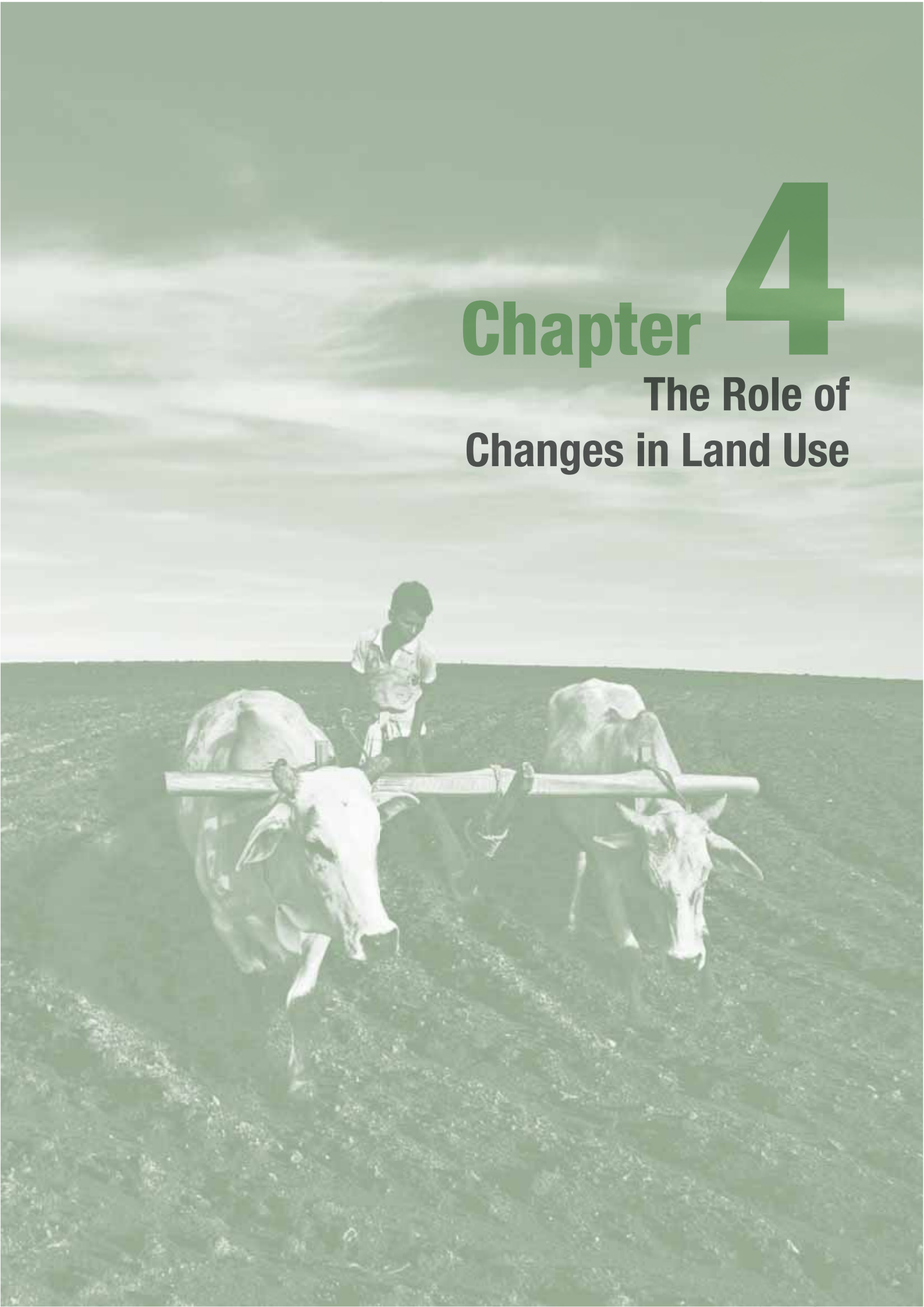
Chapter 4

The Role of Changes in Land Use



Lead Article: KEY IMPLICATIONS OF LAND CONVERSIONS IN AGRICULTURE

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Abstract

Land conversions in agriculture are important for food security in developing countries at the present time, and are likely to increase even more in the future.

- In relation to overall land use, land conversions take place (a) within agricultural land, from meadows or pastures to cropland and to land for producing animal feed or biofuel feedstock; and (b) to agricultural land from other land use types, such as from forests, drylands and wetland areas. The dynamics of these processes are estimated to be in the range of 0.2 to 0.3 per cent of the global land area, suggesting that 26–39 million hectares of land are converted annually.
- The effects of land conversions on small-scale farming can be both positive and negative. Farmers convert new land for improving their livelihoods, but they are negatively affected by land degradation and the intrusion of built-up areas into agricultural land. Strategies should focus on medium- to low-potential areas in support of small-scale farmers and pastoralists to help them sustainably increase their agricultural production.
- Land conversion to biofuel feedstock production can provide a moderate additional income, although farmers are likely to be negatively affected by associated land losses. On a global level, however, efforts to achieve economies of scale, density and more intensive production of biofuel feedstock, along with other land deals, may threaten food security. Today's policy incentives disproportionately favour large-scale biofuel feedstock production, mostly for export markets. Innovative arrangements are needed to ensure that land conversions to biofuel feedstock production are made in a responsible manner, and that small-scale farming, including mixed-crop livestock and pastoral systems, can be integrated into global agriculture.
- Land prices and speculation are likely to increase once land is converted to more economically integrated modes of production, while subsistence-oriented, small-scale farming will remain unattractive and thus will further lose out against more powerful actors if national and international policies do not implement counter-strategies.
- Overall, the impacts of land conversions on climate are likely to be negative. While small-scale farming and livestock rearing are often climate neutral, deforestation remains extremely harmful, the large-scale rearing of ruminant livestock has negative impacts on greenhouse gases, and so far little is known about the overall impacts of biofuel feedstock production on climate.

A. Introduction

Land cover and land use are constantly changing*, both* within and outside the agricultural sector (table 1). Table 1 shows that only a few of the globally dominant land use and cover systems are stable in terms of their land area. A larger number of systems are expanding (italics) at the expense of others that are decreasing (bold).

Agricultural expansion into forest lands is the most threatening global change process. Deforestation is likely to continue in the near future. All non-protected forest areas are threatened by over-extraction of timber, deforestation, and land-use conversions to forest plantations, grazing land, or cropland. This process is estimated to already contribute about 11 per cent to global greenhouse gas (GHG) emissions – a considerable amount that could be avoided. All

agricultural activities, together, account for another 15 per cent of GHG emissions, amounting to an estimated total of 26 per cent of GHGs (IPCC, 2007). More recently, croplands for biofuel production have also started to expand into forest lands and woodlands, while land leases and sales to transnational corporations are a further major cause of this expansion.

Agricultural expansion into dryland areas is a process often driven by the spread of small-scale farming into less suitable cultivation areas. At the same time, biofuel production continues to spread into non-agricultural drylands (e.g. savannah, bush, shrub and scrublands). Here too, transnational land leases and sales are significant, although they represent a recent trend (ILC, 2011).

Land-use changes on agricultural land, however, must also be considered, as their implications may be as great as the expansion of agriculture into areas devoted to other types of land use and land cover. Conversions may take place on agricultural land, for example from intensive pasture land to cropland. Additional cropland is created mainly as a result of population pressure, but also for industrialized farming, such as large-scale farms or tree plantations in recently deforested areas.

Since 2005, about 0.5 per cent of the global land surface has been converted from cropland and dryland for food and feed to cropland for biofuel production (i.e. biodiesel, ethanol). Here again, transnational land leases and sales, although not yet important in quantitative terms, are nevertheless an indicator of current and future trends. However, biofuel production and land leases still account for a relatively small proportion of cultivated land compared with that being used for the production of animal feed (e.g. maize, cereals and soybeans). About 40 per cent of global cereal production is used for animal feed. Together with pasturing, three quarters of all agricultural land is thus being used to generate animal products (e.g. milk, meat and eggs), while only one quarter is used for producing non-meat and non-dairy products, such as cereals, vegetables, tuber crops and other plants.

Table 1: Global land use and cover types, and major spatial changes (percentage and million hectares)

Land use and/or cover	Share (%)	Surface (millions of ha)	Changes in land use
1. Agricultural land	26	3,380	One third of the land is degraded
Cropland	*11*	*1,430*	*Gains from forests and meadows*
Intensive pastures	**7**	**910**	**Loss to cropland and animal feed**
Animal feed production	*4*	*520*	*Gains from cropland and pastures*
Agroforestry	2.5	325	Mostly stable land-use system
Badlands	*1*	*130*	*Slight increase from cropland and pastures*
Biofuel production	*0.5*	*65*	*Gains from forests and pasture land*
2. Forest land	**30**	**3,900**	**Largest spatial area losses observed**
Degraded forests	**14**	**1,820**	**Most converted land use type (partly grazed)**
Dense forests	**12**	**1,560**	**Most threatened land cover type**
Protected forests	4	520	Stable forest areas
3. Dryland	35	4,550	Largest protected areas realized
Deserts and tundra	21	2,730	Stable land cover (partly grazed)
Protected drylands	**10**	**1,300**	**Losses to biofuel and land conversions (partly grazed)**
Shrublands (grazed)	**4**	**520**	**Threatened by climate change and land losses to biofuels and other conversions**
4. Built-up areas	*5*	*650*	*Rapid urban expansion into agricultural lands and drylands*
5. Wet areas	**4**	**520**	**Water surfaces and wetlands**
Global land surface	100	13,000	Global land area (excl. Greenland and Antarctica)

Source: Based on FAOSTAT (2006), with authors' estimates for sub-categories and breakdowns.

Note: Bold fonts indicate general losses of a particular type, normal fonts indicate stable situations, and italics indicate general gains in surface area.

Part of the general gain in cultivated land is converted to grazing land, some of which has turned into badlands due to extreme land degradation and soil depletion. The pressure being exerted on croplands has increased not only for the production of human food and animal feed, but also for the production of fibre (e.g. cotton, sisal) and, more recently, biofuels (feedstock, tree plantations, biodiesel and ethanol).

Last but not least, another extremely important spatial trend is urban expansion into agricultural and dryland areas. On a global level, an estimated 5 per cent of the land surface is currently being used for urban and infrastructure construction. This trend is continuing unabated, as it closely correlates with economic growth (i.e. growth of gross domestic product (GDP)). For example, in Germany the share of built-up areas has reached 10 per cent of the total land area (Hurni et al., 1996).

The main questions that emerge from table 1 in relation to land conversions in agriculture are:

- What is the magnitude of land conversions in relation to overall land use?
- What are the effects on small-scale farming and on food security, both locally and globally?
- What are the implications for land prices resulting from speculation and land grabbing?
- What are the implications for climate change?

In the following sections, this article discusses three important processes in greater detail: the recent emergence of biofuels; the consequences of changing consumption patterns and animal production systems; and the impacts of land conversions on small-scale farming. These activities currently employ over 2.6 billion people, or 40 per cent of the world population, involving women, men and children (von Braun, 2005). No other sector in the global economy employs a comparable number of persons.

B. Land conversions for biofuel production

Importance of biofuel production. There has always been a close link between agriculture and energy, as land that is being worked requires energy inputs, while agriculture can also produce energy as an output. Traditionally, agro-energy is produced in the form of fuelwood, charcoal and animal dung. These forms are still widely used in developing countries and continue to be the most important energy source, not only for the 2.6 billion people engaged in small-scale farming (IEA, 2006), but also for most people living in towns. At the same time, the potential for liquid biofuel production is greatest on cropland in the global South, where land and labour are available at lower costs than in the global North (Hazell and Pachauri, 2007; Fargione et al., 2008; Smeets et al., 2007).

Current production and use of liquid biofuels, which are now competing for land with agricultural commodities such as food, takes place mainly in industrialized and emerging economies, but production is also on the rise in developing countries (SOFA, 2008; HLPE, 2011a). Only about 0.5 per cent of the global land surface is being used to produce liquid biofuels (see table 1). Ethanol is produced mainly in Brazil, Canada, China, France and the United States. Germany leads in biodiesel production, followed by Brazil, Argentina, France and the United States (REN21, 2011: 5). Biodiesel exporters in developing countries are rare, with only Malaysia and Thailand expected to become significant players in the near future, besides Brazil and Argentina. The major feedstock used for ethanol is maize and sugarcane, while for biodiesel it is oil palm and soybean (OECD and FAO, 2011).

Brazil, the European Union (EU) and the United States are the main users of liquid biofuels, while China and India are emerging users (IEA, 2010a). Most biofuel is used for road transport, and a limited amount is used in the marine transport sector and, most recently, in aviation. The share of biofuels contributing to global final energy consumption is still low, at 0.6 per cent in 2009, but production is increasing rapidly. In 2010, about 86 billion litres of ethanol and at least 19 billion litres of biodiesel were produced. Ethanol production grew fivefold between 2000 and 2010, and biodiesel increased more than twentyfold (REN21, 2011).

Today, biofuels provide about 2.7 per cent of the fuel used in global transportation. This share is expected to rise to between 4 and 9.3 per cent in 2030 and up to 20 per cent in 2050 (REN21, 2011; IEA, 2009; IEA, 2010b). Global ethanol and biodiesel production are projected to increase over the next decade to 155 billion litres and 42 billion litres, respectively, and projected use is expected to be greater than projected production in the EU and the United States (OECD and FAO, 2011). At 7 per cent, the volume of biofuels in current international trade is rather small (IEA, 2009), but as projected demand and use will not

be at the same locations, this share will also increase, as will pressure on land, biofuel feedstock and other sources of energy from biomass. At the same time, demand for alternative forms of energy production is also expected to increase (Cotula, Finnegan and Macqueen, 2011).

Current trends. A number of policies in both developed and developing countries support the massive increase in biofuel production, based on motivations such as climate change mitigation, increasing energy security and furthering rural development. These policies, which include tax exemptions, blending and consumption mandates, and subsidies, are believed to be the main drivers of the global production of biofuels (FAO-OECD, 2009; DEFRA, 2010; HLPE 2011a). For example, overall government support for biofuels amounted to $13–15 billion in OECD countries in 2007 (Steenblik, 2007). This was more than total aid commitments to agriculture and to sectors related to food security, which amounted to approximately $12 billion in 2007–2008 (OECD-DAC, 2010). In 2009, government support for biofuels in the United States and the EU alone amounted to $8 billion (IEA, 2010a).

At present, direct government support to the biofuel sector is declining, while development and commercial banks, pension funds and private equity funds are investing larger sums (REN21, 2011; OI, 2011; van Gelder and German, 2011). At the same time, alliances between governments and multinational business lobbies have promoted biofuel development in both developed and developing countries (Franco et al., 2010), leading to the emergence of many players seeking to produce and invest in biofuel production.

The investment landscape in agriculture and biofuel production today is very diverse. Direct players such as traditional agricultural companies aiming to produce crops on the land have been complemented by indirect players working on the global stock exchanges who treat land as a speculative commodity (HLPE, 2011b). Investors are foreign, domestic or from the diaspora, but their importance varies globally: in Brazil, for example, sugarcane production is predominantly financed by domestic entrepreneurs and the government, while in the United Republic of Tanzania, domestic banks play an important role (van Gelder and German, 2011).

In 2006, approximately 1 per cent of global arable land (i.e. approximately 14 million hectares) was used for biofuel crops (IEA, 2006). Lambin and Meyfroidt (2011) estimate that in 2007 approximately 25 million hectares were already being used for such crops, and they project an annual increase of 1.5 to 3.9 million hectares based on the current policy environment, with land requirements for such crops in 2030 amounting to 44 to118 million hectares. The IEA (2010b) estimates of 20 per cent of land for those crops in 2050, would translate into between 100 and 650 million hectares (Murphy et al., 2011). If produced on cropland only, this would amount to 7–45 per cent of that land-use category, which would severely threaten food production. The current land conversion level to crop production for biofuels is estimated to be less than 0.5 per cent of the global land area (less than 65 million ha, as indicated in table 1).

Most land conversions for biofuel production are believed to be taking place at the expense of forests and pastures (Melillo et al., 2009; Fischer et al., 2009; Havlik et al., 2010; Lambin and Meyfroidt, 2011). Studies of the palm oil industry in South Asia, for example, show that from 1990 to 2005 close to 60 per cent of oil palm expansion was at the expense of forests, with strong negative impacts on biodiversity and carbon stocks (Koh and Wilcove, 2008; Koh et al., 2011). The magnitude of land acquisitions and conversions for biofuel production is extremely difficult to assess as there is a lack of information on the locations of biofuel crop plantations and biofuel feedstock origins. The fact that many crops used for biofuels, such as maize or oil palm, can have multiple uses, further complicates attempts to estimate the extent of biofuel production. Furthermore, the magnitude of indirect changes adds to the problem, as it is often difficult to establish direct causality, and the initial purpose of land conversions might not always be clear (Chalmers et al., 2011; Gao et al., 2011; Gawel and Ludwig, 2011).[2]

Impacts on carbon. Direct land-use changes seem to have a relatively small impact on carbon emissions, whereas indirect land-use changes could create a large carbon debt (Fargione et al., 2008; Melillo et al., 2009; Lapola et al., 2010; Bowyer, 2010). Nitrous oxide emissions from increased use of fertilizers will contribute more to global warming than such carbon losses (Melillo et al., 2009). Zah et al. (2007) studied environmental costs from field to tank and found that although most biofuel sources reduce GHGs by more than 20 per cent compared with conventional fuel,

the major ones, such as United States corn, Brazilian sugarcane and Malaysian palm oil, have greater aggregate environmental costs than fossil fuel.

Negative impacts on natural resources. Biofuels are either competitive or cause additional land degradation. Besides soil and land, among the most contested resources is water, as the cultivation of some biofuel feedstock such as sugarcane leads to increased water withdrawals and to social and environmental problems from field to watershed, particularly where water is already scarce (de Fraiture, Giordano and Yongsong Liao, 2008; UNEP, 2011b). Additionally, fertilizer and pesticide use in cultivation, inappropriate farming practices, and untreated water from processing plants can lead to land degradation and increased risks for local populations (German et al., 2010).

Much of the land promoted for large-scale biofuel production is declared as "marginal" or "unused", but it is frequently used as common land by villagers or pastoralists. Increased investment could provide opportunities for local livelihoods and national economies (Vermeulen and Cotula, 2010), but it may also result in dispossession of land, restricted access to natural resources and conflicts among resource users (see, for example, Sulle and Nelson, 2009; Burgers et al., 2011; Findlater and Kandlikar, 2011).

Impacts on land prices. Initial fears that increased investment may result in higher land prices (FAO, 2008) have been replaced by evidence that much of the land is obtained at prices below its actual value (OI, 2011). Investors acquire vast areas of land in many developing countries because it is given almost for free (Li, 2011). Land deals often lack transparency, and where local people are involved in biofuel production, employment contracts are often vague (OI, 2011; Cotula, 2011).

Impacts on food markets. Recent growth in biofuel production and processing was the major driver of the food price hike in 2008 (SOFA, 2008; HLPE, 2011a). Increased competition for, and restricted access to, natural resources, as well higher and volatile food prices can lead to reductions in calorie intake and to increased levels of malnutrition. Moreover, they disproportionately affect the most vulnerable groups (Rosegrant et al., 2008). To counteract growing food insecurity due to biofuel production, a recent HLPE report (2011a) and the FAO-OECD Expert Meeting on Greening the Economy with Agriculture, held in September 2011 (FAO-OECD, 2011), among others, called upon the Committee on World Food Security to "demand of governments the abolition of blending targets for biofuels and the removal of subsidies and tariffs on biofuel production and processing."

Policymakers have promoted biofuels as a means to foster rural development based on the expectation that their production will involve the participation of smallholders in outgrower schemes and create employment. This strategy seems to be successful where an already established biofuel industry exists, although much depends on policies, local authorities and smallholder cooperatives (German et al., 2010; Rist, Feintrenie and Levant, 2010). In emerging biofuel industries, however, smallholders do not benefit; rather, they bear much of the risk of an unsettled industry (Vermeulen, Sulle and Fauveaud, 2009; German et al., 2010).

In the current economic context, establishing biofuel production is competitive where economies of scale are realized, and this is usually the case where large-scale plantations are combined with industrial processing. But large-scale production means that small-scale producers may be excluded, so that instead of creating employment opportunities, labour is saved (Li, 2011) and inequities increase. Therefore the question is whether it is feasible to promote innovative business models that would bridge large-scale and small-scale production through policy instruments aimed at steering this development in order to achieve economies of scale, particularly for feedstock processing, and creating market access for smallholders (Dufey, 2007; Arndt et al., 2009; Malik et al., 2009; Vermeulen, Sulle and Fauveaud, 2009; Gmünder and Portner, 2010).

There is a consensus that the provision of energy from agriculture is needed in many places to meet demand, particularly in the rural South. Processed forms of bioenergy such as biofuels can be an opportunity, but this energy should not be produced at the expense of food, the environment or the poor, which is mostly the case when produced on large-scale plantations that produce feedstock for export instead of for local consumption. While many countries have policies in place to steer development, they still lack enforcement (Schoneveld et al., 2011).

There is considerable uncertainty about how present law or voluntary certification schemes, such as the

Roundtable on Sustainable Biofuels (RSB, 2011), could be effectively implemented. Governments urgently need to remove mandatory targets and biofuel subsidies that stimulate large-scale biofuel feedstock production. They should also ensure that much-needed investments in agriculture are made in a responsible way, that smallholders have rights to secure access to land and natural resources, and, where they are involved in large-scale energy-agribusiness, they should be offered decent working conditions.

C. Land conversion for livestock production

Livestock production and animal source food have played a critical role in human development (Randolph et al., 2007) and have regained prominence in the recent debate on the food crisis. According to estimates by the FAO (2006a), the livestock sector accounts for 40 per cent of agricultural GDP and (partially) employs 1.3 billion people. The sector is of particular importance to the economy in developing countries, where it contributes up to 80 per cent of agricultural GDP and serves as a major source of livelihood for about 600 million rural poor (CGIAR, 2005). Besides its economic importance to agriculture in general, livestock are a major asset, particularly in pastoral and agropastoral systems (FAO, 2009a), fulfilling various functions in rural households and communities. In addition to being an important source of food and income, livestock offer considerable potential for reducing the vulnerability of their owners and expanding livelihood opportunities (Randolph et al., 2007).

It is estimated by CGIAR (2005) that currently two thirds of the world's domestic animals, such as ruminants, are kept in developing countries, where over 90 per cent are owned by rural smallholders. By 2007, the production of meat and eggs in developing countries had surpassed that in developed countries, and the production gap for milk was almost closed (FAO, 2009a). The world's livestock population experienced an unprecedented overall increase of 53.7 per cent between 1980 and 2009 for the four major animal categories of cattle, sheep and goats, pigs, and chicken. In 2009, total stocks in these categories amounted to almost 23 billion animals: 1.38 billion cattle (6 per cent), 1.96 billion sheep and goats (8.6 per cent), 942 million pigs (4.1 per cent), and 18.63 billion chicken (81.3 per cent). As table 2 shows, the increase in livestock has been most pronounced in Africa and Asia, whereas the statistics show declining livestock holdings in Europe and a moderate increase in America and Oceania.

The trend of increasing livestock populations worldwide seems to be continuing, in line with an expected doubling of meat consumption by 2050 compared with the present rate of consumption (Nardone et al., 2010). This will result in annual global meat production of 465 million tons and a milk output of 1,043 million tons (FAO, 2006a). However,

Table 2: Growth of livestock and shares of different livestock, by region, 1980–2009 (per cent)

	America	Asia	Africa	Europe	Oceania	World
Increase in cattle	23.2	24.4	59.6	-49.7	10.5	13.4
Increase in sheep and goats	-15.7	64.8	81.9	-47.8	-47.0	25.2
Increase in pigs	4.9	46.9	170.2	-24.5	20.7	18.0
Increase chickens	138.1	343.7	168.6	-12.2	106.9	158.2
Share of cattle, 2009	36.9	31.3	20.0	9.1	2.8	100.0
Share of sheep and goats, 2009	6.7	49.9	30.3	7.6	5.6	100.0
Share of pigs, 2009	17.0	59.6	2.9	19.9	0.6	100.0
Share of chicken, 2009	27.7	53.3	8.0	10.4	0.6	100.0
Total share of livestock	26.0	51.9	10.4	10.4	1.2	100.0
Total increase	37.6	120.0	120.1	-33.5	22.8	53.7
Increase in human population, 1980–2005	41.5	49.6	88.7	5.5	46.0	46.1

Source: FAOSTAT, 2011.

it is expected that growth rates of meat production will decrease, whereas those of milk will continue to rise rapidly, as increased demand for dairy products in developing countries appears to be continuing unabated (FAO, 2006a).

As a result of increasing demand for livestock products and the rapid growth in livestock production, livestock systems have experienced profound changes (IAASTD, 2008). However, not all livestock systems have been equally affected and challenged by changing conditions and risks from the effects of climate change that can affect the food system (Godfray et al., 2010). Industrial livestock systems are on the rise worldwide and are indispensable for meeting the global demand for livestock products. These intensive systems are, however, being increasingly confronted with environmental restrictions and rising feed prices (Seré et al., 2008). Mixed crop-livestock systems where crops and animals are integrated on the same farm (IAASTD, 2008) will continue to be critical to future food security, as a large proportion of the global population depends on these systems for its livelihood (Thornton et al., 2009). It is expected that farmers in these systems will further diversify and intensify their production in the face of the challenges posed by increasing competition for land and rising costs of inputs as well as access to services (Seré et al., 2008). Pastoral systems are confronted with different developments and resulting adaptation requirements. On the one hand, in suitable areas, improvements in pastures and adapted management systems could increase the economic viability of livestock rearing. However, on the other hand, pastoral systems will also have to cope with the growing encroachment of crop production (Seré et al., 2008), accelerating pasture degradation, and increasingly difficult access to feed and water resources (Thornton, 2010).

Drivers of change in the livestock sector. It is commonly assumed that the major drivers of the observed increase in production and consumption of livestock products are related to the growing global population and to dietary changes as a result of rising incomes among a considerable proportion of the world's population (Nellemann et al., 2009; FAO, 2006a). However, population growth is only one of many factors, and, arguably, not the most prominent (table 2). A study by FAO (2009a) showed a positive correlation between increased incomes and livestock consumption in countries with lower incomes, but a less positive, or even a negative, correlation for countries with higher GDP per capita. Besides the important role of income levels, urbanization plays a considerable role in boosting consumption of meat and milk products as a result of people adding variety to their diet (Delgado, 2003). Dietary trends can be summarized in terms of decreasing intake of fruit and vegetables and increasing intake of meat, sugar, salt and pre-cooked and convenience foods (Popkin, 1998; WHO/FAO, 2003 cited in IAASTD, 2008). Socio-cultural factors, such as traditions and religious beliefs, also have a major influence on the consumption of livestock products, while natural endowment having a direct impact on production potential. One example of socio-cultural differentiation is South Asia, where meat consumption is lower than expectations based on income levels (FAO, 2009a). Further drivers of livestock production that affect consumption and prices are related to the development of markets and to improvements in transport and trade (Hawkes, 2006).

Between 1980 and 2007, meat production in developed countries increased by only 24.3 per cent, whereas it almost quadrupled in developing countries. It was mainly the East and South Asian countries, China and Brazil that accounted for this increase. China showed the biggest growth in meat production during this period (652 per cent) and today accounts for almost 50 per cent of the meat produced in developing countries, or 31 per cent of the total world production (FAO, 2009a). India, on the other hand, showed impressive growth of milk production, accounting for 15 per cent of the world's milk supply, but it remains a rather small producer of meat in relation to its size and population (FAO, 2009a).

Annual meat consumption per capita worldwide is projected to increase sharply, by 29 per cent from 2000 – from 37.4 kg to over 52 kg in 2050 (FAO, 2006b). According to Bouwman et al. (2005) and Bruinsma (2003), the greatest increase in meat consumption is expected to occur in developing countries (42 per cent) and transition economies (33 per cent). In industrialized countries, a moderate increase of 14 per cent (representing an annual meat consumption of roughly 100 kg per person) is forecast. Given that the conversion rate of plant to animal matter is only about 10 per cent (Godfray et al., 2010), a further increase in meat consumption will necessarily alter the ratio of food and feed production and will have

major implications for the prices of staple foods and land conversions.

Livestock production and land conversion. It is estimated that about 26 per cent of the global land area is used for livestock grazing, mainly as pastoral systems and to a much lesser extent as mixed crop-livestock systems (Delgado et al., 1999; FAO, 2006a). Unlike industrial livestock production systems, these systems do not rely on external inputs of fertilizers, pesticides, irrigation and feed. Fodder production is often absent in extensive pastoral systems, or is limited to shorter periods of complementary feeding (e.g. winter fodder) or to feed products derived from decentralized and non-industrialized food processing.

In order to feed the current global livestock population, about 40 per cent of total arable land is used for feed-crop production. FAO (2006a) estimates that "livestock production accounts for 70% of all agricultural land and 30% of the land surface of the planet". Despite the overall strong increase in the livestock population, between 1980 and 2009 the area under pasture worldwide increased by only by 2 per cent, while the area under crops increased by 66 per cent (FAOStat, 2011). The world forest area declined between 1990 and 2010 by 3.3 per cent, or by almost 138 million ha (World Bank, 2011) – larger than the area of Peru. These figures imply that the absolute land area and the share of arable land used for feed production and grazing are still growing at the expense of forest lands. The FAO (2006b) reports that grazing land is a key driver of deforestation, particularly in the Amazon Basin, where 70 per cent of the cleared forests is used as pasture and for feed crops. Although most of the world's feed-crop production still takes place in OECD countries, in the recent past it has been observed that different developing countries in South America (FAO, 2009a), but increasingly in Africa as well, are rapidly expanding their production of feed crops, notably maize and soybean.

Based on the development scenarios in FAO's report, *World Agriculture: Towards 2015/2030*, Bruinsma (2003) and Wirsenius, Azar and Berndes (2010) calculate an increase of 280 million ha in the total agricultural area by 2030, or 5 per cent more than today. Lambin and Meyfroidt (2011) present a high estimate for an increase in the area under permanent pasture of 151 million ha by 2030, which would be in line with most land use models that project an increase of about 10 per cent for the period 2010–2050. In the event that grazing systems are not expanded but livestock production is intensified to meet the anticipated demand for livestock products, cropland for animal feed production would have to increase by 115 million ha (Lambin and Meyfroidt, 2011).

The observed growth in global livestock demand and how it translates in the future into allocated land area will largely depend on international investments in agricultural land, particularly in developing and transition economies (HLPE, 2011b). According to data for 2011 from the International Land Coalition (ILC), 9 per cent of registered large-scale land acquisitions were related to grazing grounds or animal feed production. The ILC estimates the total arable land and pasture area used or allocated to international land investors for livestock to be 55 million ha. Investments directly related to livestock production are thus a very prominent driver of large-scale land acquisitions, given that about 203 million ha of land worldwide are estimated to have been leased or sold or are under negotiation in the period between 2000 and 2010 (Anseeuw et al., 2012).

Livestock production and environmental implications. Today, more than half of the earth's land surface is used for agriculture, and estimates suggest that 40 per cent of this is moderately degraded, while another 9 per cent is highly degraded, resulting in a global reduction in crop yield of 13 per cent (Breu et al., 2011; Oldeman, 1994; Wood, Sebastian and Scherr, 2000). In addition, it is estimated that about 20 per cent, or 680 million ha of the world's grazing land, and 73 per cent of rangelands located in dryland areas have been degraded as result of overgrazing since 1945 (Delgado et al., 1999). Overgrazing is a function of grazing and recovery time, the number of grazing animals and natural resource buffering capacity. The effects of overgrazing include a reduction in soil cover, compaction leading to reduced water infiltration, and water- and wind-induced soil erosion. At the same time, overgrazing can alter the composition of the vegetation, with palatable perennial species being replaced by less palatable plants due to their reduced ability to compete (Liniger et al., 2010). Drylands and mountain areas are particularly affected by such overgrazing, as in many cases livestock is the main asset of the people living in these often marginal areas (FAO, 2006b; Delgado et al., 1999). Reduction of overgrazing and better pasture productivity can

be achieved by institutional and regulatory measures relating to access and use of commonly pooled resources, by better pasture management practices, and by improving livestock quality and productivity. Besides challenges related to overgrazing, the livestock sector and the different segments of the production chain also have a considerable effect on water use, water quality and hydrology, and ecosystems. Estimates by the FAO (2006a) indicate that activities related to the livestock sector account for more than 8 per cent of global water use, while feed production accounts for another 7 per cent.

Besides its direct effects on the natural resource base, the livestock sector is a major factor contributing to climate change. It is estimated that livestock-related activities are responsible for 18 per cent of the world's GHG emissions or about 80 per cent of the overall emissions from agricultural activities (Steinfeld et al., 2010). Greenhouse gases in the livestock sector arise either directly (through enteric fermentation and manure) or indirectly, and along the food chain (land-use change, feed production, processing and transport). Livestock rearing is responsible for 9 per cent of carbon dioxide (CO_2) emissions, which are released when forests and other natural vegetation are replaced by pasture and feed crops. Steinfeld et al. (2010) estimate that 34 per cent of livestock-related carbon emissions are due to deforestation, 25 per cent are from enteric fermentation and 25.9 per cent from manure. A similar amount of CO_2 is released by the on-farm use of fossil fuel, by the manufacturing of chemical fertilizers, by transport and by livestock product processing. The livestock sector is also responsible for emissions of other GHGs, including 37 per cent of human-induced methane (which has 23 times the global warming potential (GWP) of CO_2), 65 per cent of anthropogenic nitrous oxide (with 296 times the GWP of CO_2) and 64 per cent of ammonia, which is a major cause of acid rain (FAO, 2006a; FAO, 2009a; Steinfeld et al., 2010).

Implications for the development of the livestock sector. The livestock sector plays an important role in global economic development and in the livelihoods of about 2.6 billion persons directly involved in the agricultural sector. In particular, the sector, in combination with other agricultural activities, provides opportunities for poverty reduction and greater food security for the growing world population. However, rapid changes in this fast-growing sector also substantially risk marginalizing smallholders and their multifunctional agricultural systems, thereby affecting the food security of the world's poor, particularly in developing and transition economies. A second area of concern relates to the risk of livestock-induced environmental degradation impeding ecosystem services. Third, uncontrolled further development of livestock poses a major threat to human health, given that zoonotic diseases transmitted between animals and humans account for 60 per cent of all human pathogens.

In order for the livestock sector to address the above challenges and contribute to global development, it must become an integral part of global agriculture, meeting social, ecological and economic requirements simultaneously. To achieve this, all three livestock production systems below will have to be carefully adapted and further developed. The key to such a development is for investments in the livestock sector to be made not only (1) in industrial production systems but also (2) in mixed livestock crop systems and (3) in pastoral systems. Economically viable and socially acceptable investments will need to address increased productivity, environmental concerns, and the competing land resource demands of crop and livestock production systems. To achieve this, enabling institutional and policy frameworks and cooperation at different levels are needed. In order to make livestock systems a part of sustainable agriculture international cooperation will be necessary, as well as coordinated action at the regional and local levels to achieve changes in the way livestock products are produced and consumed. This transformation will demand action from all actors in livestock and agriculture systems, including producers, investors, procurers, decision-makers, researchers and not least of all, from consumers (for more information, see the lead article of Idel and Reichert in chapter 2 of this Review).

D. Conversions due to small-scale farming and rural poverty

In the coming decades, global agriculture faces three major challenges: (i) producing approximately 70 per cent more food for a projected population of 9 billion people by 2050 (FAO, 2009b), (ii) dealing with a variety of increasing risks and shocks, including climate change and commodity price volatility, and (iii) ensuring and enhancing the provision of ecosystem services such as climate change mitigation and

water regulation. These challenges most prominently concern small-scale farming, which provides a livelihood for about 2.6 billion people living mostly in low-income countries of the global South (von Braun, 2005). These women, men and children account for about 99 per cent of the global agricultural population and currently cultivate approximately 50 per cent of the world's agricultural land, providing an estimated 25 per cent of global cereal production (table 3) and about half of total food production (IAASTD, 2008).

Changing agricultural practices have enabled world grain harvests to double in the past four decades, largely due to production gains resulting from Green Revolution technologies, including high-yielding cultivars, chemical fertilizers and pesticides, mechanization and irrigation (Foley et al., 2005). Yet the majority of small-scale farming continues to be characterized by low labour productivity, and low to moderate land productivity. Sub-Saharan Africa and Latin America have experienced the least agricultural development, but may have the largest potential for improvement in the coming decades.

Small-scale farming involves growing crops to be used at least in part by individual households. Such farming is a significant source of livelihood, and some of the crops are sold in local or national markets (Lininger, 2011). Farming systems have evolved through adaptation to various natural conditions. Some systems focus on cropping, others on livestock rearing, and still others on a combination of both. In Africa and Asia, average farm size is 1.7 ha, and grain yields may vary from 0.5 to 1.5 tons per hectare in a low-potential, manual, traditional and small-scale system. Farms in developing countries are tending to become smaller, while farms in middle- to high-income countries are becoming larger (von Braun, 2005).

Of the 1.4 billion people living in extreme poverty (defined as those living on less than $1.25/day) in 2005, approximately 1 billion (i.e. around 70 per cent) lived in rural areas (IFAD, 2011). Significant progress in poverty alleviation has been achieved in East Asia, where today the incidence of rural poverty (based on the $1.25/day line) is around 15 per cent. In South Asia and sub-Saharan Africa, 45–60 per cent of the population still suffers from extreme poverty, while 80–90 per cent of the rural population lives on less than $2/day (IFAD, 2011). Thus, small-scale farming and rural poverty are intrinsically linked.

While there are households that live in persistent poverty, relatively large proportions of people continuously move in and out of poverty, sometimes in

Table 3: Assessment of small-scale versus large-scale farming at the global level

	Total	Small-scale (metabolic)	Large-scale (mechanized)
Land under cultivation (million ha)[a]	**1 600**[b]	800	800
Percentage	100	50	50
People in agriculture (million)	**2 600**[b]	2 575	25
Percentage of people in agriculture	100	99	1
Number of farms (million)	608	**600**[a]	8
Percentage of small- and large-scale farms	100	88.7	1.3
Cultivated area per farm (ha)	**2.6**[c]	**1.3**[c]	100[c]
Percentage of land under cereal production	50	50	50
Average cereal yields (tons/ha)	**2**[c]	1[c]	3[c]
Annual cereal production (million tons)	**1 600**[b]	400	1200
Percentage cultivated on small- and large-scale farms	100	25	75

Sources: Estimations (in normal font) by the Centre for Development and Environment, based on available data (in bold) from: [b] public sources (FAO, WB, IAASTD), and [c] Von Braun, 2005.

Notes: [a] Cultivated land is composed of most of the cropland, plus parts of animal feed production land, as well as some agroforestry and biofuel areas (see also table 1).

a matter of years. Households fall into poverty primarily as a result of a lack of resilience to risks and shocks. Apart from important aspects, including political or social conflicts, ill health and unforeseen social expenses, many risks relate to farming practices, loss of access to land and natural resources, market dynamics and price volatility, poor harvests due to environmental risks and climate variability, and weakened institutional environments. Conversely, households can escape from poverty when they have secured access to land, education and ownership of physical assets. Furthermore, opportunities such as markets, infrastructure and enabling institutions play a key role (IFAD, 2011).

In conclusion, the status of small-scale farming is intrinsically linked to a complex interplay of determinants relating to a specific local context, but it is also driven by developments at national and global levels. Among these, the competing demands for food, feed, fibre and fuel are the most prominent factors that intensify pressures on land. These so-called "teleconnections" of land-use change, where production and consumption of land-based products are increasingly distant and range across varying spatial scales, represent a major challenge for devising future strategies for sustainable small-scale farming (GLP, 2005).

Land conversions through small-scale farming. Today, nearly half of the global land surface is devoted to agricultural activities (Oldeman, 1994; Foley et al., 2005). This spread of agricultural land for a growing world population represents, perhaps, the most prominent feature of global change. The coming decades will witness further significant demographic changes, with the rural population expected to peak between 2025 and 2045, followed by a decline, and the developing world's urban population will outnumber the rural population. In South-East Asia, the rural population is already decreasing; in North Africa, West Asia and in South and Central Asia, numbers may start to decline around 2025, and in sub-Saharan Africa, around 2045 (IFAD, 2011). Nevertheless, poverty will remain largely a rural problem. Any strategy for rural development and poverty alleviation will thus have to consider that the majority of the world's poor will live in rural areas for many decades to come.

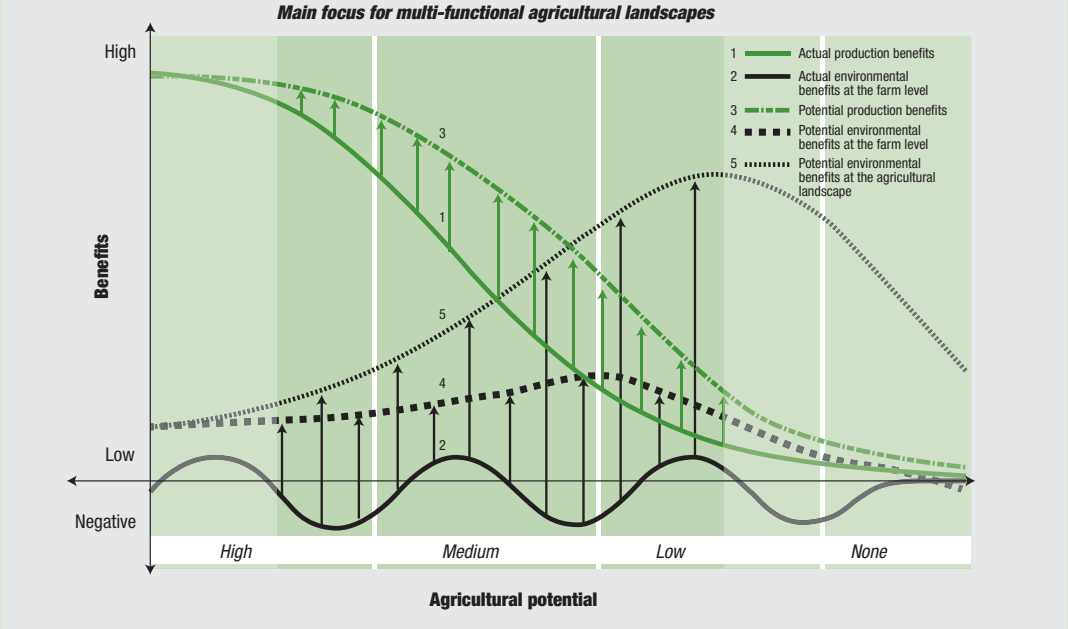
In trying to understand the significance of small-scale farming for more recent land conversions, demographic trends alone provide an incomplete basis. We need to draw a more differentiated picture in space and time, and understand how the relationship between population growth and land conversion is mediated by other factors such as environmental conditions, land settlement policies and market forces. Agricultural land has steadily grown by 0.3 per cent per annum during the past two decades. Yet most of this must be attributed to the extension of permanent pasture, while cropland has remained fairly static. There have been important regional differences, with a decrease of cropland in Europe that is offset by large gains in Africa and Latin America. At the same time, irrigated areas have shown a progressive but slowing growth rate during that period (Wood et al., 2000). Therefore, it may be assumed that small-scale farming currently plays a prominent role in land conversions in Africa and to a certain extent in Latin America, although pasture extension related to commercial farming is probably more important. In Asia, the role of small-scale farming in land conversion is less significant.

In regions affected by small-scale land conversions, it appears that rapid agricultural expansion and intensification mainly occurs at the fringes of high-potential areas, where the natural potential is perceived to be underutilized. On the one hand, this concerns forest edges and steep mountain slopes; on the other hand, these areas of rapid agricultural expansion are mainly in semi-arid areas with good soils and the potential for high productivity if water can be provided.

According to Chomitz (2007), approximately 70 million people live in remote tropical forests, and about 800 million rural people live in or near tropical forests and savannahs. The forests provide a livelihood for these people, as they offer land for farming, mainly through shifting cultivation; but they are also an important source of food, income, fuel and medicines. Such land-use practices have caused a 700–1,100 million ha net loss of forests over the past 300 years (UNEP, 2011b). However, much evidence shows that in recent times, commercial agriculture and other activities such as road and urban constructions, rather than shifting cultivators and subsistence farmers, have been the main drivers of deforestation (DeFries et al., 2010; Geist and Lambin, 2002; Mertz et al., 2009; Rudel et al., 2000).

Drylands, a second hotspot of small-scale agricultural

Figure 1: Actual and potential benefits from agricultural activities according to current agricultural potential.



Note: Shaded area shows the main focus on promoting multi-functional agricultural landscapes.
Source: Authors

expansion, cover approximately 41 per cent per cent of the global land surface, and they are home to more than 2 billion people, 90 per cent of whom live in developing countries (UNEP, 2011b). Overall, approximately 2 per cent of global terrestrial net primary production (NPP) is lost each year due to dryland degradation, or between 4 and 10 per cent of the potential NPP in drylands (Zika and Erb, 2009). Among various other triggers such as urbanization, desertification, wildfire and overgrazing, the transformation of grasslands to croplands and inadequate cultivation practices play a key role in such degradation processes. In addition, the expansion of large- and small-scale agriculture is pushing pastoralists into more marginal areas, thereby forcing them into vicious circles of impoverishment and desertification.

Towards future strategies: Small-scale farming in multifunctional agricultural landscapes. Small-scale farming must be at the centre of any strategy that pursues the goal of feeding a growing world population while addressing rural poverty in a context of increasing environmental degradation and climate change. It should build on a thorough understanding of the manifold and changing pressures on small-scale farming, the conversions related to such pressures, and the resulting economic, social and environmental impacts from the local to the global level.

There is a growing consensus that sustainable agricultural intensification in small-scale farming must address the systemic interactions between agricultural productivity, environmental service provision and the improvement of human well-being. A diversity of agricultural and land-use practices, combined in multifunctional agricultural landscapes is likely to achieve the best set of outcomes. While agricultural intensification will continue to play an important role in future global food production, context-specific approaches are also needed in order to achieve sustainable land use based on biophysical as well as socio-economic considerations (DeFries and Rosenzweig, 2010). Moreover, hot spot areas of agricultural expansion on the fringes of high potential areas should become the main focus for such multifunctional agricultural landscapes. Figure 1 schematically presents the core elements of such an approach.

In Figure 1, total production and environmental

benefits are depicted along a gradient of decreasing agricultural potential. This stipulates that from high potential areas – often dominated by intensified and large-scale agriculture – the production benefits decrease rapidly towards more marginal areas, dominated by small-scale and often subsistence farming (curve 1). Meanwhile, the highest potential for additional production benefits can be located in medium to lower agricultural potential areas (curve 3). Hence these areas might offer the best returns on investments for productivity increase. In terms of actual environmental benefits (curve 2), assessment is more difficult, but generally they would appear to be rather negative both in high- and low-potential areas comprising large- as well as small-scale farming. However, the potential environmental benefits increase slightly from high- to lower-potential areas at the farm level (curve 4), and significant environmental benefits can be expected at the agricultural landscape levels (curve 5). While large-scale enterprises cover whole landscapes, small-scale enterprises allow for multiple use areas in-between, thereby increasing environmental services and offsetting trade-offs of more intensive components.

In summary, strategies for sustainable intensification of small-scale farming should focus on developing agricultural landscapes in areas with medium to low potential for agriculture. There, the highest additional production potentials can be tapped while environmental benefits can be increased significantly. Such strategies, in order to leapfrog agricultural development for improved well-being without compromising environmental health, will require investments on a global scale, as well as an enabling policy and institutional environment. For this purpose, the ongoing revaluation of rural areas for ecosystem service provision beyond the economically productive function of land represents an opportunity that should be harnessed. Under the guidance of strengthened public institutions from the local to the global level, multifunctional small-scale agriculture and pastoralism should feature at the top of rural development agendas. Key domains of intervention relate to legal and institutional security of land and natural resources, agricultural extension and capacity development, innovative mechanisms that reward ecosystem service provisions, improved economic governance and a regulated integration into agricultural markets, as well as political empowerment of largely marginalized segments of rural populations.

E. Implications of land conversions for food security

Implications of global and local change. Global food security is primarily dependent on the production of food in agriculture (including food products from forests and fisheries), but also on the distribution and availability of food for consumers and subsistence farmers, and finally, on the amount of food stored at household, community, enterprise, national and international levels. Food production will depend on how much land is allocated to other uses such as feed, fibre or all forms of fuel, how much increase in production is possible, particularly from small-scale farming, and on the extent of change in consumption patterns to animal protein. Last but not least, food production is dependent on the availability of inputs such as seeds, land, water, natural and industrial fertilizers, and in particular, on the effects of climate change on agricultural production in the near and distant future.

In small-scale farming, food security will depend on the extent of further pressures exerted on farm sizes, the extent of soil degradation that occurs, the degree of pressure on land, the spread of water scarcity, the extent to which small farm productivity can be enhanced with inputs and research, and whether market access can be facilitated. In sum, there are a number of intrinsic drivers of rural poverty that need to be addressed as a priority.

Improvement of food security from local to global levels. The following 10 measures could help small-scale farmers to contribute to food security:

1. *Regulating land conversions:* preventing land conversions on land used by small-scale farmers and pastoralists will secure their livelihoods as long as they have no alternatives.
2. *Ensuring land tenure:* external investments in land quality will become attractive for small-scale farmers when their land is secured, even if these are not directly beneficial for production but rather for maintaining ecosystem services. Tenure needs to be guaranteed by States with the support of the international community.
3. *Improving market access:* market chains should be developed for small-scale farm products, including for the pre-processing and labelling of products for storage and easier transport, thereby making products more competitive.

4. *Developing gender equity:* equal rights for female farmers are seldom guaranteed in small-scale farming, yet women are often the main actors on the farm, and their empowerment, both economically and in decision-making, would contribute to improved livelihoods.
5. *Raising farm productivity:* production per hectare on small-scale farms could be doubled in the coming 40 years with only moderate inputs, improved seeds and breeds, better farm implements and research centred on small-scale farming.
6. *Increasing farm size:* Arresting a further decline in land size per small-scale farm and maintaining or even increasing farm plots would be beneficial for moderate mechanization and modernization, even in small-scale farming.
7. *Promoting sustainable land management:* Reversing further degradation of land on small-scale farms would ensure increased productivity and generate other ecosystem services from soil, water and biodiversity.
8. *Removing subsidies:* subsidies for agricultural products, particularly in developed countries and transition economies, should be removed, as they create price distortions and affect international commodity markets.
9. *Internalizing transaction costs:* incorporating transaction costs in food and feed prices, including global taxation on fossil fuels, would enable equal access to markets for large- and small-scale farming alike.
10. *Anticipating climate change:* there is need for a better understanding of the implications of climate change and appropriate measures to be taken against it through research, early warning and early action.

Implications of land conversions. Small-scale farming is the most vulnerable to food insecurity, and it is likely to be very strongly affected by land conversions, particularly from cropland to livestock production, as a result of changing consumption patterns. Any likely bans on the extension of cropland into pastures and forests will place increasing and additional pressure on farm sizes, although the number of farms might decrease in the coming decades. Biofuel production and changes in livestock production are additional factors that will have a potentially growing influence on small-scale farming, provided current policies are maintained or enhanced. However, this latter pressure also concerns other land use and cover types, as biofuel will affect not only cropland but biodiversity and natural resources in other land-use systems as well.

Commentary I. Land Grabbing and Future Conflicts

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Abstract

On the grounds of equity and ethics, it is necessary to halt the unsustainable plunder or use of resources to the extent that they are permanently lost to future generations. Land grabbing, a manifestation of greed, shows a trend of people living as if there were no tomorrow. It is clearly not simply a desire to respond to food deficits somewhere, but a ploy to control the food systems of the world and subject people to the vagaries of speculation.

The web of global crises currently confounding the world has had deep impacts on vulnerable communities in developing countries. As the world lurches from one crisis to another, bids to find solutions have been merely compounding, rather than resolving, the crises. For example, with regard to the fossil-fuel-driven climate crisis, some saw agrofuel production and use as a key solution. However, agrofuels cannot replace fossil fuels because there is simply not enough arable land to cultivate the amount of crops needed to meet the voracious appetite of combustion engines in cars and machinery. Moreover, agrofuels retain the fossil fuel production, transportation and utilization paradigm (e.g. refineries, pipelines) thus causing the world to imagine there is a change when in fact it is business as usual.

Moreover, the conversion of land from the cultivation of crops for food to crops for agrofuels has had an impact on food supply. Some argue that agrofuel production runs parallel to that of food production, and that one does not impact the other. Considering that the same workforce is engaged in both processes, it is evident that the two cannot be delinked and neither can land uptake – they are all interrelated. Some promoters of biofuels claim that they do not use food crops, and that their crops (such as jatropha) are grown on marginal lands. The jatropha plant and the claims around it have also raised new issues, including that lands considered marginal might appear so to persons who neither live in the locality nor understand the dynamics of local land-use systems. The marginal land argument is also seen as a ploy used by policymakers and speculators to mark out such lands for grabbing while marginalizing the people who own, understand and use those lands.

The United Nations estimates that Africa has at least 500 million hectares (ha) of marginal, unused and underused land and that the Democratic Republic of the Congo is believed to have around 150 million hectares (Dynes, 2008). However, the classification of land as being marginal or not can be contentious, especially if it fails to consider local knowledge and technologies.

The food crisis has also triggered the search for land by speculators and others who see lands in Africa as suitable and available for purchase for crop production aimed at export out of Africa. This seems like the colonial cash-cropping system returning in a different guise. Interestingly, not all cases have concerned land grabbers from outside Africa. There have been instances of Africans grabbing lands in other African countries and others playing the role of middleman to facilitate the land grabs, as revealed in a report by GRAIN (2009), for example. The case of the Libyan Arab Jamahiriya's incursion into Mali is worthy of note in this regard. A multimillion dollar national rice initiative announced by the Government of Mali was intended to help local farmers produce more so that the country would no longer be dependent on rice imports.

However, the Government handed over an enormous tract of prime rice land to a Libyan investment fund and some Chinese companies. In addition, in 2004, Mali's President, Amadou Toumani Touré, offered up to 100,000 ha to the Libyan Arab Jamahiriya as part

of a larger infrastructure investment project for the area that included the enlargement of a canal and the improvement of a road. This was within the framework of the Libya Africa Investment Portfolio (LAP). The arrangement showed that the infrastructure provision was contracted to CGC, a Chinese company owned by China's big oil corporation, SINOPEC, while an unnamed Chinese firm was contracted to supply Chinese hybrid rice seeds. The GRAIN report revealed that, although the project claimed to produce rice for Mali, there was "plenty of reason to suspect that the real motivation is to export rice to Libya."

A. Paths to land grabs

A land grab deal that would have swallowed up half of the arable land in Madagascar was aborted. In that deal, Daewoo, a company from the Republic of Korea, was to lease 1.3 million ha of arable land on that island State for the cultivation of corn and oil palm for export back to its home country. The oil palm seeds as well as corn were to be imported from Latin America. The objective of the scheme was to boost the Republic of Korea's food security by providing it with up to 2.5 million tons of corn per year, representing half of its corn imports. Hong Jong-Wan, a manager at Daewoo, was quoted as saying, "We want to plant corn there to ensure our food security. Food can be a weapon in this world. We can either export the harvests to other countries or ship them back to Korea in case of a food crisis." The protests that ensued after the revelation of the deal led to its cancellation, and the political fallout saw the unseating of the president of the country.[3]

Actions elsewhere also have the potential to intensify land grabs in Africa. For example, the move by the Government of Indonesia to impose a two-year moratorium on new palm oil plantations in order to protect its remaining rainforests has prompted agribusiness giants such as Sime Darby to switch their expansion plans to Cameroon, Ghana and Liberia. This rush into Africa is set to cause massive deforestation and loss of farmland of the local communities (Levitt, 2011), which are sure conflict trigger points. The implication of this shift is instructive: while the Indonesian plan is well-intentioned, it is clear that regulations limited to one country will simply cause investors and speculators to shift their activities elsewhere where regulations may be lax or non-existent.

B. Food crisis, land grabs and the "new colonization"

The food crisis of 2007–2008 was characterized by some analysts as a silent tsunami (*Economist*, 2008) that hit the developing world. However, there was nothing silent about it: the upheaval had been building up over time and the rumbles were audible and the waves visible. As noted by a recent report (Cissokho et al., 2011), developing countries have suffered for some decades from swift changes in the prices of their commodity exports, on which most of them rely heavily for their export earnings, and this problem has been compounded by rising price volatility in food imports from the global markets. Their proposed solutions include shielding their vulnerable markets from price volatility by promoting the production and consumption of what they term "non-traded" crops.

The food crisis combined with the financial crisis have prompted speculators to focus on investing in land for the cultivation of crops for energy and/or for food. This rush for land in countries in Africa, South-East Asia and Latin America by other countries and corporations has led to atrocious land grabs. The scale and purpose of the land grabs amount to nothing short of a "new wave of colonization". The crops cultivated in the grabbed lands are not intended to feed local populations; instead, they are mainly produced for export back to the home countries of the "investors," as exemplified by the land-grab deal involving Daewoo, cited above.

Another example of an attempted land grab deal was in South Sudan where one "paramount chief" signed off 600,000 ha of community land, with a possibility of ceding a further 400,000 ha, to a Dallas-based firm in 2008. Through the deal, the firm was set to enjoy a 49-year lease of the land at a princely sum of $25,000. The terms of the lease offered the company full rights to exploit all natural resources in the leased land, including the right to:

- Develop, produce and exploit timber/forest resources, including, without limitation, the harvesting of current tree growth, the planting and harvesting of hardwood trees, and the development of wood-based industries;
- Trade and profit from any resulting carbon credits from timber on the leased land;
- Engage in agricultural activities, including the cultivation of biofuel crops (e.g. jatropha plants and palm oil trees);

- Explore, develop, mine, produce and/or exploit petroleum, natural gas and other hydrocarbon resources for both local and export markets, as well as other minerals, and also engage in power generation activities on the leased land;
- Sublease any portion or all of the leased land or sub-license any right to undertake activities on the leased land to third parties.

However, resistance to this deal by the people, supported by solidarity actions from groups such as the Oakland Institute, succeeded in defeating the deal (OI, 2011).

This example of a land-grab deal, though foiled, shows the main attractions for speculators. These include the possibility to exploit surface resources, such as timber, and subsoil resources such as oil, gas and solid minerals. The speculators aim to engage in comprehensive exploitation of their grabbed land in all ways possible. This is why, in this case, they even laid claim to the carbon stock in the trees on the land. With new types of carbon sinks being "commodified", it is conceivable that land grabbers will seek to obtain carbon credits from soil carbon sequestration. Arguably, this wave of land grabs is more objectionable than colonialism. Although this land-grab deal fell through, there are others just as obnoxious that have not been stopped.

Sometimes land grabs may pass unnoticed, as with the recent decision by a mining company, African Barrick Gold, in the United Republic of Tanzania to erect a 14-kilometre concrete fence around its mining concession, ostensibly to keep villagers from sneaking in to steal gold (*Reuters*, 2011). Completion of its so-called security fence in 2012 will suggest that its grabbing of the territory is in perpetuity, and with this stroke of genius the company is possibly depriving the citizens of access to parts of the land on which they could still eke a living without interfering with the mining activities of the company. Equally, the communities are deprived of access to the beauty of the natural landscape, although the relentless claws of mining machineries may have already scarred it.

C. Conflicts and resistance

Conflicts and resistance over land grabs are also increasing in the Ogoni land of Nigeria. The people of this region are known for their epic battles against degradation of their territory through the oil extraction activities of Shell Petroleum Development Company (Shell) and the Nigerian National Petroleum Corporation (NNPC). Shell was expelled following mass peaceful uprisings in 1993. Since then there have been attempts to reopen the oil wells in Ogoni, but without success. Possibly as a step towards ensuring a return of the oil giant into the territory, the United Nations Environment Programme (UNEP) was commissioned to assess the environmental situation of Ogoniland.

The UNEP assessment (2011a) presented to President Goodluck Jonathan on 4 August 2011 showed hydrocarbon pollution in surface water throughout the creeks of Ogoniland and up to 8 cm in the groundwater that feeds drinking wells at 41 sites, including a serious case in Nisisioken Ogale in Eleme, Rivers State. Soils were found to have been polluted with hydrocarbons up to a depth of 5 metres in 49 observed sites, while, benzene, a known cancer-causing chemical was found to be present in drinking water at a level 900 times above the level deemed acceptable by the World Health Organization (WHO). The report also documented that fisheries have been destroyed and that wetlands around Ogoniland are highly degraded or facing degradation (Environmental Rights Action, 2011). These impacts combined, have led to an irreparable loss of livelihoods, and will take 30 years to remediate. Pollution appears to have made a permanent grab on Ogoni lands.

While the Government of Nigeria and Shell dither over what to do about the destroyed Ogoni environment, there are persistent efforts by both government and private entities to further grab massive tracts of what is left of land in the territory for banana and other plantations. One company is canvassing the idea of producing what it euphemistically calls "Ogoni oils" from jatropha. Because of the highly sensitized state of the Ogoni people, there is determined resistance, and this is clearly not a land grabbers' haven.

D. Conclusion

The push by transnational corporations for land to grow crops for export and biofuels in addition to supply their need for pulp and paper is compounded by the appetite of emerging economies such as Brazil, China and India for increasing amounts of other natural resources, including water and minerals. For example, it is said that the Government of Mozambique

is allocating 60,000 square kilometres of land (7.6 per cent of the country) in four of its provinces – Nampula, Niassa, Zambezia and Cabo Delgado – to 40 Brazilian farmers for commercial soy cultivation to supply the ever-expanding Chinese market (Nhantumbo, 2011). The issues raised by land grabs are indeed diverse and severe.

Land grab is a real menace in a world ridden with crises. Watson, a leading figure in setting up the Intergovernmental Platform on Biodiversity and Ecosystem Services, suggests that global ecosystems face severe threats from five key drivers: land conversion (such as deforestation), overexploitation (such as overfishing), the introduction of exotic species, pollution and climate change (cited by McCarthy, 2011).

On the grounds of equity and ethics, it is necessary to halt the unsustainable plunder or use of resources to the extent that they are permanently lost to future generations. Land grabbing, a manifestation of greed, shows a trend of people living as if there were no tomorrow. It is clearly not simply a desire to respond to food deficits somewhere, but a ploy to control the food systems of the world and subject people to the vagaries of speculation.

Land grabbing is an unsustainable path and needs to be reigned in. Only a global examination and a global regulatory framework will be able to stem the flood. Apart from regulating this scourge, there is also the need to secure land rights and ensure that those rights are respected, especially in the more vulnerable regions and countries where such laws do not exist. The world cannot afford new forms of conflict arising from land grabbing. More and more people are being displaced by land grabs, livelihoods are being destroyed, and hunger is being imported while food products are exported.

Commentary II. Evaluation of Land Investment Deals in Africa: Preliminary Findings

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Abstract

The Oakland Institute's analysis on land investment deals has identified three major lacunae, which point to the need for:

- better data on and a better understanding of the concept of "land availability",
- a better understanding of the land deals (i.e. their nature and their implications for developing countries and for food-insecure populations), and
- addressing the issue of land rights.

Instead of using marginal or infertile land as is often claimed, most deals identified are actually taking place in the vicinity of water resources that offer irrigation potential, or near other infrastructure (railways, roads) or on fertile soils. Major African rivers, such as the Nile, the Zambezi and the Niger, are tapped by these land grab deals, which give the investors control not only of the land, but also of water.

Despite widespread claims, the Oakland Institute's field research and analysis of the land deals in seven African countries has found that their promises of economic development through their investments in land and agriculture are often overstated. Large-scale land investment may improve some macroeconomic indicators of development, but it may also result in considerable environmental and social costs to the host country, and loss of livelihoods or lost economic opportunities for its citizens.

Land investments – the purchase or lease of vast tracts of land from mostly poor, developing countries by wealthier, food-insecure countries and private investors for the production and export of food and agrofuel crops – have grown into an international phenomenon. According to the World Bank, in 2009 alone nearly 60 million hectares of fertile land throughout the world (i.e. almost 4 per cent of global cropland) were acquired by investors, often at giveaway prices. Over 70 per cent of these land deals were in Africa.

International aid agencies and multilateral lending institutions have commonly supported foreign direct investment (FDI) as a way to eradicate hunger and poverty. Many of them suggest that FDI can help developing countries by generating income and employment and enabling the transfer of technology and know-how. In addition, it is believed to promote the development of processing and economic and social infrastructure in "host" countries. This implies that African countries are therefore beneficiaries in such deals. However, currently, little is understood of the legal, social and economic implications of the land deals involving FDI. The authors of a comprehensive research on land grabs (FAO/IFAD/IIED, 2009) recognized that their report had "only started to scratch the surface of a very complex set of issues." The Oakland Institute's own analysis has identified three major lacunae, which point to the need for: (i) better data on and a better understanding of the concept of "land availability", (ii) a better understanding of the land deals (i.e. their nature and their implications for developing countries and for food-insecure populations), and (iii) addressing the issue of land rights.

Given the paramount importance of addressing this knowledge gap, the scale and rate at which these land deals are happening, and the complete lack of transparency surrounding them, the Oakland Institute initiated a research project, entitled Understanding

Land Investment Deals in Africa in 2009, which studied seven countries: Ethiopia, Mali, Mozambique, Sierra Leone, South Sudan, the United Republic of Tanzania and Zambia. In June 2011, the Institute released a paper which highlights some of the main findings of its first phase of research on land investment deals in Africa.[4]

A. Who are the investors?

News coverage has tended to emphasize the role that countries such as China and the Gulf States have played in the acceleration of land acquisitions in Africa. However, the Oakland Institute's investigation, involving over 50 deals in the seven African countries covered, revealed a major role played also by Western firms, wealthy United States and European individuals, and investment funds with ties to major banks such as Goldman Sachs and JP Morgan. Other investors include alternative investment firms such as London-based Emergent Asset Management that seeks to attract speculators, including universities in the United States such as Harvard and Vanderbilt, with the promise of gaining access to agricultural land that will yield high financial returns for their endowments. Another example concerns several Texas-based interests that are associated with a major 600,000 ha deal in South Sudan which involves Kinyeti Development, LLC – an Austin, Texas-based "global business development partnership and holding company," managed by Howard Eugene Douglas, a former United States Ambassador at Large and Coordinator for Refugee Affairs.

A key player in the largest land deal in the United Republic of Tanzania is Iowa agribusiness entrepreneur, Bruce Rastetter, who concurrently serves as CEO of Pharos Ag, co-founder and Managing Director of AgriSol Energy and CEO of Summit Farms, and is an important donor to Iowa State University. Rastetter was recently appointed to the Iowa Board of Regents by Terry Branstad, Iowa's Governor. Iowa State University has provided "private" research services that benefit Rastetter's investments in the United Republic of Tanzania.

Many European companies are also involved in land deals in African countries, often with support provided by their governments and embassies in those countries. For instance, Swedish and German firms have strong interests in the production of biofuels in the United Republic of Tanzania. Major investors in Sierra Leone include Addax Bioenergy of Switzerland and Quifel International Holdings of Portugal. And Sierra Leone Agriculture is actually a subsidiary of Crad-l (CAPARO Renewable Agriculture Developments Ltd.) based in the United Kingdom.

B. Are investors buying unused available land?

The Oakland Institute's research found several cases where small farmers, viewed as "squatters", have been forcibly removed from their ancestral lands with no compensation in order to make room for the cultivation of export commodities, including biofuels and cut flowers. In Ethiopia, for example, the villagization process of nearly 700,000 indigenous people is taking place in the very same areas targeted for land investment by large-scale investors. People who are being forced off their ancestral lands are afraid to oppose displacement for fear of their lives and threats of imprisonment in a country where political violence and human rights violations are common.

In Samana Dugu in Mali in 2010, when bulldozers moved in to clear the land, men, women and youth from the community who protested the cutting of their trees were met by police force, and were beaten and arrested. And in the United Republic of Tanzania, the memorandum of understanding between AgriSol Energy from the United States and the local government stipulates in its first article that the two main locations – Katumba and Mishamo – for the company's project are refugee settlements that will have to be closed before the project can start. Yet the 162,000 refugees living there had fled Burundi in 1972 and have been farming this land for 40 years.

Overall, when farmers are not simply removed from their land, the land leased to investors in Africa is either fallow land or forests, generally used by the local population for a wide range of purposes (e.g. collection of timber, wild food, firewood, medicinal plants, conservation of watersheds and protection against erosion). Instead of using marginal or infertile land as is often claimed, most deals identified are actually taking place in the vicinity of water resources that offer irrigation potential, or near other infrastructure (railways, roads) or on fertile soils. Major African rivers, such as the Nile, the Zambezi and the Niger,

are tapped by these land grab deals, which give the investors control not only of the land, but also of water.

C. Does foreign investment in land lead to economic development?

The belief that large-scale land investment in Africa will result in much-needed economic development is strongly promoted by foreign investors, government officials and international institutions. As a result, many African governments fervently encourage foreign investment in agricultural land, and offer what some have called "mouthwatering" incentives to investors.

Officials trust that land deals will spur growth with incoming capital, assist with infrastructure and create employment for local people. On their part, investors reinforce these ideas with bold promises of economic development, "modernization" and numerous jobs. Despite widespread claims, the Oakland Institute's field research and analysis of the land deals in the seven countries has found that their promises of economic development through their investments in land and agriculture are often overstated. Large-scale land investment may improve some macroeconomic indicators of development, but it may also result in considerable environmental and social costs to the host country, and loss of livelihoods or lost economic opportunities for its citizens. An analysis of various economic issues related to foreign investment in land demonstrates that the opportunities for economic development are in fact limited. There are several reasons for this as discussed below.

D. Investor incentives resulting in forgone public revenues

African governments are offering a wide range of incentives to attract foreign investment. These include fiscal incentives, such as duty exemptions, full or partial tax holidays, and/or reductions in the tax rate for specific types of activities, as well as non-fiscal incentives, including allowing expatriate employment and remittance of profits and other benefits for foreign personnel. The foregone public revenues as a result of investor incentives can severely undermine a country's tax base. Import duties, for example, represent approximately 15 per cent of total government revenue in Mozambique and 45 per cent in Sierra Leone. The 2009/10 tax exemptions in the United Republic of Tanzania amounted to 95 billion Tanzanian shillings ($425 million) – more than half the 1.3 trillion Tanzanian shillings ($795 million) the Government planned to borrow from commercial sources for infrastructure financing in 2010/11. Had it been collected, it would have provided 40 per cent more resources for education or 72 per cent more resources for health in 2009/2010.

E. Low land prices and rental fees

In Africa, land is readily offered in the form of huge tracts at extremely low prices or lease rates compared with those in other continents (tables 4 and 5).

Table 4: Sampling of farmland lease fees, by land deal

Location	Deal	Price ($/ha/yr)	Lease terms
Ethiopia	Saudi Star	Free land rent	10,000 ha; 60-year lease
Mali	Malibya	Free land rent	100,000 ha; 50-year lease
Ethiopia	Karuturi	6.75[a]	300,000 ha; 99-year lease
Sudan	Nile Trading and Development	0.04	600,000 ha at $25,000; 49-year lease
Sierra Leone	Sierra Leone Agriculture	2	43,000 ha; 45-year lease
Sierra Leone	Quifel Agribusiness SL Limited	5	126,000 ha; 49-year lease

Source: Based on Oakland Institute field research, October 2010-June 2011.

Notes: [a]Karuturi initially leased land for just $1.25/ha (20 birr/ha), but in subsequent negotiations with the federal Government, that price was raised to $6.75/ha (111 birr/ha).

Table 5: Sampling of average farmland prices, by selected countries, 2010

Location	Average price ($/ha/yr)
New Zealand (dairy)	23,000
United Kingdom (average – all land types)	22,000
United States (dryland in corn belt)	16,000
Poland	4,550–8,125
Brazil (Mato Grosso dryland)	7,000
Argentina (Central provinces)	5,000–10,000

Source: The Knight Frank Farmland Index 2010.

Low prices are certainly attractive to foreign investors. According to Susan Payne, Chief Executive Officer (CEO) of Emergent Asset Management, "In South Africa and Sub Saharan Africa the cost of agriland, arable, good agriland that we're buying is one-seventh of the price of similar land in Argentina, Brazil and America. That alone is an arbitrage opportunity. We could be moronic and not grow anything and we think we will make money over the next decade." (see: http://www.oaklandinstitute.org/emergent-video).

The benefits from the investments for the host countries are undermined by these low prices. Payne alludes to the fact that, because of low land prices, it is perhaps in the investor's best interest to sit on the land and profit from arbitrage between low land acquisition prices compared with their sales values as the market improves. While such speculation often entails higher risk, returns on speculative investments in African farmland have been reported to reach 25 per cent. Indeed, many of the land deals investigated by the Oakland Institute are not yet operational, indicating that the investments may have been made solely for speculative rather than productive purposes.

F. Does foreign investment in agriculture lead to job creation?

The promise of job creation is often the argument presented by investors, governments and international institutions to convince local communities of the benefits of foreign investment in agriculture. Because of the large role agriculture plays in African economies, the sector has great potential as a driver of their economic development and job creation. Activities such as storage to reduce post-harvest losses and to get the best from market opportunities, as well as investments in value-added production, such as processing, seem particularly relevant to make the most of the tremendous potential of African agriculture. Improving smallholder productivity and production is also essential for a sector largely dependent on family farms.

Yet the majority of land deals investigated by the Oakland Institute offer basic wage labour employment, mostly low-paying positions which present a number of disadvantages. Often, it is unclear how many jobs will be created, or whether those jobs will offer fair compensation for local farmers' lost lands and livelihoods. Furthermore, modern agricultural schemes are highly mechanized and provide relatively few, often short-term, seasonal jobs. There is no indication that investors are seeking to maximize local employment or that governments are giving priority to job creation. On the contrary, investors often find scalable, mechanized agriculture to be more manageable, and governments lure these investors by placing few or no limits on expatriate workers. It appears, therefore, that lofty employment claims made by investors generally are not substantiated by actual job creation, or by jobs that bring significant development benefits. Indeed, evidence shows that large-scale agricultural investments provide minimal benefits to local communities, and this should be taken into consideration by development practitioners and policymakers when evaluating the legitimacy of "responsible" agro-investment. To truly spur job creation, host governments would need to establish investment agreements that contribute to, rather than detract from, local livelihood options.

Oakland Institute's evidence is supported by other findings, including a study by the World Bank (2010) which found scant evidence that foreign land investment was creating many local jobs. The requirements for labour vary greatly among crops and production systems, such that crop choice and organization of production will have far-reaching impacts on the potential for agricultural investment to create employment. A 10,000-ha maize plantation in the Democratic Republic of the Congo, for example, created only 0.01 jobs per hectare, while a sugarcane plantation generated 0.351 jobs per hectare. The

World Bank report found job creation in Ethiopia to be similarly limited, with an average of 0.005 jobs/ha in cases where figures were provided. The report noted, "The patchy data that are available suggest that investments create far fewer jobs than expected." Comparing these figures with the labour intensity of family farms, smallholder soybean production, for example, creates 0.125 jobs/ha – nearly eight times more jobs than the 0.016 jobs/ha created by large-scale soybean production.

Also according to the World Bank, wage labour income is 2 to 10 times lower than the income of the average smallholder. Moreover, as mentioned earlier, most agricultural wage labour positions are seasonal. Thus the impressive number of positions Karuturi claims it will create – as many as 20,000 to 30,000 – in Ethiopia is misleading in terms of actual employment creation for local development.

A large body of research supports the notion that small farms are more productive, biodiverse and sustainable than large, industrial-style plantations. Furthermore, in terms of local peoples' well-being, small-scale agriculture offers a number of benefits. In the first place, the production of goods by small farms is relatively less capital-intensive (meaning that more labour is used to produce each unit of the good) than that by large farms. This implies that small farms employ relatively more labour, including rural unskilled labour, than do large farms, and thus provide more gainful livelihood options for locals. Secondly, small farms have higher output per land unit because they utilize their land more efficiently, growing multiple crops, and thereby improve local food security. Small farms also are more productive because of their relatively high concentration of labour per hectare compared with larger farms. Additionally, because the household provides most of the workforce, the costs of supervision are low, since household labour is generally self-supervising in effort and diligence.

Lastly, since small farms utilize relatively more labour per land unit, they distribute a relatively larger proportion of their profits, revenues and output to their labourers. The average farm size for crop-based farming in Mali is just 4.7 ha, and one third of the 805,000 farm households cultivate less than 1 ha. To put this in perspective, the area covered by the recent large land deals identified by Oakland Institute's research in Mali could sustain, conservatively, 112,537 farm families – well over half a million people (686,478). Instead, that land is now concentrated in the hands of 22 investors, who are planning to employ only a few thousand plantation workers.

G. Does investment improve food security?

Most of the countries targeted by investors suffer from food insecurity. Though the food security argument is often put forward by governments and investors in support of large-scale agricultural investments, Oakland Institute's research finds little assurance that those investments have improved food security. In many cases local food farms are sold in order to make room for the cultivation of export commodities, including crops for biofuels and cut flowers. Many of the land leases identified are for the production of agrofuels. In Mali, half of the investors with large land holdings in the Office du Niger intend to grow crops for agrofuels, such as sugarcane, jatropha or other oleaginous crops. Similarly, in Mozambique most of the investments are in the timber industry and agrofuels rather than in food crops. Food crops represented only 32,000 ha of the 433,000 ha that were approved for agricultural investments between 2007 and 2009.

H. Are plantations more productive and profitable than small-scale farms?

Another argument put forward in favour of large farms is that they are supposedly more productive. However, here too, the Oakland Institute's investigations confirm the existence of a large body of previous research which shows that in many instances small farms are more productive than large plantations. In Mali, for example, where the system of rice intensification has been adopted along the Niger River near Timbuktu, farmers have been able to attain yields of 7 to 15 tons/ha/yr, (or an average of 9 tons/ha/yr), which is more than twice the conventional irrigated rice yield in the area, and more than the forecasts of the Moulin Moderne du Mali, one of the major investors in large-scale rice production. The small-scale, village-based irrigation schemes involve plots of just 35 ha of land, shared by as many as 100 farmers, thus each household has access to only one third of a hectare. Yet from that piece of land they are able to earn $1,879

– more than double the average annual per capita income of $676.

If the rice intensification scheme were to be replicated successfully in the Office du Niger, 10,000 ha of such small-scale irrigation schemes could provide livelihoods for 285,715 farmers and dramatically increase rice production and revenues.

I. Placing sustainable agricultural development in the proper context

Research conducted by the Oakland Institute demonstrates that a renewed focus on agriculture is crucial for overcoming the current crisis of world hunger in the context of climate change, and for providing livelihoods to farmers while enabling developing countries to meet the Millennium Development Goals. However, the Institute's research also shows that investment in agriculture does not necessarily translate into food security or livelihoods for smallholder farmers who form the bulk of the world's poor. As pointed out by Olivier De Schutter (2009), United Nations Special Rapporteur on the Right to Food, the issue is not one of merely increasing budget allocations to agriculture, but rather, "that of choosing from different models of agricultural development which may have different impacts and benefit various groups differently."

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Notes

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2 Land-use changes are categorized as direct and indirect changes. Direct changes occur when biofuel feedstock, such as soybean for biodiesel, displaces an existing land use system, such as grazing land for cattle. This in turn may lead to a change in another area, for example from forest to grazing land, which is then known as an indirect change.

3 See: Hope for Madagascar, at: http://fanantenana.wordpress.com/2009/06/18/the-truth-about-land-grab/.

4 For more information about this research project, see: http://media.oaklandinstitute.org/special-investigation-understanding-land-investment-deals-africa.