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Small Farms as a Planetary Ecological Asset: Five Key Reasons Why We Should Support the Revitalisation of Small Farms in the Global South

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About the Author

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Chapter One

INTRODUCTION

THE globalised economy has placed a series of conflicting demands on existing croplands. Not only is this land required to produce food for a growing human population, but it also must meet the increased demands for biofuels; and it must do so in an environmentally sound way that preserves biodiversity with minimal use of petrochemicals thus reducing greenhouse emissions, while still representing a profitable activity to millions of farmers.

These pressures are setting in motion a global food system crisis of unprecedented scope that is already signalled by food riots in many parts of the world. This crisis, which threatens the livelihoods of over a billion hungry people, is the direct result of the dominating industrial farming model, which is dangerously dependent on fossil fuels and has also become the largest source of human impact on the biosphere. Ninety-one per cent of the 1.5 billion hectares of cropland are under annual crops worldwide, mostly monocultures of wheat, rice, maize, cotton, and soybeans highly dependent on inputs of chemical fertilisers and pesticides and huge amounts of irrigation water, and which increasingly advance at the expense of forests and other natural vegetation. In this century, one of the main ecological dilemmas arising from the environmental homogenisation of agricultural systems is an increased vulnerability of crops to climate change. Subsidised grain monocultures convey temporary economic advantages to a few large-scale farmers, but in the long term they do not represent an ecological optimum. Rather, the drastic narrowing of cultivated plant diversity has put the world's food production in greater peril. The social and environmental impacts of local crop shortfalls resulting from such uniformity can be considerable in an era of climatic extremes as crop losses often mean ongoing ecological degradation, poverty, hunger and even famine.

Before the end of the first decade of the 21st century, humanity is quickly realising that the fossil fuel-based, capital-intensive, industrial-agricultural model is not working to meet the global food demands. Soaring oil prices are inevitably increasing production costs and food prices, which have already escalated to the point that today $1 purchases 30% less food than one year ago. This situation is rapidly being aggravated by farmland being turned from food production to biofuels; it is also being complicated by climate change, which has reduced crop yields as a result of droughts, floods, and other unpredictable weather events. Expanding land areas devoted to biofuels and transgenic crops is further exacerbating the ecological footprint of vast monocultures. Moreover, industrial agriculture presently contributes at least one-quarter of current greenhouse gas emissions, mainly methane and nitrous oxide. Continuing this dominant degrading system, as promoted by the current economic paradigm, is no longer a viable option.

The immediate challenge for our generation is to transform industrial agriculture by transitioning the world's food systems away from reliance on fossil fuels. We need an alternative agricultural development paradigm: one that encourages more ecological, biodiverse, sustainable, and socially just forms of agriculture. Fortunately there are today thousands of new and alternative initiatives flowering across the world to promote ecological agriculture, preservation of the livelihoods of small farmers, production of healthy, safe and culturally diverse foods, and localisation of distribution, trade and marketing. Many of these sustainable models are rooted in the ecological rationale of traditional agriculture, which represent millenary examples of successful forms of community-based local agriculture. These microcosms of traditional agriculture offer promising models for other areas as they promote biodiversity, thrive without agrochemicals, and sustain year-round yields (Denevan 1995). Such systems have fed much of the world for centuries, while conserving ecological integrity through application of indigenous knowledge systems and continue to do so in many parts of the planet.

The Via Campesina has long argued that small farmers are of central importance for communities to be able to meet growing food demands. The Via Campesina believes that in order to protect livelihoods, jobs, people's food security and health as well as the environment, food production has to remain in the hands of small-scale sustainable farmers and cannot be left under the control of large agribusiness companies or supermarket chains. Only by changing the export-led, free-trade-based, industrial agriculture model of large farms can the downward spiral of poverty, low wages, rural-urban migration, hunger and environmental degradation be halted. Social rural movements embrace the concept of food sovereignty as an alternative to the neo-liberal approach that puts its faith in an inequitable international trade to solve the world's food problem. Instead, it emphasises farmers' access to land, seeds and water, focusing on local autonomy, local markets, local production-consumption cycles, energy and technological sovereignty and farmer-to-farmer networks.

Being a global movement, the Via Campesina has recently brought their message to the North, partly to gain the support of foundations and consumers, as political pressure from a wealthier public which increasingly depends on unique food products from the South marketed via organic, fair trade, or slow food channels could marshal the sufficient political will to curb the expansion of biofuels, transgenic crops and agroexports and put an end to subsidies to industrial farming and dumping practices that hurt small farmers in the South. But can these arguments really captivate the attention and support of Northern consumers and philanthropists? Or is there a need to come up with a different argument, one that emphasises that the very quality of life and food security of the populations in the North depend not only on the food products but in the ecological services provided by small farms of the South. In fact it is herein argued that the functions performed by small farming systems still prevalent in Africa, Asia and Latin America, in the post peak oil era that humanity is entering, comprise an ecological asset for humankind and planetary survival. In fact, in an era of escalating fuel and food costs, climate change, environmental degradation, GMO pollution and corporate-dominated food systems, small, biodiverse, agroecologically managed farms in the Global South are the only viable form of agriculture that will feed the world under the new ecological end economic scenario.

Chapter two

WHY WE SHOULD SUPPORT SMALL FARMS

THERE are at least five reasons why we should support the maintenance and revitalisation of small farms while being solidarious with the cause and struggle of small farmers in the South:

a. Small farmers are the key to the world's food security

While 91% of the planet's 1.5 billion hectares of agricultural land are increasingly being devoted to agroexport crops, biofuels and transgenic soybean to feed cars and cattle, millions of small farmers in the developing world produce the majority of staple crops needed to feed the planet's rural and urban populations. Of the 960 million hectares of land under cultivation (arable and permanent crops) in Africa, Asia and Latin America, 10-15% is managed by traditional farmers. In Latin America, about 17 million peasant production units occupying close to 60.5 million hectares, or 34.5% of the total cultivated land with average farm sizes of about 1.8 hectares, produce 51% of the maize, 77% of the beans, and 61% of the potatoes for domestic consumption. In Brazil alone, there are about 4.8 million family farmers (about 85% of the total number of farmers) that occupy 30% of the total agricultural land of the country. Such family farms control about 33% of the area sown to maize, 61% of that under beans, and 64% of that planted to cassava, thus producing 84% of the total cassava and 67% of all beans (Altieri 1999).

Africa has approximately 33 million small farms, representing 80% of all farms in the region. Despite the fact that Africa now imports huge amounts of cereals, the majority of African farmers (many of them women) who are smallholders with farms below 2 hectares, produce a significant amount of basic food crops with virtually no or little use of fertilisers and improved seed (Benneh 1996). In Asia, the majority of more than 200 million rice farmers, each cultivate around 2 hectares of rice making up the bulk of the rice produced by Asian small farmers. Farms of less than 2 hectares constituted 78% of the total number of farms in India but contributed nonetheless to 41% of the national grain production (Greenland 1997).

Small increases in yields on these small farms that produce most of the world's staple crops will have far more impact on food availability at the local and regional levels, than the doubtful increases predicted for distant and corporate-controlled large monocultures managed with such high-tech solutions as genetically modified seeds.

b. Small farms are more productive and resource-conserving than large-scale monocultures

Although the conventional wisdom is that small family farms are backward and unproductive, research shows that small farms are much more productive than large farms if total output is considered rather than yield from a single crop. Traditional multiple cropping systems provide as much as 20% of the world food supply. Polycultures constitute at least 80% of the cultivated area of West Africa, while much of the production of staple crops in the Latin American tropics occurs in polycultures (Francis 1986). These diversified farming systems in which the small-scale farmer produces grains, fruits, vegetables, fodder, and animal products out-produce yield per unit of single crops such as corn (monocultures) on large-scale farms. A large farm may produce more corn per hectare than a small farm in which the corn is grown as part of a polyculture that also includes beans, squash, potato and fodder. In polycultures developed by smallholders, productivity in terms of harvestable products per unit area is higher than under sole cropping with the same level of management. Yield advantages can range from 20% to 60%, because polycultures reduce losses due to weeds, insects and diseases and make a more efficient use of the available resources of water, light and nutrients.

By managing fewer resources more intensively, small farmers are able to make more profit per unit of output, and thus, make more total profits – even if production of each commodity is less (Rosset 1999). In overall output, the diversified farm produces much more food, even if measured in dollars. In the USA data shows that the smallest 2-hectare farms produced $15,104 per hectare and netted about $2,902 per acre. The largest farms, averaging 15,581 hectares, yielded $249 per hectare and netted about $52 per hectare. Not only do small-medium-sized farms exhibit higher yields than conventional farmers, but do so with much lower negative impact on the environment. Small farms are 'multi-functional'– more productive, more efficient, and contribute more to economic development than do large farms. Communities surrounded by populous small farms have healthier economies than do communities surrounded by depopulated large mechanised farms. One recent study on the impact of small farms on local economies found that small producers create 10% more permanent jobs, a 20% larger increase in retail sales, and a 37% larger increase in local per capita income. Small farmers also take better care of natural resources, including reducing soil erosion and conserving biodiversity.

The inverse relationship between farm size and output can be attributed to the more efficient use of land, water, biodiversity and other agricultural resources by small farmers. So in terms of converting inputs into outputs, society would be better off with small-scale farmers. Building strong rural economies in the Global South based on productive small-scale farming will allow the people of the South to remain with their families and will help to stem the tide of out-migration. And as population continues to grow and the amount of farmland and water available to each person continues to shrink, a small farm structure may become central to feeding the planet, especially when large-scale agriculture devotes itself to feeding car tanks.

c. Small traditional and biodiverse farms represent models of sustainability

Despite the onslaught of industrial farming, the persistence of thousands of hectares under traditional agricultural management documents a successful indigenous agricultural strategy of adaptability and resiliency. These microcosms of traditional agriculture that have stood the test of time, and that can still be found almost untouched after 4,000 years in the Andes, MesoAmerica, South-East Asia and parts of Africa, offer promising models of sustainability as they promote biodiversity, thrive without agrochemicals, and sustain year-round yields even under marginal environmental conditions (Wilken 1987). One of the salient features of traditional small farms is their high degree of biodiversity. Such systems support a high degree of plant diversity in the form of polycultures and/or agroforestry patterns which are endowed with nutrient-enriching plants, insect predators, pollinators, nitrogen-fixing and nitrogen-decomposing bacteria, and a variety of other organisms that perform various beneficial ecological functions (Altieri 1995).

The local knowledge accumulated over millennia and the forms of agriculture and agrobiodiversity that this wisdom has nurtured, comprise a Neolithic legacy embedded with ecological and cultural resources of fundamental value for the future of humankind (Dewalt 1994). The indigenous knowledge behind the agricultural modification of the physical environment is very detailed; such that many small farmers can recognise more than 500 plant species, while soil types, degrees of soil fertility, and land-use categories are also discriminated in detail by farmers. Recent research suggests that many small farmers cope and even prepare for climate change, minimising crop failure through increase used of drought-tolerant local varieties, water harvesting, mixed cropping, opportunistic weeding, agroforestry and a series of other traditional techniques. Surveys conducted in hillsides after Hurricane Mitch in Central America showed that farmers using sustainable practices such as 'mucuna' cover crops, intercropping and agroforestry suffered less 'damage' than their conventional neighbours. The study spanning 360 communities and 24 departments in Nicaragua, Honduras and Guatemala showed that diversified plots had 20% to 40% more topsoil, greater soil moisture, less erosion and experienced lower economic losses than their conventional neighbours (Holt-Gimenez 2001).

Apparently small farms which exhibit the combination of stable and diverse production, internally generated and maintainable inputs, favourable energy input/output ratios, and articulation with both subsistence and market needs, comprise an effective approach to achieve food security, income generation, and environmental conservation (Altieri 2002). Key features of self-sustaining small farms include:

- Farms are small in size with continuous production serving subsistence and market demands

- Maximum and effective use of local resources and low dependence on off-farm inputs
- High net energy yield because energy inputs are relatively low
- Labour is skilled and complementary, drawn largely from the household or community relations. Dependency on traction and manual labour shows favourable energy input/output ratios
- Heavy emphasis is on recycling of nutrients and materials
- Building on natural ecological processes (e.g. succession) rather than struggling against them
- Diversified farm systems based on several cropping systems, featuring mixtures of crops, and crops with varietal and other genetic variability.

Small farms featuring the above features have enabled farmers to generate sustained yields meeting their subsistence needs, despite marginal land endowments, climatic variability and low use of external inputs. Part of this performance is linked to the high levels of agrobiodiversity exhibited by traditional agroecosystems, which in turn positively influence agroecosystem function (Thrupp 1998). Diversification is therefore an important farm strategy for managing production risk in small farming systems. A re-evaluation of indigenous knowledge and technology can serve as a key source of information on adaptive capacity and resilient capabilities exhibited by small farms, features of strategic importance for world farmers to cope with climatic change. In addition, indigenous technologies often reflect a worldview and an understanding of our relationship to the natural world that is more realistic and more sustainable that those of our Western European heritage.

d. Small farms represent a sanctuary of GMO-free agrobiodiversity

In traditional agroecosystems the prevalence of complex and diversified cropping systems is of key importance to the stability of peasant farming systems, allowing crops to reach acceptable productivity levels in the midst of environmentally stressful conditions. In general, traditional agroecosystems are less vulnerable to catastrophic loss because they grow a wide variety of crops and varieties in various spatial and temporal arrangements (Clawson 1985). Traditional small-scale farmers grow a wide variety of cultivars. Many of these plants are landraces grown from seed passed down from generation to generation, more genetically heterogeneous than modern cultivars and thus offering greater defences against vulnerability and enhancing harvest security in the midst of diseases, pests, droughts and other stresses. In a worldwide survey of crop varietal diversity on farm involving 27 crops, scientists found that considerable crop genetic diversity continues to be maintained on farm in the form of traditional crop varieties, especially of major staple crops. In most cases, farmers maintain diversity as an insurance to meet future environmental change or social and economic needs. Many researchers have concluded that variety richness enhances productivity and reduces yield variability (Jarvis et al 2007). For example, studies by plant pathologists provide evidence that mixing of crop species and/or varieties can delay the onset of diseases by reducing the spread of disease-carrying spores, and by modifying environmental conditions so that they are less favourable to the spread of certain pathogens (Wolfe 2000). Recent research in China, where four different mixtures of rice varieties grown by farmers from 15 different townships over 3,000 hectares, suffered 44% less blast incidence and exhibited 89% greater yield than homogeneous fields without the need to use fungicides (Zhu et al 2000).

At issue is the possibility that traits important to indigenous farmers (resistance to drought, competitive ability, performance on intercrops, storage quality, etc) could be traded for transgenic qualities which may not be important to farmers (Jordan, 2001). Under this scenario risk could increase and farmers would lose their ability to adapt to changing biophysical environments and produce relatively stable yields with a minimum of external inputs while supporting their communities' food security.

Although there is a high probability that the introduction of transgenic crops will enter centres of genetic diversity, it is crucial to protect areas of peasant agriculture against contamination from GMO crops, as traits important to indigenous farmers (resistance to drought, food or fodder quality, maturity, competitive ability, performance on intercrops, storage quality, taste or cooking properties, compatibility with household labour conditions, etc.) could be traded for transgenic qualities (i.e. herbicide resistance) which are of no importance to farmers that don't use agrochemicals. Under this scenario risk will increase and farmers will lose their ability to produce relatively stable yields with a minimum of external inputs under changing biophysical environments (Jordan 2001). The social impacts of local crop shortfalls, resulting from changes in the genetic integrity of local varieties due to genetic pollution, can be considerable in the margins of the developing world.

Maintaining pools of genetic diversity, geographically isolated from any possibility of cross fertilisation or genetic pollution from uniform transgenic crops, will create 'islands' of intact germplasm which will act as extant safeguards against the potential ecological failure derived from the second green revolution increasingly being imposed with programmes such as the Gates-Rockefeller AGRA in Africa. These genetic sanctuary islands will serve as the only source of GMO-free seeds that will be needed to repopulate the organic farms in the North inevitably contaminated by the advance of transgenic agriculture. The small farmers and indigenous communities of the Global South, with the solidarious help of scientists and NGOs, can continue being the creators and guardians of a biological and genetic diversity that has enriched the food culture of the whole planet.

e. Small farms cool the climate

While industrial agriculture contributes directly to climate change through no less than one-third of total emissions of the major greenhouse gases — carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), small biodiverse organic farms have the opposite effect by increasing the sequestration of carbon in soils. Small farmers usually treat their soils with organic compost materials which absorb and sequester carbon better than soils that are farmed with conventional fertilisers. Researchers have suggested that the conversion of 10,000 small-to-medium-sized farms to organic production, would allow to store so much carbon in the soil that it would be equivalent to taking 1,170,000 cars off the road (Rosenzweig and Hillel 1998).

Further climate amelioration contributions by small farms accrue from the fact that most use significantly less fossil fuel in comparison to conventional agriculture mainly due to a reduction of chemical fertiliser and pesticide use, relying instead on organic manures, legume-based rotations and diversity schemes to enhance beneficial insects. Farmers that live in rural communities near cities and towns and linked to local markets, avoid the energy wasted and the gas emissions associated with transporting food hundreds and even thousands of miles.

Chapter Three

CONCLUSIONS

A SALIENT feature of small farming systems is their high levels of agrobidoversity arranged in the form of variety mixtures, polycultures, crop-livestock combinations and/or agroforestry patterns. Modelling new agroecosystems using such diversified designs are extremely valuable to farmers whose systems are collapsing due to debt, pesticide or transgenic treadmills or climate change, as diverse systems buffer against natural or human-induced variations in production conditions. There is much to learn from indigenous modes of production, as these systems have a strong ecological basis, maintain valuable genetic diversity and lead to regeneration and preservation of biodiversity and natural resources. Traditional methods are particularly instructive because they provide a long-term perspective on successful agricultural management under conditions of climatic variability.

Agroecologists have a key role in understanding the ecological mechanisms underlying the sustainability of traditional farming systems, and translating them into principles that take various locally available and appropriate technological forms applicable to a massive number of farmers will be a key task of the next two decades. Today more than ever it is critically important for scientists to highlight the role of traditional agriculture as a source of genetic material and regenerative farming techniques which constitutes the foundation of a sustainable rural development strategy directed at resource-poor farmers (Altieri 2002). Agroecologists should also support organised social rural movements in the South that oppose industrial agriculture in all its manifestations. Many of their territories increasingly constitute isolated areas rich in unique agrobiodiversity, including genetic diverse material, therefore acting as extant safeguards against the potential ecological failure derived from inappropriate agricultural modernisation schemes. It is precisely the ability to generate and maintain diverse crop genetic resources that offer 'unique' niche possibilities to small farmers that cannot be replicated by farmers in the North condemned to uniform cultivars and to co-exist with GMOs. The 'cibo pulito, justo e buono' that Slow Food promotes, the Fair Trade coffee, bananas, and the organic products so much in demand by Northern consumers can only be produced in the agroecological islands of the South. This 'difference' inherent to traditional systems, can be strategically utilised to revitalise small farming communities by exploiting unlimited opportunities that exist for linking traditional agrobiodiversity with local/national/international markets, as long as these activities are justly compensated by the North and all the segments of the market remain under grassroots control.

Consumers of the North can play a major role by supporting these more solidarious and equitable markets which do not perpetuate the colonial model of 'agriculture of the poor for the rich', but rather a model that catapults small biodiverse farms as the basis for strong rural economies in the South. Such economies will not only provide sustainable production of healthy, agroecologically produced, accessible food for all, but will allow indigenous peoples and small farmers to continue their millennial work of building and conserving the agricultural and natural biodiversity on which we all depend now and more so in the future.

References

Altieri, M.A., 1995. *Agroecology: the science of sustainable agriculture*. Westview Press, Boulder.

Altieri, M.A., 1999. 'Applying agroecology to enhance productivity of peasant farming systems in Latin America'. *Environment, Development and Sustainability* 1: 197-217.

Altieri, M.A., 2000. 'The ecological impacts of transgenic crops on agroecosystem health'. *Ecosystem Health* 6: 13-23.

Altieri, M.A., 2002. 'Agroecology: the science of natural resource management for poor farmers in marginal environments'. *Agriculture, Ecosystems and Environment* 93: 1-24.

Benneh, G., 1996. *Toward sustainable smallholder agriculture in Sub-Saharan Africa*. International Food Policy Research Institute. Lecture Series 4. Washington DC.

Browder, J.O., 1989. *Fragile lands in Latin America: strategies for sustainable development*. Westview Press, Boulder.

Clawson, D.L., 1985. 'Harvest security and intraspecific diversity in traditional tropical agriculture'. *Econ. Bot.* 39: 56-67.

Denevan, W.M., 1995. 'Prehistoric agricultural methods as models for sustainability'. *Advanced Plant Pathology* 11: 21-43.

Dewalt, B.R., 1994. 'Using indigenous knowledge to improve agriculture and natural resource management'. *Human Organization* 5: 23-131.

Francis, C.A., 1986. *Multiple cropping systems*. MacMillan, New York.

Greenland, D.J., 1997. *The sustainability of rice farming*. CAB International. Wallingford, UK.

Holt-Gimenez, E., 2001. 'Measuring farmers agroecological resistance to Hurricane Mitch'. *LEISA* 17: 18-20.

Jarvis. D.I. et al, 2007. *Managing biodiversity in agricultural ecosystems*. Columbia University Press, New York.

Jordan, C.F., 2001. 'Genetic engineering, the farm crisis and world hunger'. *BioScience* 52: 523-529.

Richards, P., 1985. *Indigenous Agricultural Revolution*. Westview Press, Boulder.

Rosenzweig, C and D. Hillel, 1998. *Climate change and the global harvest: potential impacts of the greenhouse effect on agriculture*. Oxford University Press, New York.

Rosset, P., 1999. 'Small is bountiful'. *The Ecologist* 29: 2-7.
Thrupp, L.A., 1998. *Cultivating diversity: agrobiodiversity and food security*. World Resources Institute. Washington, D.C.
Wilken, G.C., 1987. *Good Farmers: traditional agricultural resource management in Mexico and Guatemala*. University of California Press, Berkeley.
Wolfe, M., 2000. 'Crop strength through diversity'. *Nature* 406: 681-682.
Zhu, Y., H. Fen, Y. Wang, Y. Li, J. Chen, L.Hu and C.C. Mundt, 2000. 'Genetic diversity and disease control in rice'. *Nature* 406: 718-772.

SMALL FARMS AS A PLANETARY ECOLOGICAL ASSET: FIVE KEY REASONS WHY WE SHOULD SUPPORT THE REVITALISATION OF SMALL FARMS IN THE GLOBAL SOUTH

Humanity is quickly realising that the fossil fuel-based, capital-intensive, industrial-agricultural model is not working to meet the global food demands. Soaring oil prices are increasing production costs and food prices, and the problem is aggravated by other factors such as farmland being turned from food production to biofuels and climate change reducing crop yields.

This book argues that small, biodiverse, agroecologically managed farms in the global South are the only viable form of agriculture that will feed the world under the new ecological and economic scenario.

Five reasons are given for supporting the maintenance and revitalisation of small farms:

- Small farms are the key to the world's food security;
- Small farms are more productive and resource-conserving than large-scale monocultures;
- Small traditional and biodiverse farms represent models of sustainability;
- Small farms represent a sanctuary of GMO-free agrobiodiversity;
- Small farms cool the climate.

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TWN ENVIRONMENT & DEVELOPMENT SERIES

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