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Agricultural innovation for food security and environmental sustainability in the context of the recent economic crisis: Why a gender perspective?

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Background Paper

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Introduction

The recent interlinked food, fuel and financial crises have aggravated poverty and food insecurity, particularly in the developing world. International food prices have surged in the past half-decade, making food less affordable to many, and drawing attention to the deeper structural flaws in the global food production system. In addition, the technology and agricultural practices in the last 40 years have led to the degradation of productive land, large green house gas (GHG) emissions and extensive water pollution; all of these factors have threatened the sustainability of food production.

A major technological upgrading in agriculture will have to take place to open the space for the adoption of sustainable technologies and land management practices to increase food production with environmental sustainability.

At the heart of the food security challenge are small scale farmers – many of which are women – as around 90 per cent of food consumed in developing countries is locally produced. In Africa and East and South-East Asia, women account for over 40 per cent of the agricultural workforce but they have restricted access to land, credit, markets and technology. The paper argues that meeting the food security challenge whilst protecting the environment will require explicit policies to build sustainable agricultural innovation systems with a strong gender perspective to make knowledge and technology available to female farmers.

The paper sets out by providing an overview of the state of global food insecurity. It proceeds by outlining the structural and environmental constraints to increasing food production and access, before identifying multiple interventions aimed at addressing these constraints. The study then revisits the ‘‘Green Revolution’’ experience of the 1960s-1970s to draw lessons on paving the way towards a second radical transformation of agriculture to expand food production, whilst protecting the environment. Focus shifts to the central role of small-scale farmers, and particularly women, in enhancing sustainable food production, followed by the obstacles faced by female farmers. The paper concludes with policy implications calling for the building of gender-sensitive sustainable agricultural innovation systems at the national level, as well as supporting actions in the international arena.

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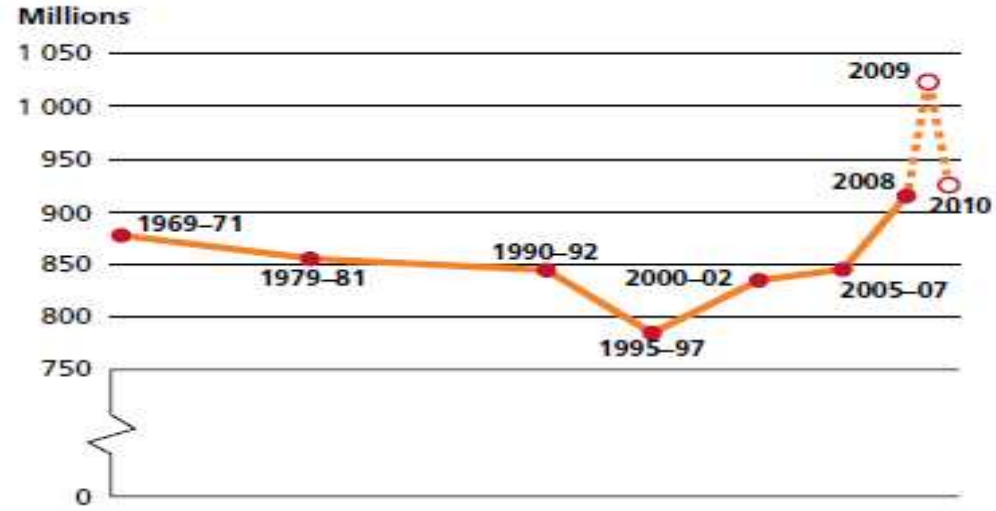
Persistent food insecurity

The 2007-2008 food crisis and the renewed surge in food prices in 2010-2011 have exposed deep structural problems in the global food system and the need to increase resources and foster innovation in agriculture to accelerate food production. The dramatic food price increases in 2007–2008 and the ensuing economic crisis saw the global number of undernourished people surpass one billion in 2009, signalling a threat to world economic, social and political stability.[2] Although the number and proportion of hungry people declined in 2010, amid signs of economic recovery, those figures remain above pre-crisis levels, leaving 925 million people undernourished (FAO, 2010) (figure 1).[3]

The overwhelming majority (98 per cent) of the world's undernourished people live in developing countries, with two thirds of them concentrated in seven nations (Bangladesh, China, the Democratic Republic of the Congo, Ethiopia, India, Indonesia and Pakistan). Most hungry people (almost 580 million) reside in Asia and the Pacific, although sub-Saharan Africa has the highest share of undernourished people when compared to the total population (30 per cent, or around 240 million people) (FAO, 2010) (figure 2).

Figure 1: Undernourished population worldwide, 1969-2010

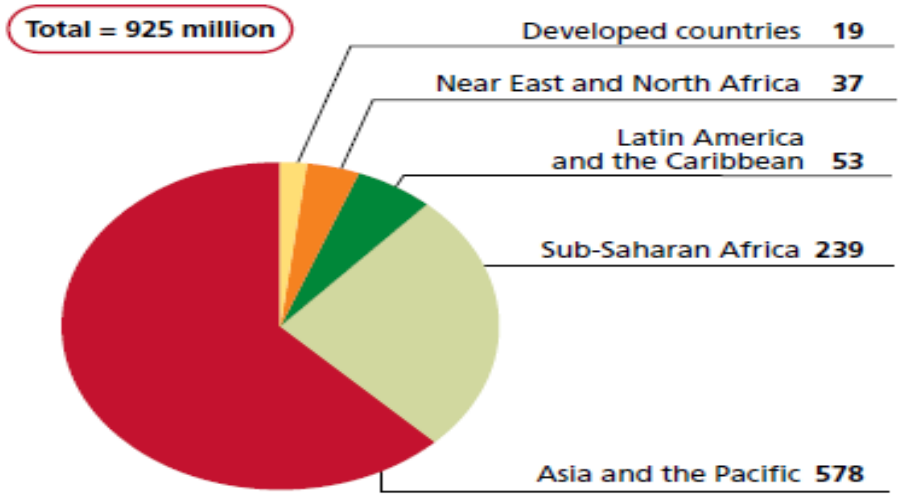


Source: FAO (2010).

[2] The World Food Summit Plan of Action considered food security as existing ''when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life'' (FAO, 1996, para. 1). Based on this definition, undernourishment is thus a key indicator of food insecurity. Undernourishment exists when caloric intake is below the minimum dietary energy requirement, which is the amount of energy needed for light activity and a minimum acceptable weight for attained height. It varies by country and over time depending on the gender and age structure of the population.

[3] FAO's latest estimates of under-nutrition do not take into account recent price rises, so the 925 million figure is likely to be overly optimistic. [Press Conference presenting ''Access to Land and the Right to Food'', Report of the Special Rapporteur on the right to food presented at the 65th General Assembly of the United Nations [A/65/281], 21 October 2010.]

Figure 2: Undernourished population by region, 1969-2010



Source: FAO (2010).

While progress varies from country to country, developing countries as a group have not moved closer to the food security targets of halving the number of undernourished people by 2015 established at the World Food Summit; instead, the number of undernourished people increased by almost 10 per cent between 1990 and 2010.[4] Some progress has been made towards the less ambitious target in the Millennium Development Goal (MDG) 1: the share of undernourished people declined from 20 per cent to 16 per cent over the same period.

The 22 countries regarded as facing a ‘‘protracted food security crisis’’ are home to over 165 million undernourished people (about 20 per cent of the world‘s total).[5] The proportion of undernourished people ranges from under 15 per cent in Côte d‘Ivoire to almost 70 per cent in the Democratic Republic of the Congo (FAO, 2010).

Patterns of food security vary not only *between* but also *within* countries. Aggregate data typically mask inequalities at the regional, local and household level. For instance, although China has achieved food security at the national level, there remain pockets of poverty and food insecurity, with 130 million people (or 10 per cent of the

[4] Commitments agreed to at the 1996 World Food Summit included the call for at least halving the number of undernourished people in the world by the year 2015 (FAO, 1996, para. 7). This goal was reinforced by the Millennium Declaration adopted by Heads of State and Government in September 2000, which resolved to halve by 2015 the proportion of the world's people who suffer from hunger (United Nations, 2000).

[5] Protracted crisis situations are characterized by recurrent natural disasters and/or conflict, longevity of food crises, breakdown of livelihoods and insufficient institutional capacity to respond. Countries in protracted crisis include Afghanistan, Angola, Burundi, Central African Republic, Chad, Congo, Côte d‘Ivoire, the Republic of Korea, the Democratic Republic of the Congo (DRC), Eritrea, Ethiopia, Guinea, Haiti, Iraq, Kenya, Liberia, Sierra Leone, Somalia, Sudan, Tajikistan, Uganda, and Zimbabwe (FAO, 2010).

population) still undernourished.[6] Nutritional patterns differ along geographical, social, ethnic and gender lines. In developing countries, a higher share of children living in rural areas are underweight (20 per cent), compared to those residing in urban areas (14 per cent). Income is also an important determinant of under-nutrition. In Africa, the share of underweight children from the lowest household wealth quintile (28 per cent) is twice as high that from highest quintile (14 per cent). Though overall prevalence rates of under-nutrition are similar for male and female populations, there are regional differences. In Africa, the share of underweight children is slightly higher in boys (21 per cent) than in girls (19 per cent); in Southern Asia the reverse is true. In certain countries and communities gender differences in the prevalence of under-nutrition are exceptionally large. For instance, in India 49 per cent of female children are underweight compared to 46 per cent of male children (FAO, 2011).

Agricultural context: high food prices and environmental degradation

The unsettling reality is that one in seven people on the planet lack access to sufficient food and an equal number are over fed, when sufficient food is produced globally to feed the world‘s population. This is evidence of serious shortcomings in the functioning of the global food system (Godfray et al, 2010).

This is largely the result of structural imbalances in food demand and supply. Demand for food has risen owing to continued global population growth, rising incomes, and altered dietary patterns in an increasingly urbanized world. Use of food crops for bio-fuels is increasingly adding to this demand. Agricultural output has not kept pace with this growing demand owing to competition for land, adverse climatic conditions (possibly linked to climate change[7]), high oil and farm input prices, and dwindling public investment in rural infrastructure, agricultural research and extension and food price supports.

Tighter food supply and demand conditions have led to the prevalence of higher and more erratic world food prices in recent years. This has been aggravated by the significant increase in financial speculation in commodity futures markets over the past decade, which has contributed to the persistence of high and volatile food prices (Gilbert, 2008; United Nations, 2011b). International prices for corn, wheat and rice more than doubled between 2006 and 2008. While prices declined in late 2008, food prices have since rebounded, attaining new record highs in February 2011. Despite conflicting evidence, it would appear that recent price rises have also been accompanied by higher volatility, which increases uncertainty, thereby hindering investment in human and physical capital, technology and innovation (FAO, 2009).

[6] http://www.fao.org/hunger/en/

[7] Climate change impacts agriculture in many ways, with changes in temperature, precipitation and climatic variability affecting the timing and length of growing seasons and yields and thereby exacerbating land degradation and contributing to water scarcity (Agrawala and Fankhauser, eds., 2008). For instance, it is estimated that, in Southern Africa, yields could fall by up to 50 per cent between 2000 and 2020 (IPCC, 2007); and that, by 2080, 600 million additional people could be at risk of hunger as a direct consequence of climate change (UNDP, 2007).

The severe impact of the recent food price crises on living conditions is attested by the riots that have broken out in over 30 countries. Increasing food prices have had a particularly negative impact on the poor who spend 50 to 70 per cent of their income on food (von Braun, 2009). Higher food prices are estimated to have pushed over 150 million people into poverty since 2007 (World Bank, 2008; 2011). Although higher prices provide incentives to increase production, many small farm holders are unable to respond owing to lack of access to finance, agricultural inputs, markets and technology (United Nations, 2008).

While the expansion of food production is vital for achieving food security and reducing poverty, it is also associated with negative environmental consequences. Agricultural activities that underpin food production have been recognized as a major contributor to greenhouse gas emissions, water scarcity and pollution, land degradation, and biodiversity loss.

Unsustainable natural resource management also has adverse socio-economic impacts. In particular, land degradation can lead to substantial productivity losses, thereby posing risks to food security. It is also a predominant factor in the migration of people. Use of inorganic fertilisers and pesticides, and the spread of pests and livestock diseases, can further adversely affect human health (IAASTD, 2009). Natural resource degradation may also exacerbate gender inequalities by increasing the time requirement for fulfilment of female responsibilities such as food production, fuelwood collection, and soil and water conservation. For instance, in rural Rajasthan, India, approximately 50 person-hours per month are required for households gathering fuelwood (Laxmi and others, 2003). In Malawi, women spend between 4 and 15 hours per week collecting firewood (Rehfuess, Mehta and Prüss-Üstün, 2006).

Many roads to food security

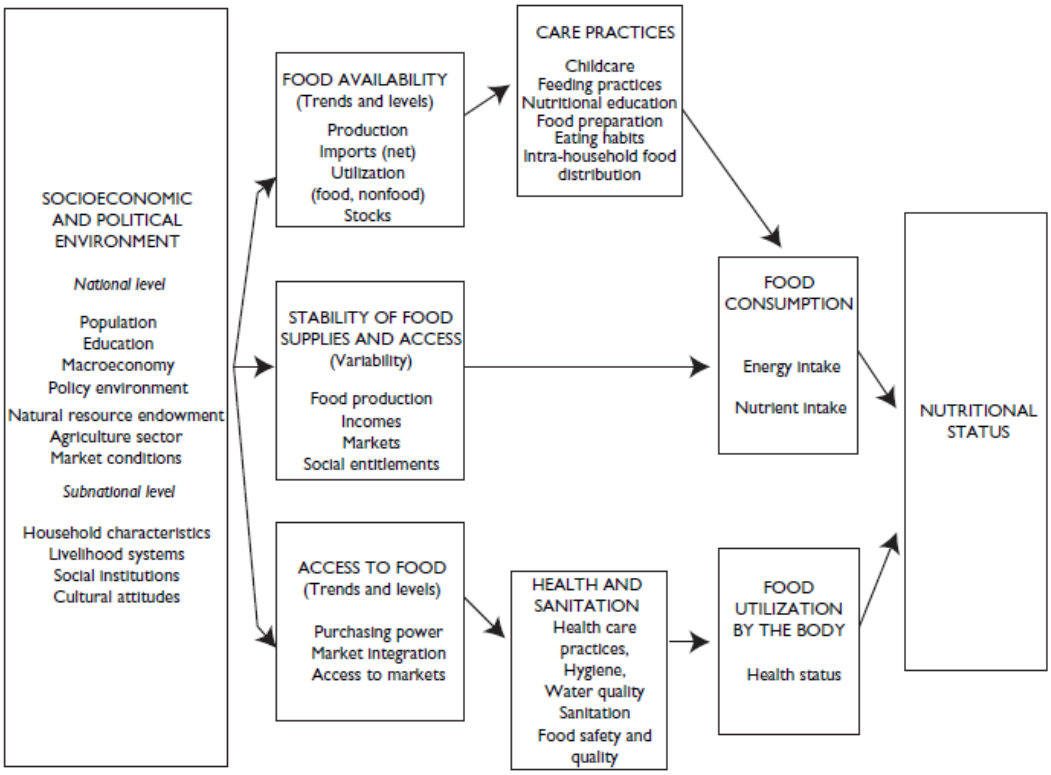
Achieving the goal of food security requires explicit interventions to address the specific constraints that restrict the *availability*, *accessibility* and/or proper *utilization* of food for nutrition. Countries with a poor natural resource base for agriculture may have to rely on imports to guarantee food availability; in these cases, the development of foreign currency earning activities and fair international trade practices are critical for food security. In other contexts, sufficient food production may not be enough to guarantee food security if people (or groups of people) do not have the resources to purchase enough food for consumption; job creation and policies to guarantee decent employment may be needed to improve income generation and sustainable access to food. Finally, the link between access to food and adequate nutrition may require specific interventions in at least two areas. Firstly, extended infrastructure for water and sanitation and improved people‘s health to make sure food intake translates into appropriate nutrition. Secondly, appropriate regulation and technical innovation may be needed to guarantee the safety and adequate nutrient content of food crops.

Safety nets and emergency food distribution mechanisms have been used extensively in response to natural catastrophes (droughts, floods, and so on) but also in response to civil war and political conflict. Safety nets and other forms of social protection have also been used to ensure minimum consumption levels of people at times of economic crisis or in countries with large income inequality. Conditional cash

transfers and emergency employment programmes have contributed to preventing food insecurity and to reduce extreme poverty.

The specific context of each country will dictate different policy combinations to guarantee food security for all citizens. There is little that can be said in general, except that food security is a complex phenomenon that requires well designed interventions to guarantee the availability and accessibility of food and appropriate nutrition (figure 3). Food security remains an urgent global, national and local challenge. It requires the design and implementation of policy initiatives as part of the national development strategies of countries as well as better governance of global trade and food distribution systems.

Figure 3: Elements in achieving food and nutrition security



Source: World Bank, FAO and IFAD (2009).

In the remainder of this paper, the focus of attention is the first policy challenge identified above: how to increase the availability of food for all. Current patterns of under-nutrition and the need to increase food production to feed a growing population require an increase in food production by an estimated 70 per cent globally and 100 per cent in developing countries by mid-century. If the goal of environmental sustainability is to be attained, increasing food production will have to be achieved without placing additional stress on natural resources and with the use of eco-friendly technology.

Combating hunger and malnutrition in a sustainable manner and guarding against high and volatile food prices will require a radically different approach addressing the structural constraints on food production. This would entail both the establishment of an integrated national framework for sustainable natural resource management, and a harnessing of the technology and innovation needed to increase the productivity, profitability, resilience and climate change mitigation potential of rural production systems and forests.

In thinking about the conditions to induce a new transformation in agriculture the experience of the first green revolution in agriculture may provide important policy guidance.

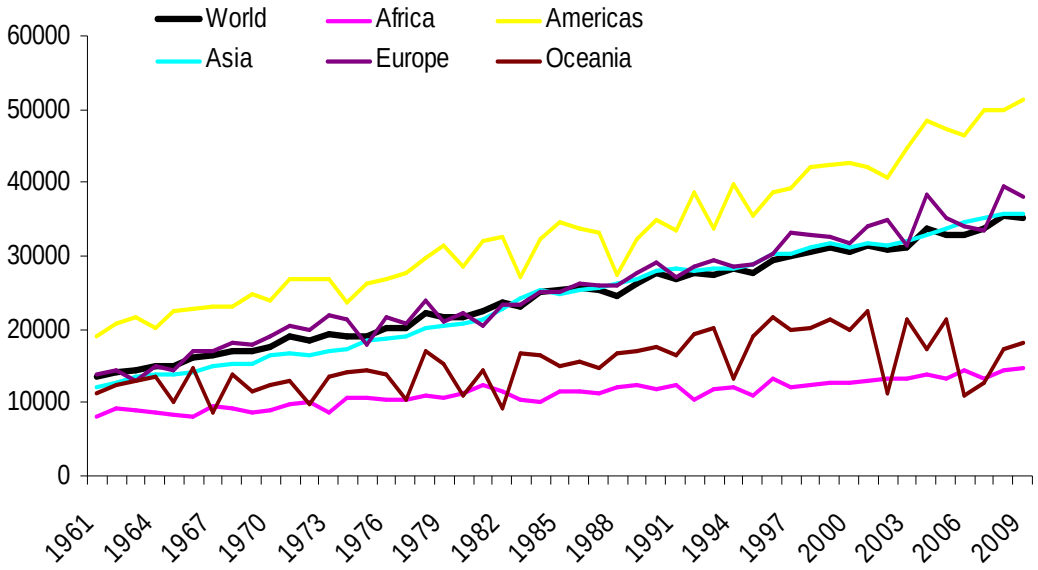
The Green Revolution in the 1960s and 1970s

In response to a similar food security crisis in the 1950s, the ‘‘Green Revolution‘‘ experience of the 1960s-1970s in Asia and Latin America brought about dramatic increases in productivity and production of staple crops through the adoption of a specific package of technologies – namely, higher-yielding varieties of wheat, rice and maize, chemical fertilizers, and irrigation (UNCTAD, 2010).

The Green Revolution of the 1960s and 1970s was a response to widespread poverty and food insecurity in developing countries at a time when close to one third of the population in the world (one billion people) were vulnerable to hunger and malnutrition (Spielman and Pandya-Lorch, 2009). High dependence on food aid in Asia and the risk of repeated famines in India prompted a concerted international effort for the radical transformation of agriculture through the development of high yielding seed varieties (IFPRI, 2002).

The technological innovations that gave rise to the green revolution were based on the breeding of new varieties of wheat, rice and maize, later on extended to millet, sorghum, maize, cassava and beans. The new seed varieties were more resistant to pests and disease, more responsive to chemical nutrients, and had shorter agricultural cycles that allowed double and even triple cropping (IFPRI, 2002; Lipton, 2010). Results were impressive; in the period 1970-1995 there was a rapid expansion in the production of cereals in Latin America and Asia (figure 4). Cereal production in Asia increased from about 310 million tons a year in 1970 to 650 million in 1995 and, although the population increased by 60 per cent, food production rose faster, with the result that cereal and calorie availability per person increased by nearly 30 per cent and wheat and rice became cheaper (Hazell, 2009). Real per capita income more than doubled in Asia from 1970 and 1995 and poverty decreased (IFPRI, 2002).

Figure 4: Cereal yields, 1961-2009 (Hg/Ha)



Source: FAOStat

In Latin America the price of cereals decreased, making them more accessible to the poor in urban and rural areas. The consumption of calories per person also increased in spite of rapid population growth.

The research and development (R&D) that supported the green revolution was based on a large and inter-connected system of international research centres sustained through large contributions from governments in developed and developing countries and from private foundations. The original research conducted in the International Centre for maize and Wheat Improvement (CIMMYT) in Mexico and the International Rice Research Institute (IRRI) in the Philippines was rapidly expanded to other research centres and in 1971 the Consultative Group on International Agricultural Research (CGIAR) was created to coordinate research. These centres were able to attract unprecedented long term international support to sustain research operations, gene banks and nursery programs within an environment of open and free exchange of information and plant genetic materials under a shared research agenda for food security (Dubin and Brennan, 2009). In the first two decades of operation the budgets available to the centres that are part of the CGIAR grew fast, from US $15 million in 1970 to US $305 in 1990 (Pardey and Beintema, 2001).

But the success of the green revolution must also be placed in the historical context that facilitated a global consensus to fight poverty and hunger. Internationally the green revolution emerged in the context of the cold war where poverty and hunger were perceived by western governments as a source of social tensions and the expansion of communism in Asia and Latin America (Hazell, 2009).

In Asia and Latin America, governments gave priority to investments in infrastructure to expand rural roads, irrigation and electrical power, and the construction of facilities to improve the storage and distribution of cereals. Basic education, agricultural

research, and extension services to support farmers also improved and international lending for agricultural development was prioritized (in the 1980s, around a quarter of the total lending from the World Bank was for agriculture - Pardey and Beintema, 2001).

There are important lessons to learn from the experience of the green revolution in Asia and Latin America on paving the way towards a second large transformation of agriculture:

i) The development of new technology and management systems in agriculture does not occur over night, it requires long term support for R&D and an environment of cooperation, experimentation and learning with efficient and free flow of information and a shared research agenda. Adequate and long term financial support from national and international public sources is most important.

ii) The adoption of new technology and innovative practices in production requires an enabling policy framework and adequate investment in infrastructure, capacity development among farmers, as well as access to inputs, credit and markets in a process where governments play a key role in directing resources and creating incentives to ensure these conditions.

iii) Radical transformation of agriculture for food security is possible when there is political will and long term commitment—from national and international stakeholders—around a common agenda for food security.

To the extent that the technology behind the green revolution helped to intensify food production, it made a positive contribution to the preservation of forest and wetlands from conversion to cropping (Hazell, 2009). But this positive contribution was partly offset by the over-extended use of chemical fertilizers and water and the extension of mono cropping.

The technology from the green revolution relied on improved seeds, heavier use of fertilizers and chemical pesticides and intensive use of water. The accumulation of chemical residues depleted the soil micronutrients while intensive use of water eventually led to the depletion of water tables and the build up of salt in the most productive land; the combination of all these factors led to land degradation, the contamination of water sources, and increased risk of occupational poisoning. At the same time, the expansion of monocultures led to the loss of biodiversity including the decimation of beneficial insects and wildlife and the growth of new pest biotypes (Lipton, 2010).

Towards a true green technological revolution in agriculture

The challenge of increasing agricultural production for food security nowadays is far more complex than in the past and will require strengthened systems of innovation with the flexibility to respond to the specific needs of farmers in a variety of ecological and socio-economic contexts (Lipton, 2010), without expanding the agricultural frontier and with sustainable use of natural resources. Achieving these objectives simultaneously will require a great transformation in agriculture and land management. There are at least five areas where technology and innovation need to accelerate the transitions towards sustainable agriculture: improve pest management

to reduce the contamination of water sources, soil erosion and human poisoning; improve weed control to reduce the use of herbicides; make more efficient use of water to avoid depletion of water sources and contamination; reverse land degradation; and protect biodiversity and natural ecosystems.

Water conservation, soil protection and biodiversity enhancement need to form part of an integrated approach of sustainable land and forest management, which must also integrate biophysical with socio-cultural, institutional and behavioural variables, while recognizing the multifunctional nature of agriculture. A holistic, cross-sectoral approach should consider trade-offs and build on synergies between sectors to prioritise and promote technically available and economically feasible ‘‘win-win’’ options that ensure food security, poverty reduction and environmental sustainability. In this endeavour, a sustainable agricultural innovation system (SAIS) perspective provides a useful framework for policy-making. By recognising the dynamic nature of learning and innovation and the multiplicity of actors engaged in the innovation process and the institutional contexts within which they interact helps to identify the kind of policies and incentives to stimulate innovation to increase food productivity whilst protecting the environment (United Nations, 2011a).

It is important to recognise that there is an abundance of successful experiences of localised innovation to address these issues, often in response to weather and other shocks (see, for example, Pretty et al., 2006). The policy challenge is how to identify and support the scaling-up of these local instances of agricultural innovation in poor and food insecure countries and regions. In doing so, important lessons can be drawn from several well-known examples of rural innovations with large-scale impacts such as the integrated pest management (IPM) approach, the Farm Field Schools (FFF), the System of Rice Intensification (SRI), the networks of millers and politicians that popularized the use of New Rice for Africa (NERICA), the diffusion of micro-irrigation in Bangladesh, and watershed management in India (Hall et al., 2010; Brooks and Loevinsohn, 2011). Common features among these widespread efforts in sustainable agriculture intensification include explicit support from Governments, multilateral and civil society organisations, and/or direct involvement of local farmers, including women, in donor-led initiatives.

Central role of small scale farm holders in the battle against poverty and hunger

In supporting a new transformation in agriculture for food security and sustainable management of natural resources, it is important to take into account the specific context in developing countries. In recent years, there is growing international consensus over the centrality of small-scale farm holders of which a large proportion are women, in improving food security. The need to support small-scale farming stems from the fact that they are the mainstay of food production in most developing countries. Between 75 and 90 per cent of staple foods in developing countries are locally produced and consumed (UNCTAD, 2010). Almost 90 per cent of all farmers in developing countries cultivate plots of two hectares or less, and are often net buyers of food (IFPRI, 2005).

Increasing productivity of small-scale farms would not only directly enhance food security, but also contribute to poverty reduction by raising farm incomes and freeing

labour resources for industrial development. Small-scale farming, which tends to be more diversified in crop cultivation, has several advantages over large-scale monoculture systems. There is empirical evidence showing that for certain crops, small scale production is more efficient than large scale (20-60 per cent higher yields) and also less damaging for the environment (including climate change mitigation) (Altieri, 2008).

However, realisation of these advantages is conditional on small farm holders having adequate access to technology and knowledge relevant to the diversity of agro-ecological conditions and local crop varieties, as well as appropriate access to rural infrastructure (such as irrigation and roads), to affordable credit and farm inputs (such as quality seeds, fertilizers and pesticides), weather insurance, and education. Such conditions are a requisite for the successful adaptation of sustainable farming techniques and this is where the new revolution in agriculture represents a major departure from the previous green revolution: there is no standard ‘‘technical package’’ that will be able to respond to the technical requirements of the large variety of food requirements and agro-ecological conditions of very diverse local contexts of regions and countries with food deficits. Instead a menu of technological options and supporting services needs to be made available to small scale farmers in countries and regions facing food insecurity.

Innovation in agriculture and the role of women

Women account for a significant share of the agricultural workforce and have the potential of making important contributions to increasing food production and improving natural resources management, provided a supportive policy framework, sensitive to the specific needs of female farmers and rural workers, is put in place.

In Africa, women account for more than half of the agricultural output, 60 per cent of marketing and almost all food production in Sub-Saharan Africa (Mehra and Rojas, 2008). In Africa and East and South-East Asia, women make up over 40 per cent of the agricultural workforce. Estimates of the share of female employment in that work force range from around 35 per cent in Côte d‘Ivoire and the Niger to over 70 per cent in Lesotho (FAO, 2011). In Latin America there is an increasing presence of women in small scale agriculture.

Women are also a large share of employment in export oriented agriculture in developing countries. As reported by Mehra and Rojas (2008), women make up almost 80 per cent of workers in flower exporting activities in Zimbabwe, 75 per cent in the cotton industry in Tajikistan, and over 60 per cent in shrimp processing in Bangladesh.

The growing presence of women in agricultural production in developing countries is being referred to as the ‘‘feminization’’ of agriculture. Largely driven by trends of male out-migration, there are an increasing number of female-headed households around the world and changing patterns of gendered division of farm labour. In Africa, a quarter of households are headed by women, although the share varies significantly among countries, ranging from under 10 per cent in Burkina Faso, to close to 50 per cent in Namibia, South Africa and Swaziland (FAO, 2011).

In creating the conditions necessary to increase food production with environmental sustainability women have a crucial role to play, not only as food producers, but also as those chiefly responsible for food processing and preparation in developing countries. Their traditional position as primary family care-takers – with tasks including gathering fuel and fetching water, cleaning, cooking, child rearing, and caring for the sick – is critical in ensuring household-level improvements in food and nutritional security.

Women‘s responsibility for providing food for their families also extends to their role as wage earners. Both rural and urban women in waged labour dedicate a substantial portion of their income to purchase food. Notably, empirical research confirms gender-differentiated patterns in the disposal of income, with women having a higher marginal propensity than men to spend on goods that benefit children and for collective household consumption.[8]

Women, further, contribute to food security through the preservation of biodiversity and plant genetic resources. Women farmers are skilled in biodiversity management and are major repositories of traditional knowledge upon which many indigenous populations survival strategies depend (World Bank et al., 2009). Women often experiment with and adapt indigenous species and thus become experts in plant genetic resources (Karl, 1996; Bunning and Hill, 1996). Women‘s experience with traditional knowledge for sustainable agriculture is evidenced, for instance, in the West Usambara highlands of Tanzania, whereby soil conservation was adopted by almost 60 per cent of female-headed households but less than 40 per cent of male-headed households (Tenge et al., 2004).

Constraints faced by female farmers

Despite their central role in agriculture and food security, women in developing countries often face constraints which limit their capacity to improve food production and enhance food and nutritional outcomes. These include gender inequalities in accessing resources such as land, credit, rural organizations, agricultural inputs and technology, education and extension services, as well as the ‘‘gender blindness‘‘ of agricultural development policies and research.

Women often face discrimination in accessing agricultural inputs and support services, which hinders their ability to improve farm productivity and market their goods. This is owing to a confluence of factors including gender blind development policies and research; discriminatory legislation, cultural attitudes and norms, and lack of participation in decision-making and policy design.

A mere 5 per cent of landholders in North Africa and West Africa are women, only 15 per cent in sub-Saharan Africa, and 25 per cent in a sample of countries in Latin America; furthermore, the average farm size is significantly smaller (FAO, 2011). Small farm holders around the world face constraints in accessing loans and other

[8] Male income is more strongly associated with ‘‘adult‘‘ or ‘‘bad‘‘ goods such as alcohol, cigarettes and ‘‘female companionship’’ (Alderman et al., 1995; Duflo and Udry, 2004).

financial services, but in most developing countries the share of female smallholders who can access credit is 5–10 percentage points lower than for their male counterparts (Ibid). Insufficient credit and lack of membership in rural organizations, in turn, denies women access to modern agricultural inputs and technologies such as improved seeds, fertilizer, pesticides and mechanical tools and equipment. Gender inequalities are also documented in terms of access to rural education and training. Only 5 per cent of all agricultural extension resources worldwide were found to be directed at female farmers and only 15 per cent of the extension personnel were female (FAO, 1993).

Gender differentials in terms of access to productive agricultural resources present an important obstacle to raising global food production and productivity. Notably, it has been estimated that if women enjoyed equal access to agricultural land, inputs and technologies, they could increase farm yields by 20 to 30 per cent. This would translate in a rise in agricultural production in developing countries by 2.5 to 4 per cent and a decline in the number of people with hunger by 12 to 17 per cent (FAO, 2011).

As outlined previously, inequitable access to productive resources partly stems from the reality that women‘s contributions are often unrecognized in mainstream agricultural policies and research agendas. Much of women‘s work relating to agricultural production and food security remains ‘‘invisible‘‘. Women have traditionally held the major responsibility for carrying out unpaid care-taking activities (such as food preparation, health care, cleaning and sanitation, and collection of fuel and water) and other non-remunerative work (including subsistence agriculture). These activities are not typically accounted for in national accounts, surveys, censuses and policies (see Floro, 1995; Cagatay, 1996).

Despite a growing supply of gender disaggregated data and studies on women‘s contributions to agriculture and food security, household level data tend to ignore the intra-household distribution of agricultural responsibilities and resources. Research and policies thereby fail to account for conflict of interests and patriarchical power relations within the family, which often lead to detrimental impacts for rural women and girls. Notably, there is ample evidence of the existence of gender-related differentials in household health-seeking and nutritional behaviour.[9]

This relates to a body of work testifying to the existence of a ‘‘geography of gender‘‘– that is, regional differences in the forms and magnitude of gender inequality associated with variations in patriarchal regimes, particularly among the poorer countries of the world. The most marked forms of gender inequality are associated with regimes of extreme forms of patriarchy (or so-called ‘‘male farming systems’’ – Boserup, 1970) characteristic of North Africa and much of Asia. Restrictions on female mobility, patrilineal inheritance and patrilocal marital practices have meant the economic devaluation of women and their overall dependence on men in much of this region. In contrast, research in sub-Saharan Africa points to the prevalence of highly complex, lineage-base homesteads with considerable gender segmentation (or ‘‘female farming systems’’, whereby spouses may work on separate fields and maintain individual accounting units).

[9] (See, for example, Sen, 1990; Sen et al. , 2002; Osmania and Sen 2003)

In practice, there are also gender-related rigidities in the intra-household division of labour, with limited ‘‘substitutability‘‘between the labour of women and men, particularly in the ‘‘reproductive‘‘sphere (Folbre, 1986). With the commercialization of agriculture, increasing opportunities for women to undertake paid rural activities have often led to a ‘‘double burden‘‘, whereby women are expected to undertake remunerative work as well as maintain their traditional care-taking responsibilities, with often detrimental impacts of their health. For instance, in the Philippines increases in women‘s market participation was accommodated by reductions in their leisure time, with the time devoted to domestic work and child care remaining roughly the same (Ibid).. When farm and domestic tasks are combined, women typically work an average of 13 hours more than men each week in Asia and Africa.[10]

Women also bear a disproportionate part of the HIV/AIDS burden; not only are they more likely than men to be infected, but are also more likely to be the ones caring for those suffering from HIV/AIDS (UNAIDS, 2006). ‘‘In agrarian societies, the HIV/AIDS epidemic is intensifying existing labour bottlenecks, increasing widespread malnutrition; providing a barrier to traditional mechanisms of support during calamities, *massively adding to the problems faces by rural women, especially female-headed farm households arising from gender division of labour and land rights/resources*, and deepening macroeconomic crises by reducing agricultural exports. In extremis, it is creating the new variant famine’’ (de Waal and Tumushabe, 2003 – emphasis added, p. 2).

By ignoring women‘s unpaid household burden and the intra-household distribution of labour and resources, rural policies can be designed in a ‘‘gender blind‘‘ manner and have serious consequences for women. For instance, structural adjustment programmes (SAPs) and trade liberalization policies which have been widely implemented since the 1980s in several developing countries, can affect women negatively through the impact of changes in income, prices, public expenditures, and working conditions (Young, 1993).[11] SAP policies have expanded the extraction and production of natural resources to be traded on the international market; this has favoured large over small producers and men over women. Gender-insensitive policies have, in the view of various researchers, contributed to past food crises in Africa (Gladwin, 1991; Gordon, 1996) and the increased domestic and subsistence burdens of women (Nyoni, 1991; Sen, 1996). Unequal gender divisions of labour and resource control in agriculture (especially in sub-Saharan Africa) may constitute barriers to the achievement of macroeconomic objectives by constraining the response of peasant farmers to new incentives provided by SAPs. In principle, the incentives under SAPs should shift women in agricultural labour away from food production. But women continue to engage in subsistence production as family responsibilities make them less mobile than men. Men control and benefit most from cash-crops; often redefining (women‘s) food crops into (‘‘their‘‘) cash crops, when the former become major sources of cash income (Gordon, 1996). In addition, by ignoring women‘s unpaid reproductive labour, such policies fail to account for the fact that public expenditure cuts have resulted in many activities such as health services being shifted from the public sphere to the female reproductive sphere (especially in the

[10] http://web.unfpa.org/intercenter/food/womenas.htm (accessed 29 July 2011).
[11] For feminist work on structural adjustment see, inter alia, Cornia et al (1987); Bourguignon et al. (1991); Elson (1995); Gladwin (1991); Haddad (1991); Beneria and Feldman (1992); Sparr (1994); Bakker (1994); Stromquist (1999).

case of poor families). Increasing women‘s burden does not only have negative implications for their own health and well-being, but also jeopardizes the welfare of the next generation (Darity, 1995).

Agricultural research, too, pays insufficient attention to female farmers and their particular needs. Agendas tend to be focused on improving rural production technologies and techniques for more lucrative export-oriented crops, which tend to fall under the realm of male responsibility, whilst neglecting staple food crops for domestic consumption traditionally cultivated by women. This is partly caused by the lack of female representation and decision-making in agricultural research. Women‘s participation in agricultural research is less than 20 per cent in developing countries, although there are large differences across regions. The percentage of women engaged in agricultural research ranges from 3 per cent in Eritrea and Pakistan, to circa 40 per cent in Argentina, Botswana and Uruguay, to 55 per cent in Myanmar.

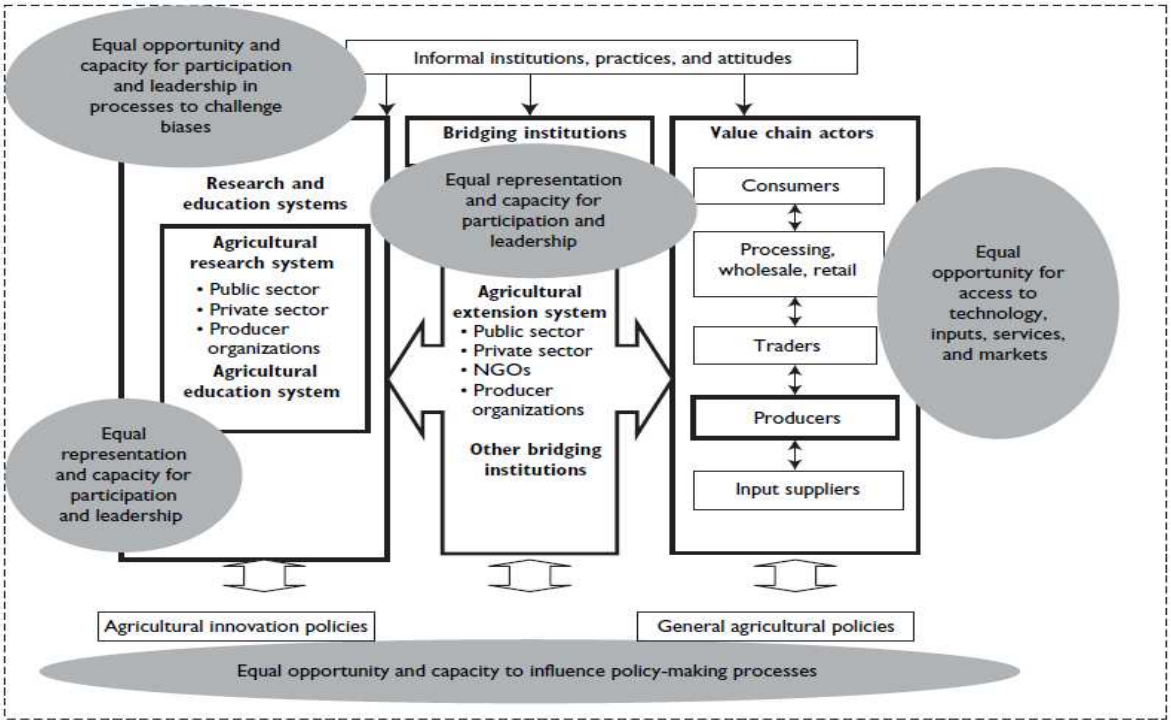
Building gender-sensitive Sustainable Agricultural Innovation Systems (SAIS)

The preceding analysis suggests that it is critical to recognize the different roles and circumstances of men and women in food production and markets in order to design informed research agendas, projects and programmes, improve agricultural output and incomes, and enhance food and nutrition security. Reducing gender inequalities in access to productive resources and technological opportunities in agriculture is a necessary condition to increasing the sector‘s contribution to sustainable development, poverty reduction and food security (World Bank et al., 2009).

The sustainable agricultural innovation system (SAIS) framework has the potential to contribute to mainstreaming gender perspectives by taking into account the many actors involved in the value chain, the diverse organizations that facilitate education, research and extension systems, as well as the policies, attitudes and practices that frame agricultural research, education and training, production and trade. The SAIS framework attaches great importance to matters of equality in access to technology, inputs, services and decision-making processes (ibid) (figure 5).

The technological transformation for sustainable agriculture will require the creation of enabling conditions at all levels of agricultural research, policy and value-chain to support a full, fair and viable participation of women in sustainable systems of food production.

Figure 5: Interrelations among the Elements of Agricultural Innovation Systems



Source: World Bank et al. 2009

Since the 1980s, national and international support for agricultural research has decreased, with expenditures for agricultural R&D in Africa, East and South-East Asia (excluding China) and the Middle East remaining low. The development and adaptation of new technology required to increase sustainable food production demands significant long-term public and private funding towards agricultural R&D. Further, the model of operation of research institutions needs to become more flexible and inclusive so at to improve their responsiveness to the needs of small-scale farmers, including through joint experimentation and learning, and adoption of a multidisciplinary focus. Agricultural research also demands closer and more direct collaboration among public research institutions, the private sector and small-scale farmers through innovative partnerships, including patent buyouts, prizes, joint ventures, co-financing and advance-purchase agreements, comprehensive risk assessments and suitable regulatory schemes (Pardey and Beintema, 2001; Bhagwati, 2005; Elliot, 2010; Lipton, 2010).

Agricultural research and policies must also be drafted through a gender sensitive lens by focusing on the needs and capabilities of resource-constrained rural women. Research and policies need to examine how the envisaged applications could potentially reduce or aggravate gender-based differences, such as the work burden of women, and access to markets and income (Schierbinger, 2010). An increasing number of female scientists and decision-makers must also be represented in agricultural research institutions. Research should, further, incorporate the repertory of knowledge and skills that local communities, including women farmers, have developed over time to sustain their livelihoods and resolve their environmental challenges. Tapping on traditional knowledge can usefully complement and contribute

to the development of modern science and technology. There are important benefits from recognizing and supporting rural women innovators, by fostering the production of innovations that are context-appropriate and have a greater chance of uptake by low-income households. As an example, Prolinnova, a civil-society multi-stakeholder international network engaged in participatory and localized innovation development, illustrates a gender-responsive, pro-poor agriculture innovation model that uses local expertise. The Prolinnova network supports local innovators, including farmers or other natural resources users, to find ways of improving their livelihoods, building on existing local, indigenous knowledge with minimum external interference. It provides grants to male and female inventors for purchasing inputs, materials and equipment, and offers technical assistance. Women farmers are part of the grant steering committee and thus influence the direction of local research (Letty and Waters-Bayer, 2010).

Increasing awareness and stimulating the adoption of sustainable technology and crop management practices – particularly in light of the potential trade-offs between increasing food production and halting environmental degradation – will also require a wider dissemination of knowledge, information, information and communications (ICT) technology and technical support for small-scale farmers, including women, through quality education in rural areas. This includes support for adult literacy and innovative peer-to-peer learning programmes and adequate extension services. The experience of the Farm Field Schools – operating in 87 countries – shows that innovation and flexible natural resource management can be advanced through farmer-to-farmer learning, with participation from formal and informal research institutions. Education, publicity, advocacy and legislation are also important with respect to reducing food waste and promoting the adoption of sustainable diets and consumption practices.

Making sustainable agriculture technologies available to small-scale farmers in diverse agro-climatic regions further requires substantial investments in rural infrastructure, including roads, irrigation, electricity, and storage facilities.
This must be complemented by measures to improve market access – including to credit, inputs and insurance – for small-scale farm holders, with a particular emphasis on improving access for female farmers. Of note is that such policies need to be context specific. For instance, in regions such as Asia and Latin America where over-use of fertilisers has caused depletion of natural resources, Governments may need to reconsider their continued subsidisation. This is contrary to the case of sub-Saharan Africa, where small-scale farm holders generally use a fraction of the recommended fertiliser levels. In addition, introduction of risk-reduction mechanisms (such as grants, tax incentives, innovative insurance policies and new forms of venture capital) can be critical in averting devastating income losses of small farm holders, which undermine investment, including in technology and innovation (Leeuwis and Hall, 2010).

Improving women‘s access to productive resources, technologies and markets will require gender analysis in policy-making and targeted support. However, such efforts cannot be confined to economic and technological solutions. In order to ensure that women producers benefit from a more dynamic agricultural sector linked to food security and sustainable development, other gender inequalities related to income and time poverty have to be addressed. Combating gender bias in rural contexts will

require changes in legislation, policies, and institutions - including changes in deep-rooted patriarchal attitudes and norms. Strategies to open new opportunities for women farmers thus have to address intra-household distributions of income and assets, the sharing of paid and unpaid work and domestic responsibilities, and the rise in number of female-headed households in rural areas linked to male out-migration. Enhancing income and food security among small-sale farm holders in developing countries may also necessitate improved access to land through re-distribution practices and more secure property rights.

In implementing these policies, governments will have to overcome political obstacles and build stronger partnerships and coalitions among the multiple stakeholders within a sustainable agricultural innovation system (SAIS). For example, through regulation to prevent monopolistic practices in food markets and adoption of ethical and environmental certification processes, new opportunities emerge for linking small farm holders to larger exporting markets along global food value chains.

International action

The international community has much to contribute to a global agenda for food security and environmental sustainability. Delivering on the financial pledges made in the aftermath of the food crisis of 2007-2008 would constitute an important down payment on realizing the commitment to the goal of eradicating hunger. International action is also needed to reform agricultural subsidies in OECD countries, which undermine the ability of farmers in developing countries to compete. This includes re-thinking subsidies to biofuels, and support to new generation biofuels to reduce the diversion of agricultural land use from food production. Non-tariff measures on food trade must be reformed so that these are truly science-based and adequate assistance is provided for small scale producers to meet them. The WTO Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) and other bilateral and regional trade agreements that incorporate TRIPS-based provisions – which introduce monopolistic and exclusive rights regimes into plants and seed varieties – may also need to be modified to permit knowledge and seed sharing in developing countries.

Reconstituting the global, regional and national capacities for agricultural R&D with international financial support can further result in the generation of a rapid increase in agricultural productivity. New financing mechanisms should also be developed to expand payments to small farm holders, including women, in developing countries for environmental services that help protect natural resources, preserve biodiversity and increase carbon sequestration in agriculture and forestry. Finally, effective regulation of commodity futures markets can help minimize unwarranted price volatility, which dilutes incentives to invest and undermines the viability of poor farmers and rural workers around the world.

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