potentially more fundamental strategic changes in policy, land rights and access, natural resources management, innovation capacity building, education are required etc (Howden et al, date; Boyd et al, 2009).

Key areas of action to tackle gender inequality and promote women's empowerment include:

- **Building the voice, leadership and collective action of women farmers**

Efforts must be made to build the voice of women and marginalized groups to counter and challenge inequitable norms and power relations. Participatory processes should seek to support women farmer's participation and influence in adaptation decision-making at local, district, national and international levels. Convincing key actors and decision-makers of why gender matters is important through in-depth specialist studies, but also through direct dialogue and exchanges with rural women. Participatory video can used to support women's research at the local level and communication of their concerns to wider audiences, including direct dialogue with policy-makers.

- **Gender and agricultural innovation systems**

Agricultural innovation processes in the light of climate change need to be decentralized to cope with the diversity and local specificity of smallholders systems and of gender dynamics. Participatory, multi-stakeholder learning processes should be facilitated, involving different actors from the value chain and across the agricultural innovation system. An important first step is to identify all the agricultural innovation system and value chain actors – and the broader context of social and gender dynamics in which these actors operate.

Shared learning plots at local level for testing of possible new adaptations, should be based upon existing innovation by local farmers – but should include women farmers groups as well as male farmer groups. Farmer to farmer exchanges, participatory video, and farmer field schools can all be used as part of this learning process, supporting women and male farmers to collect their own weather data, for example, and to practice response farming (changes within the season in response to climate variation). Again steps should be taken to ensure that women farmers are supported to participate in this process.

Learning platforms can be established at different levels to enable learning by wider decision-makers and service providers and for scaling up purposes. There are on-going programs of action-research, but more emphasis is needed for understanding social and gender dynamics as climate change shocks and stresses increase. Women farmers and marginalized groups should be supported to participate as well as men in district, national and international exchanges of findings.

- **Gender, agro biodiversity and climate change**

Given the growing recognition of the importance of agro-biodiversity in maintaining farming system resilience to climate change and other shocks and stresses, take steps to raise awareness amongst agricultural research and extension professionals of the value of women farmer's and well as male farmer knowledge and practice in this regard. It is important to challenge narratives of agricultural development which ignore the importance of agro-biodiversity and farmer's own innovation in adaptation (as well tackling the structural obstacles to positive change) and the role of many women farmers (e.g. in bean seed selection) in sustaining this agro biodiversity. It is important not to generalize and associate women with nature as an inherent characteristic, but at the same time where women do have specialist knowledge and capabilities these should be the starting point for action.

- **Gender Impact Assessment**

New social and technical innovations for adaptation to climate change must be developed through localized, participatory processes of learning and action, with steps taken to support women's participation as well as that of men. Impact assessment must be carried out of climate change adaptation projects to assess who is being affected and how. For example, new crop index insurance schemes, or local collection and reading of rainfall and temperature data as part of approaches promoting response farming, should all be accompanied by impact assessment, and in which gender analysis should be an integral part.

A whole range of agronomic and farm level innovations may be developed as part of participatory adaptation to climate change, and a gender analysis should explore how these innovations are changing gender and social dynamics to avoid exacerbating existing inequalities and to maximize positive outcomes:

- Cropping adaptations (*timing, locations, altitudes*)
- Modifying inputs (*resistant varieties/species to heat drought/shock*)
- Improved soil & water management (*e.g. fertilizer amounts & timing, irrigation technologies*).
- Plant breeding (*long-lead times, crops may not be appropriate once developed, need for wide crosses*)
- Crop & LH diversification
- Protecting crops (*shade netting, polytunnels, wind breaks*)
- Agroforestry (*Tree shade in tea, coffee, & cocoa to reduce temperature effects on sensitive crops & for nutrient recycling. Requires forward planning*)
- Pest & diseases: *more resistant crop varieties, different weed management practices*

Where weather and seasonal forecasts are being shared with local communities, attention is required as to how different people are interpreting this data. Their interpretation will be shaped by past individual climate experiences, cultural ideas of the climate and the reasons for changes in it (e.g. spiritual beliefs in gods influencing rainfall) and their actual or perceived ability to adapt (based on access to and control of livelihood resources). Gender and social dynamics will thus play a role in how users interpret climate data and if and how they act upon it.

Monitoring and evaluation processes should track a range of actors in the innovation system, including farmers, but also extension staff, NGOs, input suppliers, researchers, meteorological staff, and media. Monitoring should investigate who is benefiting, who bears the costs, as well as unexpected outcomes and who is making decisions within the household, local community and beyond.

- **Gender and Value Chains**

Conventional value chain analysis emerged as a tool for unpacking commodity supply chain structures and relationships between chain actors (Porter, 1985). Participatory value chain analysis (see e.g. Albu and Griffiths, 2005) involves identifying the key actors and their functions in a value chain, the actors providing supporting services (e.g. input suppliers) and the enabling environment (policies, laws, regulations, informal institutions, trends) in joint analysis with local stakeholders. More recently the horizontal dimensions of value chains (e.g. the social, gender and environmental dynamics and impacts) have been given much greater attention (social impacts, gender and environmental dimensions of value chains and Nelson and Galvez, 2000; Nelson, Tallontire and Collinson, 2002; Nelson, Martin and Ewert, 2007; Barrientos and Smith, 2006; Barrientos, Dolan and Tallontire, 2003; Martin et al, 2006; Bolwig *et al*., 2008; Riisgard *et al*., 2008; Tallontire, et al, 2009; Neilson and Pritchard, 2009; Nelson, forthcoming). Much of this work has focused on global value chains (including certified chains), however, and more analysis is needed of gender in non-export value chains, particularly in crops in which women often play a critical role. This kind of analysis may help to reveal how power relations operate in the value chain, how and where barriers and opportunities exist, preventing women's participation and what potential there is for value chain upgrading.

All smallholders face barriers to participating in value chains, but women in particular may not have sufficient access to credit, and other inputs to enable them to benefit. Women tend to have lesser access to formal education and formal work, and face poorer working conditions in many agribusiness operations and estates. Smallholders may participate in value chains linked to larger companies through contract or out-grower farming schemes. There are some recent examples from biofuel value chain studies (e.g. palm oil in South East Asia) where smallholders have become indebted to larger companies as they use the latter's services but then their yields are not sufficient to pay the company back (Schott, 2009). Other studies indicate that smallholders may benefit significantly from support from private companies, particularly if they are backed up in negotiations to achieve fair and transparent contracts (Kudadjie-Freeman, et al 2008). The gender dimensions of contract farming and out-grower schemes are underdeveloped in the development literature, but there are clearly barriers to the participation of women and female headed households in many such business models.
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There are many other business models in which smallholder farmers may participate and upgrading of roles in the value chain may enable smallholders to capture more added value. Examples include leases and management contracts, tenant farming and sharecropping, joint ventures, farmer-owned business and upstream and downstream links (Vermeulen and Cotula, 2010). Again, as with contract farming and out-grower schemes the gender dimensions need consideration (see USAID, 2009). What roles do female and male farmers have in such schemes? Do they have decision-making influence or management roles? Are they benefiting from the income earned? Have their workloads changed? As the climate changes there may be new pressures on value chains and participants and issues of resilience come to the fore? In supporting increased smallholder participation in value chains and in considering the gender dynamics of this, it is also important to bear in mind relative vulnerability to shocks and stresses. Does the development of new business models and upgrading of smallholder participation lead to greater or lesser resilience to shocks and stresses? How are women and men differently affected by this?

- **Better understanding through specialized studies of gender dynamics, beans and livelihood processes.**

Although there has been increased recognition of the importance of beans in overall livelihood systems, the knowledge, labor and priorities of women farmers is still often undervalued. The symbolism, diverse perceptions and power relations behind bean decision-making in local communities and amongst different innovation system actors should be explored in a small number of different agro-ecological situations. Although such studies cannot provide generalizable findings, they can be an important tool in demonstrating *why gender is important* to decision-makers and scientists. They can also form an initial part of participatory action research processes. These studies should seek to provide nuanced and sophisticated analyses of how climate change pressures will interact with other pressures to change local gender dynamics.

Background

- What is the national gender context? (Laws, policies, levels of awareness)? Have there been improvements in gender equality?
- How far do national adaptation strategies take into account gender issues?
- Characterize agricultural innovation system actors? What level of gender and climate knowledge do these actors have?

Participatory research

- What are women's and men's respective roles in household livelihood strategies?
- What are the other key forms of social difference at community level? What are the coping and adaptive strategies currently used by poorer and better-off groups?
- What is the gender and social division of labor in farming and livelihoods?
- What are the challenges that female and male smallholder farmers face?
- Who has power in decision-making within the household, at community level and at national level? How are these roles and power relations changing with climate change and adaptation programs?
- How are patterns of resource rights, access to and control of livelihood resources gendered and socially differentiated?
- How do diverse women and men interpret the climate?
- What are the main climate risks and who do they affect?
- Do women and men observe (different) changes in the climate? If yes, how do women and men say these changes are affecting their livelihood activities? (Including frequency and strength of disturbances).
- How do diverse groups of women and men see the future?

Social scientists have lagged behind in climate change arenas, but are now required to work with climate scientists and agricultural specialists to identify impacts and find appropriate solutions jointly with local communities in a gender-sensitive manner. Gender specialists are needed to inform this research

- **Identify policy and broader systemic changes required for more equitable development**

Multi-stakeholder processes are needed (for example involving government at various levels, and the private sector, alongside farmers and researchers), to incorporate wider perspectives and to feed upwards into policy and investment decisions. Women's participation should be supported at levels in such multi-stakeholder learning and action processes.

Capacity building support should reach and prioritize key stakeholders and vulnerable groups, including women and marginalized groups (children, the elderly, ethnic groups, the very poor etc). Such processes need to open up spaces for new alternative framings and narratives about what are desirable

development paths, what are key development priorities, what makes a agricultural system resilient, and what are the key trade-offs in particular decisions. Improved mapping and modelling of climate impacts and visualizing (also known as *backcasting*) based on this information and stakeholder debate (see Chapin et al, 2009) can increase attention to likely possible future development pathways for specific regions, landscapes and communities and the role of agricultural adaptation. Attention should be paid to gender issues and the involvement of women as well as men in such processes, because otherwise the interpretation of maps and models and the debates on desired futures will be gender blind and could exacerbate gender inequalities. Instead, such processes should consider what the future might look like with greater gender equality, because there could be opportunities to demonstrate a better future for everyone – rather than gender equality representing only a threat to vested interests.

Key determinants of gender inequality need to be identified at national level and increased action taken. For example, tackling women's (and men's) weak and insecure land tenure rights requires action through policy reform (removing systemic discrimination in laws and policies), capacity building (e.g. training women on their land rights) Etc.

Such processes of participatory planning and explore future pathways of development are also important because they can enable consideration of the limits to adaptation. How are livelihood systems changing for different social groups and how might they change in the future as the limits to adaptation are reached? What can be done now to avoid these scenarios (such as support for livelihood diversification or migration/resettlement)? A foresight function of this nature is critical given the increasing complexities of decision-making for planners, plant breeders etc in the light of climate change and the need to look beyond the next few years. Consideration of gender and social dynamics is particularly important. In many parts of Sub-Saharan Africa, rural populations are ageing and feminizing, presenting significant challenges for those left behind and indeed the urban populations that depend upon their food production.

- **Setting research priorities**

More knowledge is needed of the responses to climate change of a broader range of crops, livestock and wild species of relevance to smallholders and subsistence farmers. It is critical that crops and livestock of importance to female farmers and female-headed households (e.g. beans, tropical root crops, sorghum and millet, small livestock including scavenging poultry) are given appropriate priority for investigation in relation to climate change impacts.

Assisting agricultural adaptation (e.g. new varieties, improved soil and water conservation including use of new tools) requires careful interdisciplinary and participatory research. *Gender-sensitive* participatory action research to develop appropriate agricultural adaptations (technological *and* social innovations) in crops and livestock in the light of climate change is needed. For example, if the storage and marketing of smallholder crops is affected by climate change (e.g. losses to insect pests and pathogens of crops stored on-farm or by small traders, damage in transport, indirect costs of being able to store less on farm and more vulnerability to seasonal price swings) (Morton, 2007) it is important to discuss with different social groups including women and female headed households to see how they may be differently affected by such challenges.

More understanding is needed of how information flows between stakeholders can be optimized and what are the appropriate topics, media, approaches to learning etc that can involve women and marginalized groups more equally. Gender blindness in extension services is well-known and key steps are outlined in Martin and Nelson, (2008), e.g. targeting messages to needs of female farmers, recruitment of more women extension workers, etc

- **Organizational change and gender equality**

New approaches to agricultural innovation and learning systems provide opportunities to tackle gender inequalities and social discrimination, and for promoting greater engagement of women and marginalized groups because they involve a wider variety of actors and seek to change attitudes (Nelson, Martin and Yaye, 2008). However, to achieve this requires gender awareness and changes in incentives and organizational cultures. Above all political will and leadership is required to place gender equality and women's empowerment as a priority in any development organization's mission, rather than as a sideline.

Research implementation has to be responsive to gender and social difference and based on good practice in participatory agricultural planning (Nelson, Martin and Yaye, 2008). This involves two key elements (FAO, 1997a, p9): firstly, 'policy planning that responds to the different constraints, needs and priorities of different groups of farmers, where these differences are based on gender, socio-economic situation, age, ethnicity, religion etc'. Secondly, 'policy-makers and planners are aware of these differences and of how best to respond to them because men and women farmers from different socio-economic, age, and ethnic groups have taken an *active* part in planning agricultural development activities' (FAO, 1997a, p9). These perspectives need to be at the forefront of agricultural research for development informing not only theoretical understanding, but practical orientation. It has already been noted that some participatory research processes do not succeed in moving beyond fairly simplistic notions of gender roles, social differentiation and what constitutes empowerment (Cleaver, 2000) and so improvements could be made in existing programs through training and capacity building.

The organization managing research, such as a national agricultural research institute – and other actors in the innovation system - must be gender-sensitive in culture, structure and practices in order to achieve women's empowerment and gender equality (Nelson and Martin, 2008). It is not enough to demand this at the local level. A Forum for Agricultural Research in Africa (FARA) study of agricultural research across Africa concluded that gender issues were not raised systematically, the commitment and awareness of board members on gender was inadequate, the balance of female and male scientists is highly skewed, and greater engagement of diverse rural groups in framing research agendas is needed (FARA, 2006). Development organizations often reflect gender inequalities in wider society. These widely prevalent external gender disparities affect: who is qualified and available to work; patterns of staffing; training; promotion; career development opportunities, and setting of research priorities in programming etc. There have been successes in gender mainstreaming, but it is also important to analyze why there has sometimes been less success than expected. A whole range of tools and approaches are available for achieving gender mainstreaming, but achieving gender equality is fundamentally a political process, which challenges existing norms and power relations and in some places gender fatigue has been experienced (a great deal of rhetoric and little action).

In one sense climate change imperatives make these previously identified priorities and approaches only more urgent if climate change responses are to be equitable and not worsen inequalities. What hope then for the double mainstreaming of both climate change and gender into development processes given existing constraints and the scale of immediate, and compelling priorities? To some extent there are new opportunities for gender issues to be tackled head on as new funds, policies, programs and projects arise. But greatly increased lobbying and activities at international, national and local levels is needed to raise awareness and commitment to gender, social differentiation and climate change. It is not easy to be heard given the enormous amount of research, lobbying, negotiations, planning and action currently underway in relation to climate change. Tackling climate change imperatives is often likely to create synergies in achieving other development priorities, but the trade-offs and difficult decisions should not be under-estimated especially in an era of global financial instability and food security concerns. In this

context, it is critical that awareness is raised of why gender and social difference is not an *optional* extra, but an integral and necessary part of successful development and climate change responses.

Responding to climate change will most likely require new knowledge and understandings, new collaborations, actors and partnerships, as well as significantly scaled up responses in agricultural adaptation and more generally.

- **Climate is a cultural construct**

Climate is not just a scientific fact, but it is understood differently according to each individuals lived experience and the cultural values and norms through which climate events are experienced. The reasons why climate changes are occurring is understood through the lens of culture, occupation, personal experience etc and it is important in adaptation to understand, challenge and respond to this. For example, seasonal forecasters providing scientific messages to communities must understand that this information will play into on-going power processes and cultural interpretations of weather and climate, and farmer responses will vary according to their entitlements but also their trust in the external scientific package of information, and their own views of climate/weather patterns. Different cultural values and worldviews will inform priority setting processes as well as interacting with power relations in shaping who has what power to act (Roncoli et al, 2003).

- **New partnerships and linkages**

*Ex*ternal scientific knowledge on climate change is urgently needed in an accessible and appropriate form for different actors in the innovation system. It is important to consider how this information is shared, with whom, using what media and how this can be made more gender-sensitive. New partnerships may be needed with meteorological services. New linkages are needed between research communities (e.g. between disaster risk reduction and climate change adaptation practitioners and academics). New funding sources will become available creating opportunities – but it is important that gender targets and monitoring is conducted to ensure gender mainstreaming and support access for more marginalized groups. Funding will become available for both adaptation and mitigation and where possible actions should be supported that provide benefits for both (e.g. community based biofuel projects).

- **New skills, knowledge, awareness and attitudes**

Climate change is throwing up new challenges and as a result may require new skills sets. For example, agricultural graduates will need a wider set of skills and knowledge to enable them to work with farmers, and this includes awareness of the gendered and socially differentiated impacts of climate change (Chancellor et al, 2008). Farmers need more support than ever, especially where their indigenous knowledge cannot be applied to new situations (e.g. where new crops and cropping patterns are introduced, old skills are being lost such as in weather forecasting and knowing when to plant, or entire livelihood activities lost undermining masculine or feminine identities and causing great suffering). Climate change and agricultural adaptation debates need to be opened up to greater participation from smallholder farmers – particularly the voices and knowledge of women farmers, which is usually less well heard.

References

Adger W.N., Eakin H., and Winkels A. 2008. 'Nested and networked vulnerabilities to environmental change'. *Frontiers in Ecology and the Environment* May 2008
Available at http://www.esajournals.org/toc/fron/0/0

Adger, N.W., Dessai, S., Goulden, M., Hulme, M., Lorenzoni, I., Nelson, D. Naess, L.O., Wolf, J., Wreford, A (2009) Climate Change, 93:335–354.

Adger, W.N., S. Agrawala, M.M.Q. Mirza, C. Conde, K. O'Brien, J. Pulhin, R. Pulwarty, B. Smit and K. Takahashi, (2007): Assessment of adaptation practices, options, constraints and capacity. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 717–743.

Alber, Gotelind (2009) 'Gender and Climate Change Policy'. Chapter 9 in ed.s Guzman, Jose Miguel, George Martine, Gordon McGranahan, Daniel Schensul, Cecilia Tacoli, 'Population Dynamics and Climate Change' UNFPA and IIED.

Aguilar, L. (2004). Climate change and disaster mitigation: Gender Makes the Difference. Gland: The World Conservation Union (IUCN). Available at http://www.genderandenvironment.org/admin/admin_biblioteca/documentos/Climate.pdf.

Aguilar, L., Araujo, A. and Quesada-Aguilar, A. (2007). *Gender and Climate Change – Women as agents of change*. Climate Change Briefing. Fact Sheet IUCN. Gland: IUCN. Available at http://cmsdata.iucn.org/downloads/climate_change_gender.pdf.

Aguilar, Lorena (2009). *Training Manual on Gender and Climate Change*. Prepared with joint contributions from International Union for Conservation of Nature (IUCN) and the United Nations Development Programme (UNDP) in partnership with the Gender and Water Alliance, International Network on Gender and Sustainable Energy (ENERGIA), United Nations Educational, Scientific and Cultural Organization (UNESCO), Food and Agriculture Organization (FAO) and the Women's Environment and Development Organization (WEDO) as part of the Global Gender and Climate Alliance (GGCA). Available at http://www.generoyambiente.org/archivos-de-usuario/File/ecosistemas_especificos.pdf.

Ahmed, S. and Fajber, E. (2009). "Engendering adaptation to climate variability in Gujarat, India". *Gender & Development.* 17(1): 33–50. Available from http://dx.doi.org/10.1080/13552070802696896

Alber, G. (2009) 'Gender and Climate Change Policy'. Chapter 9 in ed.s Guzman, Jose Miguel, George Martine, Gordon McGranahan, Daniel Schensul, Cecilia Tacoli, 'Population Dynamics and Climate Change' UNFPA and IIED.

Albu, M. and Griffiths, A. (2005). Mapping the market: A framework for analysis for rural enterprises development policy and practice'. Available at: Practical Action. http://www.practicalaction.org/markets-and-livelihoods/docs/ia2/mapping_the_market.pdf

Anderson, S., Morton, J. and Toulmin, C. (2009). "Climate change for agrarian societies in drylands: implications and future pathways", in R. Mearns and A. Norton (eds.), Social Dimensions of Climate Change: Equity and Vulnerability in a Warming World. Washington, DC: The World Bank

Anderson, Cheryl; Fischer, Elizabeth; and Marra, John (2009) 'Integrating Climate Adaptation in Hawai'I Disaster Risk Management'. Presentation at the Sheraton Hotel, Waikiki, HCPO and HIGICC conference. Sept. 23–25, 2009. Accessed at: http://resilientcommunitieshawaii.org/presentations/04%20Molokai%20Integrating%20Climate%20Adaptation/Anderson/Integrating%20Climate%20Adaptation%20in%20Hawaii%20Disaster%20Risk%20Management.pdf

Anderson, Cheryl (2009) 'Gendered dimensions of disaster risk management, natural resource management and climate change adaptation in the Pacific'. The SPC Women in Fisheries Information Bulletin Number 20. Accessible at: http://www.spc.int/Coastfish/News/WIF/WIF20/WIF20_03_Anderson.pdf. (Accessed on 15.06.10)

Babagura, A. (2010) Gender and Climate Change: South Africa Case Study. Heinrich Boll Stiftung, Southern Africa. Available at: http://www.boell.org.za/downloads/GCC_south_africa.pdf. (Accessed on 30.05.10)

Back, Emma, Cameron, Catherine and Tanner, Thomas (2009). *Children and Disaster Risk Reduction: Taking stock and moving forward*. Brighton: Children in a Changing Climate, IDS. (Available from: http://www.childreninachangingclimate.org/docs/Child%20Led%20DRR_Taking%20Stock.pdf)

Back, Emma and Cameron, Catherine (2008). *Our Climate, Our Children, Our Responsibility: The implications of climate change for the world's children*. London: UNICEF United Kingdom. Available at http://www.unicef.org.uk/publications/pdf/climate-change.pdf

Baker, L. (2009) 'Feeling the Heat: Child survival in a changing climate'. International Save the Children Alliance, UK. Available at: http://www.savethechildren.org.uk/en/docs/Feeling_the_Heat_composite_low_res.pdf

Bartlett, Sheridan (2008). *Climate Change and Urban Children: Implications for adaptation in low and middle income countries*. London: International Institute for Environment and Development. Available at http://www.iied.org/pubs/pdfs/10556IIED.pdf

Banda, K. (2009) 'South Africa: Growing Sunflowers and Soya in Limpopo Province for Biodiesel Production; in Karlsson, G and K. Banda (2009) 'Biofuels for Sustainable Rural Development and Women's Empowerment', Energia. http://www.energia.org/biofuelscasestudies.html

Barrientos, S., and Smith, S. (2006) 'Main findings and recommendations from an independent assessment for the Ethical Trading Initiative', Ethical Trading Initiative. Available at: http://www.ethicaltrade.org/sites/default/files/resources/Impact%20assessment%20Part%201,%20main%20findings_0.pdf. (Accessed on 15.06.10)

Barrientos, S., Dolan, C., and Tallontire, A. (2003) 'A Gendered Value Chain Approach to Codes of Conduct in African Horticulture'. World Development, Volume 31, Issue 9, September, 2003, pp1511–1526.

Bartlett, Sheridan (2009) 'Children in the context of Climate Change: A Large and Vulnerable Population'. Chapter 8 in ed.s Guzman, Jose Miguel, George Martine, Gordon McGranahan, Daniel Schensul, Cecilia Tacoli, 'Population Dynamics and Climate Change' UNFPA and IIED.

Beales, Sylvia (2009). *Witness to climate change: Learning from older people's experience* London: HelpAge International. (Available from http://www.helpage.org/Resources/Briefings#A1gJ)

Bezner-Kerr, R. (2008). 'Gender and agrarian inequality' in Snapp, S. and Pound, B. 'Agricultural Systems@ Agroecology and rural innovation for development'. Academic Press.

Bolwig, S., Ponte, S. du Toit, A., Riisgaard, L., and Hialberg, N. (2008). 'Integrating poverty, gender and environmental concerns into value chain analysis' A conceptual framework and lessons for action research. DIIS Working Paper no 2008/16.

Boyd, E. (2002). 'The Noel Kempff Project in Bolivia: power and gender in climate mitigations' in Masika, R. 'Gender, Development and Climate Change'. Oxfam Publishing.

Boyd, E., Grist, N., Juhola, S. and Nelson, V. (2009). 'Theme Issue: Development Futures in a Changing Climate'. *Development Policy Review*. Vol. 27, No. 6, November 2009. Wiley Blackwell. Editorial: 'Exploring development futures in a changing climate: Frontiers for Development Policy and Practice', p659-674.

Campbell, K.L.I., Garforth, C., Heffernan, C., Morton, J., Paterson, R., Rymer, C, and Upton, M. (2005). *Smallstock in Development,* CD-ROM. DFID Livestock Production Programme, Natural Resources International Ltd, Aylesford, Kent, UK. ISBN: 0-9546452-8-6 Available at: http://www.smallstock.info/issues/gender.htm. [Accessed on 24 March 2010]

Cannon, T. (2002). "Gender and climate hazards in Bangladesh". *Gender & Development*. 10(2) 45 - 50. Available from http://pdfserve.informaworld.com/748777_666_741921480.pdf

Cannon, T. (2008). 'Reducing People's Vulnerability to Natural Hazards. Communities and Resilience, Research Paper No. 2008/34, United Nations University, UNU-WIDER. World Institute for Development Economics Research.

Care International (2009). 'Climate Vulnerability and Capacity Handbook'. Prepared by Angie Dazé, Kaia Ambrose and Charles Ehrhart. Available at: http://www.careclimatechange.org/cvca/CARE_CVCAHandbook.pdf. (Accessed on 15.06.10).

Chancellor, T., Morton, J., Tabo, R., Von Kaufmann, R. (2008). 'Climate change and agricultural development'. Chapter 2: Forum for Agricultural Research in Africa (2008) 'Strengthening Capacity for Agricultural Research and Development in Africa: Volume 3', Accra, Ghana. Available at: http://www.fara-africa.org/library/browse/SCARDA_Vol_3__16_April_2008.pdf. (Accessed on 15.01.10).

Cleaver, F. (2000). 'Analysing gender roles in community natural resource management: negotiation, lifecourses and social inclusion', *IDS Bulletin* 31(2): 60–7.

Conroy, C. (2008). 'The Nature of Agricultural Innovation'. Chapter 10 in Snapp, S. and Pound, B. 'Agricultural Systems: Agroecology and rural innovation for development'.

Dankelman, Irene (2008). *Enhancing Women's Reproductive Rights in an era of Climate Change. Gender, Climate Change and Human Security: lessons for population policies.* Paper presented at the EuroNGOs conference in Lyon, 2 October 2008. *Radboud University, Women's Environment and Development Organization (WEDO) and Women in Europe for a Common Future (WECF).* Available from http://www.eurongos.org/Files/HTML/EuroNGOs/AGM/Paper_Lyon__Oct_2008__Irene_Dankelman.pdf

Dankelman, I. (2008b). *Mainstreaming gender in climate change policies: urgencies, challenges and perspectives*. Paper presented at the Third Global Congress of Women in Politics and Governance on the theme of gender and climate change, organized by CAPWIP, The Philippines. Available from http://www.capwip.org/CAPWIP%20Manila%20PP%20Irene%20D.%20(1.pdf

Davies, S. (1996). 'Adaptable livelihoods: coping with food insecurity in the Malian Sahel'. Macmillan.

Day, Will, Pirie, Antoinette and Roys, Chris (2007). *Strong and Fragile: Learning from Older People in Emergencies*. London: HelpAge International. Available from http://www.reliefweb.int/rw/lib.nsf/db900sid/PANA7CPE6X/$file/HELPAGE_nov2007.pdf?openelement

Denton, F. (2002). "Climate change vulnerability, impacts and adaptation: why does gender matter?" *Gender & Development*. 10(2): 10–20. Available from http://pdfserve.informaworld.com/328387_666_741921483.pdf

Denton, Fatima (2004). "Gender and Climate Change: Giving the "Latecomer" a Head Start". *Institute of Development Studies* (IDS) *Bulletin*, Institute of Development Studies at the University of Sussex, 35(3):42-49. Available from http://www.ids.ac.uk/ids/bookshop/index.html

Drucker, A.G., S J Hiemstra, N Louwaars, J K Oldenbroek and M W Tvedt (2008). "Riding out the storm: animal genetic resources policy options under climate change", paper given at the conference on Livestock and Global Climate Change, 17-20 May 2008, Hammamet, Tunisia. The conference was organised by the British Society for Animal Science and ICARDA. For further info see http://www.bsas.org.uk/downloads/LGCC_ProgrammeFinal.pdf

Eakins, H and A.L. Luers (2006). 'Assessing the Vulnerability of Social-Environmental Systems' in Annual Review of Environmental Resources, 2006. 31:365–94.

Enarson, E., Fothergill, A., Peek, L. (2006). 'Chapter 8: Gender and Disaster: Foundations and Directions' in 'The Handbook of Disaster Research'. Eds. Rodriguez, Havidan; Quarantelli, Enrico L.; Dynes, Russell R. New York: Springer 2006.

Ensor, J. and Berger, R. (2009). 'Understanding Climate Change Adaptation: Lessons from Community Based Approaches', Practical Action Publishing.

FAO (1997a). 'Gender and participation in agricultural development planning: Key issues from ten case studies'. Women in Development Service, Rome.

FAO (2005). 'Building on gender, agrobiodiversity and local knowledge: A training manual' http://www.fao.org/sd/links/documents_download/manual.pdf

FAO (2007). *'People-centred climate change adaptation: integrating gender issues - Awareness of climate change from a gendered perspective'*. Rome: Food and Agriculture Organization of the United Nations. Available at ftp://ftp.fao.org/docrep/fao/010/a1395e/a1395e00.pdf

FAO (2010). 'Does gender make a difference in dealing with climate shifts? Research results from Andhra Pradesh, India'. Available at: http://www.fao.org/climatechange/19120-1-0.pdf

FARA (2006). 'Agricultural research delivery in Africa: An assessment of the requirements for efficient, effective and productive national agricultural research systems in Africa'. Main report and strategic recommendations.

Filiberto, D., Wells, N., Wethington, E., Pillemer, K. and Wysocki, M. (undated) 'Climate change, vulnerability and health effects: Implications for the older population'. Available at: http://www.cals.cornell.edu/cals/devsoc/outreach/environment-and-community/upload/HealthEffects.pdf

HelpAge International (2007). *Older people's associations in community disaster risk reduction - A resource book on good practice.* London: HelpAge International. Available at http://www.reliefweb.int/rw/lib.nsf/db900sid/MCOT-7MEK4W/$file/helpage_dec2007.pdf?openelement

Hemmati, M. and Rohr, U., (2002). 'Engendering the climate change negotiations: experiences, challenges and steps forward' in Terry, G. (Ed.) (2009). *Climate Change and Gender Justice.* Practical Action Publishing in association with Oxfam GB. Available from http://www.oxfam.org.uk/resources/downloads/wigad_climate/WIGAD_climate_change_gender_justice_book_pap.pdf

Howden, S.M., ois Soussana, J-F., Tubiello, F.N., Chhetri, N., Dunlop, M. and Meinke, H. (2007). 'Adapting agriculture to climate change'. Proceedings of the National Academy of Sciences of the United States of America: http://www.pnas.org/content/104/50/19691.full.pdf+html

Karlsson, G and K. Banda (2009). 'Biofuels for Sustainable Rural Development and Women's Empowerment', ENERGIA.

Kudadjie-Freeman, C., Richards, P., Struik, P. (2008). 'Unlocking the potential of contract farming: Lessons from Ghana', IIED Gatekeeper Series, 139, December 2008

Lamboll, R., Morris, M., and van Broekhoven, L. (2002). 'Biodiversity conservation and rural development in Tanzania: Experience, examples, and issues'. In Grimble R. (Ed). 'Biodiversity conservation in rural development'. Chatham, UK: NRI/DFID. ISBN: 089545415.

Lambrou, Y. and Grazia, P (2006). 'Gender: The missing component of the response to climate change'. Rome: FAO. Available from: http://www.generoyambiente.org/admin/admin_biblioteca/documentos/pe1_051001d1_en.pdf.

Leach, M., Scoones, I. and Stirling, A. (2010). 'Dynamic Sustainabilities: Technology, Environment, Social Justice'. Pathways to Sustainability. Earthscan, London, Washington D.C.

Macchi, M, G. Oviedo, S. Gotheil, K. Cross, A. Boedhihartono, C. Wolfangel, M. Howell (2008), 'Indigenous and Traditional Peoples and Climate Change'. Issues Paper. IUCN. Available at: http://www2.ohchr.org/english/issues/climatechange/docs/IUCN.pdf. [Accessed on 24 March 2010]

Masika, R ed. (2002). 'Gender, Development and Climate Change'. Oxfam Publishing.

Martin, A. and Nelson, V. (2008). 'Gender issues in the design and delivery of extension services: analysis of current knowledge and evidence', NRI, University of Greenwich report.

Martin, A., Nelson, V. , J. Ewert, M. Omosa, M. Morris. Briefing paper No.4: Comparative Livelihood Impacts of Codes of Practice in the Kenyan Cut Flower and South African wine Industries. 2006.

McLean, K.G. (2009). 'Advance Guard: Climate Change Impacts, Adaptation, Mitigation and Indigenous Peoples – A Global Compendium of Case Studies'. UNU-IAS Traditional Knowledge Initiative. Accessed at: http://www.unutki.org/downloads/File/Publications/UNU_2009_Advance_Reading_Copy_Advance_Guard_Compendium.pdf

McGray, H., Hammill, A., Bradley, R., with Schipper, E.L. and Parry, J-E. (2007). 'Weathering the storm: Options for framing adaptation and development'. World Resources Institute. Available at: http://pdf.wri.org/weathering_the_storm.pdf (Accessed 5.06.10).

Mitchell, Tom; Katharine Haynes; Nick Hall; Wei Choong; and Katie Oven (2008). "The Role of Children and Youth in Communicating Disaster Risk." *Children, Youth and Environments* 18(1): 254–279. Retrieved [date] from http://www.colorado.edu/journals/cye. http://www.childreninachangingclimate.org/docs/CYE_CommunicatingRisk.pdf

Morton, J. (2007). 'The impact of climate change on smallholder and subsistence agriculture'. 19680–19685 _ PNAS _ December 11, 2007 _ vol. 104 _ no. 50

Morton, J. (2010). 'Strengthening Local Agricultural Innovation in the Face of Climate Change', Presentation to AAA.

Nassif, F. (2008). 'The Gender-Livestock-climate change connection: local experiences and lessons learned from Morocco', pp.154–158 in [Tunis Conference proceedings – same as for Drucker, which is pp.81–84].

Neefjes, K., Hai, V.M., Nelson, V., Dankelman, I, Anh, T.V., Fitzgerald, I. (2009). 'Responding to climate change in Viet Nam: Opportunities for improving gender equality. A policy discussion paper'. Ha Noi, December 2009, UN and Oxfam in Viet Nam. Available at: http://www.un.org.vn/index.php?option=com_docman&Itemid=266&lang=en

Nelson, V. (forthcoming). 'Scoping the gender issues in biofuel value chains'. FAO.

Nelson, V., A. Martin, and Joachim Ewert. (2007). The Impacts of Codes of Practice on Worker Livelihoods; Empirical evidence from the South African wine and Kenyan cut flower industries. *Journal of Corporate Citizenship* 28, December 2007. pp61–72.

Nelson, V. , J. Ewert, A. Martin. (2005). "Assessing the social impact of codes of practice in African export agriculture" *Development in Practice*, **15**, 3 /4, 539–546.

Nelson, V., Tallontire, A. and Collinson, C. (2002). Assessing the potential of ethical trade schemes for forest dependent people: comparative experiences from Peru and Ecuador. *International Forestry Review* **4,** 99–110.

Nelson. V and M Galvez (2000). The Social Impact of Ethical and Conventional Cocoa Trading in Ecuador. NRI Report.

Nelson, V. and M Galvez (2000). The Social Impact of Ethical and Conventional Brazil Nut Trading in Peru. NRI Report.

Nelson, V., Martin, A. and Aissétou Dramé Yayé 2 (2008). 'Gender and diversity in sustainable agricultural research and innovation: Issues, challenges and the way forward'. SCARDA briefing papers 4. Volume 3. Forum for Agricultural Research in Africa.

Nelson, V. and Stathers, T. (2009). 'Resilience, power, culture and climate: a case study from semi-arid Tanzania, and new research directions', in Terry, G. (2009) 'Climate change and gender justice', Practical Action. Available at: http://www.oxfam.org.uk/resources/downloads/wigad_climate/WIGAD_climate_change_gender_justice_book_pap.pdf

Nelson, V., Meadows, K., Cannon, T., Morton, J., and Martin, A. (2002). "Uncertain predictions, invisible impacts, and the need to mainstream gender in climate change adaptations". *Gender & Development*. 10(2): 51–59. Available from http://pdfserve.informaworld.com/567890_666_741921482.pdf

Nelson, D., Adger, N., and Brown, K. (2007) 'Adaptation to Environmental Change: Contributions of a Resilience Framework'. Annual Review of Environment and Resources', Vol. 32: 395–419.

Nelson, V., Lamboll, R. and Arendse, A. (2008). 'Climate Change Adaptation, Adaptive Capacity and Development: Discussion Paper'. A background paper of the DFID-DSA Policy Forum in 2008 on 'International Development in the face of climate change: Beyond Mainstreaming'. http://climateanddevelopment.nri.org/background_papers/nelson_lamboll_and_arendse_climate_change_adaptation.pdf

Ogunlela, Y.I. and Mukhtar, A.A. (2009). 'Gender issues in agriculture and rural development in Nigeria: The role of women'. Humanity and Social Sciences Journal 4 (1): 19–30, 2009.

Parbring, Bosse 'Men in the Arctic area hit by climate change' Accessed at: http://www.nikk.uio.no/?module=Articles;action=Article.publicShow;ID=1016

Petrie, B. (2010). 'Gender and Climate Change: Regional Report'. Heinrich Boll Stiftung, Southern Africa. Available at: http://www.boell.org.za/web/107-522.html. (Accessed 15.06.10).

Pettengell, C. (2010). 'Climate Change Adaptation: Enabling people living in poverty to adapt'. Oxfam Research Report. Available at: http://www.oxfam.org.uk/resources/policy/climate_change/downloads/rr_climate_change_adaptation_full_290410.pdf. Accessed on 15.06.10.

Platform for Agrobiodiversity Research (2010). 'The use of Agrobiodiversity by Indigenous and traditional agricultural communities in adapting to climate change'. PAR synthesis paper.

Porter, M.E. (1985). *Competitive Advantage*, Free Press, New York.

Quan, J with Dyer, N. (2008). 'Climate change and land tenure: The implications of climate change for land tenure and land policy'. Land Tenure Working Paper, 2. IIED and NRI report for FAO.

Riisgard, L., Bolwig, S., Matose, F., Ponte, S., du Toit, A. and Halberg, N. (2008). 'A strategic framework and toolbox for Action Research with small producers in value chains. DIIS Working Paper No. 2008/17, Danish Institute for International Studies, Copenhagen.

Robertson, C.C. (1997). 'Black, White and Red All over: Beans, Women Agricultural Imperialism in Twentieth- Century Kenya Author(s): Claire C. Robertson Source: Agricultural History, Vol. 71, No. 3 (Summer, 1997), pp. 259–299 Published by: Agricultural History Society Stable. http://www.jstor.org/stable/3744315. Accessed: 27/03/2010 14:47

Roncoli, C., Ingram, K., Jost, C. and Kirshen, P. (2003). 'Meteorological meanings: Farmers' interpretations of Seasonal Rainfall Forecasts in Burkina Faso'. Chapter 10 in 'Weather, Culture, Climate', by Strauss, S. and Orlove, B. Berg Publishing.

Rossi, A. and Lambrou, Y. (2009). 'Making sustainable biofuels work for smallholder farmers and rural households: Issues and perspectives'. FAO, Rome,

Roy. M. and Venema, H.D. (2002). 'Reducing risk and vulnerability to changing climate in India: the capabilities approach' *in* Masika, R (2002) 'Gender, Development and Climate Change'. Oxfam Publishing.

Salick, J. and A. Byg (2007). 'Indigenous Peoples and Climate Change' University of Oxford and Missouri Botanical Garden'. A Tyndall Centre Publication. Tyndall Centre for Climate Change Research, Oxford, May 2007. http://www.ecdgroup.com/docs/lib_004630823.pdf. [Accessed on 24 March 2010]

Schott, C. (2009). 'Socio-economic dynamics of biofuel development in Asia Pacific'. Friedrich Ebert Stiftung, Jakarta, Indonesia.

Skutsch, Margaret, M. (2002). "Protocols, treaties, and action: the 'climate change process' viewed through gender spectacles". *Gender & Development*. 10(2): 30–39. Available from http://pdfserve.informaworld.com/707568_666_741921471.pdf

Tallontire, A.M, Opondo, M., Nelson, V., Martin, A. (2009). 'Beyond the vertical? Using value chains and governance as a framework to analyse private standards initiatives in agri-food chains?' Journal of Agriculture and Human Values. Published 19.09.09, Springer Netherlands.

Terry, G. (Ed.) (2009). 'Climate Change and Gender Justice'. Practical Action Publishing in association with Oxfam, G.B. Available from: http://www.oxfam.org.uk/resources/downloads/wigad_climate/WIGAD_climate_change_gender_justice_book_pap.pdf

Thornton , P.K., van de Steeg, J., Notenbaert, A., Herrero, M. (2009). 'The impacts of climate change on livestock and livestock systems in developing countries: A review of what we know and what we need to know'. Agricultural Systems 101 (2009) 113–127.

Thornton, P., Herrero, M., Freeman, A., Mwai, O., Rege, E., Jones, P. and McDermott, J. (2007). 'Vulnerability, Climate change and Livestock – Research Opportunities and Challenges for Poverty Alleviation'. Journal of SAT Agricultural Research, Volume:4, Issue:1 Available at http://www.icrisat.org/Journal/SpecialProject/sp7.pdf

UN/ISDR (2008). 'Gender perspectives: Integrating Disaster Risk Reduction into Climate Change Adaptation: Good Practices and Lessons learned'. Accessible at: http://unisdr.org/eng/about_isdr/isdr-publications/17-Gender_Perspectives_Integrating_DRR_CC/Gender_Perspectives_Integrating_DRR_CC_Good%20Practices.pdf

UNFPA (2009). 'Climate change connections: A resource kit on climate, population and gender'. Gender and population. Available at: http://www.unfpa.org/public/publications/pid/4028. [Accessed on 24 March 2010].

USAID (2009). 'Promoting gender equitable opportunities: Why it matters for agricultural value chains'.

van Crowder, L. (1997). Women in Agricultural Education and Extension. *Sustainable Development Dimesions April 1997*, Rome: FAO.

Vermeulen, S. and Cotula, L. (2010). 'A survey of business models that provide development opportunities for smallholders', FAO and IIED.

Walker, B. and D. Salt (2006). 'Resilience thinking: Sustaining Ecosystems and People in a Changing World'. Island Press.

World Bank, FAO, IFAD (2009). 'Gender in Agriculture Sourcebook'. Available at: http://siteresources.worldbank.org/INTGENAGRLIVSOURBOOK/Resources/CompleteBook.pdf. (Accessed on 15.06.10).

Wong, S (2009). 'Climate change and sustainable technology: re-linking poverty, gender and governance' in Terry, G. (Ed.) (2009). *Climate Change and Gender Justice.* Practical Action Publishing in association with Oxfam GB. Available from http://www.oxfam.org.uk/resources/downloads/wigad_climate/WIGAD_climate_change_gender_justice_book_pap.pdf

Ziergvogel, G., Taylor, A., Hachigona, S., and Hoffmaister, J. (2008). 'Climate adaptation in southern Africa: Addressing the needs of vulnerable communities'. Commissioned by Oxfam GB, Stockholm Environment Institute.