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Opportunities and Challenges Facing Farmers in Transitioning to a Green Economy Agriculture Practice

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Introduction

Understanding the needs and critical role of farmers in advancing sustainable development requires recognizing the commonly shared and the distinctively different conditions and capabilities that exist in the developing and developed world countries. Today's agricultural production paradigms span a variety of practices ranging between the developed world's **'high input–higher yielding'** farming methods that significantly rely on the use of fossil hydrocarbon inputs; and those of the developing world's **'low input-lower yielding'** farming methods that use little if any fossil fuel based resources but generally produce low yields and reduce soil fertility. In choosing public and private initiatives to encourage and enable farmers to transition to **'sustainable input–higher yielding'** agriculture practices; we must recognize that there is no single strategy that could deliver the magnitude of transformation needed to achieve widespread adoption of the broad array of Green Agriculture practices.

As used in this paper, **'Green Agriculture'** refers to a variety of integrated farming practices that emphasize the use of naturally and sustainably produced soil nutrients and cultivation of diversified crops and livestock husbandry in a manner that enhances overall farm productivity in balance with local, regional and global environmental resources. These practices improve water use efficiencies and control soil erosion by promoting minimal disturbance of the topsoil and maintenance of adequate ground covers of organic carbon matter. In the aggregate, green farming practices demonstrate increased agricultural productivity of currently farmed lands; reduced vulnerability to price volatility of fossil hydrocarbon resources and improved agricultural resilience and adaptability to changing climate conditions. Green agriculture also encompasses a range of social equity benefits that improve farmer livelihoods while producing and preserving beneficial ecological services.

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A primary goal of green agriculture systems is to enable farmers to increase their efficient use of inputs to realize higher produce yields in order to meet growing consumer demand for nutritious food. Of equal importance are goals to improve the social equity and prosperity of farmers and their communities and to restore and maintain a healthy environment. Truly sustainable agriculture stewardship must not only improve current farmer livelihoods and their productive use of natural capital resources and ecosystem processes; it must do so in ways that do not compromise the health and prosperity of future generations that will follow.

This policy paper has been prepared to highlight the key opportunities and challenges confronting farmers throughout the world as they consider and adopt practices that contribute to green economic development, poverty eradication and improved food security. It focuses on the role of farmers in green economic development and how a transition to a green economy could benefit farmers. It also describes the primary means to accomplish sustainable farming and discusses key policies and public/private investments that would advance a 'green agriculture' transition. It is intended to catalyze multi-stakeholder dialogues that place farmers at the center of international efforts to assess costs and benefits and to build a consensus for action at local, national, regional and global scales.

This policy brief presents a set of best practice recommendations intended to stimulate discussion by farmers, their representative organizations, governmental and private sector leaders and other stakeholders involved in the agricultural production sector. This paper could also help inform and guide deliberations and planning efforts now underway to advance International Environmental Governance (IEG) and to establish a more effective Institutional Framework for Sustainable Development (IFSD). This paper may also serve as a high level summary that articulates farmers' issues and perspectives in order to encourage their consideration in the comprehensive multilateral discussions to be undertaken during important institutional, public and private sector deliberative and decision making processes and forums, including the Rio + 20 Summit.

Key Messages to Principal Stakeholders

Farmers

There are many challenges facing today's farmers. The nature and scale of these challenges vary according to whether they farm large tracts of land with mechanized cultivation of high yield monoculture crops boosted by petrochemical fertilizer, pesticides and herbicide inputs or farm small land areas with hand tools and without the use of any petrochemical inputs that results in degraded soil fertility; or if they practice a variety of farming methods between these extremes. They all share vulnerability to the vagaries of weather; to encroaching climate change; to increasing costs of fossil fuel based inputs to changing consumer demands and to the rising market power of agricultural input suppliers and

Key messages to smallholder farmers:

- Strive for improved and gender equitable legal rights to ownership and tenure for the lands that you farm
- Develop and share knowledge and information on sustainable agroecological farming methods
- Establish and strengthen farmer associations that amplify your voice and commercial power
- Leverage farmer association capabilities to improve access to capital and to supply value added markets
- Invest in post harvest storage and warehouse infrastructures to improve market access options
- Support local and regional commercial production of organic agricultural inputs
- Augment integrated agroecological practices with micro-dosing of synthetic inputs for higher yields
- Partner with neighboring farmers to improve local watershed management and land stewardship
- Demand participation in public policy development decision making and in public/private partnerships
- Participate in community seed banks that stock and share high quality indigenous crop variety seeds

the buyers of their products. Farmers also confront a continued and accelerating rural-to-urban migration of young adults in search of jobs and improved livelihoods. The social impacts of this worldwide trend include an impaired availability and capability of rural labor; diminished viability of non-farm rural enterprise and qualitatively lower levels of civil society benefits in rural areas.

Key messages to large scale industrial farmers:

- Invest in precision application technologies that improve your efficient use of inputs
- Adopt increased crop diversification and more extensive integrated crop rotation cycles
- Implement reduced tillage and No-Till cultivation techniques to improve soil conditions
- Invest in more efficient water irrigation technology
- Participate in land conservation set asides to reduce soil erosion and water loss and improve local biodiversity
- Advocate public support subsidies for green agriculture transitions that would replace commodity crop production subsidies
- Participate in sustainable agriculture certification and product labeling market formation initiatives

However, these commonly shared challenges are further delineated by the specific conditions of local geographies and agri-climates; economic and health constraints of individual farmers and many other factors. These distinctly different challenges are shaped by each farmer's specific situation regarding land tenure and ownership; access to capital and degree of indebtedness; availability of agricultural technical support; gender inequities; and other conditions. Only when all of the above noted challenges are addressed can we begin to formulate strategies that encourage a transition to sustainable agricultural practices that are tailored to the needs of smallholders and large industrialized farmers who in the aggregate represent the global agriculture sector.

Public Policy Makers

Policy makers from all levels of government, including local, state, regional and national executive, regulatory and legislative leaders and representatives of international institutions all have significant roles in determining how the public sector could encourage private sector investments in sustainable agriculture production systems. Foremost is the need to recognize and value the multi-functionality of agriculture which provides economic products, social livelihoods and environmental benefits. With this perspective, policy makers need to identify, reform and eliminate public policies that promote unsustainable agricultural practices. Farmers' excessive reliance on non-renewable resources is a key contributor to climate change and is promoted by public subsidies of market prices for unsustainable inputs (e.g. lower costs for synthetic fertilizer or electric power used for irrigation pumping). These perverse subsidies reduce the competitiveness of more efficient and sustainable farming inputs and methods.

Key messages to policy makers:

- Support agrarian land rights reforms that enable smallholder farmer ownership of their farms
- Reduce and eliminate direct and indirect subsidies for unsustainable farming practices and inputs
- Establish public financial support for farmers' initial green agriculture transition efforts and investments
- Increase public funding of agroecological sciences, research and development and higher education
- Support green agriculture extension services, field trials and wireless information services for farmers
- Increase public investment in agriculture, especially if farming is a major contributor to GDP and jobs
- Implement oversight of large agribusinesses' market dominance to ensure a competitive private sector
- Promote innovative transborder policy mechanisms that enable watershed area governance
- Implement public procurement preference policies for local, sustainably produced food
- Integrate national health and environment goals with sustainable agriculture and food security
- Invest in rural and urban sanitation infrastructures that recover wastes for organic nutrient inputs
- Initiate citizen/consumer awareness and education efforts to inform the public of sustainability benefits
- Reform trade policies to support phyto-sanitary standards and smallholder farmers participation in value added domestic and export markets
- Promote bioenergy policy priorities for sustainable biofuels to modernize domestic agriculture sector

There are also hidden subsidies in the form of inadequate regulation of practices that pollute the environment and emit GHG's. The inefficient use of agrochemical inputs results in significant runoff of these chemicals from fields into freshwater supplies. Similarly, livestock wastes from large feedlots also impair water quality. These chemical and organic pollutants

have detrimental consequences for aquatic species (e.g. eutrophication of wetlands and coastal area fisheries) and human health. These negative externalities of environmental degradation are generally not factored into the costs of conventional agriculture production; resulting in farmers being incented by market forces to ignore such consequences. Initiatives to monitor and measure such externality costs and include them in market prices for unsustainably produced agricultural products would dramatically advance the economic viability of a wide range of green agriculture innovations. In addition, preferential consideration of sustainably produced food should be included in international trade policy reforms that encourage food safety standards and increased participation of smallholders in domestic and export markets.

Another critical area of public policy is the role of government in educating its citizens about the multiple benefits of sustainable agriculture; with particular attention to the personal and public health implications of nutritious food consumption and more sustainable dietary behaviors. Building improved consumer awareness of the value of more nutritious and sustainably produced food and other agricultural products will be a critical counter balance to consumer market pressures for less expensive food and for diets with higher proportions of resource intensive meat and dairy products.

Private Sector Business Leaders

It is clear that the needed scale and pace of a global transition to green agriculture practices can only be achieved with the full commitment and resources of the private sector. Green agriculture's potential for sustainable productivity and environmental gains should make it an important issue for businesses. However, from a market economy perspective, quickly generating high economic returns on many green agriculture investments may be challenging. It may be particularly difficult to achieve quick returns in many industrialized farming operations that require multi-year transition efforts. The gradual rebuilding of natural capital assets may be difficult for private sector managers who are responsible to shareholders and financial institutions who seek maximized near term profits. Furthermore, expectations for year-to-year profit growth have the effect of highly discounting the future value of productive gains that would be realized with green agriculture investments that are made today.

Key messages to private sector:

- Build supply chain partnerships with farmers that support sustainable agriculture practices
- Support capacity building of farmers and their communities to participate in value added functions
- Reduce your products' ecological footprint with more efficient processes, packaging and local suppliers
- Invest in consumer information and product certification processes to increase demand for sustainable products
- Cooperate in forming industry alliances to promote harmonious sustainability certification standards and compliance protocols
- Invest in sustainable agriculture input suppliers and promote formation of rural supply chain networks
- Scale up sustainable supply chain pilot projects to become core operations practice of the firm

Given these challenges, it will require innovative business leaders with a strategic view of both the near and long term to embrace sustainable business plans based upon green agriculture principles. Private sector initiatives should create supply chain models that promote collaboration among key suppliers, farmers and their wholesale customers. Within the agriculture and food system sectors, such partnerships are needed between food processors, leading brands, major consumer market retail outlets and their 'upstream' suppliers of agricultural products (e.g. farmers, wholesale aggregators and exporters). Encouragement of sustainable farming practices should be a core element of comprehensive risk management strategies that benefit all parties. Agroecological practices would help farmers

provide high quality products at reasonable costs regardless of uncertain future fossil hydrocarbon prices or availability; and would enable farmers to better adapt to climate change stresses.

Retail businesses are responsive to changing markets for agricultural products. These firms spend significant resources to brand and promote their products in order to influence consumer purchasing decisions. Global population growth, increasing per capita incomes and continued urbanization are resulting in consumer demands for more and higher quality agricultural products (e.g. more meat and dairy, more processed foods). Consumers also seek lower prices. Sustainably meeting all of these demands will be challenging. The private sector has an opportunity to inform consumers of the benefits of sustainably produced food by certifying and branding such products in the retail marketplace. Such eco-labeling initiatives are critically needed to build consumer demand and a willingness to pay for green agriculture's multiple benefits.

Non-Governmental Organizations (NGO's)

Non-Governmental Organizations (NGO's) can be highly effective catalysts for transforming current unsustainable farming practices into more sustainable, environmentally balanced and socially equitable agriculture production systems. The NGO community spans a broad spectrum of issues and agendas for changing society with many organizations focusing on improving conditions facing the poor in the developing world. Some NGO's are large, heavily endowed philanthropies or international organizations with operations throughout the world; while others may be relatively small groups that have coalesced to focus on actions that address a specific local or national issue. The breadth of diversity across the 'NGO sector' is extensive; which makes it difficult to make high level recommendations regarding what NGO's should do to advance sustainable farming.

Key messages to NGOs:

- Increase and expand coalition building efforts across the global NGO community for green agriculture
- Enable increased public access to sustainable farming technical information and field performance data
- Extend outreach efforts to engage more farmer organizations and agribusinesses to form partnerships
- Increase public awareness of the health and ecological impacts of diets that emphasise consumption of meat, dairy and highly processed foods
- Increase citizen and consumer pressure on public and private sector to adopt green agriculture plans
- Promote and sponsor scientific research and social capacity building to support agroecological farming
- Integrate green agriculture initiatives with poverty alleviation and MDG efforts

When considering their strengths and opportunities to undertake initiatives, foremost is the relative degree of independence most NGO's have with regards to prevailing public or private sector interests. Although practically every NGO requires financial support from a variety of donors, governmental agencies or other supporters; most NGO's have a fairly wide degree of latitude with respect to the issues they choose to address and the engagement tactics they adopt. Some may undertake more confrontational public policy advocacy campaigns that provide information and focus citizen interest and support for a particular issue targeted by the NGO. Others may choose to support innovative field projects that put into practice sustainable farming methods that deliver tangible, positive impacts to the participating families and communities. Still others may have the resources to sponsor major research and development programs that generally are only possible with the support of governmental appropriations or private corporate investments.

Most NGO's have the ability to quickly focus on an issue and decide a course of action. This organizational nimbleness gives the NGO community an ability to work

with other groups that have similar concerns and goals and facilitates the rapid formation of alliances and collaborations to address a set of common objectives. With the broadening reach of internet telecommunications and information sharing technologies; geographically dispersed NGO's have the capability to work with each other in ways that can be highly effective in impacting local, national and global initiatives for positive change. Furthermore, NGO's have a distinct advantage in serving as a brokering agent between farmers, public agencies and private industry to create 'public/private partnerships' that can undertake innovative initiatives and demonstration trials to test and advance best practices in sustainable agriculture. Such initiatives are urgently needed to generate the proof of concept evidence that is often required to justify much larger public and private sector decisions to invest in a global transition to green agriculture.

Patterns of Agricultural Production Systems

There are a wide range of agricultural production methods currently in use throughout the world. These practices span a variety of techniques that rely on differing levels of land, water, labor, energy, capital and other inputs and are significantly defined by local climatic and agroecological conditions. The difference between current production paradigms may be concisely viewed as a spectrum of choices reflecting varying degrees of dependence on the use of industrialized, highly mechanized, high input farming techniques and smallholder farming operations that are characterized by a higher reliance on manual labor, draught animal power and the relatively low use of farm mechanization and fossil fuels, synthetic fertilizers and other agrochemical inputs. For this policy brief, discussion will primarily focus on the extremes of production patterns as evidenced in U.S. agriculture production systems and those of subsistence smallholder farmers in Least Developed Countries (LDC's).

U.S. farming sector as representative of Developed World conditions

U.S. agriculture is highly productive, having demonstrated over the past sixty years continuously increasing output yields on the basis of both land area and labor inputs. Similar high levels of production performance have also been achieved in Europe and other OECD countries. When considering the perspectives of U.S. farmers, it is important to note that there are nearly 2.2 million farms operating in the U.S.; with an average size of 419 acres per farm (i.e. 168 hectares). The average age of an American farmer is 57 years old and average capital investment per farm (i.e. machinery, tractors, etc. but excluding livestock or land and building values) is approximately $88,000 (USDA-NAS. US Census of Agriculture 2007). Recent increases in global food prices; the limited availability of unused land that could be cultivated and high capital costs of mechanized equipment are driving the increase of farm land values. These changes have made it challenging for younger generations to afford farm land and contribute to agricultural production.

U.S. agricultural output is predominantly produced on large scale farming operations. Although large scale family farms with annual sales greater than $250,000 and non-family (e.g. corporate owned) farms represent only 12% of total U.S. farms; these large farms (i.e. with an average of nearly 2000 acres per farm) produced 84% of the total value of U.S. farm production (USDA-ERS. 2010a). This increasing level of concentration of U.S. agricultural output from large acreage farms is even more evident in livestock operations. Although only 2.7% of all dairy farms have more than 1000 head of milk cows; these large operations represent 44% of the national

cow inventory and produce 48% of all milk. An even more extreme concentration of production is found in the hog and pig subsector; where only 0.5% of all operations have more than 20,000 head of livestock, yet control nearly two-thirds of the total national swine inventory (USDA-NAS, 2011).

This trend of increased specialization and concentration of crop and livestock production has resulted in nearly 60% of all cultivated acreage planted with four crops (i.e. corn, wheat, soy and cotton). The dominance of monoculture commodity crops is partially due to increased market demands for globally traded commodities, livestock feed and 1st generation biofuel feedstocks and is also encouraged by current production subsidies from the U.S. government. The rapid rise of Concentrated Animal Feeding Operations (CAFO's) reflects growing domestic and international demand for meat products and the continued specialization of the various stages of animal husbandry. The significant production levels for these monoculture commodity crops have been enabled in part by relatively high application rates of fertilizers (e.g. U.S. corn production uses an average Nitrogen input of more than 143 lbs. per acre in 2010)(USDA-ERS. 2010b). However, fertilizer use has stabilized over the past 10 years due to the greater use of improved hybrid plant varieties; precise application of inputs and other innovative technologies.

The high use of synthetic inputs in the U.S. has created significant environmental impacts; particularly with respect to the leaching of nitrates, herbicides and pesticides into fresh water and marine ecosystems. Agrochemical runoff has resulted in increased eutrophication in downstream watersheds and estuaries and has prompted federal and state governmental regulation and oversight of pollution sources from the agriculture sector. High intensity input farming and the increase of ruminant livestock and related concentrated animal feeding operations are significant sources of nitrous oxide and methane GHG's and also contribute to nutrient loading of fresh water supplies that can result in hypoxic conditions that are lethal to many aquatic species. Furthermore, there are signs that Herbicide Resistant (HR) weeds are appearing on many farms that rely on the use of herbicides (e.g. glyphosates) and genetically modified herbicide tolerant crops to control weeds and increase crop yields.

In contrast to the environmental impacts of conventional farming practices; there are promising trends in which certified organic agriculture production acreage in the U.S. has increased by 51% between 2005 and 2008. U.S. organic produce and beverage revenues grew at an annual rate of nearly 8% in 2010; far outpacing overall market growth of less than 1% (Greene, *et al*. 2010). The rapid growth of market demand for organic food and other products has been stimulated by growing consumer awareness of improved food safety and quality of organic produce; and that organic farming practices have more benign ecosystem impacts. However, even with its recent growth, the current magnitude of organic farming gains should be qualified with the recognition that organic foods currently represent only 4% of the total U.S. food and beverage market (OTA, 2011).

The wide range of income and production output levels across all U.S. farms indicates that even within this affluent and industrialized nation, there is a significant divergence of views on what are the most appropriate and effective actions needed to transform current practices into a more sustainable green economy agricultural sector. This divergence suggests that different strategies will be needed in order to motivate and enable large industrialized farms and small to medium sized family farms to undertake the adoption of green agricultural practices.

Furthermore, it should also be noted that substantial productivity gains are also being achieved by high intensity input farming operations in Brazil, China, India and other rapidly developing nations. However, these gains are accompanied by increasing concern about long term sustainability given their reliance on non- renewable resource inputs; increased irrigation that often exceed hydrologic recharge rates and continued deforestation pressures .

Smallholder farming as representative of Developing World conditions

There have been significant improvements in total agricultural productivity gains in many Developing World nations over the past fifty years. However, in most cases the smallholder farmers in these nations produce the majority of food domestically consumed. Despite rising agricultural production in most countries, continued threat of food insecurity, significant incidence of malnourishment and hunger among the poor and rapidly growing populations are factors that should make smallholder farmers the primary focus of any efforts to improve sustainable farm production. Approximately 85% of all smallholder farms in the developing world have land areas of less than 2 hectares (*Byerlee, et al*. 2007) and more than one half of smallholder farms are operated by women. In some countries such as in Sub-Saharan Africa, women lead nearly three-quarters of all farming households. These predominantly rain fed farms are characterized by very low or no use of synthetic fertilizers or other inputs and a reliance on manual labor for cultivation and harvesting. Many of these farms produce subsistence levels of food for the family with little surplus available to sell in local markets for income.

These smallholder farm operations are more susceptible to topsoil erosion due to the continued depletion of soil nutrients; poor soil structure and the limited retention of crop residues or ground cover on their fields. Furthermore, their crop yields are significantly less than the production levels achieved by farms in the same region that are irrigated and applying adequate inputs or that are implementing more integrated agroecological cultivation practices. In addition, most smallholder farmers lack adequate post harvest storage and handling capabilities that result in substantial levels of spoilage and loss of harvested produce. Poverty levels are high and many smallholder farmers, particularly women have limited or no assurance of land tenure. These economic vulnerabilities result in most farmers having severely limited access to working capital that is needed to improve their operations and increase crop and livestock yields.

In many developing countries, the severely limited transportation infrastructure in rural areas significantly impacts the availability and cost of agrochemical inputs and higher quality seed. Such infrastructure inadequacies also impair the development of sustainable agricultural input production and distribution supply chains and technical services that are needed to support smallholder adoption of agroecological practices. These transportation constraints also limit most farmers' access to regional, national and international markets. Farmers' inadequate physical access to markets is compounded by their frequent lack of information on current market prices that can negatively affect the farm gate prices that they are offered at harvest time.

There are significant social challenges confronting smallholder farmers such as limited formal education and literacy levels that can impair their ability to negotiate equitable commercial contracts with suppliers and customers; apply for governmental support programs; register for land rights and participate in other institutional agreements and entitlements. Inadequate rural public health services and vulnerability to disease and illnesses are additional factors that impact the

availability and capabilities of the rural labor force. In many countries with rising populations, the growing number of children and young adults is overwhelming many rural areas' capacity to provide additional land for farming. Smallholder farms continue to decrease in size as existing arable land is subdivided among siblings. The difficulty in acquiring land for new farmers is a significant factor that contributes to rural conditions that compel many young adults to migrate to cities in search of jobs and better livelihoods.

Common Conditions of Developed and Developing World Farming Sectors

As stated earlier in this paper, there are both *commonly shared and distinctly different* conditions that should guide and shape the actions that must be taken to enable farmers in the Developed and Developing World to adopt more sustainable agricultural practices. Many of the key differentiating factors between the two farming paradigms are described above. Some of the most important commonly shared factors that impact farmers' ability to efficiently manage their production costs, receive profitable market prices and earn decent incomes are:

- increasing abiotic risks of climate change and extreme weather (e.g. drought, floods, rising temperatures and sea levels) and environmental degradation constraints (e.g. water pollution)
- increasing biotic risks such as evolving and changing pest pressures; invasive plant species; declining biodiversity of beneficial species (e.g. pollinator insects, pest predators; etc.)
- continuing market concentration of 'upstream' agricultural input suppliers (e.g. fertilizer and agrochemicals; biotechnology seed breeders; etc.)
- increasing market concentration of 'downstream' agriculture produce buyers; with transnational trading and retail firms and commodity speculators wielding greater influence on global prices for farm outputs
- rising costs of fossil fuel based inputs and other non-renewable resources (e.g. phosphorus fertilizer) and emerging constraints on fresh water availability
- continuing market concentration of 'downstream' agricultural produce customers (e.g. global commodity trading firms; multinational food brands; large retail supermarket grocery operators; etc.)
- increasing demands for land, capital and inputs from bioenergy producers; in which the emergence of a new form of 'cash crops' for biofuels offers both income opportunities and competitive risks to farmers
- continuing decline of rural communities as younger generations move to urban areas and consequential constraints on the availability of farm labor

Best Practices in Conservation Agriculture and Ecosystem Restoration

There are a wide variety of 'green agriculture' best practices techniques and technologies that improve agricultural productivity and can be implemented in a variety of scales. Their benefits include improving soil fertility, pest control and water management with reduced use of non-renewable resources and enhancing farmers livelihoods and strengthening rural communities.

These benefits are important to all farmers regardless of the scale of their operation. Many farms in the developed world have long been implementing best practices such as post harvest storage; precision input application; organic-centered agriculture and watershed management. However, in the developing world these practices are just beginning to be addressed and adopted. Other practices such as

low till cultivation and the local production and use of organic fertilizers are expanding throughout the world; although at a pace far slower than what is needed to achieve widespread adoption of green agriculture practices. Some of the methods described in this paper have the potential to provide immediate productivity gains; while others may require several years to achieve their full benefits. However, all of these techniques must be assessed and properly matched with specific local conditions facing the farmer and the environment. If adopted, these practices individually and in the aggregate should contribute to humanity's transition to more sustainable agricultural production systems.

The Third World Network (TWN) and Institute for Sustainable Development (ISD) have worked with 57 villages in the Tigray region of Ethiopia to demonstrate how organic composting can increase crop yields without the use of synthetic fertilisers. Their multi-year trial has revealed that aggregate yields from composted fields were 80 per cent greater than comparable plots treated with imported fertiliser; and 106 per cent greater than yields from control plots that were not given any fertiliser inputs (Edwards, *et al.* 2008).

Production and use of organic compost fertilizers

A fundamental element of sustainable farming is the production and use of organic fertilizers made with biomass wastes, crop residues, tree litter, livestock manures and other photosynthetically produced matter. Improved capture and management of organic nutrient flows enable farmers to return soil nutrients and organic hummus to their fields; thus reducing the amount of synthetic fertilizer that may be needed for higher yield crop production. Increasing Soil Organic Carbon (SOC) levels also improves soil structure; enhances its water percolation and retention capacities and sequesters significant amounts of CO_2 that helps reduce GHG levels in the atmosphere. The local and regional production of organic fertilizers (e.g. sourced from composting, vermiculture and livestock manure management) presents opportunities for increasing rural jobs and productively using organic wastes that might otherwise create water pollution, methane gas emissions and other negative environmental externalities. The production and use of organic fertilizer is increasing in the developed world as consumer demand for organic food continues to rise. However, this practice is also particularly applicable to developing countries because of the economic multiplier values of retained purchasing power and more jobs from investments in locally produced organic fertilizers that displace expensive, imported foreign manufactured petrochemical fertilizers.

More efficient and precise application of inputs based on soil condition and crop growth cycle

Current high intensity input farming practices often apply excessive amounts of fertilizer and other inputs that are not effectively converted into higher crop yields. The over application of such inputs generally result in significant environmental pollution from chemical leachates in fresh water sources and GHG emissions and are often accompanied by occupational health hazards to farmer workers and their families. Furthermore, the excessive use of pest and herbicides can lead to unintended suppression of non-targeted species that provide biodiversity and other agricultural benefits. In response to the rising costs of fossil fuel based agrochemical inputs and the regulation of non-point source pollution, particularly in the developed world; many farmers are beginning to use improved 'time release' fertilizers; nitrogen-inhibitor treated fertilizers; and Global Positioning System (GPS) controlled input applicator technologies that adjust the levels of distributed inputs to accurately match specific and varied soil conditions throughout their fields. Although precision input technologies are more expensive than conventional input broadcast systems; the input savings from these technologies are proving to be cost effective for many farmers in the Developed World. These practices are also being modified and

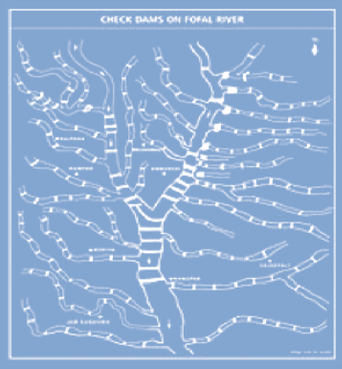
adopted by Developing World smallholder farmers who are increasing their crop yields by using micro-doses of synthetic fertilizers that are a small fraction of conventionally recommended application levels.

Reduced tillage and No Till cultivation

Conventional tillage practices that significantly disturb top soils during planting and weed management are known to contribute to excessive soil erosion from wind and rainfall runoff. These practices also promote accelerated volatilization and release of CO_2 and other GHGs that are contained within the soil. Farmers who adopt reduced or no till methods minimize top soil disturbance by retaining large quantities of ground cover crop residues or green manure crops that protect the soil surface and gradually return organic nutrients and carbon to the soil. Use of this practice is growing among developed world farmers with the introduction of No Till mechanized equipment; and could also be implemented by smallholder farmers if increased development and manufacture of smaller scale and draught animal driven No Till and direct seeding equipment were promoted.

The Indian NGO, Vruksh Prem Seva Sanstha Trust (VPSST) has organised 27 villages along the Fofal River to form watershed management committees that built check dams; riparian tree planting buffers and water storage cisterns to capture rainfall during the monsoon season for use in irrigating their fields during the dry season.

Within 8 years the villages built 1605 check dams that created an infrastructure capable of improving the area's water retention capabilities that resulted in raising ground water table levels and enabling farmers to grow more crops and raise more livestock (CSE, 2008).



Improved rainwater capture and watershed management

Practices that maintain organic ground covers on fields will retain rainfall and reduce evaporation losses. There are also a variety of complementary techniques that re-contour landscapes to capture rainwater and reduce water runoff and soil erosion. These practices include the integration of vegetative and riparian buffers; field terracing on steeply sloped terrains and agroforestry intercropping to decrease water runoff. The excavation of shallow depressions to capture and concentrate water (e.g. zai pits) has been proven particularly effective in restoring degraded land in arid regions for horticulture and orchard cultivation. On a more expansive landscape scale, the construction of surface water reservoirs and catchments are enabling crop production during the dry season and facilitates irrigation of nearby fields. Community watershed management initiatives are successfully replenishing and maintaining groundwater tables and are providing potable water supplies to rural communities.

Farmers are also adopting more efficient irrigation techniques; such as drip irrigation and the use of System Rice Intensive (SRI) practices that reduce the frequency of flood irrigation of paddies and increases overall rice yields.

Agroforestry methods and multiple/inter-cropping rotations

Agroforestry techniques focus on the integration of purposely selected trees and bushes in the same field with a variety of cereal and cash crops. Farmers who adopt agroforestry often use N-fixing species that naturally produce fertilizers and whose leaf litter contributes to soil nutrient enrichment. The tree canopies and root structures also help reduce soil erosion and excessive heat impacts and improve water retention. Furthermore, agroforestry can provide opportunities

for locally managed sustainable fuel wood production that could support household cooking and heating energy needs. The adoption of this technique in East Africa has significantly increased maize, sorghum and other crop yields.

Increased crop and livestock diversification

Traditionally practiced in the developing world, crop diversification and rotation strategies that include nitrogen fixing crops provide multiple benefits of improved soil fertility; reduced vulnerability to pests; and contribute to biodiversity. Diversified farming also contributes to improved human and livestock nutrition with the inclusion of vegetables, fruits and other micro-nutrient rich foods and feed. Of particular relevance to smallholder farming are opportunities to integrate animal husbandry into their operations. When these practices have been adopted, local farmers create sustainable crop and livestock nutrient cycles in which fields and pastures produce livestock feed and grasses that eventually result in byproduct organic wastes that are recovered as valuable farming inputs. Local production of feed and fodder for livestock and returning manures as fertilizers for field application are succeeding in increasing combined farming and livestock productivity. Landscape scale integration of crops and livestock between cooperating groups of farmers are an effective strategy for stimulating rural economic development.

An effective example of combining biologic IPM with crop and livestock diversification can be seen with the "Push Pull" technique that is being adopted in Eastern Africa.

Desmodium, a perennial N-fixing fodder plant is intercropped with maize and other cereals. It emits pheromones that repel the stem borer moth from entering the field.

When combined with perimeter plantings of Napier grass that emit pheromones that attract the moth and whose leaves capture and kill their larvae; the "Push Pull" IPM practice effectively deters and suppresses stem borer infestations.

Also, *Desmodium* roots emit chemicals that protect the crops from invasive Striga weeds (Khan, *et al*. 2011).

Integrated Pest Management (IPM)

Alternatives to agrochemical pesticide and herbicide use are being demonstrated with diverse methodologies that utilize preventative pruning, crop rotations and the encouragement of beneficial predator insects and other species to combat pests and reduce year over year pest pressures. Farmers benefit from significant improvements in their cereal crop yields with the Push Pull technique's pest management capabilities and natural nitrogen enrichment of soils and by fodder production for livestock that brings them additional income and provides manure fertilizer for their farms.

Improved post harvest storage to reduce waste and losses

In addition to implementing means to sustainably increase crop yields, farmers in the developing world are also investing in household and cooperative scale grain storage systems (e.g. metal silos and other structures that protect harvested grains from spoilage and losses to vermin) and improved produce packaging and handling systems. The use of higher quality storage systems not only reduces post harvest losses; they also enable farmers to have more options on when to sell their produce in order to earn higher prices than those that are offered immediately after harvest time.

Increased farmer participation in value added processing

In addition to sustainable cultivation practices, smallholder farmers need support in developing the capacity to qualitatively improve the value of their

produce by applying quality control, sanitation and food safety measures that are desired by consumer markets. These initiatives are particularly critical if smallholders are to succeed in supplying domestic urban and export markets with agricultural products that comply with international food phtyo-sanitary standards. The challenge of smaller economies of scale for rural processing plants; limited availability of clean water and reliable power and inadequate transportation infrastructures create barriers to farming communities' ability to participate in value added production. It is clear that financial and technical support from private agribusiness partners, international institutions and public sector agencies is required if smallholder farmers are to participate in additional value creation along the field to market supply chain.

Green Economy Opportunities for Farmers

Improved crop yields and less dependence on fossil hydrocarbon inputs

The foremost green economic opportunity for farmers is their potential to maintain or increase their crop yields and overall production outputs without needing to apply significant amounts of fossil hydrocarbon based inputs. One of the key characteristics of sustainable agriculture is its use of agroecological cultivation practices, renewable organic resources and biological pest management to support crop production. These practices would reduce the consumption of nonrenewable fossil fuel resources (e.g. petroleum and natural gas) that are used to manufacture conventional agrochemical inputs. For those farmers currently using 'high intensity input -higher yielding' practices; there is much evidence that they could achieve comparable productivity levels with much less dependence on fossil carbon intensive resources. With respect to smallholder farmers that currently use 'low input - lower yielding' practices; their adoption of sustainable agriculture methods should produce significant gains in crop yields. These productivity improvements would help many poor farmers quickly move beyond subsistence farming; creating marketable surpluses that would enable them to earn cash incomes needed to improve their livelihoods. These positive outcomes are possible without smallholders having to adopt the unsustainable, high intensity input farming techniques currently used in most of the Developed World.

Increased farm gate prices for sustainably produced and eco-label certified products

The continued growth of certified organic food and fiber market segments, especially in affluent nations, is an indication that as consumers become more aware of the health and environmental benefits of sustainably produced agricultural goods, many demand and are willing to pay premium prices for such products. Farmers who have adopted organic farming methods and are certified and branded as such to the consumer market generally earn higher prices for their output. Such income gains require knowledgeable farmers who are able to successfully manage the transition to organic practices which include implementing improved food handling and distribution processes required for certified organic products. Farmers' production efforts must also be complemented by food processors and marketers communicating the added value of organic products to retail consumers. It should be noted that a farmer's adoption of agroecological practices does not necessarily require becoming 'certified organic.' There are an increasing number of food system initiatives that are assessing the degree of sustainability of various products that are marketed;

and that promote 'eco-labeling' to differentiate such products in the consumer marketplace. As this trend continues to grow, it is expected that participating farmers would economically benefit from these changing consumer attitudes and preferences. However, challenges still remain with the additional cost and complexity of many certification processes. Many farmers, particularly small holders will need technical and financial support to implement certification methods and reporting requirements.

Increased participation in value added processing and handling of raw farm produce

An opportunity that is closely related to farmers achieving increased crop yields is their involvement in a range of on farm and rural community based activities associated with improving the quality, grading, storing, packaging and processing of the raw farm products that they harvest. This requires capacity building efforts that train farmers in modern phyto-sanitary processes and related enterprise management skills. Such investments could enable farmer associations or community based entrepreneurs to establish value added supply chain processes that extend from the field to wholesale and retail markets. Improved access to capital (e.g. for cleaning and sorting equipment; milk refrigeration; sanitary packaging and storage facilities; local power generation etc.) would also be needed for farmers and their organization to fully participate in these new income opportunities. Farmer associations must also improve their capacity to negotiate equitable contracts with input suppliers, financial lending institutions and the customers of their farm produce.

Job opportunities in rural non-farm enterprises that produce organic agricultural inputs

Green agriculture will require a significant increase in the local and regional production of organically sourced inputs; appropriately scaled mechanized farm equipment (e.g. No Till machinery, micro irrigation systems, grain silos, etc.) and other technologies. An important objective of many rural development initiatives is to encourage and strengthen Small and Medium Enterprises (SME) that could supply these products and related technical services to the agricultural sector. The employment opportunities created by such agriculture related SME's would stimulate economic growth in rural areas and also increase domestic markets for farmers' products.

There are also innovative efforts to provide public sector and donor community funding of rural employment to improve agricultural natural capital assets such as enhanced watershed management; contouring sloped arable lands; tree planting projects; and other rural infrastructures. India's National Rural Employment Guarantee Act (NREGA); China's "Grain for Green" soil erosion control program; and the World Food Program's "Food for Progress" (FFP) are examples of public works projects that have created jobs for farmers and other rural labor in order to create more productive farming conditions and to improve access to markets.

Policies for Stimulating Equitable Green Economic Growth for Farmers:

Agriculture extension services and farmer field schools focused on sustainable practices

There is mounting evidence of farmers successfully adopting agroecological best practices throughout the world despite difficult conditions and the relative lack of resources. One of the most significant policy initiatives that could stimulate green agriculture would be for National Governments and civil society organizations (e.g. NGO's) to significantly increase their funding of agriculture extension outreach, training and demonstration services that focus on sustainable farming practices. Such a policy must be founded on sound agricultural science principles and be firmly committed to ensuring that women farmers are fully and equitably enabled to participate in the training programs, research and demonstration field projects and other extension efforts. These programs should also produce information materials that provide guidance in the native dialects of farmers and that are widely disseminated via wireless telecommunication networks.

Eliminate 'perverse subsidies' that lower cost of unsustainable and polluting inputs

Many national governments offer price subsidies, tax incentives and other financial assistance that effectively reduce the market price to farmers of various agricultural inputs (e.g. synthetic fertilizers, pesticides, electric power and diesel fuel for irrigation, etc.). These subsidies are intended to improve farmers' use of modern products and technologies to increase their crop yields. However, they also have the perverse effect of disguising the true higher costs (in terms of both market prices and environmental externalities) of these high intensity input farming practices. Agrochemical input subsidies reduce the competitiveness of alternative, more sustainably sourced inputs or practices that could be used as substitutes for such agrochemicals. In order to leverage private sector market forces to encourage investments in green agriculture;governments should reduce and eventually eliminate subsidies for non-renewable and environmentally degrading inputs and alternatively provide incentives that would assist farmers during their early stages of adopting sustainable agriculture methods and materials.

Reform land rights to enable smallholder farmers to own the land under their stewardship

A critical requirement for the transition to green agriculture is establishing legal assurances that those farmers who make the effort to improve soil fertility, water efficiencies and biodiversity on their farms have legal recognition of their land tenure or ownership. Many agroecological practices require several years to realize the full benefit of labor and capital investments made by farmers. If there is uncertainty regarding a farmer's or his or her children's enjoyment of such future benefits, their motivation to undertake such investments may be substantially reduced. Land titles or long term lease rights can also be used as collateral that could help farmers gain the financing they need for farm improvements and to purchase productive inputs.

Rural land management and development must require equitable partnerships with farmers

Many developing world countries are adopting policies to promote private sector investments to increase agricultural production capacities. These policies include leasing or selling large tracts of publicly owned land for conversion into large commercial farming operations (e.g. 'land grab' policies). These public land transfers to foreign and domestic businesses often include tax incentives or investment credits to further induce private sector investments in rural development. Although increased private capital to upgrade and extend rural infrastructures is clearly needed; smallholder farmers must also enabled to benefit from the productivity enhancements created by such investments. If public land transfers to commercial farm operators are conducted; the agreements must include provisions requiring the private entity to enter into out-grower and forward purchase contracts with local smallholder farmers. These agreements should also require agribusinesses to provide reasonable working capital financing and risk management services (e.g. crop insurance, etc.) to smallholder farmers and their associations as core elements of a sustainable supply chain arrangement. Large scale public land transfers for agricultural purposes should not be executed unless the transactions explicitly include equitable protections and provisions for smallholder farmers and local indigenous peoples' rights to the lands they currently use and occupy and ensure that they would participate and benefit from the resulting infrastructure improvements.

Increase international aid investments and focus on sustainable agriculture development

The proportion of Overseas Development Assistance (ODA) from national governments, international financial institutions and private philanthropy that is directed to improve the agriculture sector in the developing world has significantly declined over the past three decades. This reduction in ODA support for agriculture has occurred despite much evidence that such expenditures have proven to be highly effective in reducing poverty and improving overall food security in recipient nations. Furthermore, policies to increase ODA funding levels should contain provisions that stimulate domestic development of sustainable farming practices and productive 'low carbon' inputs. As an example, in cases where ODA programs support smallholder access to synthetic fertilizers and other agrichemical inputs; a significant portion of this aid should be invested in promoting integrated soil fertility management capacities that include domestic production of organic fertilizers, N-fixing plant seed banks and other agroecological methods for restoring and improving soil nutrient levels. Similar funding priorities should also be directed to capacity building of farmers' technical and management skills.

Reform affluent Nations' agricultural commodity price support and trade subsidies

Public price supports for selected crops in many OECD countries and pressures for increased liberalization of international export/import policies often result in volatile market conditions for smallholder farmers in the developing world. These policies need to be addressed and reformed in order to strengthen market inducements for farmers to invest in increased production capacity to meet domestic food demands. The risk of price fluctuations and commodity dumping in these countries can deter poor farmers from becoming major contributors to domestic food security and impairs their opportunity to participate in international food supply chains. Reform of international trade policies should also address the significant role of food safety and quality regulations in encouraging or dissuading smallholder participation

in growing segments of food supply commerce. While food safety measures and certifications are important to protect consumer health and interests; public and private sector programs should support smallholder capacity building in these areas to facilitate their ability to supply higher quality and value-added products.

Increase public investment in agroecological research and development

The great majority of investment in agricultural sciences research is currently driven by the private sector. This research particularly focuses on biotechnology, genetically modified organisms and agrichemicals that promote increased production of a limited variety of global food and fiber commodity crops and livestock breeds. As privately funded research, the resulting discoveries are proprietary to the sponsoring firm. The availability and affordability of these technologies to less developed countries is subject to a range of Intellectual Property (IP) rights, licensing arrangements and environmental regulations that often constrain widespread adoption.

There is a need for public sponsored research that focuses on fundamental agroecological sciences such as the biological and geochemical phenomena involved in soil fertility; beneficial species for integrated pest management and higher yielding, more resilient plant varieties and livestock breeds that are indigenous to specific regions. Such research could be conducted by agricultural universities and international research institutes that agree to place any resulting IP in the public domain. By strengthening public sector research in agroecological innovations; governments and private philanthropies could significantly improve sustainable farming practices and enhance the diversity of agriculturally valuable plant and animal species. As public domain discoveries, such research advances could accelerate the adoption of sustainable farming methods throughout the world. Furthermore, expanded public research in agricultural sciences would also stimulate capacity building and professional expertise in higher education institutions in both the developing and developed world.

Valuing green agriculture mitigation of GHG's and improvements to environmental services

It has been amply demonstrated that agroecological farming can significantly improve agricultural systems' ability to adapt to climate change. Enhanced soil fertility; increased water use efficiencies and improved resilience to droughts, heat and pest threats would enable higher yields from existing farm lands. This increased agricultural intensity per hectare would reduce land use conversion pressures that contribute to deforestation; especially in tropical regions of the Developing World. There are significant opportunities to mitigate GHG levels by organic carbon sequestration and reducing GHG emissions from today's high input intensive farming practices. Similarly, there are many environmental services, especially regarding enhanced water quality and availability that are improved and protected by green agriculture systems.

However, much progress is needed to develop the technologies and protocols to accurately and affordably Measure, Report and Verify (MRV) green agriculture's non-point source GHG mitigation and agroecological benefits. The scientific knowledge needed for identifying these benefits and the technical accuracy of quantifying GHG mitigation is improving. There is an immediate need for greater public and private investment in MRV technology research and development in order to help build a consensus that commonly shared environmental services could and should be valued and included in assessments of economic benefits and returns on investments.

Improve consumer awareness of health and environmental impacts of unsustainable diets

Most of the policies discussed have focused on ways to improve the supply side of sustainable agricultural production. Promoting the adoption of agroecological practices and discouraging the use of fossil hydrocarbon inputs are key elements of this strategy. However, the focus and function of our agricultural sector is ultimately driven by market demands and consumer behaviors. While much of the pressure on our global food system comes from an increasing population; a significant share of this demand is based upon changing consumer lifestyles and dietary habits. Rising affluence has stimulated increased demand for livestock products; which in turn imposes even greater demand for more agricultural outputs in the form of feed grains, deforestation for more pastures and other natural resource consuming activities. In addition to the increasing proportion of meat and dairy in the global diet; the demand for highly processed and sweetened foods is also driving increased production of cereals and sugars. The rapid rise of obesity, diabetes and cardio-vascular diseases are evidence of the hidden medical costs to society of such diets. Public policy needs to place a sharp focus on the interrelationships between diets and agricultural practices and their combined impacts on public health and the integrity of our environment.

Biofuel policies must require sustainability and prioritize use for agricultural productivity

Global and national demands for renewable biofuel contribute to increased agricultural production of feedstocks (e.g. corn, sugar and soy crops) that can be converted into ethanol and biodiesel fuels. Most biofuels are used in urban transportation; and are often produced for export to international markets. There are increasing competitive demands for land, water and inputs between biofuel and food production. While the production of 1st generation biofuels also supplies livestock feed as a byproduct; it must be recognized that the emergence of these bioenergy 'cash crops' impacts global commodity prices and attracts resources from alternative efforts to expand food production. Policy makers should insist that biofuel crops are sustainably cultivated; with particular attention to organic nutrient recovery needed to maintain long term soil fertility. In the developing world, it is critical that biofuel production should be prioritized for use to support modernization of the agricultural sector. Smaller scale production of biofuels for mechanized farm equipment (e.g. single axel tractors, irrigation pumps) and post harvest supply chain infrastructures could significantly enhance overall agriculture productivity; and would also stimulate rural non-farm economic development. Public support should also encourage investments in renewable electricity generation (e.g. micro-hydro, wind and photovoltaics) for decentralized power distribution networks in rural areas.

Green Economy Models that Would Benefit Farmers

Recognizing and valuing environmental services provided by agroecological farming

A 'green economy model' that would benefit farmers should include the ability to recognize and quantify economic values for agricultural production practices that, in the process of producing marketable products also reduce ecological damages and restore or improve environmental conditions that commonly benefit the local community and extended society. Under conventional economic models, such

'public goods' are seldom granted a financial valuation within the costs, benefits and returns on investment for specific endeavors. With traditional models, farmers whose individual and collective actions contribute to enhanced environmental services (e.g. watershed management that improves water quality and availability; cropping practices that support biodiversity; etc.) are unlikely to be adequately compensated for their extra efforts or for the 'opportunity costs' that they incur by not pursuing maximum farm production levels in disregard to their pollution impact.

A green economy model should assign value to the incremental and accumulating environmental benefits that accrue to sustainable farming practices such as have been done in various Payments for Environmental Services (PES) projects. Valuations are challenging to calculate; as most farming methods tend to create non-point source improvements (e.g. less GHG emissions from organically fertilized fields, fresh water filtering functions that occur across an entire watershed, etc.) that are currently difficult and costly to measure, monitor and verify. As environmental sensor equipment, remote surveillance and other means of measuring slight changes in landscapes are further developed; quantification of environmental services provided by farmers will improve and lead to increased acceptance and inclusion of PES in financial models used to determine total economic performance.

Patient capital investment models and farmer-agribusiness partnerships

Another green economy model that would advance the adoption of sustainable farming is the concept of 'patient capital' in which investors take a longer term perspective on how quickly the economic Return On an Investment (ROI), should recover the original capital (e.g. its breakeven point) and then deliver profitable gains beyond repayment of principal. This longer view of ROI is particularly important for sustainable agriculture, as many of the key practices may often require several years of effort for the full enhanced productivity gains to be realized in the form of increased crop yields, lower production costs and other economic benefits.

An emerging commercial model for patient capital investment can be seen in the innovative, vertically integrated agriculture supply chain partnerships that are beginning to form between large agribusinesses and farmers' organizations. The Sustainable Food Laboratory, a private sector alliance of NGO's and agribusinesses has reported many promising projects in which global food processing and retail brands are making investments in training and supplying improved inputs to farmers with whom they have multiple year purchasing agreements. Under these business models, food system corporations and sustainable produce suppliers would deliver quality food products and be less susceptible to future input price volatility. They would also have an improved ability to adapt to the environmental stresses that are anticipated with continued climate change.

Another effective investment partnership model for driving smallholder farmer productivity gains are NGO rural development and assistance programs that provide farmers with free or subsidized livestock, seeds or seedlings under the condition that the farmers are obliged to extend such donations to others. Such donor programs (e.g. Heifer International) stipulate that recipient farmers in subsequent years must gift some of the progeny of these donated assets (e.g. calves, community seed banks, etc.) to neighboring farmers; who are also obligated to repeat the cycle with others in their community. This cycle of receiving and then giving aid to neighbors has multiplied the overall economic impact and benefits of such NGO aid programs and strengthens community coherence and cooperative behaviors that result in improved equitable sharing of these programs' economic benefits.

Farmers' Perspectives and Recommendations Regarding International Governance:

Farmers, primarily through their representative organizations are seeking greater opportunities to directly participate in key deliberations and decision making forums that are conducted by the UN system agencies and other institutions involved with International Environmental Governance (IEG) and sustainable development initiatives (e.g. IFSD). The resources required for farmer organization leaders to attend IEG and IFSD conferences, workshops and related forums are beyond the budgets of most farmer groups. Increased UN financial support is needed to enable farmer groups to be better informed; provide more frequent input; and to more effectively participate in the international dialogue that is building with regards to IEG and IFSD issues.

Perhaps the most significant UN initiative to advance sustainable agriculture development is the Committee on World Food Security (CFS) efforts to convene and coordinate public, private and Civil Society Organization (CSO) stakeholders to address the underlying causes of and solutions to global food insecurity. The CFS is creating a "Global Strategic Framework for Food Security and Nutrition" (GSF) to inform and guide UN agency and national government actions to promote the principle of humanity's rights to food. The CSF process includes provisions for direct input from CSO's to help define the key components of the GSF. The current draft GSF provides high level encouragement of many critically important policies (e.g. emphasizing the central role of women farmers, advocacy of pro-poor incentives for smallholder farmers, etc.). However, the current GSF does not adequately focus on the potential of agroecological and organic farming methods to contribute to smallholders' ability to sustainably and economically increase their productivity. If the CSF/GSF is to be a valuable decision support resource and guide for national government efforts to define and implement sustainable agriculture strategies; it is critically important that farmer organizations increase their participation in this ongoing cross-agency UN initiative.

Furthermore, there is a critical need for improved farmer access to information, scientific findings and other data that have been assembled and used as the basis for public and private sector decision making on sustainable agriculture performance opportunities; environmental impacts and trade-offs; and policy options that are being considered to cope with these challenges. Improving farmer access to information is particularly urgent with regards to national governmental data on agricultural production; input use and costs; public subsidy costs; the disbursement of public funds and identifying the primary beneficiaries of such expenditures. Arguments continue to be raised for more public transparency and accountability regarding national government agency operations and how executive and legislative decisions are made with regards to domestic agriculture policies and programs.

Attention should also be given to the ongoing efforts to reform and restructure the Consultative Group for International Agricultural Research (CGIAR); a coalition of fifteen agricultural research centers that operate around the globe. CGIAR centers have been key contributors to many of the advances in improved plant varieties, livestock breeds and more productive cultivation practices that have been achieved in the past forty years. CGIAR research is supported by international donor funds from national governments, philanthropic foundations and to a lesser extent from private industry. Historically, each CGIAR Center was fairly independent in setting their own research agendas and in seeking funding from a wide range of sponsors.

A fundamental restructuring of the CGIAR institutions was initiated in 2010 that resulted in the formation of two governance entities; the CGIAR Consortium Board and the CGIAR Fund Council that have authority to determine the research priorities and multi-year funding levels that will be allocated to each CGIAR Center (Wise and Murphy, 2012).

The CGIAR reforms are intended to improve the focus and efficiency of research that is conducted in these quasi-public Centers and to encourage greater collaboration and partnerships between the Centers and other leading research organizations in both the public and private sectors. To further these objectives, the Consortium Board has established four System Level Outcomes (SLO) that define the high level goals of all CGIAR research. The CGIAR SLO's are to reduce rural poverty; improve food security; improve nutrition and health; and sustainably manage natural resources. The Board also formulated a Strategy and Results Framework (SRF) assessment process that will be used to qualitatively evaluate the impacts of each Center's research programs. Farmers should advocate for formal participatory engagement mechanisms to assure that their perspectives are included in the practice and evolution of this new CGIAR SRF assessment process.

Many farmer groups and sustainable agriculture advocates are recommending that agricultural practices across the spectrum of 'high intensity input' through to 'low intensity input' farming paradigms should be assessed for their respective impacts on GHG emissions. Such assessments should include both their potential to mitigate GHG emissions and their potential to sequester carbon as part of international initiatives to address and combat climate change. The most promising means by which this could be achieved would be for the UNFCCC's Subsidiary Body for Scientific and Technological Advice (SBSTA) to establish an agriculture work program. This work effort would convene experts to gather scientific evidence that would serve as the basis for determining agricultural system contributions to GHG levels and the mechanisms by which various practices could help mitigate future emissions.

Of equal importance to a new SBSTA work program would be a parallel international initiative to assemble the evidence and methods of sustainable agriculture best practices and to define technical criteria for matching their use to specific local conditions. This data and analysis should form the framework for developing National Action Plans to improve food production and farmers' resilience to the environmental stresses that will accompany continued climate change. This initiative should be a multidisciplinary effort to update and make actionable the conclusions and recommendations of the International Assessment of Agricultural Knowledge, Science and Technology for Development (McIntyre, *et al*., 2009).

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Notes

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