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# Asia at the Crossroads

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Prioritising Conventional Farming  
or Sustainable Agriculture?

February 2012

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1. Muong ethnic minority sisters Ban Thi Cuc, 19, left, and Ban Thi Yen, 20, work on their family rice field in Duong hamlet, Vay Nua commune, Da Bac district, Hoa Binh province, Vietnam. © Chau Doan / OnAsia / ActionAid.
2. Emergency response to floods in Cambodia © ActionAid.
3. Multi-Purpose Farm in Cambodia © CEDAC / ActionAid.
4. Limited access to water in Myanmar. © Celso Marcatto / ActionAid.
5. Pesticide use in Sanya, Hainan Island, Hainan Province, China © Li Xiaoguo / Xinhua Press / Corbis.
6. Tractor spraying fertilizer in a conventional agricultural system © Imageplus / Corbis

## Acknowledgements

This report was written by Mark Curtis and edited by Sameer Dossani. The report draws on reports provided by ActionAid Country teams in Myanmar, Vietnam, Cambodia, Thailand and the Guanxi Autonomous Region of China. Additional thanks to Aftab Alam, Celso Marcatto and Ruchi Tripathi for strategic inputs and Youjin B. Chung for designing this report.

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## Executive Summary

In June of 2012, representatives of over 140 nations are expected to take part in the “Rio+20 United Nations Conference on Sustainable Development”. The conference – scheduled 20 years after the first Rio conference saw an agreement that the United Nations must do something to address environmental degradation and global warming – is expected to focus heavily on the concept of the “green economy”. The “green economy” includes the idea that livelihoods, growth and environmental sustainability must go hand-in-hand in developing countries. While the concept itself may be laudable, it will be an unattainable ideal unless governments show a willingness to adopt a new development model – one based on human rights as opposed to profit for elites. A key example of the need for change – both in terms of the right to livelihood, environmental sustainability and the right to sufficient and nutritious food – is the agriculture sector. This paper seeks to address fundamental questions about the agriculture sector in Southeast Asia and China and to begin to sketch what a way forward – a way towards the “green economy” – may look like.

Countries in Asia have shown the world in recent years that massive reductions in poverty and hunger are indeed possible. Yet deep hunger persists: 568 million Asians are still currently classified as undernourished, accounting for well over half of all those living with hunger in the world. Hundreds of millions more lack essential micronutrients – so-called the ‘hidden hunger’. Rising food prices across the region and world are deepening hunger for millions of farmers who are net buyers of food, while climate change threatens to plunge hundreds of millions more people into hunger in the coming decades.

This report argues that Asian countries are at a crossroads in their agriculture strategies. Before them are two farming models: ‘conventional’, industrial farming, promoted by the Green Revolution; and sustainable, or ecological, agriculture – involving methods of farming that are gaining increasing acceptance around the world as the most viable way to promote food security and address climate change.

Based on secondary research and fieldwork among farmers in Cambodia, Myanmar, Thailand, Vietnam and the Guangxi Autonomous Region of China, we highlight the deep problems associated with conventional farming and argue that Asian countries must promote sustainable agriculture with much greater urgency than they are currently doing.

## Conventional Farming

Conventional farming – often also called industrial or high input agriculture – is strongly associated with the Green Revolution. This has sought to massively increase productivity through promoting ‘modern’ farming inputs – high-yielding seed varieties and hybrids (mainly of wheat and rice), chemical fertilizers and pesticides, and a big focus on irrigation. Conventional farming in Asia has also often prioritized producing crops for export markets and consolidated large areas of land for mono-cropping (the production of a single crop). Farmers have been encouraged to grow cash crops and to borrow money to invest in ‘high-tech’ inputs, thus increasing their costs of production, on the assumption that increased sales in local markets would be more than enough to repay their debts. Some observers regard the highpoint of the Green Revolution as running from 1965 to 1990; in fact, it remains the dominant model of agriculture promoted by governments and donors throughout the region.<sup>1</sup>

## Sustainable Agriculture

Sustainable agriculture – also often called ecological farming or alternative farming – is an approach derived from the recognition of people’s right to food. It is a way of life based on self-reliant and agro-ecological systems which promote the ability of smallholders and family farmers to gain access to and own their productive resources, such as land, water, forest and seeds and to use these to secure their livelihood, with the support of socially, economically and environmentally appropriate methods and technologies. Sustainable agriculture refers to the ability of farms to produce nutritious food without damaging soils, ecosystems or human capital, and that reduces (or eliminates) reliance on external inputs such as chemical fertilizers and pesticides. It encompasses approaches such as agro-ecology, agro-forestry, low external input farming, organic agriculture, and water harvesting in dry land areas. It aims to integrate biological and nutrient processes such as nutrient cycling, nitrogen fixation and soil regeneration into food production processes.

## The Impacts of Conventional Farming

Conventional farming in Asia has had significant successes but also major adverse impacts in recent decades. Five areas stand out:

- **Yields have risen but are slowing.** Cereal production in Asia virtually doubled between 1970 and 1995 and, during 1980-2000, production per hectare rose by 60 per cent in China and 114 per cent in Vietnam.<sup>2</sup> Although cereal yields have continued to rise since the highpoint of the Green Revolution, annual growth rates have slowed. Rice yield growth in East Asia and Southeast Asia rose by 2.5 per cent a year on average during 1970-90, but slowed to 0.5 per cent and 1.5 per cent, respectively, during 1990-2004.<sup>3</sup> Much of this is likely to be the result of the deteriorating water and soil quality produced in intensive mono-cropping systems. This trend suggests that the same high-input policies as pursued in the past will be unlikely to work in the future.
- **Poverty has fallen but is not being eliminated while inequalities are rising.** Conventional farming’s success in expanding food production has helped to reduce poverty levels: in 1975, nearly 3 out of 5 Asians were living in poverty; this declined to less than 1 in 3 by 1995.<sup>4</sup> The per capita availability of calories in Asia increased by around 30 per cent during 1970-95.<sup>5</sup> However, the figure of 568 million hungry Asians testifies to the failure to eliminate poverty. Although conventional farming methods have increased yields in many agriculturally optimal areas, they have been less effective in marginalized, resource-poor areas where farmers have no access to modern inputs and technologies.<sup>6</sup> Inequalities between regions and farmers have increased under conventional farming: one analysis of 307 studies on the Green Revolution found that 40 per cent reported increased

income inequalities.<sup>7</sup> Millions of farmers have also become heavily indebted due to taking out loans to buy expensive external inputs. Finally, Green Revolution policies do not fully explain Asian success in reducing poverty and hunger; other policies, notably land reform, have also been key.

- **Farmer and public health is being undermined.** The use of chemical pesticides has increased dramatically under conventional farming. Pesticides are responsible for millions of cases of poisoning a year and the contamination of groundwater; most Asian countries now suffer significant farmer and public health problems as a result of pesticide use. Asian governments have done little to regulate the pesticides trade, ensure farmers are adequately protected or train farmers on safe use. Farmers' health has also been adversely affected by the promotion of mono-cropping, which encourages farmers to grow cereals at the expense of other crops, leading to less diverse, nutritious diets for households and, more broadly, to relatively higher prices of crops with higher nutrition, meaning they are less easily purchased by the poor.<sup>8</sup>
- **Soils and the environment are being massively damaged.** During 1980-2000, chemical fertilizer use per hectare increased 11-fold in Vietnam, 6-fold in Thailand and nearly doubled in China.<sup>9</sup> Yet 30-80 per cent of nitrogen applied to farmland escapes to contaminate water systems and the atmosphere.<sup>10</sup> Chemical fertilizers and pesticides have contaminated water aquifers and waterways in Asia with nitrogen, phosphorous and highly toxic heavy metals.<sup>11</sup> In South and Southeast Asia, around 74 per cent of agricultural lands have been severely affected by erosion or chemical pollution.<sup>12</sup> The intensive withdrawal of water has also depleted aquifers, especially in China and South Asia, and reduced the flow of major rivers.<sup>13</sup> Nearly 40 per cent of irrigated land in dry areas of Asia is affected by salinisation, which reduces crop productivity.<sup>14</sup>
- **Conventional farming is a major contributor to climate change,** responsible for around 60 per cent of nitrous oxide emissions (mainly from chemical fertilizer) and around 50 per cent of methane emissions (much of which comes from livestock). Further greenhouse gas emissions are caused by deforestation and forest burning. Asian agriculture is responsible for around 40 per cent of global agricultural emissions of greenhouse gases.<sup>15</sup> Chinese agriculture's use of nitrogen fertilizer accounts for 8 per cent of the country's total greenhouse gas emissions.<sup>16</sup>
- **The sustainability of smallholder farming is being eroded.** Although millions of smallholder farmers, especially in China and Vietnam, have improved their livelihoods in recent decades, conventional farming has eroded the long-term sustainability of millions of others in various ways – notably by promoting mono-cropping, hybrid seeds, genetically modified organisms (GMOs) and land grabs. In particular, mono-cropping has made farmers dependent on one or two crops, putting them at risk if market prices for those crops fall. It has also severely reduced biodiversity; more than 1,500 rice varieties were lost in Indonesia between 1975 and 1990, for example. Together with high fertilizer use, mono-cropping has also often increased pest and disease problems since fertilizer often creates a dense, lush canopy in which pests can thrive. To combat this, farmers have often resorted to overuse of chemical pesticides which often kills natural predators leading to a resurgence of pest populations for which the solution is the application of still more chemical pesticides.<sup>17</sup>

### The advantages of sustainable agriculture

Sustainable agriculture uses fewer expensive external inputs and thus a major advantage to farmers is lower production costs and less indebtedness. At the same time, increasing evidence shows that sustainable agriculture can achieve yields equal to, or greater than, conventional farming. The largest study to date, led by Jules Pretty at the University of Essex in England, has been that of 286 projects whereby farmers in 57 countries were engaged in transitions to sustainable agricultural practices. It found that the average yield

increase was around 79 per cent across a wide variety of systems and crop types.<sup>18</sup> Similarly, a 2007 study by the University of Michigan, comparing a global dataset of 293 examples of yields of organic versus conventional or low-intensive food production, concluded that organic farming methods could produce enough food to feed the world population on a per capita basis; it also found that leguminous cover crops could fix enough nitrogen to replace the amount of synthetic fertilizer currently in use.<sup>19</sup> Other studies suggest that the shift from conventional to, for example, organic farming, can result in yield losses in the first two years, but that yields can be similar to those under conventional farming methods by the third year.<sup>20</sup>

Sustainable agriculture provides other advantages over conventional farming:

- Sustainable agriculture has a **minimum negative impact on the environment** and avoids contamination of soil and water resources. It promotes the reduction of waste and pollutants and discourages burning. It can also enhance soil fertility and water management by practices such as mulching or water harvesting, thus helping to maintain the safety of water sources in rural areas and has positive effects on soil drainage and water-holding capacity, with crop yields often higher in times of drought.<sup>21</sup>
- Sustainable agriculture can **mitigate climate change** by reducing dependence on fossil fuels and energy requirements, especially by reducing the use of nitrogen fertilizers. The FAO notes that organic agriculture reduces carbon dioxide emissions by 48-60 per cent<sup>22</sup> and energy requirements by 25-50 per cent<sup>23</sup> compared to conventional farming. Practices such as composting and agro-forestry also help to sequester carbon dioxide in soils and increase soil organic matter while the increased forestation and vegetation promoted under sustainable agriculture helps mitigate carbon dioxide emissions.
- Sustainable agriculture **enhances resilience and diversity** and can play a key role in helping farmers adapt to climate crises. Many farmers, including women farmers who tend to be the poorest, are vulnerable to crises and have been made more so due to mono-cropping. Practices such as crop rotation and inter-cropping increase the availability of food throughout the year, increase diversity in food production and use seeds and breeds with higher tolerance to climate extremes and pests - these can reduce the risks of income losses associated with seasonal variations or crop failures, compared to conventional farming.<sup>24</sup> Sustainable agriculture promotes and protects agro-biodiversity, including traditional seed varieties, and promotes the use of crops that are adapted to local conditions which farmers can improve, breed and freely save and exchange.
- **Farmers' health can be improved** in a number of ways through sustainable agriculture, notably by promoting a more diversified diet through producing various food items, by using fewer pesticides, and by improving the availability of clean water.
- **Sustainable agriculture benefits women farmers** by promoting their access, control and ownership over resources in the production, processing and distribution chain. Indeed, women farmers – who comprise the majority of the world's farmers – can benefit most from sustainable agriculture, since it is they who often work in the most degraded farming areas, with lower incomes to buy expensive inputs and less access to credit and thus who have the most difficulty in accessing external inputs and subsidies.

### Positive sustainable agriculture impacts in Asia

In China, various sustainable agriculture practices have been successful, such as the 'pig-biogas-fruit' model – in which biogas slurry is used to fertilize fruit trees, reducing the need for nitrogen fertilizers - and the 'rice-paddy-duck' model - which raises fish, ducks and crabs in rice paddies, controls weeds and pests and

reduces the need for chemical fertilizers.<sup>25</sup> ActionAid's research in Sancha village in Guangxi Autonomous Region - where farmers began organic rice farming in 2005— found that 76 farming households make organic fertilizer from peanut residue, fish meal, bone meal and plant ashes, and that their rice output is the same as by using chemical fertilizer. As regards organic pesticides, the farmers raise ducks in paddy fields to help control weeds and insects, and use a homemade herb liquid and moth-killing lamps. This has led to reductions in pests such as the yellow rice borer, rice plant hopper and mosquitoes.

In Cambodia, a study of 57 farmers in 7 communities, all practicing organic agriculture, found that farmers reported greater nutritional diversity, a higher level of food security, yield increases, improvements in health (mainly due to less use of pesticide), and increased incomes (mainly due to lower input costs).<sup>26</sup> Similarly, the Cambodian Organic Agriculture Association reports that conventional rice farmers achieved a nationwide average yield of 2.4 metric tonnes per hectare in the 2007/08 rainy season, whereas organic farmers obtained 3.5 metric tonnes.<sup>27</sup>

### Governments' lagging policies

In the last decade or so, most governments in Asia have begun promoting some forms of sustainable agriculture, partly in recognition of the problems with conventional farming. But our analysis is that such initiatives are extremely limited. Asian governments are not making a decisive break with conventional farming and do not have national sustainable agriculture strategies in place.<sup>28</sup> Most governments spend almost nothing on research into organic agriculture, for example.<sup>29</sup> Although they have gone furthest in promoting organic agriculture, this is mainly to secure new export markets rather than to promote the food security of smallholder farmers or environmental concerns.

In 1994 the Chinese government published a White Paper promulgating ecological farming since when policy has promoted 'eco-counties' comprising several million hectares of land.<sup>30</sup> Yet the other side of the coin is that China remains a massive producer and user of chemical fertilizers and pesticides, causing a huge environment toll, despite the fact that modelling suggests that nitrogen derived from organic fertilizers could completely replace chemical nitrogen fertilizers without affecting agricultural output.<sup>31</sup> Moreover, there is little government-funded agricultural research on organic farming methods and the local extension service plays a marginal role in supporting sustainable agriculture.<sup>32</sup>

### Recommendations to Asian governments

ActionAid calls on governments in Asia and the regional organisation, ASEAN, to prioritize sustainable agriculture in order to promote national and household food security, improve the livelihoods of smallholder women and men farmers and aid the process of adapting to climate change. Governments should:

- **Draw up national sustainable agriculture strategies.** These should outline:
  - How governments are going to prioritize supporting smallholder farmers, notably women, in promoting sustainable agriculture, what kind of support smallholder farmers are going to receive and how farmers themselves will be involved in policy design and implementation
  - The investments needed to promote these strategies, and plans for making the transition away from conventional farming.
  - How farmers' own knowledge and creativity are going to be incorporated in the process of building sustainable alternatives.
- **Re-orient extension services and create 'knowledge hubs' to support smallholder farmers in promoting sustainable agriculture to maximize their food security and food production.** Governments need to increase spending on extension, improve training for extension staff and reach much large numbers of farmers. More well-trained women extension officers are



needed to support women farmers. In particular, new extension services need to facilitate the process of building bridges between local and scientific knowledge that help local communities to innovate and reduce dependency on external inputs and which help design and implement site-specific, tailor-made sustainable production systems.

- **Transform agricultural research strategies to support sustainable agriculture.** This should include on-farm research on smallholder farmers' sustainable agriculture methods and developing publicly-bred and managed seed varieties resistant to droughts, floods and pests.
- **Phase out input subsidy schemes for agro-chemicals (fertilizer and pesticides) in favour of subsidy programmes to promote sustainable agriculture,** such as soil conservation and erosion control, composting, green manure, biofertilisers, agro-forestry and incentives to eliminate burning.
- **Provide credit programmes at low-interest rates and long pay-back periods to help smallholder women and men farmers make the transition to sustainable agriculture,** for example by supporting the use of inputs and methods that are already available, to help farmers access other local, non-fossil organic farming inputs and to help them invest in marketing and processing.
- **Take greater steps to establish community banks of grain, seeds, biomass, fodder, storage or marketing facilities at local level.**
- **Promote extensive land reforms to increase the security of tenure of smallholder farmers and ensure that such laws apply equally, in practice as in law, to women farmers.**
- **Step up support for improved water management** and incentive practices that reduce water runoff and local water harvesting, such as community and on-farm small dams, cisterns to collect water from roofs, underground dams and simple soil testing kits.
- **Implement or strengthen social assistance programmes such as food and cash transfers.** Guaranteed employment schemes could employ large numbers of people in forest conservation and integrated watershed development. School feeding programmes and public food distribution systems could procure food from smallholder farmers practicing sustainable agriculture.
- **Reduce the distance between producers and consumers, and increase access to markets** by: supporting the implementation of local processing units of smallholder farmers' products; investing in local infrastructure for transport and storage facilities; investing in local, regional and institutional markets for smallholder farmers' products; enhancing smallholder farmers' processing, business management and marketing skills by building the capacity of farmers groups; and building up women smallholders' confidence by helping them to gain new skills in marketing, business management and advocacy.

## INTRODUCTION

*“The governments of the region stand at a crossroads: business as usual, continuing with short-term profits for the few through chemically cultivated, irrigation- and energy-intensive monoculture, with the burden of long-term costs shouldered by the many; or a new long-term commitment to ecologically balanced, socially just and economically equitable agriculture to ensure food security for all”.*

– United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP)<sup>33</sup>

In June of 2012, representatives of over 140 nations are expected to take part in the “Rio+20 United Nations Conference on Sustainable Development”. The conference – scheduled 20 years after the first Rio conference saw an agreement that the United Nations must do something to address environmental degradation and global warming – is expected to focus heavily on the concept of the “green economy”. The “green economy” includes the idea that livelihoods, growth and environmental sustainability must go hand-in-hand in developing countries. While the concept itself may be laudable, it will be an unattainable ideal unless governments show a willingness to adopt a new development model – one based on human rights as opposed to profit for elites. A key example of the need for change – both in terms of the right to livelihood, environmental sustainability and the right to sufficient and nutritious food – is the agriculture sector. This paper seeks to address fundamental questions about the agriculture sector in Southeast Asia and China and to begin to sketch what a way forward – a way towards the “green economy” – may look like.

Asian countries are at a crossroads in their agriculture strategies. Before them are two farming models. The dominant model is ‘conventional’, industrial farming, promoted by the Green Revolution. The other is sustainable, or ecological, agriculture – involving methods of farming that are gaining increasing acceptance around the world as the most viable ways to promote food security and address climate change. Based on extensive secondary research and fieldwork among farmers in Cambodia, Myanmar, Thailand, Vietnam and the Guangxi Autonomous Region of China, we highlight in this report some of the problems associated with conventional farming and argue that Asian countries must move towards promoting sustainable agriculture with much greater urgency than they are currently doing.

Countries in Asia have shown the world in recent years that massive reductions in poverty and hunger are indeed possible. Yet deep hunger persists: 568 million Asians are still currently classified as undernourished, accounting for well over half of all those living with hunger in the world. Hundreds of millions more lack essential micronutrients – so-called ‘hidden hunger’.<sup>34</sup> Rising food prices across the region and world are deepening hunger for millions of farmers who are net buyers of food, while climate change threatens to plunge hundreds of millions more people into hunger in the coming decades.<sup>35</sup>

In this report, we argue that the currently dominant model of conventional farming risks worsening these trends and call on Asian governments to commit to promoting sustainable agriculture to reverse these trends and promote broad food security in the region.

## TWO MODELS: CONVENTIONAL FARMING AND SUSTAINABLE AGRICULTURE

### *Conventional Farming*

Conventional farming – which is often also called industrial or high input agriculture – is strongly associated with the Green Revolution, which got underway in many parts of Asia in the mid-1960s. The Green Revolution sought to massively increase productivity through promoting a ‘modern package’ of farming inputs – high-yielding seed varieties and hybrids (mainly of wheat and rice), chemical fertilisers and pesticides, and a big focus on irrigation. By 1980 around 40 per cent of Asia’s total cereal area was planted with modern seed varieties, increasing to around 80 per cent by 2000.<sup>36</sup> Fertiliser use per hectare in Asia grew fivefold between 1970 and 1995.<sup>37</sup>

Conventional farming in Asia has also often prioritised producing crops for export markets and consolidated large areas of land for monocropping, encouraging smallholder farmers to turn over their tiny plots to grow a single crop to be grown ‘intensively’, i.e., using chemical pesticides and fertilisers and ‘improved’ (and much more expensive) seeds bought from private companies. Farmers have thus often been encouraged to grow cash crops and to borrow money to invest in ‘high-tech’ inputs, thus increasing their costs of production, on the assumption that increased sales in local markets would be more than enough to repay their debts. Many farmers have opted into ‘contract’ arrangements whereby input packages were provided in exchange for producing for companies.

Some observers regard the highpoint of the Green Revolution as running from 1965 to 1990. In fact, it remains the dominant model of agriculture promoted by governments and donors throughout the region. During 1996-2006, for example, Asia’s consumption of chemical pesticides has continued to grow while fertiliser use rose at an average of 3.2 per cent a year, compared to the global average of 2.1 per cent; chemical fertiliser use per hectare in Asia is now twice that in the rest of the world.<sup>38</sup>

The earlier decades of the Green Revolution involved not just a technology fix but substantial state intervention in agricultural policy, notably in the provision of subsidised inputs (especially fertiliser, power and water), credit, guaranteed prices for farmers, extension services, land reform (especially in China and Vietnam) and significant budget spending (an average in Asia of over 10 per cent of government budgets during 1975-1990).<sup>39</sup> In the last decade or so, while the conventional farming model has been largely preserved, the active state role in agriculture has not: budget spending on agriculture has been slashed in most countries and market forces have become pre-eminent.

## Sustainable Agriculture

Sustainable agriculture – also often called ecological farming, alternative farming, or agro-ecological agriculture – is a farming approach derived from the recognition of people’s right to food. Sustainable agriculture refers to the ability of farms to produce nutritious food without damaging soils, ecosystems or human capital, and that reduces (or eliminates) reliance on external inputs such as chemical fertilisers and pesticides. It encompasses approaches such as agro-ecology, agro-forestry, low external input farming, organic agriculture, and water harvesting in dry land areas and aims to integrate biological and nutrient processes such as nutrient cycling, nitrogen fixation and soil regeneration into food production processes (Box 1, 2).

### BOX 1.

#### ActionAid’s definition of sustainable agriculture

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*“A whole-systems approach to food, feed, and fibre production that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. It combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved. Inherent in this definition is the idea that sustainability must be extended not only globally but indefinitely in time and to all living organisms including humans.”<sup>40</sup>*

Sustainable agriculture is a way of life based on self-reliant and agro-ecological systems which encompass all forms of livelihood for family farming, farm workers, the landless, pastoralists, livestock farmers, fisheries and hunter-gatherer societies. The sustainable agriculture approach promotes the ability of farmers, particularly smallholders and family farmers to gain access to and own their productive resources, such as land, water, forest, pastures, genes and seeds and to use these to secure their livelihood, growth and development with the support of socially, economically and environmentally appropriate methods and technologies. The approach enhances the power of farming communities to increase their income, build resilience to shocks, claim control over their production systems, including the processing and marketing of agricultural products. It requires farmers to participate and contribute to the development of local, national and international policies in food and agriculture, which are necessary for the fulfilment of their right to food.

**BOX 2.****Methods of sustainable agriculture**

Jules Pretty, a prominent academic analyst of sustainable agriculture, highlights the following seven approaches:

1. *Integrated pest management (IPM)*, which uses ecosystem resilience and diversity for pest, disease and weed control, and seeks only to use pesticides when other options are ineffective.
2. *Integrated nutrient management*, which seeks both to balance the need to fix nitrogen within farm systems with the need to import inorganic and organic sources of nutrients, and to reduce nutrient losses through erosion control
3. *Conservation tillage*, which reduces the amount of tillage, sometime to zero, so that soil can be conserved and available moisture used more efficiently.
4. *Agroforestry*, which incorporates multifunctional trees into agricultural systems, and collective management of nearby forest resources.
5. *Aquaculture*, which incorporates fish, shrimps and other aquatic resources into farm systems, such as into irrigated rice fields and fish ponds, and so leads to increases in protein production.
6. *Water harvesting* in dryland areas, which can mean formerly abandoned and degraded lands can be cultivated, and additional crops grown on small patches of irrigated land owing to better rain water retention.
7. *Livestock integration* into farming systems, such as dairy cattle, pigs and poultry, including using zero-grazing cut and carry systems.

Source: Petty, J. 2008. 'Agroecological Approaches to Agricultural Development', *Background Paper for the World Development Report 2008*, p. 2.

Sustainable agriculture makes use of the knowledge and skills of farmers, integrating traditional and scientific knowledge, improving their self-reliance, and emphasising peoples' collective capacities to work together to solve common agricultural and natural resource problems such as those concerning pest, irrigation or forest management.<sup>41</sup> Thus, sustainable agriculture uses farming practices and technologies that fit local conditions, notably local, traditional varieties of seeds (bred by farmers themselves) and animal dung or crop residues for fertiliser, and that do not require large financial investments for inputs and technology – hence critically reducing the farm production cost.

Sustainable agriculture also promotes growing a variety of crops to maximise family food security and recognises the 'multi-functionality' of agriculture – farming as a way of life that promotes food security, environmental protection and community well-being. Sustainable agriculture methods often require increases (compared to conventional farming) in labour time and in technical knowledge of farming methods. For a comparison of conventional and sustainable agriculture, see Table I.

**TABLE 1.****The two models compared**

	<b>Conventional Farming</b>	<b>Sustainable Agriculture</b>
<b>Credit</b>	High demand to buy 'high-tech' inputs	Low demand for external inputs; some demand for loans to support entrepreneurial activities
<b>Seeds</b>	Use of 'improved' hybrid varieties or genetically modified organisms (GMOs)	Emphasis on use of local, traditional varieties bred by farmers
<b>Chemical fertiliser and pesticide</b>	High and often increasing use	Reduced and sometimes no use, with emphasis on natural inputs such as organic compost and crop residues
<b>Extension service advice</b>	Critical. Large need for training, especially on appropriate and safe use of chemicals	Critical. Large need for good advice on sustainable agriculture methods. But also an emphasis on sharing farmers' existing knowledge
<b>Equipment</b>	Emphasis on large-scale machinery and mechanisation	Emphasis on small-scale labour-saving devices and animal farming.
<b>Production goals</b>	Emphasis on maximising yield Emphasis on producing for markets	Emphasis on good production, food security and crop diversity Production for market balanced by goal of greater self-reliance

**TABLE 2.****Where does ActionAid stand in the debate and practice on sustainable agriculture**

<b>For</b>	<b>Against</b>
Local control over natural resources, seeds, land, water, forest, knowledge and technology	Corporate control and concentration over natural resources, seeds, land, water, knowledge, technology
Appropriate technology that works with the nature and combine food production with environment preservation	Technology that works against nature

Acknowledgement of need to work with local knowledge, environments, soils, and work on solutions that are context specific – both from an agro-ecological, institutional and social perspective	One size fits all solutions that do not take account of local agro-ecological zones, or different social and cultural realities
Centrality of women's role in food production, seed preservation, water quality and environment protection	Agriculture that ignores the needs and roles of women
Greater role of the state in providing public goods like agricultural research, rural infrastructure, access to institutional market, access to local markets and social protection	Withdrawal of the state as a duty bearer from agriculture and from supporting the most marginalised rural communities
Looking at local context specific solutions that work for poorest and most marginalised communities, for smallholder farmers and their groups	One size fits all solutions that doesn't understand and appreciate the diversity amongst rural farming community
Building the political voice and identity of smallholder farmers aiming to enhance the space and participation of farmers movements and groups on the process of construction of public policies to attend their specific demands	Marginalisation of smallholder farmers
We support multiple solutions to preserve local biodiversity, facilitate the access to high quality seeds adapted to the local conditions, including household seed banks, community seed banks, regional gene banks, community seeds selection and improvement, multiplication and distribution of seeds by smallholder farmers groups, government extension and private traders	Corporate control over seeds and loss of biodiversity at local farm level
Availability of affordable credit specific for smallholder farmers and grants (social transfers) for marginal farmers	Credit at high interest rates for smallholder farmers
Use of locally adapted seeds, vegetable, animal species and races that are under the control of local communities and smallholder farmers social movements	Hybrids and high yielding varieties that do not take account of local realities (economic, social, climatic)
Smallholder Farmer - Scientist partnerships that builds solutions for the local communities demands, based on local tests designed, monitored and evaluated by smallholder farmers local groups	Top down agricultural research that does not take into account farmers realities, does not involve farmers on the design and implementation and is often not disseminated well
Supporting transition processes to sustainable agriculture, based on local reality, aiming to reduce the dependency on external inputs and to improve the sustainability, food security and resilience of smallholder production systems	High input intensive agriculture that does not build resilience and that promotes a uniform solution
Diversified farming systems that helps improve food security, livelihoods and build resilience	Mono-cropping that often does not build on resilience



## THE IMPACTS OF CONVENTIONAL FARMING

*“There is growing evidence that the Green Revolution has, at its worst, increased inequality, worsened absolute poverty and resulted in environmental degradation”.*

– Asian Development Bank Institute (ADBI)<sup>42</sup>

Conventional farming in Asia has had significant successes but also major adverse impacts in recent decades. Five areas stand out:

- Yields have risen but are slowing
- Poverty has fallen but is not being eliminated while inequalities are rising
- Public health is being undermined
- Soils and the environment are being massively damaged
- The sustainability of smallholder farming is being eroded

### *Yields have risen but are slowing*

The Green Revolution has certainly massively increased production. Some accounts note that it pulled the region back from the edge of an abyss of famine, leading to regional food surpluses within 25 years.<sup>43</sup> Cereal production in Asia virtually doubled between 1970 and 1995, from 313 million to 650 million tonnes.<sup>44</sup> During 1980-2000, production per hectare rose by 60 per cent in China and 114 per cent in Vietnam.<sup>45</sup> Cambodia, by 2008, was achieving a rice surplus, becoming self-sufficient in rice for the first time in 25 years.<sup>46</sup>

Although cereal yields have continued to rise across Asia since the highpoint of the Green Revolution, annual growth rates have slowed. Rice yield growth in both East Asia and Southeast Asia rose by 2.5 per cent a year on average during 1970-90, but slowed to 0.5 per cent and 1.5 per cent, respectively, during 1990-2004.<sup>47</sup> Much of this is likely to be the result of the deteriorating water and soil quality produced in intensive mono-cropping systems, to which we return below. In many places, farmers have to use increasing amounts of chemical fertiliser to maintain the same yields over time.<sup>48</sup> These trends suggest that the same reliance on expensive external inputs as in the past will be unlikely to work in the future.

### Poverty has fallen but is not being eliminated while inequalities are rising

Conventional farming's success in expanding food production has helped to reduce poverty levels. In 1975, nearly 3 out of 5 Asians were living in poverty; this declined to less than 1 in 3 by 1995.<sup>49</sup> Production gains increased the per capita availability of calories in Asia by around 30 per cent during 1970-95.<sup>50</sup> Real food prices fell. Between the early 1960s and the mid-1980s, for example, the UN Food and Agriculture Organisation's (FAO) global food price index roughly halved, increasing the purchasing power of households who were net food buyers.<sup>51</sup> The focus countries of this study have all reduced hunger during the past two decades (Table 3). However, there are three major qualifications to this success.

**TABLE 3.**  
Changes in hunger levels, 1990-2008

	Number of people undernourished (million)		Proportion of people undernourished	
	1990	2008	1990	2008
China	210	130	18	10
Cambodia	3.8	3.6	38	25
Myanmar	N/A	N/A	N/A	N/A
Thailand	15	10.7	26	16
Vietnam	21	9.6	31	11

Source: FAO. 2011. *The State of Food Insecurity in the World 2011*, p. 46.

The first is that hunger and poverty have not been eliminated, to which the figure of 568 million hungry Asians testifies. In some other countries at the forefront of the Green Revolution, hunger levels have actually risen, as in India, where 225 million people are now undernourished, compared to 177 million in 1990; the proportion of Indians hungry has decreased only marginally, from 20 to 19 per cent during the same period.<sup>52</sup>

Although conventional farming methods have increased yields in Asia's agriculturally optimal areas, they have been less effective in marginalised and resource-poor areas where farmers, especially women, have no access to modern inputs and technologies.<sup>53</sup> Although conventional farming has sometimes benefitted landless people by providing work opportunities on farms, it has also displaced many smallholder farmers as production has been consolidated into large, more integrated farming systems<sup>54</sup> (Box 3).

A massive problem throughout the region is that millions of farmers have become heavily indebted due to taking out loans to buy expensive external inputs. When the price of commodities has fallen or crops have failed due to pests or disease, farmers have often been left without livelihoods; this is most brutally evidenced in the more than 180,000 farmer suicides in India over the past decade.<sup>55</sup> In Thailand, 25 million farmers, or 88 per cent of the total, are now in debt and many are unable to pay back a total of 43 billion baht (US\$1.4 billion) to the Bank of Agriculture and Agricultural Cooperatives, which provides most of the loans to farmers.<sup>56</sup> Thai tenant farmers' average debts amount to 73 per cent of their annual incomes.<sup>57</sup> The government has recently been forced to step in and announce a cancellation of farmers' debts worth US\$ 1.3 billion.

### BOX 3.

#### Exporting food while people go hungry

A key consequence of the conventional farming model is growing food for export. Vietnam, China and Thailand are all major exporters of rice, while Cambodia has recently become a net rice exporter. This can, of course, increase earnings for the country. At the same time, however, and despite success in reducing hunger levels in recent decades, 10-25 per cent of these countries' populations are hungry.

	2007 cereals net export (tonnes)	2008 cereals net export (tonnes)	% of population undernourished
<b>Cambodia</b>	40,157	294,228	25
<b>Thailand</b>	8.4 million	9.6 million	16
<b>Vietnam</b>	2.6 million	3.2 million	11

Source: FAO Stat; FAO. 2011. *The State of Food Insecurity in the World, 2011*, p. 46.

Second, inequalities between regions and farmers have routinely increased under the conventional farming model. One meta-study of 307 published studies on the Green Revolution found that 40 per cent reported increased income inequalities.<sup>58</sup> The Green Revolution began in regions with assured irrigation and although it subsequently spread to areas that depended more on rain-fed crops, it did not benefit many of the poorest regions, notably India, where regional inequalities increased.<sup>59</sup> The UN's Economic and Social Commission for Asia and the Pacific (UNESCAP) notes that conventional and export agriculture has also marginalised women, who in Asia are responsible for over half the tasks in rice production. It notes: "As countries have moved towards cash crops... and commercial farming has become more mechanised, women have been steadily displaced as farmers and reduced to being agricultural workers".<sup>60</sup>

Third, does the Green Revolution itself actually explain Asian success in reducing poverty and hunger? Evidence suggests that it contributed in some ways, but that other policies, notably land reform, have also been key (Box 4).

#### **BOX 4.**

##### **Does the Green Revolution explain rural poverty reduction in China and Vietnam?**

China's policy reforms have reduced poverty and hunger on a scale unparalleled in history. The number of poor people (living on less than \$1 a day) in rural China fell from around 490 million in 1979 to around 90 million in 2002.<sup>61</sup> In the 20 year period after 1981 the proportion of the population living below the poverty line fell from 53 to 8 per cent.<sup>62</sup> China reduced the number of undernourished people from around 1 in 3 of the population in 1980 to 1 in 10 today.<sup>63</sup>

Vietnam has also made massive progress in combating hunger and poverty. During 1990 – 2001, it reduced the prevalence of under-nourishment from 31 to 17 per cent of the population and the number of undernourished people from 21 to 14 million.<sup>64</sup> The prevalence of poverty fell from 58 per cent in 1993 to 16 per cent by 2006.<sup>65</sup> By 1989 Vietnam was producing a national food surplus, notably due to increased production of the staple, rice, and had become the world's third largest rice exporter.<sup>66</sup>

What explains this success? The literature on China typically breaks the reforms into the 'incentive reforms' that dominated in 1978-84 and gradual liberalisation, and export-led growth, from 1985 into the 1990s.<sup>67</sup> Although Chinese growth was high throughout the whole period, poverty reduction fell most in the first reform period of 1978-84, and also during 1995-97.<sup>68</sup> After 1978, the major factor explaining agricultural growth – which rose by 7 per cent a year<sup>69</sup> – was the Household Responsibility System (HRS) reforms which reintroduced household farming after more than 30 years of collectivised agriculture. This big land reform programme gave farmers the ability to control land and to sell their surplus farm production to the market. More than 95 per cent of China's farmland was contracted out and returned to 160 million farm households.<sup>70</sup> Land distribution was highly egalitarian, allocated strictly according to household size and, as a result, each household's holding was fragmented into an average of nine tracts, even though the average size of a holding was only around 1.2 acres.<sup>71</sup>

A 2009 discussion paper by the International Food Policy Research Institute (IFPRI) concludes that there is broad consensus that the institutional reform creating the HRS land reform was the *primary factor* for the remarkable growth in agricultural output between 1978 and 1984, accounting for 40-60 per cent of that growth.<sup>72</sup> One other study found that 49 per cent of this growth derived from the HRS and 46 per cent derived from increases in inputs (most importantly fertiliser applications, which were responsible for one third). Another study found that 78 per cent of productivity growth was attributable to the HRS and 22 per cent to crop price increases implemented by the government.<sup>73</sup> According to the FAO, after 1984, the primary engine of agricultural growth was labour-intensive technological change, in particular the use of modern seed varieties and inputs such as chemical fertilisers and irrigation. Annual growth in agricultural GDP was around 3-4 per cent and was sustained by public investment in rural infrastructure and in research and technology development.<sup>74</sup> Clearly, a variety of factors explain China's success, with land reform being central.

Vietnam tells a similar story. From 1986 to 1993, in particular, the *Doi Moi* ('Renovation') reforms fundamentally transformed the agricultural sector. The key reform – 'Resolution 10' of 1988 – de-collectivised agriculture by obliging agricultural cooperatives to contract land to individual farm households for 15 years (for annual crops) and 40 years (for perennial crops). Within a decade after the land reforms

took hold in 1987, over 10 million households – more than 87 per cent of all peasant households – had been allocated rights to use land covering 78 per cent of Vietnam's land. These reforms encouraged farmers to produce food staples, livestock and high-value crops far more productively and profitably.<sup>75</sup> Farm households were allowed to buy their own capital stock irrespective of the supply available from the cooperatives and thus buy animals, equipment and machinery.<sup>76</sup> The redistribution of agricultural land was the main element behind Vietnam's poverty reduction.<sup>77</sup> The incentives given to farmers to invest were critical.

In Vietnam, as in China, one reason for success was the egalitarian nature of the land reforms. Land was distributed according to the number of family members in order to ensure that each household had enough land to meet its subsistence requirements.<sup>78</sup> There were restrictions on the maximum amount of land that could be held by households – 3 hectares for per farm in the Red River Delta and 5 hectares in the Mekong Delta for annual crops, for example.<sup>79</sup> Another important aspect of the land reform was the intention to create gender equality in land tenure with the names of both husband and wife appearing on the land use right certificate.<sup>80</sup> According to an FAO analysis, the major factor in explaining agricultural growth in this period was the dramatic increase in the quality of labour used for agriculture.<sup>81</sup> 'Put simply', the study for FAO notes, 'people worked harder once they gained security of tenure and the right to make their own production and marketing decisions'.<sup>82</sup>

In 1993, further land reform ensued in the form of a Land Law that extended land use rights to 20 years for growing annual crops and 50 years for growing perennials. One study into the causes of agricultural growth in Vietnam at this time attributes 28 per cent of the growth during 1986-2005 to fertiliser inputs, 23 per cent to labour, 18 per cent to increased land cultivation and 14 per cent to use of water pumps.<sup>83</sup> A study for the FAO notes that although some agricultural growth is explained by extending the area of agricultural land (which rose by 41 per cent during 1985-2002<sup>84</sup>), 'the major reason for the increase in total agricultural output in the past 20 years has been increased input usage', meaning more intensive use of labour, particularly in the application of chemical fertilisers and widespread use of Integrated Pest Management systems. Fertiliser usage per hectare expanded threefold between 1985 and 2002, with the most rapid increase in usage following the 1993 Land Law. The 'more intensive investment in improved soil fertility is clearly related to the reforms enhancing farmers security of tenure over the land', a study for the FAO concludes.<sup>85</sup>

### **Farmer and public health is being undermined**

The use of chemical pesticides has increased dramatically under conventional farming. Pesticides are responsible for millions of cases of poisoning per year and the contamination of groundwater. Virtually all countries in the region now suffer significant farmer and public health problems as a result of pesticide use (Box 5).

#### **BOX 5.**

#### **Pesticide poisonings: Selected recent study findings**

##### **Cambodia**

- A 2010 study by the University of Copenhagen found that 88 per cent of aquatic farmers sampled

near Phnom Penh had experienced symptoms of acute pesticide poisoning, and that this was associated with the number of hours spent spraying. The pesticides used included the most toxic insecticides as classified by the World Health Organisation (WHO).<sup>86</sup>

- The study mirrored a 2002 report by the Environmental Justice Foundation, which found that 88 per cent of 210 pesticide-using farmers interviewed had recently experienced symptoms of poisoning.<sup>87</sup>
- A 2010 study of markets in Phnom Penh found that 15 per cent of long beans and 85 per cent of white-stemmed kale on sale contained detectable levels of (highly toxic) organophosphate and carbamate pesticides.<sup>88</sup>

### Vietnam

- A 2010 study for the University of Wageningen in the Netherlands found that the increased use of pesticides by farmers 'has caused severe health problems for farmers and vegetable consumers'.<sup>89</sup>
- A 2005 study for the World Bank noted that the incidence of poisoning among rice farmers in the Mekong Delta – which produces half of Vietnam's rice – from exposure to organophosphate and carbamates is 'quite high'.<sup>90</sup>
- A study by the University of Hohenheim in Germany found groundwater pollution from pesticides in the mountainous Chieng Khoi watershed in northern Vietnam; pesticide concentrations exceeded the European drinking quality water standard.<sup>91</sup>
- In 2009, the Ministry of Agriculture and Rural Development's Plant Protection Department found that 6 per cent of vegetables sold at markets contained excessive levels of pesticides, and food poisoning cases involving 5,020 people, killing 33.<sup>92</sup>

### Guangxi, China

- A survey in Wuming country of Guangxi province during 2007-2009 showed 113 insecticide poisoning cases among mainly women farmers, and 5 deaths.<sup>93</sup>

### Thailand

- In a study of 1999-2003, Thailand's Ministry of Public Health found that half of all food samples tested contained pesticide residues.<sup>94</sup>
- Various other studies show significant pesticide pollution of water and rivers in Thailand.<sup>95</sup>

Although Asian countries have vigorously promoted chemical pesticide use, they have done little to regulate the trade or ensure farmers are adequately protected. In virtually all countries, there is a widespread illegal trade in pesticides across borders, the presence of fakes on the market (Box 6), and inadequate training given to farmers on the safe use of pesticides. Farmers routinely go without adequate protective clothing either because they cannot afford to buy such equipment or because they are unaware of the dangers. Pesticide storage routinely takes place inside houses, close to food and within reach of children.<sup>96</sup> ActionAid's fieldwork in four areas of Guangxi Province in southern China found that farmers have been told little about the long-term harmfulness of pesticides, herbicides or chemical fertilisers. Villagers' knowledge about chemical pesticides and fertiliser comes mainly from the sellers of the same products.

**BOX 6.**  
**The cost of pesticides in China**

China is the world's largest pesticide producer and consumer but the domestic market is flooded with fake or sub-standard products – 13 per cent of pesticides on sale in 2010 were sub-standard, according to government figures.<sup>97</sup> A 2001 study estimated that the impacts of pesticides in rice farming causes costs of \$1.4 billion each year both in health costs to farmers and the adverse impacts on biodiversity.<sup>98</sup>

Farmers' health has also been adversely affected by the push under conventional farming to promote mono-cropping. Although the Green Revolution has increased the per capita supply of food, intensive mono-cropping has encouraged farmers to grow cereals at the expense of other crops, leading to relatively higher prices of crops with higher nutrition, meaning they are less easily purchased by the poor.<sup>99</sup> According to the FAO:

*“The specialisation of agricultural systems into a few staple foods has exacerbated micronutrient deficiencies”, such as with Vitamin A, iodine and iron, thus becoming a “major public health concern”.*<sup>100</sup>

One study of farmers in Thailand suggests a further adverse health impact of conventional farming. A 2006 Japanese analysis found that the increased amount of rented farming land under the Green Revolution, especially that devoted to cash-cropping, alongside absentee landlords consolidating their landholdings, widened inequality in land tenure. With a focus on cash rather than food crops, and less land for farmers – deterring them from making investments – the result was deterioration in farmers' nutrition and an increase in child deaths.<sup>101</sup>

**Soils and the environment are being massively damaged**

During 1980-2000, chemical fertiliser use per hectare increased 11-fold in Vietnam, 6-fold in Thailand and nearly doubled in China<sup>102</sup> (Box 7). Chemical fertilisers can cause soil degradation and reduce soil fertility in farmlands through destroying organic matter and causing pollution and dead zones in lakes and rivers.<sup>103</sup> Some 30-80 per cent of nitrogen applied to farmland escapes to contaminate water systems and the atmosphere.<sup>104</sup>

Fertilisers and pesticides have contaminated water aquifers and waterways in Asia with nitrogen, phosphorous and highly toxic heavy metals such as copper and zinc.<sup>105</sup>

Vast areas of cropland, grassland, woodland and forest in Asia have been lost or degraded as a result of agricultural practices. In South and Southeast Asia, around 74 per cent of agricultural lands have been severely affected by erosion, wind or water or chemical pollution.<sup>106</sup> Much land degradation is the result of over-intensive cultivation, often the result of excessive use of chemical fertiliser and over-intensive livestock keeping.<sup>107</sup> According to UNESCAP, overuse of fertilisers in countries such as Vietnam, Thailand and Myanmar – which increased fertiliser use by up to 90 per cent during 1992-2002 – is having detrimental effects on the structure and nutrient balance of the soil.<sup>108</sup>

### **BOX 7.**

#### **The cost of fertilisers in China and Thailand**

China accounts for around a third of the world's use of fertilisers, and these have taken a heavy toll on the environment. Land degradation in China now affects 37 per cent of the country's territory<sup>109</sup>; if this process continues, crop output in north-eastern China could fall by as much as 40 per cent over the next 50 years<sup>110</sup>. A study by Greenpeace found that, in two chemical-intensive locations in northern China, nearly half the amount of nitrogen fertiliser applied by farmers leaches into the environment.<sup>111</sup> Government figures show that Chinese agriculture is responsible for 57 per cent of nitrogen pollutants and 67 per cent of the phosphorous pollutants in water and that the Yangtze, Yellow and Pearl Rivers carry nearly a million tonnes of dissolved chemical nitrogen annually.<sup>112</sup>

In Thailand, fertiliser use increased 94-fold from 1961 to 2003 which, along with chemical pesticides, has contributed to widespread water pollution.<sup>113</sup> Greenpeace recently found that in asparagus farms in the Central Plain, 55 per cent of tested groundwater wells had nitrate levels above the WHO drinking water safety limit.<sup>114</sup>

Since farming practices that depend on chemical fertilisers do not maintain the soil's natural fertility, farmers need to apply ever more chemicals to achieve the same results.<sup>115</sup> ActionAid's research with farmers in the Irrawaddy Delta region of Myanmar, where farmers suffer from increasing land degradation, has found that yields are falling due to declining soil fertility but that farmers cannot afford to use the ever-increasing amounts of expensive chemical inputs needed to maintain or increase yields.

Water supply and quality have also been badly affected by conventional farming. Agriculture is the world's principal user of water, accounting for around 70 per cent of withdrawals. In Asia, the overuse of water has become extremely serious and all water users – domestic, industrial and agricultural – have been withdrawing more water than the renewable capacity of the natural hydrological cycle.<sup>116</sup> Intensive withdrawal has depleted aquifers, especially in China and South Asia, and reduced the flow of major rivers.<sup>117</sup> Nearly 40 per cent of irrigated land in dry areas of



Asia is believed to be affected by salinisation, which reduces crop productivity.<sup>118</sup> Overuse has been encouraged by government policies such as subsidies for constructing inefficient irrigation systems.<sup>119</sup>

In addition, conventional farming is a major contributor to climate change. Globally, agriculture is largely neutral in the case of carbon dioxide emissions but is responsible for around 60 per cent of nitrous oxide emissions, mainly from chemical fertiliser, and for about 50 per cent of methane emissions, much of which comes from livestock. Further greenhouse gas emissions are caused by deforestation and forest burning. Agriculture in Asia is responsible for around 40 per cent of global agricultural emissions of greenhouse gases.<sup>120</sup> Chinese agriculture's use of nitrogen fertiliser accounts for 8 per cent of the country's total greenhouse gas emissions.<sup>121</sup>

Asia is likely to be hard hit by climate change. According to the Intergovernmental Panel on Climate Change (IPCC), mid-twenty first century cereal crop yields could increase by up to 20 per cent in East and Southeast Asia but decrease by up to 30 per cent in Central and South Asia; by the end of the century, rice production in Asia as a whole could fall by 3.8 per cent<sup>122</sup> (Box 8).

#### **BOX 8.**

##### **Vietnam and climate change**

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Vietnam is among the countries likely to be badly affected by climate change, with the Mekong River Delta one of the most vulnerable regions in Southeast Asia to climate change due to its exposure to sea level rises.<sup>123</sup> Some studies suggest that the summer-autumn crop production in the Keong River Delta could fall by 40 per cent as a result of climate change, while the rising sea level would salinise 45 per cent of the Delta's land area. Nearly 80 per cent of Vietnam's population lives in areas prone to seasonal flooding from monsoon rains and typhoon storms. A study for the UNESCAP notes that these effects from climate change 'may threaten the impressive economic progress the country has made'.<sup>124</sup>

**TABLE 4.**  
**Major environment effects of conventional farming**

<b>Environmental damage</b>	<b>Impact</b>
Soil erosion	Low productivity, salinity, water-holding capacity
Sediment damage	Reservoir siltation, increased navigation channel siltation, floods, increased costs of road maintenance, habitat degradation
Over irrigation	Depletion of groundwater, water logging, salinisation
Agrochemical damage	Worker health, water contamination, weed chocking, cost of mending damage
Soil compaction	Low soil productivity
Deforestation	Soil erosion, crop damage from high wind, loss of genetic diversity
Wetland drainage	Decreased water purification service, genetic diversity loss
Air pollution	Odour, smoke, ozone layer depletion

Source: Setboonsarng, S. 2006. 'Organic Agriculture, Poverty Reduction and the Millennium Development Goals', *ADB Institute Discussion Paper No.54*, p. 716.

### ***The sustainability of smallholder farming is being eroded***

Even though millions of smallholder farmers, especially in China and Vietnam, have seen their livelihoods improve in recent decades, the conventional farming model has eroded the long-term sustainability of millions of others in Asia in a variety of ways – notably by promoting mono-cropping, hybrid seeds, GMOs and land grabs.

Mono-cropping has **made farmers dependent on one or two crops**, putting them at risk if market prices for those crops fall. It has also severely reduced agro-biodiversity; more than 1,500 rice varieties were lost in Indonesia between 1975 and 1990, for example. Together with high fertiliser use, mono-cropping has also often increased pest and disease problems since fertiliser often creates a dense lush canopy in which pests can thrive. To combat this, farmers have often resorted to overuse of chemical pesticides which often kills natural predators leading to a resurgence of pest populations for which the solution is the application of still more chemical pesticides. Problems have been further compounded by pests becoming more resistant to commonly used pesticides.<sup>125</sup>

A further, related problem arises from many **farmers' dependence on hybrid seeds**. Hybrid rice has been promoted across Asia in recent decades as a magic bullet for ending hunger. Most seeds are sold by Chinese companies for whom the trade is big business, and the market they aim at is mainly large-scale farmers using mechanised, chemical input agriculture for export. For some smallholder farmers, however, dependence on hybrids has locked them into a requirement to purchase seeds every year, along with fertiliser and pesticides – entailing increased costs that increase their debts. The use of hybrid seed varieties has often increased farmers' yields, contributing to increasing incomes. But hybrids do not always increase yields by as much as many claim, as the following studies testify:

- A study by the University of Agriculture and Forestry in Vietnam found that although hybrid rice seeds have increased yields in the Red River Delta region, in less favourable farming areas the impact of hybrids was 'modest or even insignificant'.<sup>126</sup> Another university study found that hybrid rice yields were not significantly different than conventional varieties; farmers reported yield increases with hybrids of just 2 per cent. However, the farmers used more chemical fertiliser with hybrids, which also increased pests and diseases.<sup>127</sup>
- Recent research in Yunnan and Sichuan provinces of China by the NGO, GRAIN, found that rice farmers' yields from hybrids are modest and far from the claims made by manufacturers; some farmers' yields had fallen after changing from traditional to hybrid varieties.<sup>128</sup>

Conventional farming has also led to **promoting genetically modified organisms (GMOs)** in some countries, with China, India and the Philippines being the significant planters of GM crops in Asia. The first GM crops were planted in 1996 and by 2009 GMO cultivation extended to 130 million hectares in 25 countries around the world, grown by 13 million smallholder farmers; most grew cotton, with 7 million of them in China.<sup>129</sup> NGOs have long cited evidence that GM crops do not produce higher yields, that they bind farmers to buying products from large corporations and that many required increased use of chemical pesticides.<sup>130</sup> The UNESCAP notes that "the benefits of GM are far from certain" and that there is "little consistent evidence of higher yields".<sup>131</sup> The emphasis on GM crops has to an extent diverted some governments from promoting seed policies that would be of more benefit to smallholder farmers, such as establishing community seed banks, supporting public seed multiplication mechanisms and strengthening national seed legislation that protects farmers' rights.

Finally, in many countries, smallholder farmers are being further marginalised under conventional farming by the government preference for **consolidating land and the phenomenon of land grabs**. The Cambodian government, for example, is offering up vast areas of land to foreign investors while around 20 per cent of the population is landless and a further 25 per cent have less than half a hectare.<sup>132</sup> The facilitation of land grabs is a direct counter to the urgent need to provide adequate land and better tenure security to smallholder farmers, especially women.

## THE ADVANTAGES OF SUSTAINABLE AGRICULTURE

Increasing evidence shows that sustainable agriculture can achieve yields equal to or greater than conventional farming, and also provides various critical advantages over the dominant model promoted by governments and donors.

### *Yields and profitability*

There is substantial evidence that sustainable agriculture can increase yields significantly, often comparably to conventional agriculture, and with lower input costs. To cite just some three examples:

- The largest study to date, led by Jules Pretty at the University of Essex in England, has been that of 286 projects whereby farmers in 57 countries were engaged in transitions to sustainable agricultural practices. It found that the average yield increase was around 79 per cent across a wide variety of systems and crop types.<sup>133</sup>
- A 2007 study by the University of Michigan, comparing a global dataset of 293 examples of yields of organic versus conventional or low-intensive food production, concluded that organic farming methods could produce enough food to feed the world population on a per capita basis; it also found that leguminous cover crops could fix enough nitrogen to replace the amount of synthetic fertiliser currently in use. The study also noted – critically – that yield increases from organic farming methods would be even greater if more agricultural research were focused on sustainable agriculture.<sup>134</sup>
- Research commissioned by the UK government reviewed 40 sustainable agriculture projects in Africa during the 2000s – involving agro-forestry and soil conservation, conservation agriculture, integrated pest management, aquaculture and novel policies and partnerships. It showed that crop yields more than doubled over a period of 3-10 years.<sup>135</sup>

Several studies suggest that the shift from conventional to, for example, organic farming, can result in yield losses in the first two years, but that yields can be similar to those under conventional farming methods by the third year.<sup>136</sup> A major advantage of sustainable agriculture to farmers is lower production costs. Research from various developing countries points to lower production costs in organic farming systems because less external inputs are used and, for certified organic producers, price premiums are received.<sup>137</sup> ActionAid's research in Muk Kampoul district of Kandal province in southern Cambodia found that farmers using natural fertilisers and insecticides do not necessarily achieve better yields than

farmers using chemicals, but their production costs are lower and therefore profitability is higher.

## **Advantages over conventional farming**

Sustainable agriculture provides various advantages over conventional farming, including:

### **Soil and water management**

Sustainable agriculture has a minimum negative impact on the environment and avoids contamination of soil and water resources. It promotes the reduction of waste and pollutants and discourages burning. Sustainable agriculture can realise more food per unit of water in a number of ways, for example by using more water efficient seed varieties and by more water-efficient farm management and supplemental irrigation.<sup>138</sup> Organic farming methods can also enhance soil fertility and water management by practices such as mulching or water harvesting, thus helping to maintain the safety of water sources in rural areas<sup>139</sup> and have positive effects on water-logging, soil drainage and water-holding capacity, with crop yields often higher in times of drought<sup>140</sup>.

### **Climate change**

Sustainable agriculture can mitigate climate change by reducing dependence on fossil fuels and energy requirements, especially by reducing the use of nitrogen fertilisers. The FAO notes that organic agriculture reduces carbon dioxide emissions by 48-60 per cent<sup>141</sup> and reduces energy requirements by 25-50 per cent compared to conventional farming<sup>142</sup>. Sustainable agriculture practices such as composting and agro-forestry also help to sequester carbon dioxide in soils and increase soil organic matter, helping to increase productivity, while the increased forestation and vegetation promoted under sustainable agriculture helps mitigate carbon dioxide emissions.

### **Resilience and diversity**

Many of the world's farmers are vulnerable to crises, and have been made more so due to mono-cropping. ActionAid believes that sustainable agriculture is a *climate resilient* tool to increase the preparedness of smallholder farmers to face the impacts of climate change. It is based on identifying major or likely risks faced by local communities, and on designing implementing site-specific adaptation strategies aimed at reducing vulnerabilities and increasing resilience of the smallholder production systems. Practices such as crop rotation, inter-cropping and polyculture (multiple cropping) increase the availability of food throughout the year, increase diversity in food production and have preferences for seeds and breeds with higher tolerance to climate extremes, pests and diseases - these can lessen the risks of income losses associated with seasonal variations or crop failures, compared to conventional farming.<sup>143</sup> The FAO notes that:

*“well managed organic agriculture uses a number of preventive approaches that can greatly reduce the risk of severe yield fluctuations due to climactic and other uncontrolled incidents, contributing to the resilience of the food supply...It is organic management’s self-correcting process that gives a climate-related value to the agro-system”.*<sup>144</sup>

Sustainable agriculture promotes and protects agro-biodiversity, including traditional seed varieties, and promotes the use of crops that are adapted to local conditions which farmers can improve, breed and freely save and exchange. It also allows for participatory improvement and breeding of local seed varieties as well as public research.

### **Health improvements**

Farmers’ health can be improved in a number of ways through sustainable agriculture, notably by promoting a more diversified diet through producing various food items, by using fewer pesticides, and by improving the availability of clean water. Some studies suggest that crops grown by organic farming methods can improve diets since they contain significantly more vitamin C, iron, magnesium and phosphates and fewer nitrates than conventional crops.<sup>145</sup>

### **Labour migration**

Sustainable agriculture is sometimes criticised for requiring increased manual labour, and some practices, including organic farming, do tend to require more farm work. Yet this is often positive, providing more farm jobs, especially for women, and safeguarding livelihoods by keeping people on the land and living from it, reducing the need for migration. Other sustainable agriculture activities have reduced the need for farm labour.<sup>146</sup>

### **Benefits to women**

Sustainable agriculture promotes women’s access, control and ownership over resources in the production, processing and distribution chain. Women farmers – who comprise the majority of the world’s farmers – can benefit most from sustainable agriculture, since it is they who often work in the most degraded farming areas, with lower incomes to buy expensive inputs and less access to credit and thus who have the most difficulty in accessing external inputs and subsidies. But their ability to benefit is not automatic and depends on affirmative action directed specifically towards women.<sup>147</sup>

## **Examples of positive sustainable agriculture impacts in Asia**

Successes in sustainable agriculture are being increasingly captured in studies by academics and practitioners in Asia.

In China, for example, a variety of sustainable agriculture practices have been shown to be successful, such as the 'pig-biogas-fruit' model – in which biogas slurry is used to fertilise fruit trees, reducing the need for nitrogen fertilisers – and the 'rice-paddy-duck' model – which raises fish, ducks and crabs in rice paddies, controls weeds and pests and also reduces the need for chemical fertilisers.<sup>148</sup> ActionAid's research in Sancha village in Guangxi Autonomous Region – where farmers began organic rice farming in 2005, funded by the extension service – found that the 76 farming households make homemade organic fertiliser from peanut residue, fish meal, bone meal, Tung seed meal and plant ashes, and that their rice output is the same as by using chemical fertiliser. As regards organic pesticides, the farmers raise ducks in paddy fields to help control weeds and insects, and use bio-pesticides (homemade herb liquid) and moth-killing lamps. This has led to reductions in pests such as the yellow rice borer, rice plant hopper, rice fly and mosquito.

In Cambodia, a study of 57 farmers in 7 communities, all practicing organic agriculture, found that farmers reported greater nutritional diversity, a higher level of food security, yield increases, improvements in health (mainly due to less use of pesticide), and increased incomes (mainly due to lower input costs).<sup>149</sup> Similarly, the Cambodian Organic Agriculture Association reports that conventional rice farmers achieved a nationwide average yield of 2.4 metric tonnes per hectare in the 2007/08 rainy season, whereas organic farmers obtained 3.5 metric tonnes.<sup>150</sup>

Some sustainable agriculture methods use some, but reduced, amounts of agro-chemicals, and have also been shown to be successful. Site-specific nutrient management was developed by the International Rice Research Institute (IRRI) to reduce fertiliser use, avoid nitrate run-off and raise yields of intensive rice paddies; it does, however, involve the continued use of nitrogen fertilisers.<sup>151</sup> Conservation Agriculture, or zero tillage, which involves the direct planting of wheat after rice without any land preparation and which leaves rice residues on the ground as mulch, uses small amounts of fertiliser and often also requires herbicides for general weed control. Conservation Agriculture is widely used in Latin America and also in parts of Asia and Africa, with more than 50 million hectares now under no-tillage systems.<sup>152</sup>

Integrated Pest Management (IPM), which integrates pest-resistant varieties, natural control mechanisms and the use of some pesticides, has long been shown to reduce the need for chemical pesticides. A review of 62 IPM initiatives in 26 developed and developing countries (including China, Vietnam and Thailand), involving over 5 million farmers, found that in over 60 per cent of the projects pesticide use declined and yields increased; the most likely explanation being that pesticides are substituted by good information, increasing the management skills of farmers who become more skilled in agronomic practices, and that farmers invest some of their cash saved from pesticides in other inputs such as higher quality seeds and inorganic fertiliser<sup>153</sup> (Box 9).

A well-known successful farming model is the System of Rice Intensification (SRI), which allows farmers to produce rice in a more affordable, environmentally-friendly way by using organic compost, natural pesticides and hand-weeding instead of expensive chemicals and uses half the water and much less seed than traditional rice-growing methods. SRI has been successful in a number of countries and is practiced by around 100,000 farmers in Vietnam, after being introduced through the IPM programme in 2002<sup>154</sup> and by around 130,000 farmers in Cambodia, after being endorsed by the Cambodian government in 2005<sup>155</sup>. In Cambodia, SRI is reported as achieving a doubling of rice yields, substantial reductions in the use of fertilisers and chemicals and increases in farm profits of 300 per cent.<sup>156</sup> Other studies suggest increases in yields of 30-150 per cent.<sup>157</sup>

A 2004 study by the German aid agency, Deutsche Gesellschaft für Internationale Zusammenarbeit (GTZ), found that since the profits of Cambodian rice farmers practicing SRI were higher than conventional farmers, if just 10 per cent of farmers converted 40 per cent of their rice area to SRI, the economic benefit to the country would be \$36 million.<sup>158</sup> An ADBI study found that if 20 per cent of poor Cambodian households used SRI methods, the number living in poverty would fall by 21,300 people, reducing the poverty rate by 3 per cent.<sup>159</sup>

#### **BOX 9.**

##### **The benefits of Integrated Pest Management**

Taing Seng Hun, a 51-year old farmer in Sampan Leu village in Kandal province of southern Cambodia, has grown sugarcane for 20 years, but each year his income was usually only just enough to cover the costs of production, and in some years he found himself mired in debt. In 2005, however, and again in 2009, Taing attended IPM extension courses and learned new farming techniques to reduce the use of chemical fertilisers and pesticides and to promote crop rotation. Taing diversified into growing broccoli, cabbage, cucumber and tomato and began to receive regular information, provided by a local NGO, on local market prices for his crops.

In the past five years, Taing's yields and income have grown. His 0.7 ha plots of land used for sugarcane and vegetables now generate revenues of 19-20 million riels (US\$4,900) compared to about 12 million riels (US\$2,900) before, while production costs have fallen by 40-50 per cent by applying new farming techniques and using less chemicals. Together with his 3.5 ha plot used for growing dry season rice, Taing's family can save US\$2,000-3,000 per year, which funds the children's university education in Phnom Penh.



## GOVERNMENTS' LAGGING POLICIES

The adverse impacts of conventional farming are becoming increasingly recognised. Many international organisations – notably UNEP<sup>160</sup>, FAO<sup>161</sup> and IFAD<sup>162</sup> – are now calling for the adoption of sustainable agriculture, to different degrees<sup>163</sup>. In the last decade or so, most governments in Asia have begun promoting some forms of sustainable agriculture, partly in recognition of the problems with conventional farming. But our analysis is that such initiatives are extremely limited. Governments are not making a decisive break with conventional farming, and do not have national sustainable agriculture strategies in place.<sup>164</sup> Most Asian and developing country governments spend almost nothing on research into organic farming methods, for example.<sup>165</sup> A recent report for the IFPRI notes that “despite the development of more sustainable technologies and farming practices for Asia’s Green Revolution areas, their uptake and spread remains inadequate”.<sup>166</sup>

Asian governments have done most to promote *organic agriculture*. Organic farming methods – those that avoid using chemical and other expensive inputs – can certainly be considered a positive aspect of sustainable agriculture. Yet some aspects of formal organic agriculture – such as the certification process and, sometimes, reliance on external organic inputs – can be expensive for resource poor smallholders and do not properly constitute sustainable agriculture in our understanding of the term. When Asian governments do promote organic farming, they are mainly doing so to secure new niche export markets rather than to promote the food security of smallholder farmers or environmental concerns:

- In Vietnam, for example, organic agriculture is not focused on environmental concerns so much as driven by the demand from export markets that promise good economic returns for investors.<sup>167</sup> A 2007 study by the Vietnam Institute of Agricultural Engineering also noted that Vietnam’s development of conservation agriculture in the country was ‘slow and unremarkable’.<sup>168</sup>
- Similarly, in Thailand, the organic movement emerged in the 1980s and has since gained some momentum, with the government adopting sustainable agriculture as part of its 8<sup>th</sup> National Plan of 1997-2001 and in 2005 adopting a policy on organic agriculture. However, similar to Vietnam, government policy appears to be focused mainly on certification, accreditation and exports more than on improving extension services to reach more smallholder farmers, developing post-harvest technology and building domestic markets.<sup>169</sup> Just 0.15 per cent of Thailand’s farmland is devoted to organic farming despite the formal commitment by government.

Certified organic agriculture is now formally practiced in 120 countries globally<sup>170</sup>, with around 1.2 million Asian farmers currently certified organic producers.<sup>171</sup> Around 3.6 million hectares of land in Asia are now devoted to organic agriculture – constituting 10 per cent of the total organic agricultural area in the world – but only 0.25 per cent of farmland in Asia<sup>172</sup> (Box 10).

#### **BOX 10.**

##### **China's progress and limits**

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China is Asia's largest organic producer and the world's third largest organic farming power after Australia and Argentina. China's organic produce market has grown from 250 million Yuan (US\$39 million) in 2004 to 50 billion Yuan (US\$7.8 billion) in 2010.<sup>173</sup> In 1994 the government published a White Paper promulgating ecological farming (*Shengtai Nongye*) since when policy has promoted 'eco-counties' comprising several million hectares of land.<sup>174</sup> China's 11<sup>th</sup> Five Year Plan of 2006-10 emphasises the need to reduce the environmental impact of agriculture and reiterates the promotion of 'ecological agriculture' – a combination of environmentally beneficial traditional and modern techniques.<sup>175</sup> By 2009, nearly 4,000 enterprises in China were certified organic.<sup>176</sup>

China also has the most extensive system of payments and markets for ecosystems services, whereby farmers are compensated for protecting watersheds, biodiversity and mechanisms to prevent desertification. As of 2009, China had invested over \$90 million in such public payment schemes.<sup>177</sup> It also has an extensive programme of converting croplands to forests and grasslands.<sup>178</sup>

However, the other side of the coin is that China remains a massive producer and user of chemical fertilisers and pesticides, causing a huge environment toll, despite the fact that modelling suggests that the country possesses organic fertilisers in abundance and that nitrogen derived from organic fertilisers could completely replace chemical nitrogen fertilisers without affecting agricultural output.<sup>179</sup> Moreover, there is little government-funded agricultural research on organic farming methods and the local extension service plays a marginal role in promoting organic farming, meaning that farmers suffer from a lack of advice and knowledge on methods of, for example, pest control and soil fertility management.<sup>180</sup>

## Barriers to adopting sustainable agriculture

There are various reasons why governments and farmers may be deterred from making the transition to sustainable agriculture. One is that many **governments** remain to be convinced that sustainable agriculture can as profitable and productive as conventional farming. Thus, as IFAD notes: "*A first challenge is to convince policymakers that a sustainable intensification agenda has an important role to play*".<sup>181</sup> Another is political will – that, even given the considerable evidence in favour of sustainable agriculture, governments still find political or bureaucratic reasons for failing to make the change.

For **farmers**, the barriers can include:

- lack of adequate information and scientific knowledge;
- insecure land property rights, which deters farmers from making medium-term investments in their farming;
- lack of capacity in local extension services to work with farmers to promote farming approaches adapted to local conditions;
- the existence of incentives to use chemical inputs such as fertiliser subsidies; and
- widespread product advertising and extension officers pushing the benefits of agro-chemicals, which can deter farmers from moving away from conventional farming methods.<sup>182</sup>

A major barrier to making the transition to sustainable agriculture is the weakness of extension services in the region to train farmers in sustainable agriculture practices. Vietnam has relatively strong extension services but ActionAid's field work in three regions of the country - Hoa Binh in northern mountainous region, Dak Nong in Central Highlands and Soc Trang in Mekong Delta – showed that agriculture officers have limited knowledge of sustainable agriculture and that little farmer training is taking place. Similarly, ActionAid's fieldwork in Guangzi region in China also found that extension services are poorly promoting sustainable agriculture; rather, the extension system is vigorously promoting hybrid seeds, pesticides and fertilisers.

Yet, good extension services can have major impacts. Evidence from a perception survey of 270 households in nine villages in Cambodia suggests that farmers' productivity increased by 30 per cent following extension advice. The problem is that in Cambodia only 17 per cent of farmers have such access to extension officers.<sup>183</sup>

## RECOMMENDATIONS TO ASIAN GOVERNMENTS

*“The next stages in agricultural development will need to be much more about conserving natural resources, recycling carbon and ensuring that soils retain vital nutrients. It will also have to ensure that farmers and others protect biodiversity, conserve grasslands, wetlands and local forests in their watersheds and regenerate natural resources of soil and water”. – UNESCAP <sup>184</sup>*

ActionAid calls on governments in Asia and the regional organisation, the Association of Southeast Asian Nations (ASEAN), to take far-reaching steps to prioritise sustainable agriculture in order to promote national and household food security, improve the livelihoods of smallholder women and men farmers and aid the process of adapting to climate change. This should be supported by a similar degree of active state policy as during the first Green Revolution. We recommend that governments should:

- **Draw up national sustainable agriculture strategies.**  
These should outline:
  - ✓ How governments are going to prioritise supporting smallholder farmers, notably women, in promoting sustainable agriculture, what kind of support smallholder farmers are going to receive and how farmers themselves will be involved in policy design and implementation
  - ✓ The investments needed to promote these strategies, and plans for making the transition away from conventional farming.
  - ✓ How farmers’ own knowledge and creativity are going to be incorporated in the process of building sustainable alternatives.
  
- **Re-orient extension services and create ‘knowledge hubs’ to support smallholder farmers in promoting sustainable agriculture to maximise their food security and food production.** Governments need to increase spending on extension, improve training for extension staff and reach much large numbers of farmers. More well-trained women extension officers are needed to support women farmers. In particular, new extension services need to facilitate the process of building bridges between local and scientific knowledge that help local communities to

innovate and reduce dependency on external inputs and which help design and implement site-specific, tailor-made sustainable production systems. (ESCAP, for example, recommends establishing ICT-networked knowledge centres, including at village level.<sup>185</sup>)

- **Transform agricultural research strategies to support sustainable agriculture.** This should include on-farm research on smallholder farmers' sustainable agriculture methods and developing publicly-bred and managed seed varieties resistant to droughts, floods and pests. According to the IFAD: "If sustainable intensification is to contribute effectively to increasing agricultural productivity, there needs to be greater research expenditure, and more of it needs to be spent on the challenges of sustainable intensification faced by smallholder farmers in countries dependent on agriculture".<sup>186</sup>
- **Phase out input subsidy schemes for agro-chemicals (fertiliser and pesticides) in favour of subsidy programmes to promote sustainable agriculture,** such as soil conservation and erosion control, composting, green manure, biofertilisers, agro-forestry and incentives to eliminate burning. In fact, the UNESCAP and the IFAD have both called for a phasing out of agro-chemicals subsidies.<sup>187</sup> Subsidies on agro-chemicals could instead be used as cash incentives to support farmers in offsetting initial risks (2-3 years) associated with the local generation of biofertilisers and to build up national agricultural capital of soil and water for sustainable agricultural productivity. The Philippines ended its fertiliser subsidy programme in 2009 and introduced a 'balanced fertilisation strategy' aimed at promoting combinations of chemical and organic fertilisers. Bhutan declared its National Strategy on Organic Agriculture in 2006 and has a vision to 'go organic' nationwide by 2020.<sup>188</sup>
- **Provide credit programmes at low-interest rates and long pay-back periods to help smallholder women and men farmers make the transition to sustainable agriculture,** for example by supporting the use of inputs and methods that are already available to help farmers access other local, non-fossil organic agricultural inputs, and to help them invest in marketing and processing.
- **Take greater steps to establish community banks of grain, seeds, biomass, fodder, storage or marketing facilities at the local level.**
- **Promote extensive land reforms to increase the security of tenure of smallholder farmers and ensure that such laws apply equally, in practice as in law, to women farmers.**
- **Step up support for improved water management** and incentive practices that reduce water runoff and local water harvesting, such as community and on-farm small dams, cisterns to collect water from roofs, underground dams and simple soil testing kits.<sup>189</sup>

- **Implement or strengthen social assistance programmes such as food and cash transfers.** Guaranteed employment schemes could employ large numbers of people in forest conservation and integrated watershed development.<sup>190</sup> School feeding programmes and public food distribution systems could procure food from smallholder farmers practicing sustainable agriculture
- **Reduce the distance between producers and consumers, and increase access to markets** by: supporting the implementation of local processing units of smallholder farmers' products; investing in local infrastructure for transport and storage facilities; investing in local, regional and institutional markets for smallholder farmers' products; enhancing smallholder farmers' processing, business management and marketing skills by building the capacity of farmers' groups; and building up women smallholders' confidence by helping them to gain new skills in marketing, business management and advocacy.

## Glossary

**Agro-ecology:** The application of ecological concepts and principles in the design and management of sustainable agricultural systems. A whole-systems approach to agriculture and food systems development based on traditional knowledge, alternative agriculture, and local food system experiences.

Source: *Glossary of Terms Used in Agroecology* - <http://www.agroecology.org>

**Agroecosystem:** “A biological and natural resource system managed by humans for the primary purpose of producing food as well as other socially valuable non-food goods and environmental services”.

Source: Wood, S. et al. 2000. *Pilot Analysis of Global Ecosystems: Agroecosystems*. Washington, D.C.: World Resources Institute.

**Agro-biodiversity:** A vital sub-set of biodiversity. Agro-biodiversity is the result of natural selection processes and the careful selection and inventive developments of farmers, herders and fishers over millennia. Also known as agricultural biodiversity, or the genetic resources for food and agriculture, agro-biodiversity includes: a) harvested crop varieties, livestock breeds, fish species and non domesticated (wild) resources within field, forest, rangeland including tree products, wild animals hunted for food and in aquatic ecosystems (e.g. wild fish); b) non-harvested species in production ecosystems that support food provision, including soil micro-biota, pollinators and other insects such as bees, butterflies, earthworms, greenflies; and c) non-harvested species in the wider environment that support food production ecosystems (agricultural, pastoral, forest and aquatic ecosystems).

Source: FAO. 2004. *What is Agrobiodiversity?* – <http://www.fao.org/docrep/007/y5609e/y5609e01.htm>

**Agroforestry:** Collective name for land-use systems and technologies where woody perennials (trees, shrubs, palms, bamboos, etc.) are deliberately used on the same land management unit as agricultural crops and/or animals, in some form of spatial arrangement or temporal sequence. In agroforestry systems there are both ecological and economic interactions between the different components

Source: FAO. 2009. *Glossary on Organic Agriculture*.

[http://www.fao.org/fileadmin/templates/organicag/files/Glossary\\_on\\_Organic\\_Agriculture.pdf](http://www.fao.org/fileadmin/templates/organicag/files/Glossary_on_Organic_Agriculture.pdf)

**Biodiversity/ Biological Diversity:** The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

Source: FAO. 2009. *Glossary on Organic Agriculture*. –

[http://www.fao.org/fileadmin/templates/organicag/files/Glossary\\_on\\_Organic\\_Agriculture.pdf](http://www.fao.org/fileadmin/templates/organicag/files/Glossary_on_Organic_Agriculture.pdf)

**Carbamate:** Pesticides derived from carbamic acid and kill insects in a similar fashion as organophosphate insecticides. They are widely used in homes, gardens and agriculture. People can be exposed to organophosphates and carbamates pesticides through accidental exposure during use. People can accidentally inhale the pesticides if they are in an area where they were recently applied. The chemicals can be ingested with food or drinks that are contaminated. (See also Organophosphate)

Source: Delaware Health and Social Services –

<http://dhss.delaware.gov/dph/files/organophospestfaq.pdf>

**Composts:** Composting is a natural process that breaks down organic material like leaves, grass clippings, food scraps and paper into a nutrient-rich, soil-like material which is great for the garden! When properly maintained, compost has no unpleasant odours. Composting is best suited to homes that have a garden, as you need to have soil under the compost bin or enclosure. Using a composting bin or making a composting enclosure are options depending on the garden space available. Ready-made composting bins are available at garden centres or hardware stores.

Source: <http://www.sustainability.govt.nz>

**Conservation agriculture:** A concept for resource-saving agricultural crop production that strives to achieve acceptable profits together with high and sustained production levels while concurrently conserving the environment.

Source: Food and Agriculture Organisation (FAO). 2007. Agriculture and Consumer Protection Department. Rome, Italy Available from <http://www.fao.org/ag/ca/>

**Conventional agriculture:** An industrialised agricultural system characterised by mechanisation, monocultures, and the use of synthetic inputs such as chemical fertilisers and pesticides, with an emphasis on maximising productivity and profitability. Industrialised agriculture has become “conventional” only within the last 60 or so years (since World War II).

Source: *Organic Agriculture: A Glossary of Terms for Farmers and Gardeners, UCCE Humboldt* by Annie Eicher

**Crop Rotation:** the practice of planting a sequence of different crops and cover crops on a specific field. Crop rotations can be used to help build soil fertility, reduce insect pest pressure, and suppress weeds.

Source: *Organic Agriculture: A Glossary of Terms for Farmers and Gardeners, UCCE Humboldt* by Annie Eicher

**Desertification:** Land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities; combating desertification includes activities which are part of the integrated development of land in arid, semi-arid and dry sub-humid areas for sustainable development which are aimed at: a) prevention and/or reduction of land degradation; b) rehabilitation of partly degraded land; and c) reclamation of desertified land.

Source: United Nations Convention to Combat Desertification  
<http://www.unccd.int/convention/text/convention.php>

**Diversity:** a) The number or variety of species in a location, community, ecosystem, or agroecosystem; b) The degree of heterogeneity of the biotic components of an ecosystem or agroecosystem.

Source: *Glossary of Terms Used in Agroecology* - <http://www.agroecology.org>

**Ecological diversity:** The degree of heterogeneity of an ecosystem’s or agroecosystem’s species makeup, genetic potential, vertical spatial structure, horizontal spatial structure, trophic structure, ecological functioning, and change over time.

Source: *Glossary of Terms Used in Agroecology* - <http://www.agroecology.org>

**Genetically Modified Organism:** Organism whose genetic material has been altered using genetic engineering techniques. The outcomes of GMO in agricultural use are still questioned. Yield gains are highly variable (10-33 per cent) in some places and actually decline in others. In addition, the use of patents for transgenes may drive up costs, restricting experimentation by the individual farmer or public researcher.

Source: McIntyre, B.D. et al. (ed.). 2009. *Agriculture at a Crossroads. International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) Global Report.*

**Green Manure:** a cover crop grown to help maintain soil organic matter and increase nitrogen availability. Legumes are often used because they have rhizobial bacteria living in their root nodules that are able to fix nitrogen from the air and add it to the soil. Grasses grow quickly, providing biomass good for increasing organic matter.

Source: *Organic Agriculture: A Glossary of Terms for Farmers and Gardeners, UCCE Humboldt* by Annie Eicher

**Green Revolution:** An aggressive effort since 1950 in which agricultural researchers applied scientific principles of genetics and breeding to improve crops grown primarily in less-developed countries. The effort typically was accompanied by collateral investments to develop or strengthen the delivery of extension services, production inputs and markets and develop physical infrastructures such as roads and irrigation.

Source: *Glossary of Terms Used in Agroecology* - <http://www.agroecology.org>

**Hybrid Seed:** Seeds produced by cross-pollinated plants. They are planted to produce crops which are harvested for use. Saving seed from the crop and planting it is undesirable because the superior qualities of the



hybrid seed will have all disappeared in the following generation. Therefore, once farmers use hybrids seeds, they are obliged to buy seeds for every cropping. Hybrid seeds were the first step whereby agribusiness corporations took control of seed from farmers.

Source: Cummins, J. & Ho, M-W. 2005. *Hybrid Seed*. London: Institute of Science in Society - <http://www.i-sis.org.uk/hybridSeed.php>

**Integrated Pest Management:** The procedure of integrating and applying practical management methods to manage insect populations so as to keep pest species from reaching damaging levels while avoiding or minimising the potentially harmful effects of pest management measures on humans, non-target species, and the environment. IPM tends to incorporate assessment methods to guide management decisions.

Source: *Organic Agriculture: A Glossary of Terms for Farmers and Gardeners*, UCCE Humboldt by Annie Eicher

**Intensive Farming:** Farmers who use intensive farming methods concentrate on producing as much crop as possible on the available land. It involves either a large amount of financial or labour investment, or a high application of pesticides on a comparatively small area, or both. Intensive farming has a high potential return on investment that makes it attractive.

Source: McIntyre, B.D. et al. (ed.). 2009. *Agriculture at a Crossroads. International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) Global Report*.

**Intercropping:** The practice of planting two or more mutually beneficial crops in close proximity, typically as alternating rows or numbers of rows. (On a small scale, this is often called companion planting). Benefits can include insect or weed suppression, structural support, or shade.

Source: *Organic Agriculture: A Glossary of Terms for Farmers and Gardeners*, UCCE Humboldt by Annie Eicher

**Land Cover:** The physical coverage of land, usually expressed in terms of vegetation cover or lack of it. Influenced by but non synonymous with land use.

Source: *Glossary of Terms Used in Agroecology* - <http://www.agroecology.org>

**Land Degradation:** The reduction in the capability of the land to produce benefits from a particular land use under a specific form of land management.

Source: *Glossary of Terms Used in Agroecology* - <http://www.agroecology.org>

**Leguminous:** Cultivated or spontaneous plants in the Leguminosae (Fabaceae) family. Most species in this family has an association with a bacteria that can fix atmospheric nitrogen.

Source: *Glossary of Terms Used in Agroecology* - <http://www.agroecology.org>

**Livelihood:** A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks, maintain or enhance its capabilities and assets, while not undermining the natural resource base.

Source: Chambers, R. & Conway, G. 1992. 'Sustainable rural livelihoods: practical concepts for the 21st century', IDS Discussion Paper 296. Brighton: Institute of Development Studies.

**Marginal Farmers:** Small farmers who are 'farming yet hungry'. These are people for whom farming is a major livelihood activity, yet who have insufficient assets to produce a surplus from their agricultural activities and whose non-farm activities are insufficiently reliable or remunerative for them to rely on market purchases for adequate food intake. Marginalised food producers are often pushed to more remote or marginal lands.

Source: Concern Worldwide. 2008. *Unheard Voices: Marginal farmers in Zambia's Western Province*. Dublin: Concern Worldwide.

**Minimum Tillage:** The least amount possible of cultivation or soil disturbance done to prepare a suitable seedbed. The main purposes of minimum tillage are to reduce tillage energy consumption, to conserve moisture, and to retain plant cover to minimise erosion.

Source: *Glossary of Terms Used in Agroecology* - <http://www.agroecology.org>

**Mono-cropping:** A system of cultivation in which a single crop plant such as wheat is grown over a large area of land often for several years. Opposite mixed cropping. Mono-cropping involving cash crops, groundnuts, cotton, etc., exposes farmers in Africa to price fluctuations on the world market. Diversification is needed to stabilise farm incomes.

Source: Agriculture Dictionary - <http://www.agriculturedictionary.com>

**Mulch:** Are loose coverings or sheets of material placed on the surface of cultivated soil. Mulches can be applied to bare soil or to cover the surface of compost in containers. Depending on the type of mulch used, there are many benefits of mulching including: Help soils retain moisture in summer; Suppress weeds; Improve soil texture; Deter some pests; Protect plant roots from extreme temperatures; Encourage beneficial soil organisms; Provide a barrier for edible crops coming into contact with soil and give a decorative finish. Mulching is generally used to improve the soil around plants, but it also gives your garden a neat, tidy appearance and can reduce the amount of time spent on tasks such as watering and weeding. Mulches help soil retain moisture in summer, prevent weeds from growing and protect the roots of plants in winter.

Source: The Royal Horticultural Society - <http://apps.rhs.org.uk>

**Multi-cropping:** The cultivation of two or more crops in succession or with some overlap in the same field within one year. Double-cropping of rice after wheat is an example. When crops overlap in time, multiple cropping is a form of polyculture.

Source: Glossary of Terms Used in Agroecology - <http://www.agroecology.org>

**Nitrogen Fixation:** Process by which nitrogen is taken from its relatively inert molecular form (N<sub>2</sub>) in the atmosphere and converted into nitrogen compounds (such as ammonia, nitrate and nitrogen dioxide). Legumes (including clover, beans, alfalfa, lupines and peanuts) greatly contribute to nitrogen fixation in agricultural soils, due to symbiotic bacteria called rhizobia within nodules in their root system, producing nitrogen compounds that help the plant to grow and compete with other plants.

Source: FAO. 2009. Glossary on Organic Agriculture. – [http://www.fao.org/fileadmin/templates/organicag/files/Glossary\\_on\\_Organic\\_Agriculture.pdf](http://www.fao.org/fileadmin/templates/organicag/files/Glossary_on_Organic_Agriculture.pdf)

**No-Tillage / Zero-Tillage:** Zero tillage is the simple technique of drilling seed into the soil with little or no prior land preparation. Zero tillage is a technical component used in conservation agriculture, but not everyone carrying out zero tillage is practising conservation agriculture

Source: FAO. 2009. Glossary on Organic Agriculture. – [http://www.fao.org/fileadmin/templates/organicag/files/Glossary\\_on\\_Organic\\_Agriculture.pdf](http://www.fao.org/fileadmin/templates/organicag/files/Glossary_on_Organic_Agriculture.pdf)

**Organic Agriculture:** A production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved.

Source: IFOAM (International Federation of Organic Agriculture Movements) - <http://www.ifoam.org>

**Organophosphate:** The most widely used pesticide today and the cause of more incidences of pesticide poisoning than any other chemical class of pesticides. The chemicals in organophosphate kill insects by disrupting their brains and nervous systems. Unfortunately, these chemicals also can harm the brains and nervous systems of animals and humans. These chemicals stop a key enzyme in the nervous system called cholinesterase from working, and this can make people ill.

Source: Illinois Department of Public Health – <http://www.idph.state.il.us/Bioterrorism/factsheets/organophosphate.htm>

**Overexploitation:** Occurs when a renewable resource is exploited to the point of diminishing returns. Examples include wild plants, grazing pasture, fish stocks, forest and water aquifers. Sustained overexploitation can lead to the destruction of the resource.

Source: The Azimuth Project - <http://www.azimuthproject.org/azimuth>

**Polyculture:** Cropping systems in which different crop species are grown in mixtures in the same field at the same time.

Source: *Glossary of Terms Used in Agroecology* - <http://www.agroecology.org>

**Resilience:** Resilience is the long-term capacity of a system to deal with change and continue to develop. For an ecosystem such as a forest, this can involve dealing with storms, fires and pollution, while for a society it involves an ability to deal with political uncertainty or natural disasters in a way that is sustainable in the long-term. Increased knowledge of how we can strengthen resilience in society and nature is becoming increasingly important in coping with the stresses caused by climate change and other environmental impacts.

Source: *Stockholm Resilience Centre* - <http://www.stockholmresilience.org>

**Siltation:** Deposition or accumulation of unconsolidated or loose sedimentary material whose constituent rock particles are finer than grains of sand and larger than clay particles. Siltation can result in the silting up of reservoirs and streams and in the frequent clogging of irrigation channels. As the Southeast Asian countries expand and adapt their irrigation facilities to meet burgeoning food needs, their vulnerability to siltation and disrupted river flows will grow commensurately.]

Source: *United Nations Asian Development Institute. 1980. A Glossary of Terms in Environment. Bangkok: UN Asian Development Institute.*

**Soil compaction:** Soil compaction is a form of physical degradation resulting in densification and distortion of the soil where biological activity, porosity and permeability are reduced, strength is increased and soil structure partly destroyed. Compaction can reduce water infiltration capacity and increase erosion risk by accelerating run-off. The compaction process can be initiated by wheels, tracks, rollers or by the passage of animals. Some soils are naturally compacted, strongly cemented or have a thin topsoil layer on rock subsoil. Soils can vary from being sufficiently strong to resist all likely applied loads to being so weak that they are compacted by even light loads. In arable land with annual ploughing, both topsoil and subsoil compaction is possible. A feature of compacted soils is the formation of a pan-layer, caused by the tractor tyres driving directly on the subsoil during ploughing (above). The pan-layer is less permeable for roots, water and oxygen than the soil below and is a bottleneck for the function of the subsoil. Unlike topsoil, the subsoil is not loosened annually, compaction becomes cumulative and over time, a homogeneous compacted layer is created.

Source: *Institute for Environment and Sustainability* - <http://eussoils.jrc.ec.europa.eu/library/themes/compaction/>

**Soil Salinisation:** Accumulation of soluble salts of sodium, magnesium and calcium in soil to the extent that soil fertility is severely reduced; Process that leads to an excessive increase of water-soluble salts in the soil. See also *Water logging*

Source: *Institute for Environment and Sustainability* – <http://eussoils.jrc.ec.europa.eu/library/themes/salinization/>

**Slash and Burn Agriculture / Burning:** A pattern of agriculture in which existing vegetation is cleared and burned to provide space and nutrients for cropping.

Source: *Glossary of Terms Used in Agroecology* - <http://www.agroecology.org>

**Subsistence Agriculture:** Agriculture carried out for the use of the individual person or their family with few or no outputs available for sale.

Source: *Glossary of Terms Used in Agroecology* - <http://www.agroecology.org>

**Sustainable Development:** Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Source: *Glossary of Terms Used in Agroecology* - <http://www.agroecology.org>

**Water logging:** A problem associated with excessive irrigation on poorly drained soils. This occurs (as is common for salinisation) in poorly drained soils where water cannot penetrate deeply. It also occurs on areas that are poorly drained topographically.

Source: *Muir, P. S. 2012. Human Impacts on Ecosystems, Lecture notes at the Oregon State University.*

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