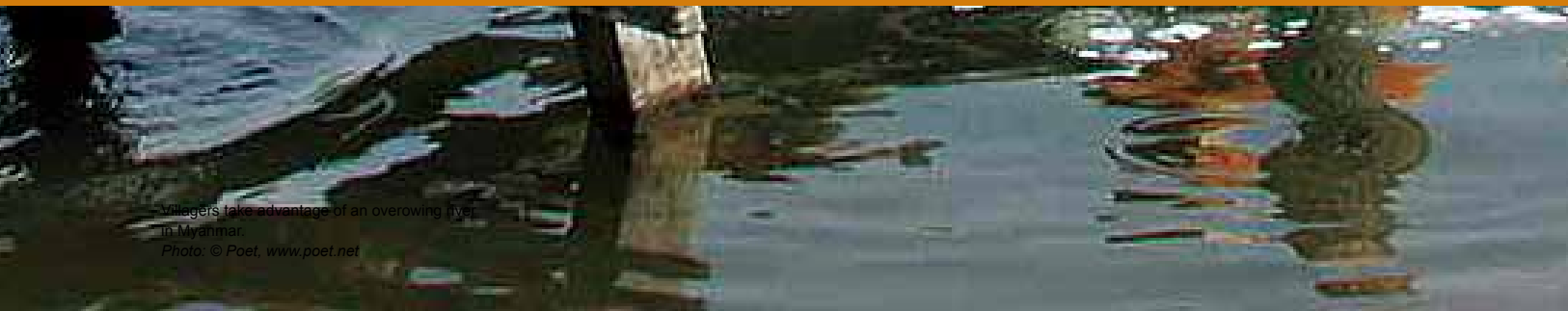


Chapter 4



Skills and Jobs for a Green Future





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Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meeting their own needs.

– *The World Commission on Environment and Development, Our Common Future (The Brundtland Report), 1987, p.43*

Eradicating poverty is the greatest global challenge facing the world today and an indispensable requirement for sustainable development, particularly for developing countries.

– *The Plan of Implementation of the Johannesburg World Summit on Sustainable Development, 2002*

The United Nations Decade of Education for Sustainable Development (DESD, 2005-2014), for which UNESCO is the lead agency, seeks to integrate the principles, values, and practices of sustainable development into all aspects of education and learning, in order to address the social, economic, cultural and environmental problems we face in the 21st century.

– *Global Development Research Center, UNESCO, 2002, www.gdrc.org/sustdev/un-desd/*

What is a green future? It is the vision of the planet and communities which are cleaner, safer and greener than today. It is the manifestation of sustainable development “that meets the needs of the present without compromising the ability of future generations to meeting their own needs” as articulated by the World Commission on Environment and Development (the Brundtland Report: 1987). It is about preventing, adapting to and mitigating the adverse effects of climate change.

Climate change affects the poor disproportionately and has far-reaching consequences for agricultural and rural development. As a major source of greenhouse gas (GHG) emissions, agriculture also has huge potential to reduce emissions through reduced deforestation and changes in land use and agricultural practices. But this potential has to be realised in ways that reduce poverty of the rural majority in developing countries and promote the goals of rural transformation.

The four parts of this chapter will discuss: (i) the importance of green development – how climate change impacts the rural poor; (ii) greening of rural transformation – sustainability issues in agriculture and rural economy; (iii) skills and capacity needs for sustainable rural transformation; and (iv) promoting skills and jobs for the green rural transformation.

4.1 How Climate Change Impacts the Rural Poor

It can be justifiably argued that in two decades since the 1992 World Conference on Environment and Development, workable policies and strategies are yet to be developed and used widely, which effectively integrate environmental sustainability and poverty alleviation in general, and rural poverty in particular. Moreover, the forces of globalisation have served more as inhibitors than drivers in placing sustainable development at the centre of economic policy prescriptions, not to speak of sustainable rural transformation, and accompanying institutional reforms (Reed: 2002).

The overwhelming reality at the beginning of the 21st century is that the extent of poverty globally remains massive. As Lester Brown put it:

The social and economic gap between the world’s richest 1 billion people and its poorest 1 billion has no historical precedent. Not only is this gap wide, it is widening. The poorest billion are trapped at subsistence level and the richest billion are becoming wealthier with each passing year. The economic gap can be seen in the contrasts in nutrition, education, disease patterns, family size, and life expectancy (Brown: 2008, p.107).

The impact of these changes, even before they reach a critical threshold, is disproportionately adverse on the rural poor and their efforts to overcome their circumstances, as noted in earlier chapters.

Effects of climate change show that poor people are most likely to be the first victims and the greatest sufferers of environmental degradation. The rural poor are more vulnerable than others to environmental hazards and environment-related conflicts and least able to cope with them when these occur. They also tend to be most dependent on the natural environment and direct use of natural resources, and are therefore most severely affected by environmental degradation and lack of access to natural resources.

On an operational level, the concept and practice of sustainable development must be focused on the fight against poverty, especially rural poverty in developing countries, given its preponderance in these countries. By integrating environmental considerations into the struggle against poverty, and vice versa, the chances of achieving meaningful progress will substantially increase. At least three key elements of this integrated approach, as noted below, have emerged from the discourse on sustainable development, and ways of enhancing skills and capacities of people through education, training and relevant supportive strategies (Ahmed: 2010).

- Overcoming marginalisation and disparity and claiming a stake for all in economic and social development: The vulnerable poor in rural areas, who form the majority in developing countries, have to be given a stake in sustainable development. Important aspects of this effort are empowerment of people at the local level in designing and achieving poverty reduction; access to productive assets, capital and technology for the poor;

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and social safety net and economic support to the ultra-poor, those who are ineligible even for microfinance, in order to enhance their capabilities to access capital and technology.

- Coping with the feminization of poverty: Women, making up two-thirds of the world's poor, are more likely than men to be poor, malnourished and illiterate. They usually have less access to medical care, property ownership, and employment, and are far less likely than men to be politically active.
- Women are also the first to encounter the effects of ecological stress, because they must walk farther to get wood for cooking and heating, to search for clean water and to find new sources of food. The responsibility for rearing children and ensuring sufficient resources to meet their needs for nutrition, health care and schooling falls upon the mother. Women's lives have been inextricably linked to the use of natural resources in traditional society. Economic and technological development and expansion of economic opportunities often altered the symbiotic relationship between humans and nature and added new stress both on women's life and on the natural environment (see Chant: 2006).
- Promoting sustainable production and consumption in the context of poverty reduction: Roughly five percent of the people of the world in North America enjoys one-third of the world's economic output. On the other hand, one-third of the world's population in China and India can lay claim on only six percent of the world's economic output.

Arguably, the central point of debate on sustainability is whether the pattern of consumption and production in North America and Europe is sustainable for the majority of the world outside the privileged enclave. Another way of posing this question is: Is it responsible behaviour on the part of the developing world to aspire to emulate and aim to achieve the pattern of production and consumption of North America and Europe? By the same token, is it responsible for the rich countries to insist on protecting the privileges they have enjoyed? If not, is there an alternative development path that the developing countries need to find and follow, while protecting and promoting the rights, dignity and well-being of all human beings? And what are the corresponding moral, ethical and

enlightened self-interest imperatives for the rich countries of the industrial world? (Korten: 2003)

Lester Brown of the Earth Policy Institute points out:

The western economic model – the fossil-fuel-based, automobile-centred, throwaway economy – is not going to work for China. If it doesn't work for China, it won't work for India or the other 3 billion people in developing countries who are also dreaming the American dream. And in an increasingly integrated world economy, where we all depend on the same grain, oil, and steel, it will not work for industrial countries either. The challenge for our generation is to build a new economy, one that is powered largely by renewable sources of energy, that has a highly diversified transport system, and that reuses and recycles everything. And to do it with unprecedented speed (Brown: 2008, p.XII).

Consequences of global warming for agriculture

The impact of climate change on agriculture and thus on the rural poor, who are dependent on agriculture for livelihood, can be devastating. The evidence of the threat of global warming on agriculture is unambiguous, though its magnitude in different contexts may be debated. Changes in temperature, precipitation, carbon dioxide storage and emission, fertiliser needs, and water on surface and underground are the major factors that affect agriculture prospects. The assumption of a moderate increase in global temperature (1-3 degrees Celsius) would have an overall moderate effect on agricultural production, but would have different impact on warmer and temperate zones of the world, with a more severe negative impact on the developing countries in the tropics.

A higher estimate of global temperature rise of above 3 degrees Celsius would adversely affect all regions, but the tropics would suffer particularly severely. Decline of wheat and maize yields in parts of Africa, Asia and Central America could be by 20 to 40 percent. Rice also would be affected, but less severely. These conservative estimates do not take into account the consequences of more intense droughts and floods, changes in surface water runoff and the effects on other crops and livestock (World Bank: 2008, pp.200-201).

Food security in jeopardy

In several Sub-Saharan African countries, declining precipitation could reduce yields from rain-fed agriculture by up to 50 percent by 2020. Agricultural production and access to food are likely to be severely compromised in many areas of the continent, endangering food security and exacerbating malnutrition (IPCC: 2007).

The high reliance on agricultural production, for both food and income, of rural people in developing countries intensify the negative effects of climate change. In Mali, agriculture accounts for 40 percent of GDP and provides primary livelihood for 80 percent of the population. In India, close to 60 percent of the working population is engaged in agriculture. The change in the patterns of the monsoon due to increases in global temperature will have detrimental effects on agricultural production and people's livelihood.

Countries such as Brazil and Egypt will be affected by decreasing precipitation, putting pressure on dwindling water resources, thus inhibiting agricultural production. Many countries such as Bangladesh, Brazil and the Philippines

already suffer from droughts and floods simultaneously, in different parts of the country or at different times of the year. These effects are likely to be further aggravated by climate change. Competition between land use for food and Biofuel production has consequences for food security and employment pattern, which calls for careful balancing (see Box 4.1 and ILO: 2011a).

Other social and economic impacts

Climate change and environmental degradation not only damage the environment; the immediate and longer term negative social and economic impacts are immense. Nicholas Stern, in his influential review of the global impacts of climate change, estimated that the reduction in global GDP due to the effects of climate change could be at least 5 percent currently and as much as 20 percent by 2050 (Stern: 2006). The number of people forced to abandon their homes and livelihoods by floods, droughts and other weather-related events would increase over the next decade; and water shortages and malnutrition threaten to affect 600 million people by 2080 (UNEP *et al.*: 2008, p.20).

Box 4.1 Policy Context in Selected Countries: Climate Change Impact and Priorities**Bangladesh**

A minor contributor to global GHG emissions, Bangladesh is suffering from highly disproportionate climate change impacts. Environmental degradation is happening through soil erosion, deforestation, increased water salinity and water body pollution. The most damaging effects of climate change in Bangladesh, heavily dependent on agriculture, are floods, salinity intrusion, and droughts that have been drastically affecting crop productivity almost every year. This is critical to the economy of Bangladesh, which relies predominantly on agriculture. Mass deforestation is occurring, including burning already low forest cover to clear land.

A system or institutional responsibility does not exist for identification of current and future skill needs for any kind of jobs – non-green or green – in the labour market. In the absence of firm policy agenda, the delivery mechanisms of the existing institutions for developing skills for green jobs remain weak.

Brazil

The primary sectors for emitting CO₂ in 2005 were forestry and agriculture, accounting for four-fifths of CO₂ emissions. The emissions and characteristics of energy supply sources point towards four primary environmental challenges:

- Decreasing the net loss of forest area;
- Implementing incentives for adoption of agro-forestry systems, no-till farming, energy efficiency, waste management and clean production measures;
- Encouraging the replacement of fossil fuels by biodiesel and ethanol for countrywide transportation; and
- Actively participating in the national Clean Development Mechanism (CDM).

The transition of Brazil towards a low-carbon economy is mainly driven by environmental legislation at international and national levels. Environmental legislation, to the extent implemented effectively, leads to direct and indirect effects on the demand for green occupations and skills.

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Box 4.1 (continued)

China

Emissions primarily produced by burning fossil fuels. Current industries need to be analysed to identify opportunities for greening as a priority, including not just non-wood pulp and paper production, but also new industries such as those for alternative energy.

The shift towards a greener economy in China will require workers to develop new green skills, leading to an adjustment in skills development strategies and training programmes. A major part of the challenge will be implementing changes in the vocational training sector, which provides training to 80 percent of occupations. Green occupations are a new concept in China and therefore few professional qualifications have been adopted. China needs to ensure that green jobs offer adequate wages and opportunities to workers.

China is planning a significant increase in its use of wind and solar power over the next decade offering new incentives. These green jobs require new skills among workers. China will need to re-direct training focus on environmental management and protection skills in eco-friendly technologies, including those which support renewable energy sectors, energy efficiency and recycling.

Egypt

A rapidly growing population places an increasing pressure on natural resources, resulting in stress on land and water and habitat destruction. Serious ecological problems are manifested in shoreline erosion in coastal zones. The Delta region faces problems of possible flooding due to rising sea levels. In addition, agricultural productivity could be negatively impacted by the increase in average temperatures. Human health hazards are likely to increase, as climate change may lead to outbreaks of vector-borne diseases. Egypt's total CO₂ emissions were estimated at 158 million metric tons, 1 percent of the total world emissions. However, emissions had escalated by 40 percent between 1996 and 2004. Major contributors to GHG emissions in Egypt are the energy sector (22 percent), manufacturing (19 percent), transport sector (18 percent), agriculture (15 percent), small combustion (9 percent), non-combustion emissions in industry (9 percent) and waste (5 percent).

A structured approach to skills response to climate change does not exist. Lax enforcement of environmental regulations is a disincentive for investing in alternatives to improve environmental performance. Initiatives for mitigation and adaptation to climate change are mostly implemented on a relatively small scale and in the form of donor-supported projects.

India

The Indian economy is now the fourth largest economy in the world and the fifth largest greenhouse gas emitter, accounting for 5 percent of global emissions. In per capita terms, it is low for a rapidly developing country. India's policies for sustainable development focus on energy efficiency and energy pricing, renewable and cleaner energy supply, pollution abatement, reforestation and mass transport. These policies could translate into projects that generate millions of "green jobs" in the coming years. Close to 60 percent of the working population of India are engaged in agriculture, making this the biggest employment sector. Crop production in India is critically dependent on the summer monsoon, making the agricultural sector highly vulnerable to climate change impacts. A major problem is the degradation of national water resources due to excessive water withdrawal for irrigation, industry and domestic consumption.

According to a recent survey, 86 percent of the labour force in India are in the informal economy and are potentially a reservoir of green workers, if they are trained and supported by policy measures. A proposed modular employable skills initiative targeting less-educated people without employable skills, workers who have acquired skills informally and Industrial Training Institute (ITI) graduates is an important step in the right direction, which has to be implemented effectively.

Indonesia

The Presidential Decree No. 5 of 2006 regarding National Energy Policy aimed to increase the use of renewable energies. The challenges for the green economy in Indonesia are:

- Land use changes in the forestry sector – emissions increase from deforestation, peat oxidation (emissions from organic soils), peat fires and forest burning;
- Energy sector – emissions of CO₂ from electricity and petroleum operations, transportation, commercial and industrial operations, and fugitive emissions (leaks and other unintended or irregular release of gases);
- Agriculture sector – emissions from rice cultivation, fertilisation, biomass, and manure management; and
- Waste sector – emissions of greenhouse gases originating from industrial wastewater treatment and discharge, domestic wastewater treatment and discharge, open burning solid waste, and unmanaged waste disposal sites.

There seem to be few linkages between the private sector and education and skills development, especially in terms of green issues; these links need to be improved to help fill the demand for green skills.

Mali

The agricultural sector is the backbone of Mali's economy: it contributes over 40 percent of national GDP and provides primary livelihood for more than 80 percent of the country's population. The performance of the agricultural sector and its capacity to adapt to climate threat are the key challenges in the future for the economy of Mali. The drive towards greening of Mali's economy hinges on how the agriculture sector responds resiliently to climate change and environmental degradation such as desertification and loss of soil fertility. Strategies or policies geared towards greening the economy are not in place and the term "green job" is not commonly known.

Box 4.1 (continued)

Greening the economy is seen more as a burden rather than an opportunity. There is some recognition of the potential in this respect, which needs to be further promoted.

The main concern about Mali clearly is adaptation within the agricultural sector. Actions on climate change are uncoordinated and a national strategic framework that defines Mali's vision is lacking. Despite Mali's vulnerability, an analysis of policies, strategies and key development programmes in Mali (GPRS II, PDES, LOA etc.) show that the impacts of climate change are not receiving due priority.

Philippines

The Philippines, an archipelago of more than 7,000 islands with a population of over 90 million, is on the UNDP's shortlist of most vulnerable countries in the world to climate change. The country is a low emitter of GHGs, contributing only 0.3 percent of the global share in 2004. The Philippines has suffered destructive episodes of El Niño droughts and La Niña floods. It is estimated that about 43 percent of the country is likely to be affected by climate change-induced drought, 20 percent by floods, and 11 percent by landslides. The negative impacts of climate change include water shortages, decreases in agricultural productivity, infectious diseases due to heat stress, and residents in low-lying coastal areas becoming "climate refugees". Coral bleaching, disappearance of small islands, and a decline in livestock production are other likely negative effects. The agricultural sector is the main focus of the Government's climate change programmes.

There are many official declarations as to the country's full alignment with global aspirations to build a climate-friendly world. Many environmental and climate change related laws have been enacted. However, there is a large gap between the enactment and enforcement of the laws. There is also a need to push more vigorously for sector-by-sector greening of the economy, including dense urban and rural poor settlements.

South Africa

The long history of structural inequalities remains an overwhelming burden for society and economy in South Africa. Key challenges and priorities have been identified. The general lack of skills in many sectors, especially of scientists, engineers, technicians, and training and development professionals, who must lead the transition to a greener economy, is a major constraint. A major challenge is to decarbonise the economy, since South Africa ranks eighth globally in terms of per capita emissions. The economy is dependent on coal-based energy with large reserves of coal in the country. Solar and other renewable sources are so far seen as mere pilot experiments.

South Africa is a semi-arid country, and lack of water is a limiting factor to agricultural and rural development. Water quality and availability is closely linked to change in land use, regional planning, economic growth and protection of biodiversity. An integrated approach to the management of land and water use is essential. South Africa is at the beginning of the greening and low-carbon economy curve and is yet to experience a significant structural shift in the economy or labour markets. The momentum is gathering, though, and the policy environment is changing in a positive direction.

Thailand

The Thailand Tenth National Economics and Social Development Plan (2007–2011) mentions a serious overuse of natural resources, citing the destruction of 10.7 million hectares of forests in 40 years. Forests now cover only one-third of the land compared to two-thirds in 1945. The seafood catch has been reduced to one-third and coral and sea grass conditions have deteriorated. Biodiversity is rapidly being destroyed by human activity with an increase in the rate of the extinction of species. Population growth and increased consumption have put pressure on air and water quality. Waste volumes are increasing faster than the capacity to dispose of them. Harmful substances have seeped into the environment and have contaminated the food chain. Thailand also relies heavily on imported fossil fuels for energy and transport needs. The increase in demand will mean that Thailand will face supply constraints as well as the risks of high GHG emissions.

The Thai Government has pledged to implement a green policy. Action plans have been developed by ministries, such as, the 15-Year Alternative Energy Plan and the DAED Four-Year Action Plan (2008–2011). These plans promote green skills development for use of new technologies. However, effective implementation in a coordinated manner remains a problem. The country still has no database on green skills and green jobs.

Uganda

Uganda, like many other developing countries, has not effectively responded to the challenges of climate change. Inaction by the majority of institutions mandated to protect the environment has led to increased vulnerability of people. The National Environment Management Authority lists environmental challenges in exponential population growth, biodiversity loss, habitat destruction, deforestation, soil erosion and degradation, pollution of air and water, and poor waste management in urban areas.

According to the Government's 2007 National Adaptation Programmes of Action (NAPA), climate change adaptation and mitigation priorities for Uganda include addressing land degradation and resource management, strengthening meteorological services, water and sanitation, water for irrigation, drought adaptation, pests and disease control, and climate change and development planning. Challenges associated with achieving these include lack of human and financial resources, unclear mandates of institutions involved, high transaction costs involved in Climate Development Mechanism (CDM) decision-making, and lack of committed leadership.

The overall direction of Uganda's economy will determine the nature of greening shifts. The country has plans for making the transition from a high-carbon to a low-carbon economy, which, if implemented effectively, will result in employment opportunities in various sectors. Opportunities exist, which must be realised, to reorient Uganda's economy to support sustainable development and build long-term resilience.

Source: Adapted from ILO. 2011a, Part 2, Summary of Case Studies. The background country reports are available at: http://www.ilo.org/skills/what/projects/lang--en/WCMS_144268/index.htm

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ILO's Skills and Employability Department, in cooperation with the European Centre for the Development of Vocational Training (CEDEFOP), launched in 2008 a global investigation of skill needs for greener economies. Investigations were carried out in 21 countries that represented 60 percent of the world population and about the same proportion of global GDP and was responsible for about half of global CO₂ emissions. The countries involved in the study were: Australia, Bangladesh, Brazil, China, Costa Rica, Denmark, Egypt, Estonia, France, Germany, India, Indonesia, Mali, the Philippines, the Republic of Korea, South Africa, Spain, Thailand, Uganda, the United Kingdom and the United States. The study drew on other collaborative work that preceded it (see UNEP *et al.*: 2008.).

The country studies were intended to reveal whether the potential for new and better jobs in greener industries is being realised, and if so, how. The synthesis of the 21 country studies attempted to look at the policy contexts at the country level. It examined the state of green structural changes and their implications for skills development, and if and how occupations changed with the greening of the economies. This chapter draws substantially on this recently published synthesis of the collaborative research (ILO: 2011a).

Excerpts from statement of the policy context in the country studies from the developing regions underscore the impact of climate change in the countries and the possibilities and priorities for action. The selected excerpts are presented in Box 4.1.

The policy context, and climate change impact and priorities, summarised from statements of national teams in the selected developing countries, are expectedly uneven. These were focused on general issues of the green economy, rather than the rural economy and the agriculture sector. A number of points illustrated by these statements, as listed below, merits attention.

- The majority of the people of the developing countries live in the rural areas, dependent on agriculture for employment and livelihood, and the agriculture sector and people's livelihood in rural areas will bear the brunt of the negative consequences of climate change. Yet the recognition of the impact on agriculture and rural people are uneven at best and barely noted in some cases. There appears to be a focus on carbon emissions

as the problem, influenced by an emphasis originating in industrial development and industrial countries, which is ultimately a major source of the problem and the solution. But this appears to have distracted attention from the immediate impact on lives of hundreds of millions of people by the proximate effects of climate change manifested in pressure on land and water and weather volatility. Admittedly, the ILO-sponsored study on green skills and jobs has emphasised the organised sector of the economy. The relative neglect of the informal economy, agriculture-related activities and the rural people remains a serious problem at the national and international level.

- The numbers and proportions affected in rural areas, as well as the potential for action with high impact on people's well-being, demand a high priority to rural economy and the rural people in considering the responses to the impact of climate change. Both the numbers in the workforce and the place of the rural economy within the national economy in the developing countries, albeit it is changing, offer possibilities that remain unexplored for adaptation to climate change, mitigation of the consequences, and indeed the possibilities of preventing some of the negative effects. Again the potential, needs and opportunities appear to be inadequately reflected in many of the expressions of impact and priorities (see the next section below).
- In many instances, even when the impacts and the need for action are recognised and policy, goals and objectives for transition to the green economy are stated, actual progress in implementation and the political will and mobilisation of support are insufficient. Capacities and relevant skills for the transition to the green economy, overall and particularly in the rural communities, are a major constraint in most countries. Assessing the situation and needs and developing strategies and planning actions for this purpose, for which the ILO collaborative study is a significant step, show some bright spots and many weaknesses (see below).

The next section of this chapter turns to the issues of greening rural transformation – sustainability in agriculture and rural economy – which, as we have emphasised, deserve greater attention than so far given.

4.2 Greening Rural Transformation – Sustainability in Agriculture and Rural Economy

There is a general agreement, at least rhetorically, since the Rio Earth Summit in 1992, that the agriculture and environment agendas are inseparable. It is generally accepted that agricultural development programmes will not succeed without sustainable use of natural resources – water, forests, soil, crops and animal diversity and the ecosystem as a whole. It is also beginning to be realised, though the full policy and action implications in different contexts have to be worked out, that agricultural development has to be seen as an integral part of a broader rural transformation agenda. The web of interconnection between the degradation of natural resources, undermining of agricultural production, continuing unsustainable use of natural resources, and increased vulnerability to risk of people requires that an integrated view is taken of agricultural and rural development and responses to climate change. The greening of rural transformation, focusing on an integrated approach to sustainably embracing agriculture and other aspects of the rural economy, has to be the overall framework for responses to climate change.

Agriculture is the main user of land and water, a major source of greenhouse gas emissions (GHG), the main cause of human-induced conversion of natural ecosystems and the loss of biodiversity (see Box 4.2). The sector with the highest worldwide greenhouse gas emissions, which threaten the temperature balance of the planet, is energy generation. It releases over a quarter of total emissions (26 percent), followed by manufacturing at 19 percent. Agriculture accounts for around 14 percent emissions globally, but combined with forestry (17 percent), they add up to almost one-third of total global emissions (International Energy Agency: 2008).

The sources and effects of greenhouse emissions vary among developing countries. The forestry-related emissions arise from both over-harvesting of timber and low rate of forest regeneration, reducing CO₂ absorption. In the Philippines, the proportion of land covered by forest has come down from 70 percent around 1900 to 6 percent today. In Bangladesh, Mali and Uganda, the use of charcoal and firewood for domestic use and making bricks for construction have resulted in rapid denuding of forest cover. Emissions attributed to agriculture are

Box 4.2 The Greenhouse Gases

What causes the greenhouse effect? Life on earth depends on energy from the sun. About 30 percent of the sunlight that beams toward Earth is deflected by the outer atmosphere and scattered back into space. The rest reaches the planet's surface and is reflected upward again as a type of slow-moving energy called infrared radiation. The heat caused by infrared radiation is absorbed by "greenhouse gases" such as water vapour, carbon dioxide, ozone and methane, which slows its escape from the atmosphere.

Although greenhouse gases make up only about 1 percent of the Earth's atmosphere, they regulate our climate by trapping heat and holding it in a kind of warm-air blanket that surrounds the planet. This phenomenon is what scientists call the "greenhouse effect". Without it, scientists estimate that the average temperature on Earth would be colder by approximately 30 degrees Celsius (54 degrees Fahrenheit), far too cold to sustain our current ecosystem.

How do humans contribute to the greenhouse effect? While the greenhouse effect is an essential environmental prerequisite for life on earth, there really can be too much of a good thing. The problems begin when human activities distort and accelerate the natural process by creating more greenhouse gases in the atmosphere than are necessary to warm the planet to an ideal temperature.

- Burning natural gas, coal and oil – including gasoline for automobile engines – raises the level of carbon dioxide in the atmosphere.
- Some farming practices and land-use changes increase the levels of methane and nitrous oxide.
- Deforestation also contributes to global warming. Trees use carbon dioxide and give off oxygen in its place, which helps to create the optimal balance of gases in the atmosphere. As more forests are logged for timber or cut down to make way for farming, there are fewer trees to perform this critical function.
- Many factories produce long-lasting industrial gases that do not occur naturally, yet contribute significantly to the enhanced greenhouse effect and "global warming" that is currently under way.
- Population growth is another major factor in global warming, because as more people use fossil fuels for heat, transportation and manufacturing the level of greenhouse gases continues to increase. As more farming occurs to feed millions of new people, more greenhouse gases enter the atmosphere.

Ultimately, more greenhouse gases means more infrared radiation trapped and held which gradually increases the temperature of the Earth's surface and the air in the lower atmosphere. During the entire 20th century, the average global temperature increased by about 0.6 degrees Celsius (slightly more than 1 degree Fahrenheit). Using computer climate models, scientists estimate that by the year 2100 the average global temperature will increase by 1.4 degrees to 5.8 degrees Celsius, depending on mitigating actions taken. The Intergovernmental Panel on Climate Change (IPCC) is of the view that the increase in global average temperature should be limited to a maximum of 2°C to avoid irreversible negative impacts.

Source: Adapted from <http://environment.about.com/od/globalwarming/a/greenhouse.htm>

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considerably higher than the world average in some large developing countries. The rate is estimated to be 21 percent of the national total in China, arising mainly from rice farming. In Brazil agriculture is responsible for 57 percent of the total national emissions (ILO: 2011a, pp.16-17; see also Box 4.2).

In developing countries, agriculture is a key entry point for interventions in environmental protection. The large "environmental footprint" of agriculture also means that there are many avenues for environmental action in this area. Identifying the opportunities and getting the right incentives in place for the stakeholders to behave responsibly towards sustainability are the first steps. Long-term support and capacity-building to improve natural resource management and coping with increased climate risks are also priorities. Strategies and actions have to give due importance to agriculture and forestry in adapting to climate change and mitigating their negative effects (World Bank: 2008, p.199).

Adapting to and mitigating the effects

Even if emissions of GHG are stabilised at current levels or reduced somewhat, adaptation of agricultural practices is urgent because the developing countries are already subject to many adverse effects in varying degree. What does adapting in the agriculture sector mean and how can it be encouraged and supported?

Farmers in many countries are already adapting and are ready to do so, when the support and incentives are available. A survey of practices in 11 African countries show that farmers are planting different varieties of the same crop, changing the planting calendar, and modifying practices to adapt to a shorter growing season. But in many other countries, more than a third of the households have not changed their farming practices, though they have been aware of climate variability or the threats of higher temperatures. Farmers report of barriers in the form of lack of credit and access to water (World Bank: 2008, p.201; Maddison: 2006).

In developing countries, farmers, especially smallholders, will need public sector support in adapting to the climate effects. These supports can be through crop and livestock

insurance, safety nets, research and adoption of research results on new pest and drought-resistant crops and dry land farming (African Development Bank *et al.*: 2007). The cost of constructing and modifying irrigation schemes needed to adapt to reduced water flow in river systems, such as those dependent on glacial melt, can run into billions of dollars.

Developing countries are responsible for about 80 percent of global emissions of GHG from agriculture in contrast to emissions from fossil fuel use and industry, for which the richer countries bear the main burden of responsibility. Agriculture in developing countries is also a major contributor to reduction in natural carbon sequestration or storage (thus reducing emissions) in soil, pastures and forests. This loss happens through change in land use pattern resulting in the loss of soil organic matter in cropland and conversion of forests to farming (World Bank: 2008, "Focus F").

Mitigation through carbon trading

The possibility of trading carbon emissions under international agreement through the Clean Development Mechanism (CDM) of the Kyoto Protocol is emerging. This arrangement can benefit farmers and rural communities in developing countries which can use land and agricultural practices that help store carbon, instead of being released to the atmosphere. The major hurdle to benefiting farmers and rural people are that the protocol so far has a limited coverage of afforestation and reforestation in addition to preventing depletion of existing forests through agriculture-related encroachment. Deforestation is the villain that creates almost a fifth of global GHG emissions (World Bank: 2008). The knowledge and understanding of the protocol and working out how it can benefit poor farmers and rural communities still remain a problem (see Box 4.3).

Broader economic and social adjustments

Transition to a greener economy focusing on agriculture and rural areas has to be part of broader long-term structural change in the economy. Socially responsible restructuring measures have to be adopted which do not punish further the poor and the disadvantaged in rural and urban areas. The costs of adjustments and how these are shared recognising prevailing inequalities and disparities have to be examined and public understanding and consensus

Box 4.3 What is Carbon Trading?

Carbon is an element stored in fossil fuels such as coal and oil. When these fuels are burned, carbon dioxide (CO₂) is released and acts as what is called a "greenhouse gas". Carbon trading is a market based mechanism for helping mitigate the increase of CO₂ in the atmosphere. Carbon trading markets can bring buyers and sellers of carbon credits together with standardised rules of trade. Any entity, typically a business, that emits CO₂ to the atmosphere may have an interest or may be required by law to balance their emissions through mechanism of carbon sequestration or storing. Entities that manage forest or agricultural land might sell carbon credits based on the accumulation of carbon in their forest trees or agricultural soils.

The carbon trade came about in response to the Kyoto Protocol. Signed in Kyoto, Japan, by some 180 countries in December 1997, the Kyoto Protocol calls for 38 industrialised countries to reduce their greenhouse gas emissions between the years 2008 to 2012 to levels that are 5.2% lower than those of 1990.

The idea behind carbon trading is quite similar to the trading of securities or commodities in a marketplace. Carbon would be given an economic value, allowing people, companies or nations to trade it. If a nation bought carbon, it would be buying the rights to burn it, and a nation selling carbon would be giving up its rights to burn it. The value of the carbon would be based on the ability of the country owning the carbon to store it or to prevent it from being released into the atmosphere. The better one is at storing it, the more one can charge for it.

The market would facilitate the buying and selling of the rights to emit greenhouse gases. The industrialised nations for which reducing emissions is a daunting task could buy the emission rights from another nation whose industries do not produce as much of these gases.

Carbon trading seems like a win-win situation: greenhouse gas emissions may be reduced while some countries reap economic benefit. Critics of the idea suspect that some countries will exploit the trading system and the consequences will be negative. Carbon Trade Watch, an independent research collective, argues that it places disproportionate emphasis on individual lifestyles and carbon footprints, distracting attention from the wider, systemic changes and collective political action that needs to be taken to tackle climate change. Debate over this idea arises because it involves finding a balance between profit, equality and ecological concerns.

Source: Adapted from <http://www.investopedia.com/ask/answers/04/060404.asp#axzz1dLsed72v>

has to be developed about policies. Attention is often focused on extractive industries and energy generation from fossil fuels and manufacturing industries as the source of the problem and areas of action in search of solutions. Clearly, these cannot be separated from issues pertaining to agriculture and rural areas, including those related to land and water use, livestock raising, forestry, and preserving biodiversity.

The move to renewable energies, clean energy, energy efficiency, green manufacturing as well as the green rural economy is intricately linked to agriculture and the rural economy. Climate friendly agriculture including more organic farming; livestock, fish and poultry raising that is sensitive to climate stress; preservation and growth of forests; and management of land and water will create new economic opportunities and jobs in both rural and urban areas. Those who take advantage of the new jobs may not all be those who are already disadvantaged and affected adversely by climate effects. The disadvantaged have to be identified and specifically targeted for assistance including training, retraining and upgrading of skills. Public dialogue and consensus building are again necessary. So is sharing roles and responsibility by the government at different levels, communities, civil society, workers and employers in the private sector, for success

in the complex endeavour to reshape the economy, build skills and capacity and match skills and jobs (ILO: 2011a, pp.55-56; UNEP *et al.*: 2008).

Green transition and stages of development

There is a strong relationship between the stage of development and the progress of green structural change as illustrated by the scope and pace of transition to the green economy among countries. The review of experiences highlighted in the recent collaborative interagency studies shows this link (ILO: 2011a; Table 4.1).

In the developed countries, the green restructuring of the economy has been going on for at least three decades. For example, Australia, Denmark, France, Germany, the United Kingdom and the United States have witnessed a gradual change that has been driven by a combination of automation, relocation to reduce costs, developments in labour market policies, major changes in the composition of the industrial sector, the growth of the services sector and an increase in service intensity in other sectors.

The broad-ranging restructuring since the 1970s has been initially driven by environmental regulations followed by fiscal policies and incentives to promote green behaviour among enterprises and consumers. Awareness raising and

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social mobilisation by the growing “green movement” have encouraged this process. This process continues with a greater emphasis on innovation and growth with the market serving as the driver of change. There is a long way to go before general public acceptance of the precepts of the green economy is achieved.

Among the middle income countries and those industrialised more recently, Costa Rica, Estonia, the Republic of Korea, South Africa and Spain were included among the 21 countries covered by the collaborative case studies on green jobs conducted by ILO and CEDEFOP. These countries, like the industrialised countries, also have been influenced by technological and market factors in their response to climate change. However, the attempt to articulate national policies including legislation and regulations are the main forces of change in these countries which are at the beginning of the greening curve towards a low-carbon economy. They are yet to experience a significant “green” structural shift in their economies and labour markets.

In many of the developing countries out of the sample of countries, including Bangladesh, Brazil, China, Egypt, India, Indonesia, the Philippines and Thailand, it was judged that “green shift” remains at an early stage. A more significant transition towards a green economy on a wider scale in these countries would require systemic efforts on several fronts. These include continuing the work on policy development and refinement, effective implementation of policy, law enforcement, and adapting to and adopting green technologies. In Mali and Uganda, green structural shifts remain at the embryonic stage, with green policy and regulations still to be accorded a high priority in public agenda (see Box 4.1 and ILO: 2011a).

In short, the priority for transition to a green economy is to combat climate change and environmental degradation and remove their negative environmental, economic and social impacts. This transition in developing countries requires an integrated view of urban and rural areas, with a special attention to agriculture and related economic activities, rural areas, and rural people. This is necessary because the rural people constitute the majority who are affected and they also can contribute to the solutions. Many developing countries, in spite of

having formulated policies, laws and regulations, falter in implementation and fall short in developing skills and capacities that are demanded by the green economy and green employment. This latter question is discussed in the following section.

4.3 Skills and Capacity Needs for Sustainable Rural Transformation

A central task in moving towards a sustainable greener economy with rural transformation as the key component is to create new skills and capacities and redefine and upgrade existing ones. This capacity building has to be done to facilitate new investments, adopt new technologies and create new jobs supporting the sustainable rural economy, mitigating the effects of and adapting to climate change. The message of the Green Jobs report (UNEP *et al.*: 2008), reaffirmed by the Skills for Green Jobs study (ILO: 2011a), is that the efforts to tackle climate change could result in the creation of millions of new “green jobs” in the coming decades in developing countries.

What are “green jobs”?

“Green jobs” can be defined as jobs that reduce the environmental impact of enterprises and economic sectors to levels that are sustainable. This definition covers work in agriculture, industry, services and administration that contributes to preserving or restoring the quality of the environment while also meeting the criteria for decent work – adequate wages, safe conditions, workers’ rights, social dialogue and social protection. It also covers activities related to both mitigation of, and adaptation to, climate change. This working definition implies, in its inclusivity and breadth, that most jobs have the potential of becoming greener. Over time, as the transition to a green economy progresses, what is considered a green job now may not be so regarded in the future. The understanding of green jobs also varies among countries and contexts. Ultimately, countries have to articulate own definitions applying agreed criteria and set benchmarks for practices considered green or non-green (UNEP *et al.*: 2008; ILO: 2011a).

Drivers of change in skill needs

Research and review of country experience presented in the Green Jobs report (UNEP *et al.*: 2008) and the Skills for Green Jobs report (ILO: 2011a) suggest that there are four main determinants of change in skills requirements: (i) physical changes in the environment itself; (ii) environmental policy and regulation; (iii) technology and innovation; and (iv) changes in markets, prices, and consumer habits. These drivers, or forces of change, are interrelated but their relative importance differs among countries.

In developed countries consumer behaviour and market forces have become major influences in shaping change in the economy, and thus, in skills and jobs. In developing countries where environmental changes are directly impacting peoples' life and livelihood, this situation is prompting development of policies and regulations. This is a stage which the industrialised countries had passed through already. However, better-informed policy-making and adjustments and refining of policies are a continuing task in all countries, developed and developing alike. Development and adaptation of appropriate technology and innovations are also critical factors in countries at different stages of development, though the criteria of appropriateness would vary. Technology and innovation also provide market signals, trigger investments, and create demand for skills and influence job profiles in both developing and industrialised countries.

Technology that is sensitive and responsive to the goal of green transition is an important driver of change in skill needs in its own right. This is so because of the critical role of skills in research and development in appropriate technologies as well as the skills in adaptation, adoption, transfer, diffusion and maintenance of new technologies in both developing and developed countries. In all these functions, the availability of relevant skills is decisive for success, but they are often in short supply.

Broadly speaking, the changing natural environment imposes greater demands on adaptation and the built environment creates a strong demand for mitigation measures. As the changing physical environment tends to loom larger in developing countries, especially in the

rural areas, the relative importance of adaptation skills is correspondingly greater there than in the developed world (ILO: 2011a, p.12).

The need for new and upgraded skills is likely to be increasingly pressing across countries and regions. Particular skills needed for green jobs in particular locations and sectors have to be identified, pinpointing where occupations will change and where new ones will come into being. Working out effective strategies for developing skills will help countries prepare for change across regions of the world and across the development spectrum.

Skill shortages

The analysis of countries' experience revealed that skill shortages already constrain the transition to a greener economy – in terms of preparing for some new occupations and in terms of changing the skill profile of a large number of existing occupations. A useful definition of skill shortage is:

...a genuine lack of adequately skilled individuals available in the accessible labour market with the type of skill being sought and which leads to a difficulty in recruitment. A skill shortage characterises the situation where employers are unable to recruit staff with the skills they are looking for at the going rate of pay. This could result from basic lack of people (when unemployment levels are very low), significant geographical imbalances in supply (sufficient skilled people in the labour market but not easily accessible to available jobs), or a genuine shortfall in the number of appropriately skilled individuals – either at new entrant level, or for higher level skilled occupations (Strietska-Illina: 2008).

As part of ILO's Global Green Jobs initiative, 11 countries in Asia and the Pacific are involved in a collaboration to encourage governments, employers and workers in generating coherent policies and effective programmes that will support a green economy, with green jobs and decent work for all (ILO: 2011).

The methodology to examine the current and future numbers of green jobs in a developing country calls for a systematic approach in assessing direct green jobs and indirect jobs that contribute to low-carbon development and environmental

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sustainability. An exercise undertaken in Bangladesh suggests that activities consistent with environmentally sustainable growth can support several million jobs (Table 4.1). Sectors such as sustainable agriculture, sustainable forestry and waste management show promise for creating large numbers of green jobs. However, some of the environment-related jobs created thus far are not “decent” due to the widespread practice of paying low wages, the very low participation of women, high wage disparities between men and women and poor or hazardous working conditions. This initial exercise also significantly admits that it was not possible to obtain an estimate for the share of green jobs in agriculture and forestry, which account for more than half of total employment in the country and presumably have the highest potential for expanding green jobs.

The 21 countries study on skills for green jobs also attempted to examine needs and prospects for green jobs. Highlights of observation from some of the developing countries are noted below.

Bangladesh

In Bangladesh, the National Capacity Self-Assessment (NCSA) for Global Environmental Management identified capacity needs at professional and technical level in respect of climate

change analysts, environmental restoration planners, environmental certification specialists, environmental economists, industrial ecologists, water resource specialists, water/waste-water engineers and geospatial information scientists and technologists (ILO: 2011a, p.216). In the context of greening the economy, skills development policies and strategies in Bangladesh are not aligned or linked to macroeconomic and environmental policies and no estimates of likely green jobs or a strategy to create these exist at present, as mentioned above (ILO: 2011a, p.217).

Brazil

In Brazil, the National Plan on Climate Change states that opportunities for green jobs exist in energy, transport, construction, ecological planning and industry. These can be realised through use of solar power and other renewable sources, adoption of an integrated planning system allowing efficiencies of energy use with efficient equipment, adoption of recycling practices, and capture and storage of carbon. No specific mention is made of the rural or agricultural sectors. It is noted that the skills supply for sustainable forest management activities is vital to the sustainability of the Amazon, reducing deforestation and the creation of conditions for sustainable use of forest resources. The need is emphasised for undertaking in-depth

Table 4.1 An Exercise in Estimating Creation of Green Jobs in Bangladesh

Economic sectors	Core environment related jobs	Direct green jobs	Indirect environment related	Total jobs
Sustainable agriculture	41,548	n.p.	47,482	89,030
Sustainable and participatory forestry	28,813	n.p.	28,121	56,934
Sustainable energy	18,823	18,823	50,561	69,384
Waste management and recycling	189,180	n.p.	212,753	401,933
Collection purification/distribution of water	8,441	n.a.	n.a.	n.a.
Climate adaptation activities	1,726,755	616,052	967,849	1,583,901
Manufacturing and energy efficiency	10,934	10,934	21,472	32,406
Sustainable transportation	178,510	178,510	54,049	232,559
Sustainable construction	1,340,000	536,000–670,000	1,416,364	2,019,364
Total	3,543,004	1,427,319	2,798,651	4,485,511

n.p. – Not possible to obtain an estimate for the share of green jobs due to data limitations.

n.a. – Not available.

Source: “Looking at the Relationship between Environment, Economy and Jobs in Bangladesh”, a study by ILO/GHK, April 2010, cited in ILO, 2011.

studies to understand how skills will be modified, by an analysis of technological impacts and procedures introduced through production processes as well as discussion of the definition of green economic activity and specific skills and qualifications relating to it (ibid., pp.230-231).

China

In 2007, China established the National Leading Group to Address Climate Change which aims to:

- Cut energy consumption per unit of GDP by 20 percent between 2005 and 2010;
- Increase the use of renewable energy to 10 percent of total energy consumption by 2010; and
- Increase forest cover to 20 percent by 2010.

As China moves towards a green economy, industries which have been historically sources of employment for millions will become obsolete, requiring vocational training and skill upgrading of workers on a huge scale. The development of low-carbon industries including the desulphurization industry is likely to create over 1 million jobs between 2005 and 2020. The cross-country study observes that China will need to focus training on environmental management and protection skills in eco-friendly technologies, including those which support renewable energy sectors, energy efficiency and recycling. This will require: (i) surveys of employees and employers on green skills; (ii) quantitative projections of employment based upon appropriate econometric models; and (iii) qualitative analysis of green skills (ibid., pp.237-48).

India

In India, the 2008 National Action Plan on Climate Change (NAPCC) outlined a national strategy that comprised eight national "missions" on – solar energy, energy efficiency, sustainable habitat, water, sustaining the Himalayan eco-system, green India, sustainable agriculture, and strategic knowledge for climate change. These missions provide an organisational structure for formulating policy and priorities, bringing the main stakeholders together, mobilising resources, guiding implementation and monitoring progress.

India has around a fifth of its area under forests. Despite the pressure on land, the target is to increase the area under forest from 23 percent to 33 percent.

The Mission on Strategic Knowledge for Climate Change is engaged in the identification of skills gaps, capacity building on climate change, and promotion of research and development. A national green skills development strategy is yet to be developed, though some steps have been taken to address the skills gap. In 2007, the Prime Minister pledged the opening of 1,600 new industrial training institutes (ITIs) and polytechnics, 10,000 new vocational schools, and 50,000 new Skill Development Centres. These together would produce over 10 million youth equipped with vocational training annually – a four-fold increase from today's level.

Little data are currently available on green skills development and the information that exists is scattered, with no central database in India. A sample survey has been proposed. Further comprehensive research is required to study the impact of green jobs on the environment and climate (ibid., pp.322-334).

Indonesia

In Indonesia, an instrument to forecast skill needs including a feedback mechanism does not exist. Technical capacity building and managerial training has been provided to authorities at national and local government level, and in publicly funded sectors and universities. The training activities proposed by the National Council for Climate Change need to be acted upon by government agencies, private enterprises and community organisations. Sustainability training as part of the strategy to develop skills for green jobs should be embedded in education systems and training at all levels. The "green" awareness in Indonesia is still emerging and green skills responses are at an early stage of development. A structured and formal green skills response is yet to be developed from the policy and planning perspective and from the point of view of the end-user (ibid., pp.335-344).

Mali

The Government of Mali considers agriculture as the backbone of national socioeconomic development; however, this is also the most vulnerable sector to climate change impacts. Major potentials exist for increasing the number of green jobs, both in the development of new occupations and new skills for existing occupations. Economic sectors that need green

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skills are renewable energy, agriculture, waste management, construction, forestry and carbon finance.

In agriculture a key issue is appropriate water management systems for both surface and underground water. New ways of raising livestock have become urgent as nomadic lifestyle and the seasonal movement of people with their livestock are becoming more difficult to practice. Sustainable fish farming practices are in demand. Furthermore, "adding value" to primary resources is essential, for example, by developing or adopting technologies which use agricultural by-products for energy generation.

Biofuel from jatropha plant is becoming a popular replacement for imported fossil fuel. The need to expand this industry has given rise to new skills gaps for nursery growers, producers and jatropha oil motor operators, and for developing its use at a local level. It is also important to train operators of machinery (agricultural, transport etc.), in adapting and maintaining these, for the use of jatropha biofuel. The agricultural meteorological network in Mali has a major skills gap. In a situation of high weather unpredictability, increasing and improving the skills in this area is a priority.

In Mali the greening of the labour market has not yet been taken as a priority. Assessing and planning for skills needs are yet to be addressed systematically by the national authorities (ibid., pp.345-354).

Philippines

There is a wide gap between legislation and the implementation of environmental reforms. A plethora of laws including two recent ones have been adopted, which should be especially relevant for green rural transformation. One of the acts known as "Mainstreaming Climate Change into Government Policy Formulations – Establishing the Framework Strategy and Programme on Climate Change" of 2009 provides for the creation of a Climate Change Commission headed by the President to serve as the country's sole policy-making body on climate change. It aims to coordinate climate change related programmes. The other recent legislation is the Organic Agriculture Act of 2010 for the development and promotion of organic farming in the country. The intent of these laws needs to be fulfilled with proper implementation.

Currently there is a shortage of decent jobs for one million new annual labour entrants, the estimated 3 million unemployed, over 6 million officially counted as underemployed, four million "unpaid family workers", and over 12 million working less than 40 hours a week. The green restructuring of the Philippine economy could have a positive impact on the total employment scenario, because of the generally labour-intensive nature of green jobs. Examples of the potentials include the shift from current chemical-based farming to organic agriculture, the growth of the renewable energy sector, reforestation programmes, and the expansion of the recycling sector.

An army of agricultural extension personnel, with training and technical support, needs to provide knowledge on agricultural technology and climate change adaptation and risk reduction to millions of farmers. There is a need to increase the agri-business and entrepreneurial skills of farmers to prepare them for the shift to organic and sustainable farming with retraining in, for example, methods of composting to produce organic fertilisers and in the selection of sturdy seeds that can withstand weeds and pests invasions.

There is currently no data from the National Statistics Office on the number of establishments going green or skills shortage or workers displaced by enterprises that have gone green. The newly created Climate Change Commission could provide the lead in this respect (ibid., pp.355-364).

South Africa

The Medium Term Strategic Framework for 2009-2014 to address climate change has two strategic priorities: the first aims at strengthening the skills and human resource base in general, and the second relates to sustainable resource management and use with a specific reference to green jobs. It is necessary to articulate and align the skills development focus and the greening focus. The overall national policy for skills development lacks explicit focus on greening. One of the areas of acute skills shortages is the education and training sector itself, with deficiencies in many aspects including the capacity to promote green skills.

Greening initiatives are in demand in various sectors

with the increased awareness of climate change, thus creating jobs that were not formerly needed. The country has large numbers of unskilled jobs in agriculture and construction. Workers in these sectors need to learn to dispose of materials and chemicals correctly, along with efficient use of energy and water. In agriculture, specialised skills areas in demand are related to managing irrigation methods and water efficiency; expertise to select proper technology, skills in using and maintaining the technology appropriately, and skills in market assessment and making business plan for investment and marketing (ibid., pp.376-388).

Thailand

The National Economic and Social Development Plan (2007-2011) of Thailand does not present a clear or specific strategy on skills development for greening the economy. However, with increased concern in general about climate change, new green competencies and skills have been promoted by government agencies and the private sector. For example, the Ministry of Agriculture organised training courses for the production and use of bio-fertilisers and better practices in terms of harvesting and packaging products to sell to both domestic and overseas markets. The Department of Alternative Energy Development and Efficiency (DAEDE) has supported research, and has developed plan for training rural people, on generating and using alternative energy, such as, biomass solar energy, hydro energy and wind energy. Thailand expects to implement World Bank-assisted biomass energy projects in 340 communities, as well as wind turbines and solar power projects creating new jobs across rural communities.

The Ministry of Agriculture has been orienting extension and training for farmers towards addressing sustainability issues. Agriculturists, agro-industries and rural businesses have been involved with local government in promoting the use of bio-fertiliser, reducing environmental risks to local communities. Agricultural officials went to sub-districts and served as mentors to farmers in adopting new practices (ibid., pp.399-406).

Uganda

Under the Ministry of Water and Environment (MWE)

auspices, a multi-sectoral and multi-disciplinary National Climate Change Steering Committee has been established in Uganda to coordinate the implementation of the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. It advises the line Ministries on Clean Development Mechanisms (CDM) and implementation of the National Adaptation Programme of Action (NAPA) under UNFCCC, prepared in 2007.

The National Environment Management Authority (NEMA) estimates that, if deforestation continues at its current rate, Uganda will lose all of its forested land by 2050, agriculture will not be viable for most farmers and biodiversity would be affected severely. With over 80 percent of Ugandans currently employed directly in the agriculture sector, this would have a crucial impact on the total economy. The major sectors for green occupations are in agriculture, energy, water and environment, forestry, manufacturing industries, transport, and trade. In agriculture, there is a need for soil scientists, plant and animal breeders and pathologists who will enable maximum agricultural productivity amid climate change scenarios. Meteorology specialists are needed who can use and disseminate satellite and climate related data. Environmental impact assessors are needed. Solar technicians are needed for the development of solar technology, including installation and maintenance. There is also great interest in implementing greening practices. These include sound soil and water conservation practices; use of better natural soil fertility measures such as crop and grazing rotation; natural pest/parasite and disease control approaches; increased use of organic matter; and the effective use of livestock waste to preserve soil fertility (ibid., pp.407-419).

The research project on skills for green jobs, building on earlier work of ILO and others explored the need for skills and capacities to improve productivity, employment growth and development, focusing especially on the imperatives of sustainability. The perspective of the green jobs study was not necessarily rural areas and rural people. But, the interface of green development and tackling poverty in developing countries, and skills and jobs in that context required attention to rural people and rural areas. The demographic and spatial concerns and the importance of agriculture and non-farm activities in the economy merited a sharper rural focus than was evident. The summary of the statements from

selected developing countries regarding needs and demands for skills for green development presented above suggest at least three conclusions.

- The needs and potentials for agriculture, the rural economy, rural people and rural areas are underestimated in the discourse on green development of countries. In the same vein, the potential for contribution to green development of agriculture, rural economy and rural people are also denied appropriate attention. There appears to be a disconnect between the proportions out of the national total in developing countries of rural people, the direct and indirect impact of climate change on rural people, and the role agriculture and the rural economy can play in adaptation and mitigation strategies, on the one hand, and the diagnostics regarding needs and development of skills and capabilities of people, at least as these are expressed in the country case studies in the skills for green jobs study.
- Green transition in national development has begun to get attention in the developing countries as reflected in policy statements, various legislative measures, and national institutional mechanisms, in the context of international dialogue on the subject, especially in the aftermath of the United Nations Framework Convention on Climate Change, otherwise known as the Kyoto Protocol, adopted in 1997. However, the efforts in implementation of the strategies and the legislations including assessment, analyses, building the database to conduct adequate diagnostics and to develop the evidence-based policies and strategies are deficient in most developing countries. So are the mechanism to monitor progress and the organisational and institutional structures and professional capacities for implementation.
- There are scattered activities in developing countries in identifying skills needs and offering green skills development opportunities either in the public sector or by private enterprises. They do not mostly add up to a coherent and comprehensive strategy and programme. However, it is necessary and possible to build upon these existing activities and work out strategies and programmes which are sufficiently comprehensive and are effectively implemented.

Promoting the second generation green revolution

The key messages of this section may be expressed in terms of adopting and acting on a second generation concept of the green revolution. In other words, the challenge is how the original green (meaning agricultural) revolution can be turned into a green revolution in the sense of environmental sustainability.

High input farming on irrigated and high-potential rain-fed land with the use of seed, fertiliser and crop-pattern technology was the essence of the green revolution that spread in the 1970s and averted a looming food crisis in the developing world. It also helped to save vast amounts of low-potential land including forests and arid land from being converted into low-yield farms to meet the demand for grains. But the typical mono-cropping practices with the package of seed-water-fertilisers-pesticides which led to dramatic increase in wheat and rice production also exacted an environmental price, often ignored at the time (World Bank: 2008, chapter 8).

Demand for irrigation water rose as was misuse and waste of water. Other problems arose from improper use of fertilisers and pesticides leading to water pollution; indirect damage to ecosystems when chemicals from farming entered water systems; and pesticide poisoning of humans, animals, plants and insects. Additional fertiliser runoff from agriculture also caused algae growth choking water channels and destroying wetlands and wildlife habitats. Evidence is mounting that the intensive and high-input farming pattern focusing on increased grain production almost at any cost is not sustainable. Land degradation and pest and weed build-up are slowing down productivity gains especially in the intensive systems of rice and wheat farming in South Asia (ibid., chapter 8).

The environmental stress and the collateral costs of intensive farming of the original green revolution farming pattern demand a re-examination of the cropping systems and management of resources to adjust these to locally appropriate sustainable methods. Incentives and pricing of inputs and products which encouraged adoption of the intensification practices now prevent the shift to diversified systems and use of alternatives to heavy use of chemicals and water and depletion of

natural soil fertility. How the balance can be shifted to diversified eco-friendly agriculture, without jeopardising food security and life and livelihood of rural people, has to be put high on the agenda for national and international response to climate change.

Supported by macro policies for greening agriculture and rural and national economies, research and knowledge dissemination, and skills and capacity building, have to be directed to exploring the elements of a second generation “green” revolution and applying these in broad-ranging rural transformation in developing countries.

4.4 Promoting Skills and Jobs for the Green Rural Transformation

Skills development systems need to go beyond matching training to labour market needs. They need to play a catalytic role in future economic growth and resilience by enabling enterprises and entrepreneurs to adapt technologies, compete in new markets, diversify economic activities and thus accelerate job growth. Availability of good quality and sufficient education and training means creation of the capability to take advantage of opportunities and to mitigate the negative impact of change (ILO: 2011a, p.IV).

What are “green skills”?

A body of literature has developed on defining and determining green jobs and green skills. The concept of green jobs has been discussed above. The following is one list that enumerates essential skills necessary for green jobs mentioned in the country cases in the skills for green jobs study. It is evident that the skills identified are general competencies and skills relevant for performing effectively as producers, consumers and decision makers in the general economic context of producing goods and services. Whether these are “green” or not depends on the specific contexts and purposes – how the products or services are produced and used; it is not inherent in the skill itself. The ILO study, as noted, did not specifically look at the rural economy and the green transition of rural areas; but the list below clearly has broad applicability (ILO: 2011a, chapter 5).

- Strategic and leadership skills to enable policy-makers

and business executives to set the right incentives and create conditions conducive to cleaner production, transportation, marketing, etc.;

- Adaptability and transferability of skills to enable workers to learn and apply the new technologies and processes required to green their jobs;
- Environmental awareness and willingness to learn about sustainable development;
- Coordination, management and business skills to facilitate holistic and interdisciplinary approaches incorporating economic, social and ecological objectives;
- Systems and risk analysis skills to assess, interpret and understand both the need for change and the measures required;
- Entrepreneurial skills to seize the opportunities of low-carbon technologies;
- Innovation skills to identify opportunities and create new strategies to respond to green challenges;
- Communication and negotiation skills to discuss conflicting interests in complex contexts;
- Marketing skills to promote greener products and services;
- Consulting skills to advise consumers about green solutions and to spread the use of green technologies; and
- Networking, IT and language skills to perform in global markets (ILO: 2011a, p.107).

The emphasis on technology-driven innovations in green transition has prompted many country reports to stress on skills in science, technology, engineering and mathematics (STEM). These skills are in demand for the economy. But science courses do not attract enough applicants, with enrolment rates low and drop-out rates high, especially in rural areas. These courses are often not on offer in rural communities or nearby towns. When the schools exist, poor learning environment and poor quality of instruction discourage students. Many types of work in the green economy demand skills such as the ability to reason and identify problems; the mathematical, scientific or technological knowledge to address these problems; the research and scientific skills to break down a complex issue into smaller parts, to recognise cause and effect relationships, and to draw conclusions. The ICT skills needed to access

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knowledge and information and use appropriate software and equipment for this purpose have become critically important (see below).

Core, generic and portable skills

In many countries the basic requirements of functional skills in literacy and numeracy remain unmet. Participation in a green economy that relies on technologies to move towards sustainable forms of production and consumption calls for a range of competencies. These extend from basic skills of reading product labels and understanding manuals and written instructions to calculating prices and costs, documenting knowledge and planning green investment. Basic literacy and numeracy skills are also a foundation for further learning and attaining technical competencies. Rural people in developing countries lacking functional literacy and numeracy can take a major leap forward towards the transition to a green economy, if the people are equipped with the basic general competencies (ILO: 2011a, p.108).

In addition to work and employment related skills mentioned above, certain core skills at a basic level are central in coping with changing economies. These include knowing how to learn, how to work in teams and how to communicate effectively, which need to be learned at a young age through participation in basic general education. Language skills are critically important in accessing knowledge related to environmental change. Basic competencies in language and mathematics are essential to participate effectively in skills training and perform well in jobs, as noted above. Basic vocational orientation and preparation should be available to all. It should include basic scientific knowledge regarding the physical and biological environment; working at a basic level with and appreciating the properties and uses of materials, such as wood, metal, soil, air and water; basic understanding of finite and renewable resources of the planet; and basic orientation about occupations and jobs, including green jobs. These basic knowledge and skills can be considered as “portable skills” which are useful whatever occupation one enters or whatever further training or education one moves into (ibid, chapter 5).

Comprehensive and well-coordinated policies

Effective policies need to combine a sound environmental policy and a comprehensive skills policy for greening which together build an effective green strategy. The

two connected arenas of policy have to be consciously designed to avoid skill gaps in achieving environmental goals, and identify, in the transition to the low-carbon economies, opportunities for new jobs and new skills. The key to achieving policy coherence lies in designing the right institutional mechanisms to ensure that policies are coordinated between different line ministries and agencies, social partners and other stakeholders.

The developing country cases reported in the ILO skills for green jobs study illustrate the mixed picture in respect of the development of coordinated climate change and skills policies. In South Africa, for example, the National Climate Change Strategy dates back to 2004, yet no plan was formulated for its implementation. The Long-term Mitigation Scenarios Plan (2008) contains an ambitious mitigation strategy but lacks an adaptation supplement. South Africa has been in the process of developing a national response to climate change including adaptation measures.

Sustainable development is a national strategy in China, and many policies and measures introduced under this umbrella – on energy efficiency, renewable energy, reforestation, and soil and water conservation – yield benefits in respect of climate change. China’s Action Plan on Climate Change addresses mitigation and adaptation, science and technology, public awareness, institutional reform, coordination across agencies and international cooperation. A comprehensive national skill development strategy for greening the economy, however, is still in the works.

Bangladesh, Mali and Uganda fall into the category of least developed countries and qualify for support under the National Adaptation Programmes of Action (NAPAs) introduced by the United Nations Framework Convention on Climate Change (UNFCCC). NAPAs are policy documents designed to help prioritise urgent and immediate climate change adaptation needs. This mechanism, if used effectively, can help formulate integrated plans and activities and receive the resource support for implementation, moving away from dealing with skills policies and environmental policies in isolation from each other.

Overall, three broad policy-related difficulties confronting countries in their attempts to move to a low-carbon economy can be identified.

- Lack of enforcement of environmental regulations of already adopted, sometimes along with a need for more detailed and elaborate legislation to protect the environment. Weak enforcement of environmental laws and consequently lax implementation reduces the demand for the new skills needed to comply with them.
- Limited awareness and capacities of policy-makers to integrate a skill dimension into policy responses to manage environmental risks. Most of the documentation on adaptation and mitigation measures, policies, strategies, action plans and programmes initiated in response to climate change and environmental degradation refers only very briefly to the skills implications of these measures, and lacks any, or any substantial, skills response component. Lack of human and financial resources, unclear mandates of institutions involved and lack of general environmental awareness are some of the obstacles hampering skills development strategies.
- Weak coordination of efforts between ministries and other governmental agencies. Mechanisms established for identifying, monitoring, anticipating and providing skills do not usually include representation from environment ministries. Similarly, ministries, agencies and institutions concerned with education and training are mostly not involved in developing environmental policies. This lack of reciprocity clearly reduces the prospects for coordinated approaches. In other cases, even if inter-ministerial coordination is undertaken successfully, coordination for implementation may be weak, and as a result policies to include a skills response in greening remain limited to isolated initiatives (ILO: 2011, pp.53-54).

In coping with the challenges of climate change and job creation and linking the two, policies for both the environment and skills are weak and generally not well aligned in many countries. The majority of developing countries does not quite have either a well-developed environmental policy or skills development policy for a greener economy. This is the conclusion from country case information analysed by the authors of the ILO study. The countries have benefited from important initiatives in the environmental field at strategic level, but generally lack implementation mechanisms, including implementation of training responses to improve skills for greening the economy. Their policies reflect weaknesses both in environment and skills areas and in links between the two.

Policy challenge – relating environment and skills issues

The coordination of skills policies and environmental policies is a critical issue in the transition to green economy and employment. As the country studies show, many countries have formulated environmental policies but have fallen short of developing the necessary associated skills policies. Others have gone further in articulating skills policies and strategies, but they have not necessarily seen the importance of or attempted to forge the links between the two.

Coherence of policies and the links between related policy arenas have many facets and are highly contextual. The ILO study on skills for green jobs, based on country experiences, has suggested following criteria for assessing and promoting policy coherence.

- One policy should not contradict another. Coordination among policies is essential to avoid working at cross-purposes.
- Policies should have good coverage and be mutually complementary to each other. Policies should reflect need and concerns of different stakeholders, including employers, workers, consumers and government agencies representing overall public interest.
- Policies should correspond to the needs of the labour market and take into account current and future challenges. Therefore, policies should be informed by research and labour market monitoring.
- There should be a clear link from policy pronouncements to actions, including finance. Lack of implementation and enforcement has been reported by countries as one of the most frequent hindrances to the greening process.
- There should be an effective monitoring and evaluation mechanism to follow policy implementation.

In short, among the developing countries, most have attempted to articulate environmental policies and many have grappled with policy priorities and strategies in skills development. It is necessary to ensure how the two moving on parallel tracks without intersection can be prevented.

Public sector and government roles

The leadership and the guidance for creating a favourable policy environment for transition to the green economy have to come from the government as part of its role in articulating the policy, priorities and strategies for the green transition. Creating the national coalition of stakeholders and partnerships of all actors in formulating and supporting the national goals and programmes is also the responsibility of the political and government leadership, as is the fostering of the political will to act effectively. The policy and regulatory framework and specific programmes should evolve through a process of participatory social dialogue keeping in view the potential social tensions, fair sharing of costs and benefits, and effective use of scarce physical and financial resources. Again the government has to provide the leadership and nurture the environment for partnership (UNEP *et al.*: 2008).

Workers and segments of society adversely affected by the green transition need protection through, for example, proactive labour policies, income guarantees, retraining and capacity building. New job opportunities arising from new low-carbon markets are expected to offset unemployment arising from the contraction of older, more carbon-intensive industries. The new green jobs will not necessarily go to those who have lost their old jobs. Disadvantaged groups in the labour market will need targeted assistance and preferential treatment. Retraining and skills upgrading are thus crucial to a successful, smooth and equitable transition to the low-carbon and green economy.

An important role of government policies and regulations and publicly funded services is to ensure equal access of all groups, especially the disadvantaged. Those with disabilities, young people, ethnic minorities and the low-skilled need to have access to productive and gainful jobs or appropriate training and skills development opportunities leading to jobs (*ibid.*, p.93). Attention is also needed on encouraging entrepreneurship and investment in diversifying local economies and creating new jobs.

Country case studies have drawn attention to public sector roles and initiatives, a few of which are briefly noted below.

India

The National Rural Employment Guarantee Act of 2005, mentioned earlier, offers guarantee of work for 100 days in a year to at least one member of rural households below the poverty line. The scheme targeted at the low-skill workforce, has a strong natural resource management component and has recently included afforestation projects. Men and women employed through the scheme planted and protected trees and acquired their skills either through traditional channels or through informal training in the field.

South Africa

In South Africa, the Expanded Public Works Programme (EPWP) has provided over one million jobs since its inception in 2004. The EPWP supports work in infrastructure, economic, social and ecosystem protection projects. It provides relevant training to the employees. The programme particularly targets vulnerable population groups.

The "Working for Water" programme in South Africa trains unemployed people in local communities to use a range of methods to control and remove invasive alien plants. The alien plants pose a threat to South Africa's water security and the natural ecological systems by diverting enormous amounts of water from more productive uses. An essential element of the programme is to enable people to participate in environmental conservation and in sustainable, decent jobs. The programme provides various jobs, including water contractor employees, chainsaw operator, brush-cutter operator, herbicide applicator, plant identifier, and health and safety representatives (ILO: 2011a, pp.83-85).

Thailand

In Thailand, the Ministry of Agriculture has organised training courses for rural farmers in producing and using bio-fertilisers based on renewable organic material rather than on chemicals or oil. The Department of Alternative Energy Development and Efficiency (DAEDE) has adopted an action plan to train people who have lost jobs in rural areas in the production, installation and maintenance of alternative energy sources (making biomass, and installing and maintaining solar, hydro and wind energy technology) (ILO: 2011a, pp.81-82).

The informal economy

The informal economy is by far the largest provider of employment in most developing countries. Measures to restructure the economy mainly in the organised sectors will leave large proportions of the people, especially in rural areas, without access to the skills development and new job opportunities. The organised sectors of the economy lend themselves to policy and regulatory interventions somewhat more easily than the dispersed informal economic activities. Quantitative estimates are hard to come by, but it can be reasonably assumed that there is large overlap between informal sector work and rural employment.

ILO estimate indicates that informal sector employment ranges from over one-third to more than 80 percent of total employment in developing countries. For example, it is reported to be – Uganda 83 percent, the Philippines 77 percent, Thailand 72 percent, Indonesia 68 percent, India 57 percent, Mali 56 percent, Brazil 46 percent, Egypt 44 percent, and Costa Rica 37 percent. However, these estimates are not based on consistent criteria. All agricultural workers are not included in some cases, in others some other sectors are excluded and data sources and their reliability vary. The researchers compiling the statistics are of the view that the actual proportions in the informal economy are likely to be substantially higher in some of the countries (ILO: 2009).

The informal economy employs a high proportion of low-skilled workers with the least prospects of moving into the formal economy or alternative employment. In India, for instance, 23 percent of men and 40 percent of women in the unorganised sector do not have primary-level education. The informal economy also consists largely of micro and small enterprises, which may need greater technical support and public assistance in restructuring (ILO 2011: p.59).

Specific measures in agriculture, forestry and livestock

Restructuring in agriculture is happening in a great variety of ways. Most of the country case studies indicate that many farmers are repositioning themselves both within the sector and in other sectors, prompted by the inability to make enough profit to live on from agriculture.

The farmers are attempting to respond to the development of machinery and technology, and various effects of climate change.

China is a prominent example, but others are following suit in agriculture, forestry and fisheries to refocus on organic food production. This is part of the shifts across sub-sectors and within the food/wood processing industry (for example, to sustainable forestry or new kinds of aquaculture), which generates corresponding training and retraining needs (UNDP: 2010, p.64).

Organic farming is more labour intensive than conventional farming, generating 20-30 percent more jobs. Moving from low-productivity conventional farming, where farmers often cannot afford pesticides and fertilisers, to organic farming requires adoption of new technologies, which generate higher yields and better productivity with impact on income poverty. This kind of shift has implications for skills development and provision for extension services.

In *Bangladesh*, organic farming is as profitable as conventional farming. Although production costs are higher, products command premium prices. It is still on a largely experimental footing, accounting for only 2 percent of the country's total cultivable land and one percent of farmers. The Ecological Agriculture Program (EAP), run by a national NGO with support from international donors, is expected to involve around 0.8 million farmers in organic cultivation on 0.22 million acres of land by 2020. The involvement of farmers in organic farming through training programmes, mostly provided by NGOs, spans over 16 districts and over 100,000 farming families.

In *Egypt*, 500 organic farms cultivate approximately 24,500 hectares of land. This is a negligible proportion of the total agricultural land, but the potential for growth is high. Development of the skills, again, is primarily met by NGOs such as the Egyptian Biodynamic Association (EBA). It provides regular training seminars, workshops, farm visits and field trips.

In *Uganda*, according to the National Organic Agricultural Movement (NOGAMU), 200,000 farmers are engaged in organic farming. NOGAMU has identified the skills needed to build capacity in the production and processing of organic

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products, and also the training needs for farmers. The training covers areas of organic production including management of pests and diseases, soil fertility, post-harvest handling of crops, weed management, and processing and marketing of products (World Bank: 2008, p.67).

Biofuels prospects

Biofuel production arguably helps reduce poverty by creating rural jobs and at the same time mitigates climate change. There are also costs that need careful consideration from the social, environmental, ethical and economic points of view. Where the costs and benefits work out in favour of turning over low-yield land to biofuel feed stocks, it creates employment and income generation opportunities for those farmers and farm workers who are forced to stop food farming for economic and environmental reasons. Retraining is important, both in restructuring from traditional agricultural crops into biofuel and in adapting to change in both fuel and food production.

In Brazil, South Africa and other parts of Latin America, biofuel cultivation is dominated by low-skill migrant labour. Requirements for skilled labour will increase as the industry grows. Farmers and farm workers will need better skills to thrive in the new environment. In Kenya, the cultivation of jatropha (a type of succulent plant found in tropical and subtropical areas of Africa, Asia and America) for biofuel production has been considered not viable for smallholder farming, despite its promising potential and good reputation elsewhere, such as Mali. This is partly because of the current methods of cultivation (monoculture or intercrop plantation rather than natural growth with very few inputs), and because of a lack of agronomic support, awareness raising and skills development. Investment in biofuels has to be integrated within a broader context of rural development and human capital formation (UN Energy: 2007; World Bank: 2008).

Enhancing effectiveness of skill training

The country cases in the ILO study indicate that short, intensive vocational training courses, tailored to the specific needs of employers are the most successful way of delivering retraining for specific new job opportuni-

ties. Such retraining has to occur locally, in rural areas, if this is where the jobs are. Ideally, it should be linked to the job opportunity and should not detach participants from existing work or from the job market. For instance, in rural areas it is more difficult for women than for men to participate in training outside their village. Thus there is a need for local training facilities. Trained trainers and teachers have to be found and the remunerations have to be such as to attract the right people as trainers. The Philippines country report refers to the import of a green technology that is not yet available in the domestic market, which means either sending Filipinos appointed to manage and maintain the technology overseas for training or bringing in expertise from abroad to train Filipinos (ILO: 2011a, pp.81-82).

Anticipating and projecting green skills and green jobs

A standard and agreed definition and statistically countable categories of green jobs and related skill, as noted above, do not exist. This creates difficulties in measuring green jobs and skills and placing these into occupational and industrial classification systems. Countries which have developed and established systems for the identification of skill needs and collect labour market information through labour market information systems (LMIS) enjoys a head-start. They need to create additional means of detecting new requirements arising from the transition to a low-carbon, greener economy. Where LMIS does not exist, as in most developing countries, ad hoc surveys can be relied upon and used as the basis for developing the information system. Effective approaches in this respect make use of public dialogue and participation at sectoral or grass-roots level with stakeholders (ILO 2011: p.145).

The developing countries without LMIS rely on ad hoc surveys organised by NGOs, international donors and, in some cases, national government agencies. On the whole, these have not produced sufficiently comprehensive information about present and anticipated green jobs and the quantitative and qualitative status of skills related to the green jobs. They often use very basic forecasting methods and use simple assumptions; e.g., counting every job created in agriculture as a green job (ibid., p.156).

Some specialised green skills

The International Standard Classification of Occupations (ISCO), last updated in 2008, classifies skill specialisation in terms of four conceptual areas: (i) the field of knowledge required; (ii) the tools and machinery used; (iii) the materials worked on or with; and (iv) the kind of goods and services produced (Greenwood: 2008).

Whether entirely new occupational categories need to emerge or some redefinition of the character or features of existing occupations will suffice, depend on the degree of change in the skill composition of occupations when economies go through the green transition. The evidence from the case studies is that redefining existing jobs and skills rather than inventing new categories is generally expected. In a way this is a bigger challenge which requires looking at existing skills and jobs critically and reshaping them rather than designing new job profiles from the scratch. The distinction probably is a matter of degree, because almost all skills and jobs in the fast paced global economy have been changing rapidly in any event. It is now necessary to bring in the green perspective into this process, which has been often neglected. Recent research including the ILO study, particularly the country cases, suggests new combinations of specialised skills which need to be given attention in promoting the green transition especially in the context of rural transformation. These, reported in the skills for green jobs study (ILO: 2011a, pp.125-126), are summarised below.

Carbon financing specialists

Flexible mechanisms introduced in the Kyoto Protocol included international carbon trading, which led to a number of new green occupations. The United Kingdom carbon finance sector employs over 21,500 staff in 2,500 companies, including emissions traders, environmental lawyers, carbon auditors and Clean Development Mechanism (CDM) project investors. Financial brokers who once traded fossil fuels are now buying, selling and trading current and future carbon emissions. The new occupational profile requires the skills of the existing occupation plus additional specialised knowledge of new green markets.

Demand for carbon consultants is growing in developing countries such as Indonesia where firms providing services related to CDM projects are increasing rapidly. Carbon consultants are hired to assist project owners in meeting national and international criteria to qualify under the CDM. A combination of technical and financial skills is needed to perform these tasks. Technical skills required include the capacity to calculate the emissions reduction potential using methods defined by the international CDM governing body. This specialised skill is particularly important for the rural economy and the agricultural sector where major potentials exist for carbon sequestration in forests and land making new rural economic activities potentially viable. The country reports for Mali and South Africa have noted the shortage of carbon consultants, but the shortage exists in other developing countries as well.

Researchers at university level

Crop varieties have to be developed and introduced that can withstand the vagaries of climate change. Demand for soil scientists, plant and animal breeders and pathologists will rise. Most researchers in agriculture have to be multidisciplinary. The scientists have to be supported by agricultural technicians for field level experimentation and trial of crop diversification and the application of improved machinery to reduce energy consumption and GHG emissions. A new occupational field in this area is precision agriculture which helps calibrate applications of herbicides, pesticides, irrigation and fertilisers to avoid over- or under-use. The skills it requires include the ability to apply remote sensing, geographic information systems (GIS) and global positioning systems (GPS).

Irrigation specialists

They will be in demand to identify appropriate irrigation technologies that improve water conservation, conduct market studies to ensure the technologies are applied effectively, and impart skills in using and maintaining the technology to end users. This is particularly important as climate change and variability increase water scarcity.

Agricultural meteorology

It is a new occupation created in response to increasing weather variability. These professionals apply meteorological information to enhance crop yields and reduce crop losses caused by adverse weather. They combine knowledge of

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plant physiology and pathology, meteorology and agronomy, common agricultural practices and remote sensing techniques. They collect satellite images and remote sensing images, including vegetation indices from centres that monitor the evolution of rainfalls, and make projections about weather, river flows and pest infestations.

Eco-adviser in agriculture

For sustainable development, eco-certification is another emerging occupation. These experts advise farms of all sizes from agribusinesses to smallholders in sustainable practices and existing certification mechanisms and standards. In the forestry sector, numbers of foresters or tree farmers are expected to rise when governments invest in reforestation to mitigate negative impacts of climate change, restore soils and conserve biodiversity. Tree farmers in countries such as Uganda need additional skills to become involved in selling the carbon sequestered by their forests on the voluntary and CDM markets.

Renewable energy specialists

This sector represents the most dynamic labour market segment for newly emerging green occupations, such as renewable energy engineers, consultants, auditors, quality controllers, and installation and maintenance technicians. These occupations are widely considered new since their skills content differs considerably from their counterparts in other sectors, albeit with some overlap. These occupations are all characterised by high added value and middle to high qualification levels. Others that may develop in the future include lawyers specialising in renewable energy legislation.

Education and training specialists

The education and training sector is of critical importance in the green transition, disseminating basic knowledge about environmental changes and influencing the behaviour of people in matters of environmental sustainability. The skills required in education itself are also changing, as teachers, trainers, instructors, school managers and public administrators adapt to change brought about by technological change and innovation, climate change and environment, greening policy and regulations about education, and labour markets.

Teaching and training personnel in all education systems and at all levels need command of the necessary skills and methods to impart environmental knowledge, to create awareness and to react flexibly to ever-changing labour market needs. But developing countries have insufficient numbers of well-trained teachers and trainers to satisfy the need to update the skills of large and growing workforces, including a need to incorporate environmental course content and update curricula in primary, secondary, tertiary and adult education and training.

The greening of the economies in developing countries and the implications for skills and capacity building within a framework of rural transformation have been reviewed in this chapter. How this perspective can be incorporated into organisations and institutions for promoting skills and capacities to fight rural poverty and bring about rural transformation will be considered in chapter 5.



Towards the future. Chengdu, China.
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Extracurricular activity in a rural school in Dujiangyan city, China.
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Rural women reading and learning in their leisure time. Yunnan, China.
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A small village in rural Ethiopia.
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