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A GREENER BURKINA Sustainable farming techniques, land reclamation and improved livelihoods

Amanda Lenhardt, Jonathan Glennie, Nicholas Intscher and Ahmed Ali, with Gabriel Morin

developmentprogress.org

Overseas Development Institute
203 Blackfriars Road
London SE1 8NJ

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Registration no. 661818
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Contact us
developmentprogress.org
developmentprogress@odi.org.uk
T: +44 (0)20 7922 0300

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Cover image: Mother farming with child in Northern Region, Burkina Faso. Photo: © Amanda Lenhardt

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Acronyms

AFD	Agence Française de Développement (French Development Agency)
CFA	Franc des Communautés Financières d'Afrique
CILSS	Comité permanent Inter-État de Lutte contre la Sécheresse au Sahel
CIRAD	Centre de Coopération Internationale en Recherche Agronomique pour le Développement (Agricultural Research Centre for International Development)
CO_2	Carbon dioxide
DANIDA	Danish International Development Agency
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FNGN	Fédération Nationale de Groupements Naam
GDP	Gross Domestic Product
GERES	Groupement Européen de Restauration des Sols (European Group for Soil Restoration)
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (German Society for International Co-operation)
GNI	Gross national income
ha	Hectare
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
INERA	Institut National pour l'Étude et la Recherche Agronomiques (National Institute for Agronomic Study and Research)
INGO	International non-governmental organisation
IPM	Integrated pest management
IRIN	Integrated Regional Information Networks
Kcal	1000 calories
LIC	Low-income country
MDG	Millennium Development Goal
NGO	Non-governmental organization
OECD	Organisation for Economic Co-operation and Development
ORD	Organisation Régionale de Développement (Regional Development Agency)
PATECORE	Projet Aménagement des Terroirs et Conservation des Ressources dans le Plateau Central (Land Development and Resource Conservation Project in the Central Plateau)
PDRD	Decentralised Rural Development Policy
PLT	Projet Logistique de Transport (Transport Logistics Project)
PPP	Purchasing power parity
SSA	Sub-Saharan Africa
SWC	Soil and water conservation
UN	United Nations
UNEP	United Nations Environment Programme
WDI	World Development Indicators
WFP	World Food Programme

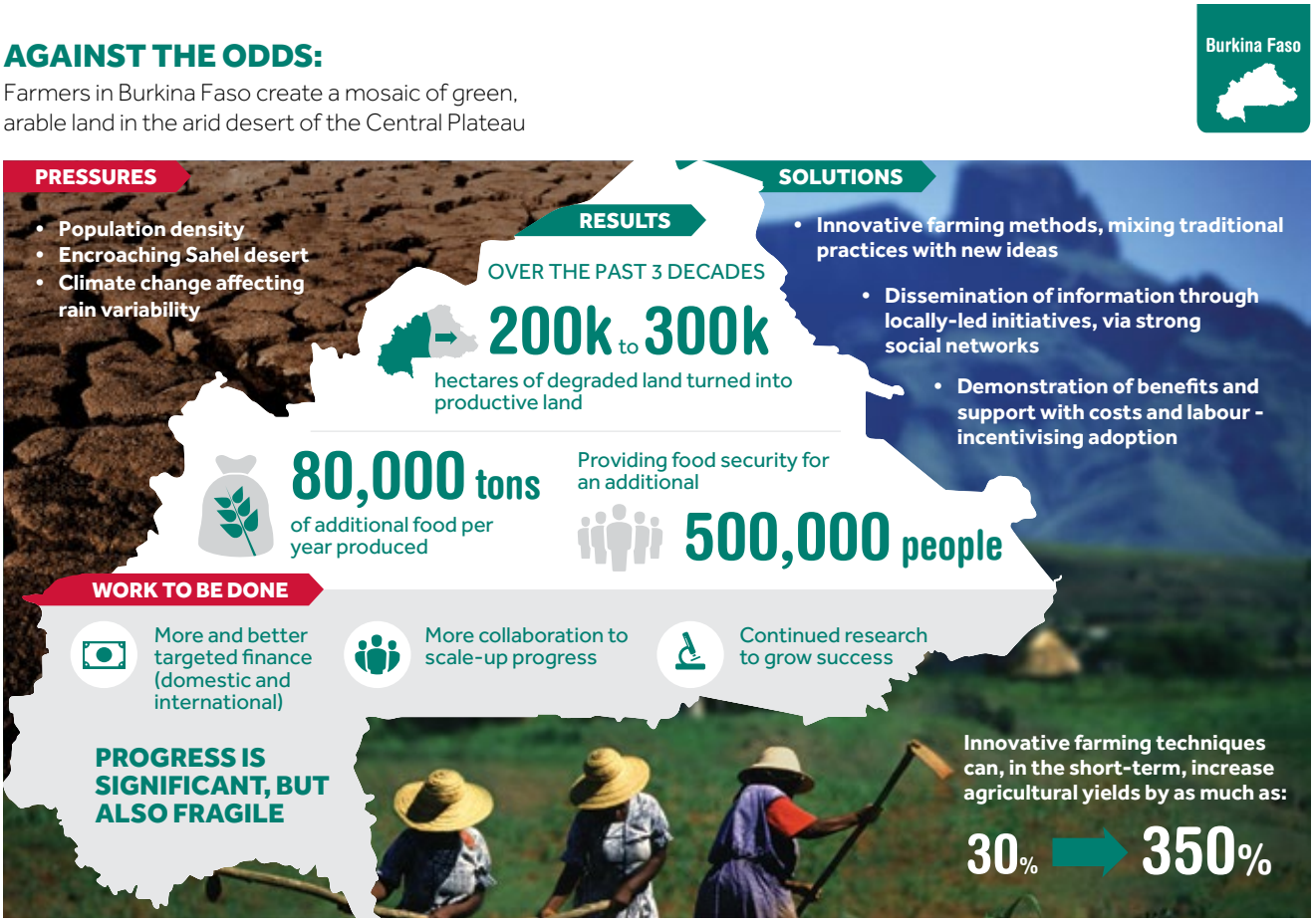
Farmer and child. Photo: © Amanda Lenhardt

Abstract

In the face of increased pressures on land and natural resources as well as a changing climate, the need for sustainably managed agricultural systems will become ever more important. The farmers of the Central Plateau region of Burkina Faso know this all too well. For decades, successive droughts, demographic pressures and the encroaching Sahel have exposed this area to the impacts of climate change. Many smallholder farmers have adapted to these pressures by reclaiming land through the adoption of techniques to conserve soil and water, measures that have also helped to mitigate the impacts of climate change on nutrition, food security and rural incomes. This case study describes the factors that have enabled 200,000–300,000 hectares (ha) of degraded land in Burkina Faso to be brought into productive use through the application of improved traditional farming techniques.

Three main factors have contributed to achieving such progress in sustainable farming in a context of environmental stress and limited resources. First, farmers themselves have been adapting these farming techniques for generations and local knowledge of suitable and efficient methods was crucial. Second, information about the improved sustainable techniques was effectively diffused through existing community networks, facilitated by civil society organisations (CSOs), international non-governmental organisations (NGOs) and government extension agents. Third, the adoption of these improved techniques was encouraged by the provision of financial support for the initial labour and start-up costs, which was essential for many of the poorest farmers.

While progress in land reclamation and sustainable farming in Burkina Faso is by no means complete and many areas remain vulnerable to environmental and economic shocks, the gains made in soil and water conservation over the last 30 years have clearly contributed to the resilience of communities and their ability to mitigate these shocks, which are now understood to be recurrent. Important lessons can be drawn from the case of Burkina Faso regarding the diffusion and adoption of appropriate agricultural technologies, effective social organisation and the role of finance in supporting and promoting progress in sustainable agriculture.



Source: Reij, Tappan and Smale (2009) 'Re-greening the Sahel: Farmer-led innovation in Burkina Faso and Niger' in Spielman and Pandya-Lorch *Millions Fed: Proven Successes in Agricultural Development.*

During the dry seasons, locals prepare the ground to control erosion and catch the water when the rains arrive. Photo: © UN Photo/John Isaac

1. Introduction

Over a period of decades up to the mid-twentieth century, once relatively fertile lands in Burkina Faso were desertified, with disastrous consequences for the communities living there. But since the late 1970s, and accelerating from the mid-1990s, some 200,000–300,000 hectares (ha) have been reclaimed in the Central Plateau region from degraded lands with very low fertility using a range of sustainable farming techniques. Agricultural output has risen significantly in these areas and overall Burkina Faso's crop production index has increased by 82% over 1990 levels (WDI, 2014). While poverty and malnutrition remain major problems in Burkina Faso, improved agricultural yields and the greater stability these techniques offer have mitigated the potentially grave impacts of this difficult agro-climatic situation. Burkina Faso could serve as an example of the kind of water and soil conservation that is possible even in adverse circumstances, a lesson that will become all the more relevant in the face of increasing climatic variability.

Attention to Burkina Faso's progress in sustainable agriculture is warranted for three main reasons. The first and most obvious is that the country has achieved remarkable progress in soil and water conservation. Starting in the late 1970s, and increasing between 1990 and 2010, farmers in Burkina Faso began to reverse the disastrous land degradation that had characterised previous decades, restoring areas that had become little more than desert to fertile cropland. Sustainable agriculture techniques have driven a 're-greening' of large parts of Burkina Faso that have in turn led to higher agricultural outputs and more efficient use of water. Agricultural water withdrawals as a percentage of total water withdrawals declined by 30% between 1992 and 2005, and the proportion of people with access to improved water sources increased by 23% over the same period (WDI, 2014).

The second reason for studying this case is that the progress has been achieved under severely adverse conditions. Burkina Faso is an extremely poor country, with a Gross Domestic Product (GDP) per capita of less than $240 and ranking 183 out of 187 countries in the Human Development Index. It is also severely vulnerable to climatic changes. The Sahelian region, which includes much of northern Burkina Faso, is considered to be one of the most vulnerable to climate change due to its dry and variable weather patterns (Martineu and Tisso, 1993; Lebel and Amani, 1999; New et al., 2000). Farming is largely small scale, often for subsistence, and based on traditional practices. This means that farmers in Burkina Faso typically have very few resources with which to adapt to the changing climate (Jalloh et al., 2013). Yet, despite these challenges, Burkina Faso has succeeded in making tangible and significant improvements in its conditions.

The third reason for examining the case of Burkina Faso is the central role of agriculture, which accounts for about 35% of GDP and employs 85% of the population (WDI, 2014). Millet and sorghum are the primary staple crops, and cotton, groundnuts, cowpeas and sesame are the major cash crops. Improvements in agricultural productivity and sustainability therefore have profoundly important ramifications for the country, both at the macroeconomic level and in terms of livelihoods.

The case study aims to understand how, under such trying circumstances, Burkina Faso has begun to reverse land degradation. We know that this progress coincided with the adoption of more sustainable farming techniques that promote soil and water conservation. But what were the main factors behind this transformation? What has been the scale of progress in adopting these new techniques as well as the direct and indirect outcomes? Which actors were involved? What challenges remain? And finally, what lessons can be drawn for other countries that seek to conserve water and soil in agricultural production, especially those with limited resources and high levels of poverty?

The study focuses in particular on the Central Plateau region of Burkina Faso, which while covering only 25% of the country is home to 43% of the population (IFAD, 2004), including most of the areas of high population density and poverty. In the Central Plateau, the accelerated degradation of cultivated soils and grazing lands, combined with the effects of population growth, climate change and increasing pressure on resources – soil, water and vegetation – had devastating human and environmental impacts.

1.1 The importance of sustainable agriculture

Global population growth, urbanisation and rising wealth are creating new patterns of consumption, including a surging demand for food, raw materials and energy (ERD, 2011). While global agricultural productivity has increased in response to this – growing about 2% per year since 2000 – land productivity seems to have reached a plateau as the rate of growth in major crops is declining (Interagency Report, 2012). Instead, farmers are increasing productivity by expanding the amount of land under cultivation.

This agricultural growth has had a huge environmental cost, and even so does not meet global needs. Intensive agricultural practices can degrade soils, reduce biodiversity and pollute water resources, especially when chemical fertilisers and pesticides are used. Extensive agriculture and livestock overgrazing can lead to deforestation, erosion

Box 1: Three interlinked problems: water, forests and soil

Water is becoming scarcer and agriculture currently accounts for at least 70% of global water consumption. Much of it is wasted due to inefficiencies, particularly in irrigation systems (UNEP, 2014a). The growing use of chemical fertilisers and pesticides is resulting in greater pollution of downstream water bodies. Poor irrigation practices also contribute to soil salinisation, which is estimated to affect 10% of the world's irrigated land, resulting in loss of agro-ecological productivity (McIntyre et al., 2009). Agricultural water consumption is contributing to water-security stress in many regions, with nearly 1.2 billion people living in areas where water is scarce (ERD, 2011), and this trend is very likely to worsen as local precipitation patterns change and as demand for household and industrial uses increases. Watershed management is therefore a crucial component of sustainable agriculture.

Deforestation is driven largely by agricultural expansion, threatening biodiversity and the livelihoods of people dependent on forest products, and contributing to climate change. Agriculture has been estimated to be the proximate cause of 80% of total deforestation (Kissinger et al., 2012). Rates of tropical rainforest deforestation are currently an alarming 13 million ha per year, which represents an area roughly the size of Greece (European Commission, 2014). Deforestation also causes around 16% of global CO_2 emissions (ibid.). Deforestation of watersheds and the drainage of wetlands also pose a major problem, reducing the water-retention capacity and aquifer levels of the watershed area and resulting in increased soil erosion and aridity.

Soil degradation affects 30% of the world's irrigated lands, 40% of rain-fed agricultural lands and 70% of rangelands. Two-thirds of Africa's agricultural area is classified as having poor soils (OECD, 2008), and three-quarters is affected by severe soil degradation caused by wind and soil erosion (Henao and Baanante, 2006). Major causes of soil degradation are the cultivation of fragile and marginal soils, overgrazing, inadequate soil-conservation practices and deforestation (OECD, 2008). Soil degradation, such as erosion, has both on-site and off-site effects. On-site effects include loss of soil, breakdown of the soil structure and the decline in organic matter and nutrients, resulting in a decline in soil fertility. Land-constrained farmers can be tempted to restrict the fallow time, which is necessary for land to regenerate. This is especially true in areas of extreme land scarcity and in regions that are densely populated. The loss of soil fertility reduces agricultural productivity and ultimately leads to land being marginalised or abandoned. Off-site effects include sedimentation downstream or downwind, which affects the flow of rivers and drainage ditches, blocking irrigation canals, shortening the life of reservoirs and increasing the risk of flooding. Soil degradation also has consequences for food production, food security and poverty, and can trigger migration, which may put pressure on other regions (Morgan, 2009; OECD, 2008).

Source: http://ec.europa.eu/clima/policies/forests/deforestation/index_en.htm

and the loss of natural habitat, with devastating long-term costs, as Burkinabé farmers have witnessed throughout much of the twentieth century.

Globally, the extent of degradation has been enormous (see Box 1 above), increasing from 15% of total land area in 1991 to 25% by 2011 (UNCCD, 2013). Unsustainable land practices have resulted in a net loss to crop–land productivity at an average rate of 0.2% per year and it is estimated that if the current rate of land degradation continues over the next 25 years, it could reduce global food production by as much as 12% over that period – the very opposite of projected demands (UNEP, 2009; IFPRI, 2012).

It is widely predicted that this pressure on land and resources will get much worse. Godfray et al. (2010), for instance, predict that the world will need to produce 70–100% more food by 2050 than at present in order to meet anticipated demands. Although the global quantity of food currently produced could feed the world's population, skewed markets and waste mean that food is unevenly distributed between and within countries.

The importance of promoting new approaches to natural resource management in agriculture has been highlighted in a range of reports, from the Millennium Ecosystem Assessment (MEA, 2005) to the International Assessment of Agricultural Knowledge, Science and Technology for Development (McIntyre et al., 2009) or the 2012 G20 interagency report on sustainable agricultural productivity growth. Sustainable agriculture has become critical to ensuring sufficient food and water for an increasing global population, creating sustainable production systems that minimise natural resource use and degradation, addressing climate change and biodiversity loss, and tackling rural poverty.

In 2010, 2.6 billion people, including the majority of the world's poorest, were involved in agriculture (UNEP, 2014b), so improving agricultural productivity in the short, medium and long term will be crucial to reducing extreme poverty and malnutrition. Enhanced productivity along with better performing agricultural markets are also important for people who are living in poverty and who also rely on buying some or all of their food. Sustainable agricultural practices are a fundamental component of food security, particularly where households are vulnerable to a rise in food prices or where they rely on subsistence farming. Achieving this represents a major challenge, especially for the most vulnerable and poor farmers who have low risk-taking ability because of their limited

savings, which means they are often unable to adopt new technologies.

Box 2: What is sustainable agriculture?

The Food and Agricultural Organization (FAO) defines sustainable agriculture (including forestry and fisheries) as that which conserves land, water, plant and animal genetic resources, and is environmentally non-degrading, technically appropriate, economically viable and socially acceptable.

Pretty et al. (2011) more specifically defines the challenge of sustainable agriculture as being to make better use of internal resources, either by minimising the external inputs used (e.g. chemical fertilisers or pesticides), or by generating internal resources more effectively (e.g. nutrient cycling, integrated pest management (IPM)), or some combination of both.

1.2 The geography, population and poverty of Burkina Faso

Burkina Faso is largely flat and arid with poor quality soils. Most of the country relies on rain-fed agriculture, but rainfall has become more variable over the past few decades, causing serious disruptions in plant-growth cycles. Desertification is one of the biggest challenges facing Burkina Faso, caused largely by the greater land needs associated with population growth and the increase in the head of livestock, inadequate methods for exploiting resources, and climatic change (namely rain variability) leading to erosion and flooding (Tankoano, n.d.[1]). Most of the herders are long-distance migrants and there can be tense relationships with settled farmers owing to disagreements about migration routes and resource rights, although cattle can also become part of a settled ecosystem, eating crop residue and supplying manure if their transit is well organised.

Burkina Faso has one of the world's highest population growth rates at 3.1% per year, and the government estimates that the population has nearly tripled in the last 30 years (IRIN, 2009). A population density of around 100 people/km^2 in some of the country's most fragile lands in the Central Plateau puts significant pressure on Burkina's limited resource base and migration to neighbouring countries is often linked to environmental stress. Between 1975 and 1985, the height of droughts in the Central Plateau region, the population of some villages dropped by at least 25% due to migration (Reij et al., 2009b). Traditionally, Burkinabé migrated to Côte d'Ivoire, mainly as seasonal workers, until the outbreak of its civil war in 2002 made the option less attractive.

Burkina Faso's economic growth has remained low but stable since independence in 1960, averaging over 5% between 1990 and 2010, compared to between 3% and 4% in previous decades. The extractives industry is the fastest growing economic sector (31% of GDP in 2011), gold being the principal mineral resource (OECD, 2007). Despite this wealth, Burkina Faso remains one of the world's poorest countries (45% of the population survives on less than $1.25/day (World Bank, 2013)), and the impressive growth figures mask a less secure reality. GDP per capita has fluctuated, falling from $352 to $225 in the 1990s and then rising to $634 in 2012 (World Bank, 2013). Burkina Faso has been regarded as a 'growth–poverty–paradox', showing relatively strong economic growth and good macroeconomic performance, but very limited reduction of poverty. This paradox has partly been explained by the droughts, which have led to higher food prices, and to the reduced purchasing power of the poor (Grimm and Günter, 2005). Burkina Faso's chronic poverty has also been directly attributed to its climatic vulnerability, mainly its aridity and lack of water for agricultural production and human consumption, the degradation of natural resources and high demographic pressure (González and Belemvire, 2011).

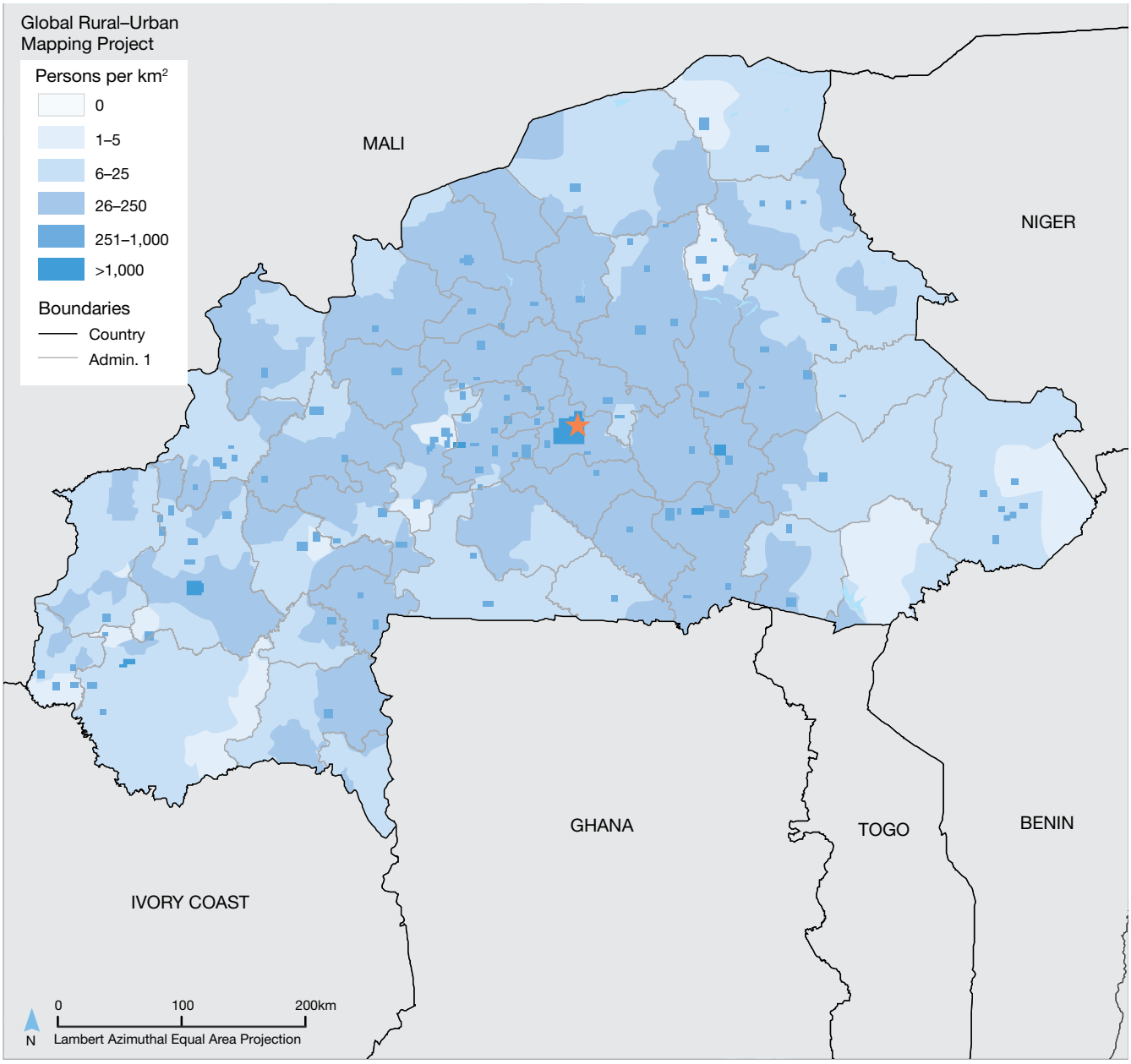
The poverty rate (defined as below $2 a day) in the provinces researched in the case study is over 95%, compared to the 2009 national average of 72.6%. Evidence has linked climatic variability and riskier agriculture to higher rates of poverty in the northern regions of Burkina Faso compared to other regions, and a lack of income diversification has been associated with poverty in the context of climate-related pressures (Reardon and Taylor, 1996).

Population density is correlated with poverty rates in Burkina Faso, as shown by the comparison between Figures 1 and 2 (overleaf). In the mid-1970s, the nexus of high population density, poverty and climate variability reached disastrous levels when a severe drought led to widespread hunger and even starvation, and causing many of those with the necessary means to migrate. Those who remained were forced to drastically alter the way they managed their land simply in order to survive.

There is, however, at least one area in which Burkina Faso has been bucking the trend. Starting in the late 1970s, farmers began to reverse the disastrous land degradation that had characterised previous decades and had turned once green areas of the country into little more than desert. Today, the achievements of smallholder farmers in the Central Plateau stand out as one of the best examples of how to achieve progress in land reclamation in the Sahel (Subsol, personal interview).

1 See: http://www.un.org/esa/sustdev/sdissues/desertification/beijing2008/presentations/tankoano.pdf

Figure 1: Population density in Burkina Faso



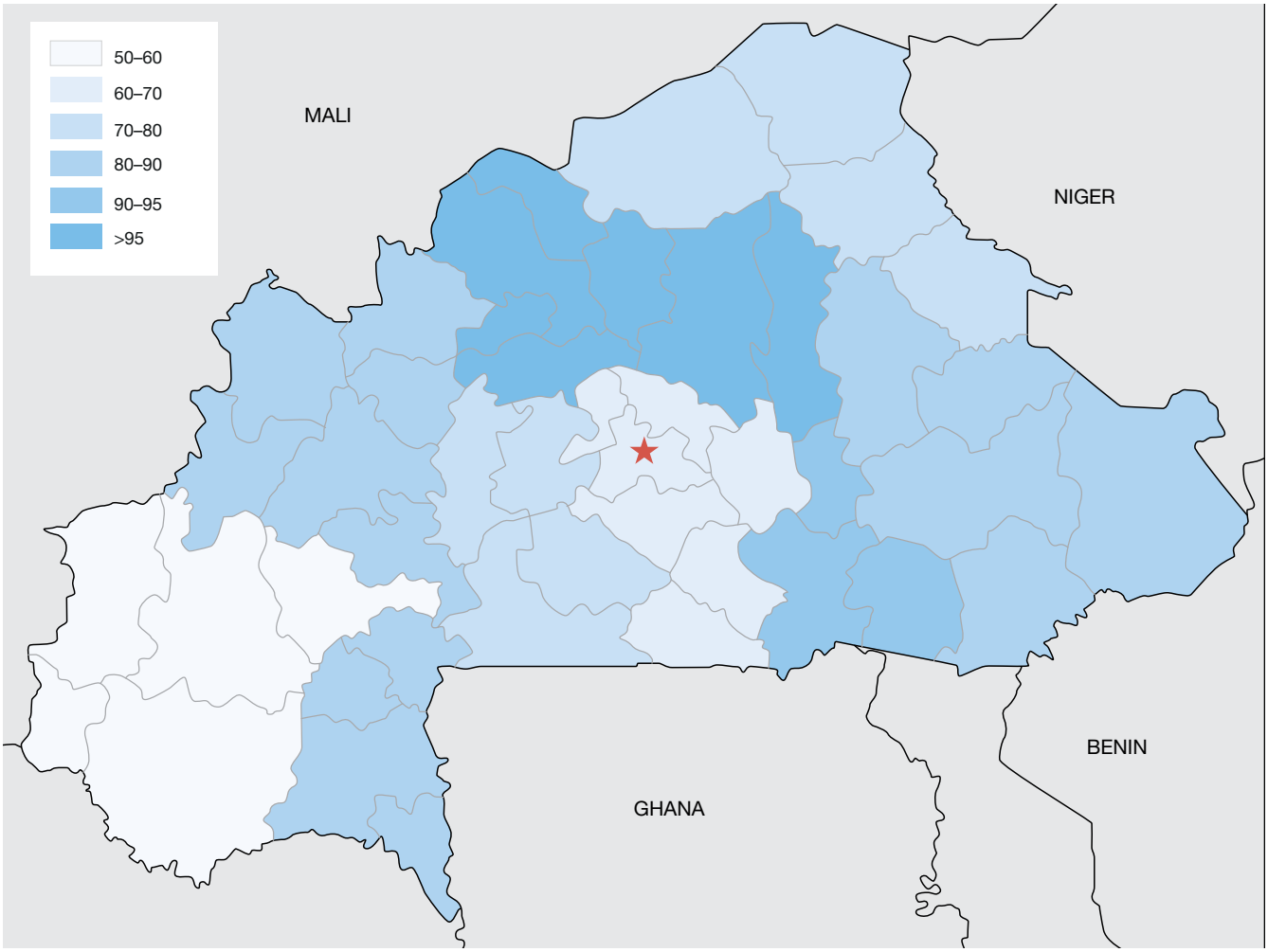
Source: Briceño-Garmendia and Domínguez-Torres, 2011, p.5

1.3 Methodology and report structure

As part of ODI's Development Progress project, there have been six case studies related to the environment. During the first phase, between 2009 and 2011, there were two case studies on sustainable resource management – one on Costa Rica's efforts to tackle deforestation and another on Namibia's community-based wildlife conservation. In the second phase, ODI began to explore issues that face many developing countries, and which are at the forefront of what are likely to be among any post-2015 successors to the Millennium Development Goals (MDGs): sustainable energy (case studies on Brazil and Vietnam) and sustainable use of land and water (case studies on Burkina Faso and China).

Burkina Faso was chosen after an analysis of environmental indicators including: agriculture value-added per worker, agricultural gross production index, change in forest area as a percentage of land area, water withdrawals as a proportion of total renewable water resources, and agricultural water withdrawals as a percentage of total renewable water resources. A range of countries was considered in terms of the absolute and relative progress they had achieved, as well as measured by deviation from fit, which accounts for a country's performance relative to its starting point (see Samman, 2012 for a detailed description of this measure). Consultation with a number of experts and a literature

Figure 2: Distribution of poverty in Burkina Faso (% of population below $2 per day, based on 2005 US$ (PPP))



Source: Wood et al., 2010 in Jalloh et al., 2013

review also contributed to the choice of Burkina Faso. The case study involved secondary research as well as over 35 interviews with farmers, civil society organisations (CSOs), government representatives, donor representatives and academics. There were also field visits to see the techniques being applied and a focus group discussion with farmers in the northern region about their perceptions of progress and remaining challenges.

The report comprises four main sections. Section 2 sets out in more detail what progress has been achieved in terms of land reclamation and relates it to the techniques for soil and water conservation employed by a significant proportion of farmers in the Central Plateau and, to some extent, more widely. We then look at whether this recuperation has led to higher yields and consequent improvements in nutrition and broader development. Section 3 focuses on the three main factors that led to this progress: what techniques worked, their diffusion and the incentives used to encourage their adoption. Section 4 examines ongoing challenges. Every year, thousands of people in Burkina Faso are still affected by droughts. We analyse why, despite important progress, even more land has not been recuperated, particularly in the context of climate change in which the greater incidence of drought and changing weather patterns pose a threat to food production. Finally, Section 5 draws out the four main conclusions for decision-makers and budget-holders: get the technology right; build on existing social organisation; ensure sufficient financing; and enlist international support.

2. What progress has been achieved?

Herder in Burkina Faso. Photo: © Amanda Lenhardt

In the area of sustainable agriculture, Burkina Faso has achieved striking progress: vast amounts of land – in the order of hundreds of thousands of hectares representing 10% of the country's arable land – have been reclaimed from degradation and desertification, agricultural yields and productivity have improved dramatically, groundwater levels have risen, forested area has been replenished, and overall food production has increased. Not only were these outcomes achieved in a context of severe credit constraints but they stand in stark contrast to both the global and regional trends in sustainable land management.

Moreover, when compared to the global trends in this area, the success achieved in the Central Plateau region is even more remarkable. The Food and Agriculture Organization (FAO) estimates that only 10% of the world's land is becoming more fertile while more than three times that amount is experiencing degradation (FAO, 2011).[2] Satellite measurements between 1981 and 2003 show that 12% of the world's productive land declined in productivity – an area home to more than 1 billion people (Bai et al., 2007). This is a particular problem in much of Africa: Kenya, for example, experienced a decline in productivity across 40% of its cropland between 1981 and 2003 (Bai and Dent, 2006), which was linked to soil erosion and nutrient depletion from overgrazing (De Pinto et al., 2011). In this section we analyse this progress in more detail.

- First we look at the initial agro-environmental, social and political context: a vicious cycle of severe land

2 For instance, 25% of the world's productive land is subject to severe degradation and 8% to moderate degradation (FAO SOLAW, 2011).

degradation involving population growth, agricultural expansion and reduced and erratic rainfall.
- Then we look at the two areas of environmental conservation in which significant progress has been achieved: soil and water conservation.
- Finally we assess what this progress has meant for the communities living in the Central Plateau, following the links between increased output and indicators of health and well-being, such as nutritional status and food security.

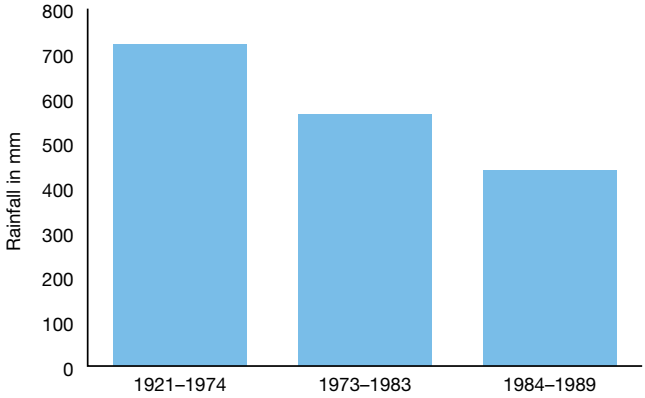
2.1 Initial situation

In the 1960s and 1970s, Burkina Faso's Central Plateau experienced the consequences of a vicious agro-ecological cycle that was driven by both human and ecological changes. To begin with, population pressures had led farmers to expand their cropland in order to meet the rising demand for food, placing great strain on land resources. The region experienced an unprecedented population boom during the second half of the twentieth century. For example, by 1975, the population in Yatenga province had already doubled its earlier 1930 levels (Kaboré and Reij, 2004). This rapid and sustained population growth made the Central Plateau home to some of the highest population densities in the country – ranging from 70 to 100 people per km^2 (IFAD, 2004). Nationally, population density more than tripled between 1961 and 2011, and the population growth rate rose steadily from the 1960s onwards – a phenomenon experienced by few other countries – although it now appears to be stabilising (Jalloh et al., 2013; WDI, 2014).

By the 1970s, the larger population created a much greater demand for food, which in turn resulted in an expansion in cropland – a process known as agricultural extensification. Kaboré and Reij (2004) report that the area of cultivated land in the Central Plateau increased faster than the population was growing with *'about 70 - 85 percent of the village territories (…) cultivated and about 40 percent of this cultivated land was marginal to agriculture'* (p.2). There was also major growth in the head of livestock, particularly from the 1970s and 1980s, making further demands on arable and range lands (Ickowitz et al., 2012). As agricultural expansion reached its boundaries, farmers responded by trying to get more out of their land without increasing inputs, for example by not returning fields to fallow. As a result, soil degradation became widespread. According to Marchal (1977), by the 1970s 80% of all cultivated land in central Yatenga province was being used permanently – that is, with no fallow periods to restore soil fertility.

The tipping point occurred when rainfall decreased and became significantly more sporadic, starting in the 1970s, causing the situation in the Central Plateau to spiral out of control. Multiple studies recorded this downward trend in annual rainfall, combined with highly variable

Figure 3: Rain in Ouahigouya, Yatenga province, 1921–1989



Source: Critchley (1991)

annual rainfall and prolonged dry periods (Mazzucato and Niemeiher, 2000; Critchley, 1991; Roncoli et al., 2001; Barbier et al., 2009).

In Ouahigouya, for example, the capital of Yatenga province, annual rainfall fell from an average of 720 mm during the 50 years prior to 1974, to 438 mm in the 1980s, as shown in Figure 3 above. Severe droughts also struck the region between 1968 and 1973 and again between 1982 and 1984, causing food crises as the population pressures and low soil fertility had already combined to reduce people's resilience to such events. While the 1968–1973 drought led to a significant loss of life, large amounts of emergency aid prevented a similar outcome in 1982–1984 (Barbier et al., 2009).

Perhaps even more damaging than the overall decline in rainfall was the growing irregularity of rain patterns in the Central Plateau. Not only did total rainfall vary significantly from year to year but even within a single growing season, variations in the location and timing of the rains caused severe damage to crops (Kaboré and Reij, 2004; Critchley, 1991). These problems have continued, with farmers in the Central Plateau village of Bonam reporting that 1997 was one of the worst agricultural years in recent memory, caused by unusual rain patterns rather than low overall rainfall (Roncoli et al., 2001) – with lighter rains in the early part of the growing season followed by torrential rain later in the season that decimated crops.

The combination of these multiple factors in the Central Plateau – climatic, demographic, and agricultural – resulted in falling groundwater levels across much of the region. Reij (1983) estimated the rate of decline of the water table to be between 50 and 100 cm per year during the early 1980s.

The worsening agricultural conditions, in turn, caused widespread migration from the Central Plateau as families sought to supplement and stabilise their agricultural incomes. Migration had long been a means for farmers in the Sahel to deal with the insecurity of agricultural returns

Box 3: Three improved techniques for sustainable agriculture in Burkina Faso

- ***Zaï.*** Otherwise known as planting pits, *zaï* are holes dug in the soil in which to place plants. Traditionally these were used on a small scale to rehabilitate hard, barren land that the rain could no longer penetrate. Innovations included widening the dimensions of the pits and the application of manure and other organic waste. The improved planting pits concentrate water and nutrients and, as they are dug in the dry season, also attract termites that improve soil structure by digging channels (Kaboré and Reij, 2004). *Zaï* planting originated in southern Mali, but it is claimed that the technical improvements made in the 1980s were credited as having been developed by farmers in northern Burkina Faso (Essama, 2005). Later, innovations in 'mechanised' *zaï* were introduced, which involved using draft animals to plough the land, important for reducing the labour required for digging the pits, but typically beyond reach of the average Burkinabé farmer.
- **Contour stone bunds.** These are semi-permeable barriers built by placing stones tightly around and within fields. The bunds follow the contour lines on sloping fields and slow down rainwater run-off, encouraging its slow absorption into the soil and reducing erosion by trapping soil particles and increasing soil moisture. Farmers use stone bunds both on fields currently under cultivation and to expand cultivation to new areas. Combining contour bunds with the application of organic fertiliser can further increase benefits (UNEP, 2013). Earlier versions of this innovation used an earth rather than a stone bund, meaning that no water could penetrate, thus causing problems for crops below by retaining all the water. Most farmers rejected this method, but it was eventually adapted, using the stone bunds that are used today.
- ***Demi-lunes.*** Also known as 'half-moons', these are ditches dug in a semi-circular shape and lined with cuttings. The hollowed portion collects water along its walls, allowing crops planted in the ditch to receive much more rain. Like contour bunds, these follow the contour of slopes across fields in order to retain run-off.

(Adams and Mortimer, 1997). When faced with new crises, many households in the region sent family members to neighbouring Côte d'Ivoire, the more fertile southern regions of Burkina Faso, or urban areas elsewhere in the country.

In sum, by the end of the 1970s, the Central Plateau was characterised by a rapidly growing population without enough land or water to sustain it. As more territory was cultivated to replace the land that had been degraded through unsustainable practices and the population's expanding needs, the vicious cycle continued. It was a situation described by one interviewee as 'change or die'. Under this great pressure, and following the great drought of the 1970s and early 1980s, techniques emerged that would begin to reverse this disastrous relationship between human beings and nature.

In the face of the deepening problems facing the region, farmers began to adopt a range of techniques to stem the land loss and recuperate land. Some worked, some failed, but three simple techniques discussed further in Section 3 – *zaï*, contour stone buds, and *demi-lunes* – are considered to have been crucial in halting desertification and reclaiming land for agricultural use. Other techniques such as Farmer Managed Natural Resources and agroforestry were also important innovations over this time, but evidence suggests that it is these three farming techniques that have had the greatest impact on soil and water conservation. We will look in detail in the next section at why these techniques were so effective, and how they spread, but first we analyse their impact.

2.2 Soil and water conservation

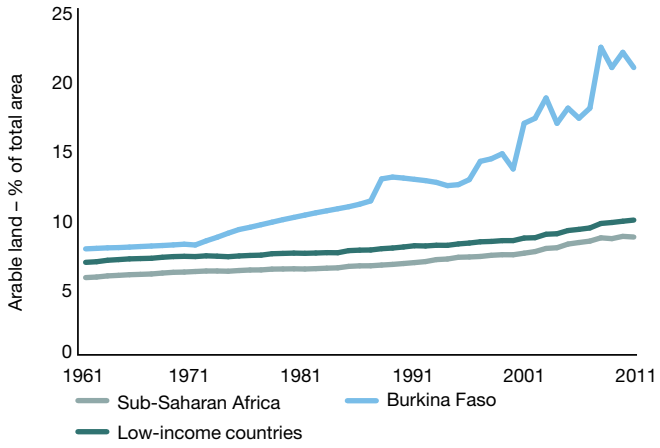
The adoption of sustainable agricultural practices, such as the three main techniques outlined above, appears to have transformed a vicious chain of events into a virtuous one. The situation in the Central Plateau has dramatically improved, with land once thought lost now brought back into use for agriculture and forestry. The total area reclaimed from degradation and desertification is striking. Across the Central Plateau as a whole, estimates range from 200,000 ha to more than 300,000 ha (Kaboré and Reij, 2004; Ouédraogo, 2005). A survey of 123 households that adopted the main sustainable agriculture techniques across five provinces of the northern Central Plateau found an average area of 1.33 ha reclaimed per household (1998 study cited in Kaboré and Reij, 2004).

National statistics show that the amount of arable land in Burkina Faso has increased significantly since the late 1980s.[3] The performance of Burkina Faso in this regard is noteworthy, as it rapidly diverged from the sub-Saharan African (SSA) average, as well as the average for low-income countries (LICs) (see Figure 4). Since 2001, Burkina Faso has exceeded even the relatively high West African average for proportion of arable land. This growth is particularly noteworthy when compared to SSA as a whole, where there is actually an annual per capita loss of 75 m^2 of arable land (IFPRI, 2011). It must be noted, however that some of this expansion has been at the expense of grazing, fallow and reserved land (Kagone, 2006).

Indeed, since the 1970s, SSA has been characterised by the world's highest per capita loss of arable land, 40%

3 Arable land is defined here as 'land under temporary crops, temporary meadows for mowing or for pasture, land under market or kitchen gardens, and land temporarily fallow. Land abandoned as a result of shifting cultivation is excluded' (World Bank Development Indicators, 2013).

Figure 4: Arable land in Burkina Faso compared to other SSA and low-income countries



Source: WDI, 2013

higher than that of South Asia, the next highest region. During the 1990s, SSA and Asia also experienced the highest rates of soil-nutrient depletion (FAO, 2011). Soil depletion refers to a lack of nutrients, minerals, organic matter, acidity, micro-organisms or structure (drainage) necessary for productive plant growth. These characteristics need to be managed and maintained to keep soil healthy, and the failure to do so eventually depletes soil quality.

In Burkina Faso, there are also strong indications that sustainable practices have contributed to better management of water resources, as groundwater levels have risen considerably because of the fact that the improved techniques require less water. Surveying 58 villages across different provinces, Reij et al. (2009b) calculated an average increase of five metres to groundwater levels in the Central Plateau. The fact that the villages with a long history of soil- and water-conservation practices experienced large gains in the water table in both rainy and in dry years, while those villages without such a history did not, suggests that progress cannot be attributed to general climatic conditions but rather to the increase in water-recharge levels due to rehabilitated lands (Kaboré and Reij, 2004; Reij et al., 2004).

In relation to water, such improvements are apparent in the national data. Agricultural water withdrawals as a percentage of the total fell from 81% in 1992 to 51% in 2005, and while industrial water withdrawals rose slightly from 0 in 1992 to 3% in 2005, much of the change has been related to increased municipal water withdrawals, from 19% in 1992 to 46% in 2005.

2.3 Increased agricultural output

In addition to the reclamation of degraded land, the overall productivity of farmland has improved, leading to a significant increase in agricultural output. At the national level, Burkina Faso has seen increasing agricultural productivity, as shown in Figure 5 (overleaf). While yields were relatively static from the 1960s to the 1980s, from in the early 1990s Burkina Faso converged with – and momentarily surpassed – average agricultural productivity in West Africa. Looking at provincial-level data, average yields for sorghum and millet in Yatenga province increased from an average of 694 kg/ha and 473 kg/ha respectively in the 1984–1988 period to 733 kg/ha and 688 kg/ha, respectively in the 1995–2001 period (Reij and Thiombiano 2003: 16).

It is hard to determine how much of this improvement is due to sustainable agricultural practices, and precise comparative measurements are complicated by the variability of annual rainfall. But while agro-climatic conditions in the Central Plateau did improve in the 1990s – with rainfall increasing by between 20% and 30% – there is considerable evidence (outlined below) that sustainable agricultural practices played an important role in the increased productivity. Furthermore, inter-annual rainfall variation has continued to rise, which as indicated above is just as, if not more, important to crop production, and these sustainable practices are particularly useful in mitigating the negative impacts of unpredictable rain patterns.

Between 1995 and 2006, a total of nine studies measured the impact of the new agricultural practices on yields in the Central Plateau under various conditions, and all recorded the positive impacts of these techniques – ranging from 40% to more than 100% (Reij et al., 2009a). When applied to barren fields, these sustainable agricultural practices were capable of achieving yields as high as 1,200 kg/ha in their first year.

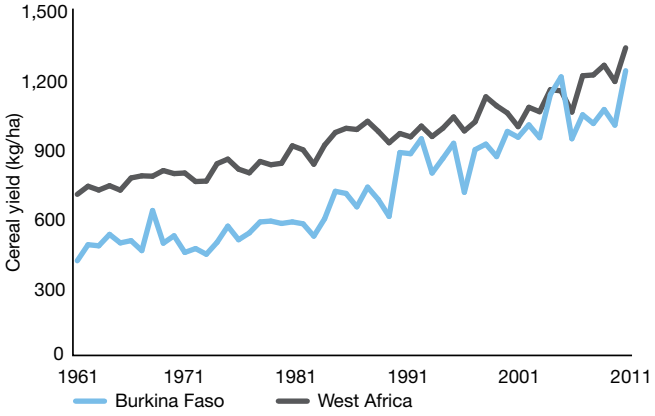
Comparisons between villages that were and were not engaging in sustainable agricultural techniques show that those adopting improved methods attained significantly higher yields (Sawadogo, 2003).[4] Since much of the land was previously exhausted to the point of producing no crops at all, its rehabilitation often brought improvements in crop yields of more than 400 kg/ha (Kaboré and Reij, 2004). The fact that land has not been regenerated uniformly across the entire Sahel, but has been concentrated in particular areas, including the Central Plateau of Burkina Faso, suggests that the adoption of more sustainable practices are behind the increased yields (Deshingkar, 2012).

Finally, two early studies (Wright, 1985; Matlon, 1985) document significant increases in yields from the adoption of stone bunds. Matlon (1985), for example, reported average yields of almost 800kg/ha, representing a 68% increase

4 Average cereal yields in villages with soil and water conservation were 793 kg/ha, while those without had only 611 kg/ha.

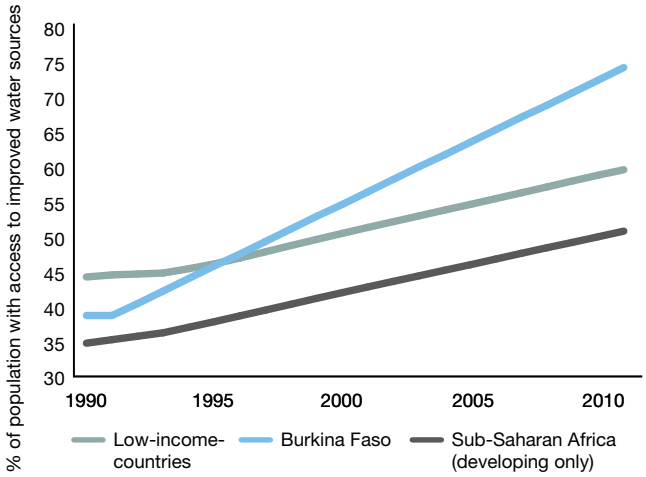
Local gardening project in the Sahel. Photo: © EC-ECHO/Anouk Delafortrie

Figure 5: Cereal yields per hectare in West Africa 1961–2011



Source: WDI, 2013

Figure 6: Improved rural water source (% of rural population with access)



Source: World Bank Indicators, 2013

over control plots in his study of 17 sites across the Central Plateau region. These studies demonstrate that increased yields are the result of adopting sustainable practices.

In addition to greater crop production, improvements in soil fertility are associated with a greater presence of trees. Trees are an important feature in daily life in Burkina Faso, serving multiple purposes including fuel, food, fodder, building material, and the prevention of soil erosion. Kaboré and Reij (2004) note that rehabilitated plots have an average of 126 trees per hectare compared to only 103 on control plots. They also note that fields treated with sustainable practices have more trees than in the previous 10 to 15 years, while those that were not continue to degrade (Kaboré and Reij, 2004).

When taken together, the evidence offers a fairly systematic expression of the positive impacts on agricultural yields and fertility achieved by the sustainable farming practices adopted in the Central Plateau.

2.4 Human impact

The main areas of human wellbeing in which we would hope to see improvements based on achieving progress in soil and water conservation and agricultural outputs include more access to water, higher rural incomes, and better nutritional status. Although it may seem logical to assume that the impact on human lives of the improved agro-ecological practices has been positive, this is hard to substantiate, let alone measure, given the multiple factors affecting human development, including but not limited to agricultural output.

This caveat notwithstanding, Burkina Faso has seen some impressive improvements in living standards associated with sustainable land and water use. Far more households than before have access to water for consumption. Rates of improved access to water in rural Burkina Faso have surpassed the LIC average and are far higher than the SSA average, as is shown in Figure 6.[5] Access to improved water sources in rural areas of Burkina Faso almost doubled from about 38.6% of the population in 1990 (the earliest available figures) to 74.1% in 2011. And while this progress does mean that more water is being withdrawn, increasing from 40m^3 to 57m^3 per capita per year between 1992 and 2005, this remains considerably lower than most countries in the Sudano-Sahelian region of SSA.

During the period under examination, some households have become fully food-secure in the Central Plateau region, and the high average food deficits characterising it

'Conditions here have improved. Before there were no bicycles, no motorbikes. Now many people produce enough to sell and we see bicycles and motorbikes around the village' – Focus group in the Northern region

5 Improved sources of drinking water are classified by WHO/UNICEF (see: www.wssinfo.org) as 'piped water on premises (piped household water connection located inside the user's dwelling, plot or yard), and other improved drinking water sources (public taps or standpipes, tube wells or boreholes, protected dug wells, protected springs, and rainwater collection).'

Box 4: Sustainable agriculture in context – the case of Tougou village

Tougou village, located in the Yatenga province of the Central Plateau, is in many ways a microcosm of the broader region. Extensive agriculture, the over-exploitation of natural resources and climatic changes combined to degrade the quality of the village's cropland. By 2008, farmers estimated that 60% of their fields had been exhausted, yet almost half of all households (47%) had no way of acquiring new land. In fact, the extent of degradation around the village was so severe that the amount of cropped land in 1992 was smaller than it had been in 1973.

There are several common types of strategy to address these problems, including the sale of livestock, eating less or diversifying crops. Particularly striking, however, is the extent of migration. While few households (20%) consider migration to be a desirable way to cope with droughts and none would support a policy to facilitate migration, most villagers have either been forced to migrate or had a family member do so.

Temporary migration is highly responsive to the annual agro-climatic conditions. For example, three and a half times more households sent family members as temporary migrants in the relatively dry season of 2004 than in the fertile season of 2006.

In this context, many households have adopted sustainable agricultural practices, such as the construction of stone bunds and *zaï* –60% have adopted stone bunds, while another 18% plan to do so at some point, and 49% have adopted *zaï*, with a further 26% planning to do so. These techniques provide new options for households to deal with the challenges they face, improve their situation, and ideally provide alternatives to migration.
Source: Barbier et al., 2009

in the early 1980s have been significantly reduced. Most families have seen a reduction in their period of food shortage from six months to two or three months (Reij et al., 2009b), suggesting a halving of the hunger gap, which is a significant achievement.

The adoption of improved planting techniques also has the potential to raise household incomes. Barro et al. (2005b) estimate that 1 CFA (West African CFA franc) invested in mechanised *zaï* (see Figure 8, page 28) yields a return of 14 CFA. On average, they estimate that investments in mechanised *zaï* planting can yield a return of 150, 000 CFA/ha per year. At the time of their study this amounted to approximately $300, or around 75% of annual per capita income.

Nevertheless, high levels of malnutrition and poverty persist in much of the Central Plateau and Burkina Faso more widely, and indices even appear to be deteriorating in some areas (see Section 4). Many factors influence nutrition and poverty, but we believe that the situation is likely to have been worse had these sustainable farming techniques not been adopted.

Although difficult to quantity, a number of interviewees stated that it would have been harder to cope with recent food crises without the gains in productivity that have been achieved. A representative of the European Union (EU) working on its humanitarian response in Burkina Faso noted that its programmes have been shifting away from emergency response towards building community resilience, with agriculture at the core (personal interview, 2013). Likewise the World Food Programme (WFP) states that water conservation and improvements in agricultural production are its main strategy for helping communities to face drought, floods and spikes in food prices (WFP, 2014).

Although the risk of famine remains, the catastrophic events of the 1973–1974 drought, which led to numerous deaths, have not been repeated (Sawadogo, 2007; PreventionWeb, 2014). While the avoidance of famine cannot be directly tied to the progress made in land reclamation and sustainable farming techniques, we know that these innovations provide significant returns within one planting season and that food production is estimated to increase by 25% to 75% with the adoption of these improved techniques (PATECORE and PLT, 2005). This suggests that their use can in indeed lessen the impact of crises on individual households.

'Preventing starvation is good, but even better is to give farmers the means to produce' – Former senior government official in agriculture

Photo: © Amanda Lenhardt

3. What are the factors driving change?

In this section we look at the main factors behind this impressive reversal after so many decades of mismanagement and failed attempts to arrest desertification:

- First, the techniques. Progress in reclaiming land was possible only because the techniques worked. In many cases, these built on existing farming techniques rather than being wholly derived from outside sources, an important distinguishing feature from earlier failed techniques. But having appropriate techniques was not enough.
- The second factor was dissemination – albeit incomplete – of this knowledge in the region and across the country, allowing other farmers to benefit from proven techniques. But for many farmers and communities, knowledge alone was not enough to ensure their uptake – constraints and barriers remained.
- The third factor was the encouragement of the adoption of the sustainable agriculture techniques offered by the government, international agencies, local producer organisations and CSOs.

A range of actors has been involved in the Central Plateau's progress, from the farmers themselves, to international donors, and several others in between. We have identified six main relevant actors: individual farmers and their communities; local and national NGOs supporting farming communities; state institutions; official donors (bilateral and multilateral) and international NGOs; researchers and academic institutions; and, more recently, local government. These played different roles at different times in the three factors of progress we have identified. Table 1 summarises the contribution each made.

3.1 Finding techniques that work

Perhaps the most important factor in the adoption of sustainable agricultural practices in the Central Plateau region has been the nature of the techniques, namely the *zaï*, the stone bunds and the *demi-lunes*. If the agricultural techniques had been less effective, none of the other factors we discuss later would be relevant. Therefore exploring how the specific practices were developed is a key part of this story.

The problem of desertification had been clear for many years before these techniques were (re-)introduced, and many previous attempts to stem the degradation of land had been tried. Why did the *zaï*, stone bunds and *demi-lunes* work where so many previous attempts had failed? It is unlikely to be coincidental that these three practices built on traditional processes and techniques already used

Table 1: Six players involved in achieving progress

Actor	Role
Farmers and communities	Developed the techniques that were later scaled up Strong community organisations were crucial in disseminating knowledge and supporting uptake
National and local NGOs	Important support networks were already established Linked communities with the state and donors
State institutions	Supported all stages of the process via local agents Gradual transformation of role, reducing presence on ground
Donors and international NGOs	Crucial at early stages in identifying and perfecting techniques Financed introduction of techniques Gradually increased in prominence, filling the gap in state involvement in some cases
Researchers and academic institutions	Sustainable agriculture techniques were not widely known in the academic community at the end of the 1980s Dissemination spread and developed the ideas more widely during the 1990s
Local government	Not a key player initially, but increasingly so since 2000

in the region as improvements were made to these farming methods, and emerged from bottom-up participation with local communities and leading farmers. This is in contrast to previous techniques, which were imported from different contexts, applied in a 'top-down' manner, and are broadly considered to have failed.

For instance, the GERES project (Groupement Européen de Restauration des Sols, 1962–1965) was a forestry scheme geared towards the development of whole watersheds with dykes, ditches and canals. The objective was to counter erosion, but people were not involved in the selection of sites to be protected and did not maintain the facilities. Consequently, despite nearly 120,000 ha developed, the results of the GERES project were close to zero or even negative (some non-maintained and defective facilities accelerated erosion). The project was consequently abandoned in 1966 after these failures.

From 1970, the Fonds de l'Eau et de l'Equipement Rural, a ministerial body investing in agricultural innovation, drew lessons from GERES and invested in small installations for the most fertile lands (likely to be better maintained by farmers), and used a slightly more participatory approach. But these techniques also proved unsuitable, causing floods in rainy years or limiting runoff downstream in dry years. Near Ouahigouya, where some of these projects took place, farmers partially destroyed the facilities so that the fields downstream could benefit from runoff (Interview, Kaboré, 2013).

In the 1960s, mechanisation was favoured. Heavy machinery such as tractors were imported from India, after the presumed successes of the Indian 'green revolution', by a government persuaded by foreign research – but their distribution was highly politicised and eventually made no impact. New seeds were distributed, but without the participation of the people involved, who were poorly informed and were known to eat the seeds rather than plant them.

Learning from such failures, farmers and the organisations that supported them sought to develop techniques better suited to the dual challenges of soil depletion and climate change. In the case of stone bunds, earlier attempts that were not permeable created problems for farmers below them as they prevented the flow of water beyond these contours, but an adaptation based on the longstanding practice of using stones to delineate fields – which were known to retain water – was developed and gradually improved so that they became efficient by following natural contours as opposed to marking property boundaries. Many farmers had for decades known instinctively that cordons of stones retained water, but it was only in the late 1970s, following catastrophic famine, and the realisation that previous attempts to recuperate land had ended in failure, that they started being perfected – with the help of several national and foreign experts – eventually becoming the semi-permeable stone bunds that have proved so effective at water retention.

Where previously local people had been the spectators of work being done *for* them, they were now deeply involved in the process. The local and national government, along with NGOs like Oxfam GB and independent foreign experts, were all involved in supporting the development of these traditional practices into even more effective farming techniques.

One of the most attractive features of these technologies is that many benefits accrue within the first planting season, or in the dry season, thus avoiding a long lag between the farmer's investment and the increased return to recuperate initial costs. This is particularly important given the resource constraints of very poor farming households, as most are in northern Burkina Faso.

As we have seen, impacts in the medium and long term include anti-erosion control and infiltration of water, maintaining or increasing soil fertility (including nutrient levels and structure), and the production and diversification of biomass, including forage. The *zaï* technique can rehabilitate land within three to five years (Kaboré and Reij, 2004), a relatively short period of time considering 10 to 15 years of fallow are typically required to achieve the same result.

The (re-)discovery of these techniques was an exciting breakthrough, but known to a very small group of farmers. As farming communities perfected the techniques, their diffusion was supported by local, national and international organisations, official agencies and CSOs alike.

3.2 Diffusing knowledge

If information about new techniques is not widely disseminated there is a risk that it fails to spread far beyond pilot plots. And if information is not accurate and appropriately communicated, farmers may misapply new techniques and even end up doing more harm than good.[6] In the case of sustainable agriculture techniques in the Central Plateau, the diffusion and adaptation of successful techniques appears to have been fairly widespread and effective.

There is little consensus on the most effective approaches to facilitate or directly disseminate new techniques at the village level. The achievements in the Central Plateau region can be seen as evolving from what Davis (2008) calls the 'traditional' view of agricultural extension – focused on increasing production, improving yields, training farmers and transferring technology – towards the contemporary view of extension which 'goes beyond technology transfer to facilitation; beyond training to learning, and includes assisting farmer groups to form (….) and partnering with a broad range of service providers and other agencies' (Davis, 2008: 48).

6 This has been the case with the misapplication of chemical fertilisers where crops have burned owing to a lack of understanding about the correct application (personal interview, former extension agent in Ouahigouya, 2013).

It is difficult to arrive at a reliable estimate of diffusion (as opposed to adoption) of sustainable agricultural practices in the Central Plateau; impact studies have generally focused on limited village or sample plots. Despite these limitations, project reports corroborated through expert interviews imply that the techniques themselves are well known and widely shared. According to interviews in one village in the northern region, it was suggested that all farmers knew about the techniques, and we take this as fairly typical. Belemvire et al. (2008) report that no village in the Central Plateau remains unexposed to the practices as all of them have at least some level of adoption. They also note that the practices have been incorporated into every rural development project in the country.

As we have seen, successful soil- and water-conserving techniques were replicated by neighbouring farmers to some extent. But that is only a small part of the story of how these techniques became common throughout the Central Plateau and beyond. The work of local, national and international organisations has been crucial to disseminating information.

3.2.1 Local organisations

Although it is not widely recognised internationally, Burkina Faso has one of the most active and diverse civil society networks in SSA. The Africa Capacity Index ranks Burkina Faso second after Ghana in SSA in terms of individual and organisational capacity as well as for its 'enabling environment' (after Ghana). Much of this is centred on agriculture and takes the form of farmers' groups as well as a large and engaged National Farmers' Union (FNGN). Farmers' groups and national NGOs are recognised as having a significant impact on the dissemination of information, not just about improved farming practices, but also marketing and credit. Some also branch out into health and education information (GFRAS, 2014).[7] The FNGN has over 300,000 members, both men and women, is spread across 1,200 villages and is independently financed through various activities that attract donor and government funds (GFRAS, 2014). The union is particularly active in the Central Plateau given its base in Ouihagouya, and has representatives who are elected by their communities in every village in the region. These local people played a crucial role in supporting the dissemination of the *zaï*, stone bunds and *demi-lune* techniques (interview with FNGN, Ouahigouya, 2013).

Some producer organisations are still growing, such as FNGN, and are involved in the dissemination of technical training in soil and water conservation, in particular *zaï* and stone bunds. Often these associations or groups are led by one or several peasant leaders who have several mandates. They are usually the most dynamic members of the community, adopting innovations observed at exchange visits organised by projects. The economic and social power of these individuals is greatly increased by such positions, which are often paid. Approaches to dissemination are as varied as the projects but overall the focus is on participation. These organisations and their broad community engagement have gone some way in mitigating what might otherwise be an inequitable distribution of information or benefits towards better connected or resourced farmers, and there has been an undeniable expansion of the skills and capacities of farmers' organisations for the dissemination and adoption of soil and water techniques (IFAD, 2006).

3.2.2 Support from national and international organisations

As the benefits of sustainable agriculture became ever clearer, farmers and their organisations were able to attract support from donors and from the government for further dissemination. As well as playing a key role in educating representatives about successful techniques, the FNGN mediated between farming communities, its core constituency, and other parts of the national and international apparatus.

Along with other NGOs, it championed and filled knowledge gaps in these techniques until they gained the attention of others, including international aid agencies.

Serious dissemination efforts began in the early 1980s with the PAF project – an agroforestry project supported by Oxfam GB – which began promoting semi-permeable stone bunds via a participatory approach in a number of villages while also establishing village committees to manage resources. At the same time, pilot projects of the German Federal Enterprise for International Cooperation (GIZ) and the Permanent Interstate Committee for Drought Control in the Sahel (CILSS), as well as associations and innovative farmers such as 6S (see Box 5) validated the bunds and *zaï* techniques as the most attractive options for farmers. *Demi-lunes* were tested by an agroforestry project funded by Oxfam GB, but did not gain immediate popularity. They were promoted between 2000 and 2010 via a project funded by the International Fund for Agricultural Development (IFAD), and farmers now increasingly use them (Reij et al., 2009b).

In parallel, the government of Burkina Faso encouraged NGOs to intervene and support villages in the northern parts of the Central Plateau since it was one of the poorest regions in the country (Reij et al. 2009). The Regional Development Agencies (ORD) of the Ministry of Rural Development began to co-ordinate rural development at the decentralised level. In most rural areas in the 1980s, and to some extent today, development projects were aimed at a rural population that was growing, largely illiterate, very socially unequal, and barely coping with the degradation

7 See: http://www.g-fras.org/en/world-wide-extension-study/africa/western-africa/burkina-faso.html

Box 5: 6S – an innovative grassroots village-development association

6S stands for Se Servir de la Saison Seche en Savane et au Sahel – which means 'Making use of the dry season in the Savannah and the Sahel'. The organisation was found in 1967 by a teacher and extension agent with the aim of using the dry season, when farmers tend not to have work, in order to promote village development.

'(6S) aims at connecting the scattered peasant self-help groups and supporting the self-reliance of villagers through providing funds and training groups in the Sahel region… One of the main reasons why these projects have worked quite well is the existence of the grassroots communicators. The communicators, as their name shows, transmit information from the grassroots to the 6S leaders and vice versa. They also conduct the literacy courses in local languages, supervise ongoing projects, receive delegations from and visit other villages, and are responsible for basic health care in the village.' (Uemura, FAO)

of agricultural and pastoral land. Village-level agency was therefore strengthened by support and capacity-building for producer organisations and associations.

Finally, the academic community began to assume an important role from the beginning of the 1990s. Whereas the universities in Ouagadougou had previously tended to promote foreign techniques, the reports from field researchers on the successful techniques now being used awakened more serious academic interest in them, which in turn generated information dissemination and rigorous academic backing.

Today, the techniques we discuss here are well known in almost all areas of the Central Plateau. In order to be truly effective, these techniques depend somewhat on a community approach, implying that communicating them successfully to neighbouring farmers and communities is in the direct interest of those who are already using them. In cases where only parts of a watershed are regenerated, i.e. only a few individual farms adopt the techniques, the full impact of these interventions cannot be realised. The adoption of stone bunds on one farm, for example, is unlikely to reduce runoff if bunds are not constructed on neighbouring farms (donor interview, Ouahigouya, 2013).

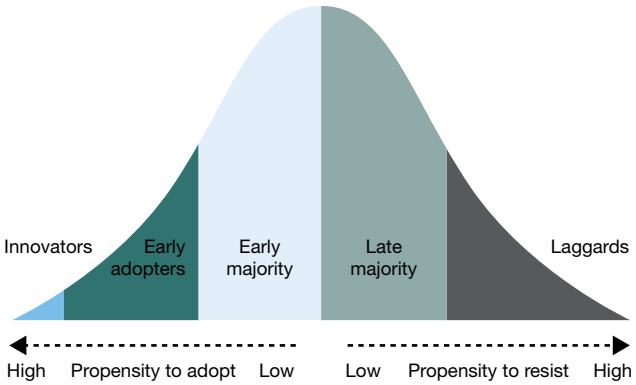
The impact of the combined efforts to encourage the adoption of sustainable agriculture techniques in the Central Plateau region of Burkina Faso and beyond is clear. Several studies suggest high rates of adoption across the Central Plateau. Ouédraogo's 2005 study of 30 households in two villages, conducted in the early 1990s, found adoption rates to be as high as 50%. They also noted significant variation in adoption as rates were found to be as low as 10% in some areas depending on the income level of households and the quality of land available.

Despite the widespread recognition of the importance of these techniques, adoption remains limited. In the village mentioned above, although everyone had heard of these techniques, not everyone had adopted them. There remain barriers to their adoption, and it is to this, the next rung of the ladder of successful water and soil conservation, that we now turn.

3.3 Encouraging adoption

Despite the broad appropriateness and effectiveness of the techniques developed in the Central Plateau, the diffusion of information about them proved in some cases to be necessary but insufficient to achieve significant adoption. Often, communities and farmers that were well aware of the techniques were not using them, suggesting that access to information was not the constraint. The first stage in the adoption of a new technology is innovation (see the Technology Adoption Curve developed by Rogers, 1962, Figure 7). This early phase was characterised by co-development and learning so that the technology was fine-tuned and adapted to the local environment by experimentation by farmers, supported by NGO technicians. This experimentation was occurring in a number of scattered villages but farmer organisations and NGOs were important for scaling them up (Reij et al., 2009b).

Figure 7: Technology adoption curve



After these adaptations had been communicated by farmers' organisations and NGOs, the qualities of the technology captured the attention of the second group: the early adopters. And this is where the barriers to adoption started to become clear. These barriers are related to

Watering the farm. Photo: © Ollivier Girard /CIFOR

the resources required to adopt even these fairly basic techniques, namely time (labour) and money, both in short supply in some of the poorest farming communities.

Any farmer is capable of mastering the *zaï* technique, but it is more commonly adopted by wealthier farmers, presumably because of their greater access to labour, either family or hired workers (Kaboré and Reij, 2004). The early adopters tend to be exceptionally committed or talented individuals and/or had a certain amount of money to invest in trying and perfecting new techniques. The majority of farmers, however, would need further incentives. The barriers facing poorer farmers are essentially inputs and labour.

3.3.1 Cost of inputs and labour

Despite the relatively low costs associated with these techniques, for most farmers the investment required to transport the stones is significant. Furthermore, biomass and water are needed for compost and organic matter inputs, which are the most important factors to improve yields – which may also contribute to lower rates of adoption among resource-poor households, since they are less likely to have livestock. Without these, the necessary nutrients needed to regenerate soil are not present. On lands that are not fully degraded there may be less of a need for biomass, but regular nutrient maintenance is necessary for all productive farming. These inputs may be costly and/or in short supply.

Although these techniques are significantly more cost-effective than previous attempts, there are also still considerable labour costs associated with their installation. It is estimated that installing *zaï* in just one hectare of land requires 300–650 hours of work (or 50 hours of so-called 'mechanized' *zaï*, using a plough as pictured in Figure 8, overleaf), or about six to twelve weeks' work for one person working every day, depending on soil conditions. Help from family members, neighbours or hired labour will generally be needed. Installing stone bunds is equally labour intensive. *Demi-lunes* are estimated to cost around US$100/ha (Ndiaye & Zoungrana, 2010).

With such high labour costs, it is intuitive that households with available or affordable labour (either through family ties or by hiring labour) would be better able to adopt the techniques. This is especially so since in 90% of farms in the country, human labour is the only source of power (Sanders et al., 1990).

Nor is it only the initial investment that constrains uptake. Regenerated plots need to be protected against straying ruminants – goats, sheep and cattle – and additional protection may also be needed against overgrazing and erosion.[8] Improvements then also need to be maintained.

The initial and ongoing input and labour costs, as well as the costs of simple tools, mean richer farmers can more easily rehabilitate land while poorer farmers can only do so incrementally. Ouedrago (2005) confirmed that the adoption of these technologies was particularly difficult for low-income households, and in a two-village study (using household data from 1992 and 1994) he found that adoption ranged from 10% to 50%, increasing with income level.

3.3.2 Mitigating costs

The only way these techniques were going to be adopted more widely was with subsidies from government agencies and NGOs committed to their uptake. A number of donors in Burkina Faso promoted these new farming techniques from the 1980s onwards, particularly GIZ, IFAD, AFD, DANIDA and the World Bank. Aid contributions steadily increased throughout the 1970s from 4.8% of Gross National Income (GNI) per capita in 1970 to 11.3% in 1979. The 1980s and 1990s saw significant donor contributions to Burkina Faso, averaging 11.7% and 16.6% of GNI respectively. In the 1980s and 1990s, according to interviewees from donor agencies, many focused on agriculture, and the Central Plateau region was targeted because of the concern about food security. Many of these donors are now turning to other areas of the country where higher-value crops are seen to provide a more viable source of income and where land degradation is less pressing (see discussion in Section 4 on financing challenges).

In the Central Plateau region, the German-funded PATECORE project was crucial in alleviating some of the adoption constraints. This was a conservation and land-development project, commencing in 1988 and ending in 2006. One distinctive feature of this project, which differed from the earlier failed donor-funded conservation techniques, was the inclusion of farmers in the planning and implementation phase, leveraging local knowledge about the types of techniques likely to work in these environments. The project encouraged villagers who requested assistance to form a land-resource management committee and develop land-use management plans. They were then trained in techniques in building stone bunds and some hand tools were provided to the village committee.

The project also helped to finance the cost of transporting stones and supervision in constructing stone bunds by a project extension expert in the first year and locally trained technician in the second year. The village community was responsible for developing a village land-use management plan, nominating volunteers for training, contributing voluntary labour for all activities, monitoring and future planning, and supervising development activities. This project was important in alleviating some of the constraints to adoption in the targeted groups in the Central Plateau by reducing the cost of inputs, particularly the cost of transporting the stones needed for the bunds. This reduced uncertainty in obtaining these essential inputs

8 This is also why it is important to work at the community level, rather than every farmer needing to 'fence' his or her plot with e.g. thorny bushes.

Figure 8: Mechanised *zaï*

Photo courtesy of Albert Barro/INERA (Institut de l'Environnement et de Recherches Agricoles)

– particularly poor farmers who are the most risk-averse – to adopt this new technology.

The benefits measured by the PATECORE project upon its completion included:

- Increased food production by between 25% and 75%, depending on the initial severity of soil degradation reducing pressure to expand cultivation onto new land
- Improved farming practices, including the integration of cattle farming and tillage
- Improved carrying capacity for the land, so the over-exploitation of natural resources did not increase despite population growth

There is some variation in the adoption levels in villages, with those that have a long history of soil and water conservation adopting these techniques more systematically (72–94% of the cultivated land has been rehabilitated) than villages with shorter history (9–43%) (Reij et al., 2009a). There is some evidence indicating that Sahelian households that are accustomed to migrating have significantly higher adoption rates largely because they have remittance income, enabling them to improve their food security by increasing production.[9] Konseiga (2004) found that households that adopted stone bunds and migrants' households in the Sahelian region of Burkina Faso have significantly higher labour assets than their counterparts. The study concluded that the direct effect of the loss of family labour through migration was compensated by increased investment in innovations because migrants were only absent outside the production season and also that migration was more likely among larger households.

Our fieldwork suggests that the adoption of these farming techniques by poor farmers is indeed more likely where there is assistance in reducing barriers to adoption, particularly in covering the cost of inputs, tools and labour. Academic research has also found that these techniques have been more widely adopted in areas of the Sahel where there has been strong external assistance (Konseiga, 2004).

9 Deshingkar (2012) challenges this proposed causal mechanism by noting the importance of public investment in SWC and suggesting that migrant families may be better educated than others and thus better able to obtain access to support provided by government and NGO schemes.

Box 6: The changing role of the state and civil society

With the introduction of structural adjustment in the 1980s and 1990s, the state largely disengaged from the agricultural sector and quickly lost its ability to co-ordinate the sector or fund interventions. One interviewee who was involved in agricultural policy during this time emphasised that this retreat was largely driven by pressure from international financial institutions, as was the case in so many developing countries at that time. The Ministry of Rural Development was split in two. While the Ministry of Agriculture and Livestock retained its supervisory role, major projects began to be implemented directly by large NGOs or consultants, funded by multilateral or bilateral donor agencies. Although decentralised services were always involved in helping to plan and implement these projects (local and provincial leadership) their resources had significantly reduced, meaning that they were dependent on project funding. Government decentralisation is only a recent undertaking, and still very much in early stages, so lower levels of government have typically played a very small role in agricultural development.

In parallel, from the early 1990s, civil society began to thrive. This was partially enabled by the introduction of legislation that led to the formalisation of NGOs and producer organisations, which in turn made possible the beginning of decentralised cooperation between funders and local organisations. It has also been suggested that the Burkinabé government has been relatively supportive of CSOs and has tended to include them as partners in development strategies more generally (ACT-A/DEWG, AACC & EED, 2011). This has led to the creation of numerous associations and producer organisations created to manage (micro) development projects and local initiatives including microcredit.

The PATECORE project illustrates this move away from the state towards civil society when, in 1997, its strategy and objectives were changed. State services at the local level, once responsible for co-ordinating the dissemination of land-regenerating techniques, were cut back. In their place was formed a partnership of farmers' organisations and NGOs, which worked directly with peasant farmers. This change was in line with the Decentralised Rural Development Policy (PDRD) adopted in 2000 which transferred the management of state resources to municipalities and CSOs.

Projects are multiplying, as are the actors involved and the domains of intervention. This has led to significant co-ordination issues, as will be discussed in the next section. The state is present only in terms of strategic and policy frameworks and its local agents of decentralised services, but plays a minimal function in the implementation and monitoring of projects. Another problem is that NGOs are rarely able to provide geographical cover (they tend to work in selected villages only) and tend to focus on specific aspects of agriculture (e.g. SWC, IPM, value chains) rather than providing a holistic service to farmers. Moreover, they are not formally accountable to their beneficiaries.

In the Central Plateau, adoption has spread beyond the wealthier minority because significant external support has been available for study tours, tools, subsidised transport for stone bunds and food-for-work projects for the poorest.

Cash-for-work and food-for-work have been key elements of a number of projects. For example, GIZ spent up to 25% of its annual budget to support the adoption of these techniques, a 'large proportion' of which was for cash-for-work (interview, donor representative, Ouahigouya, 2013) – given the high labour demands of building and maintaining bunds and *zaï*, some farmers cannot adopt the techniques without financial support. One expert argued that food- or cash-for-work projects had led to impressive adoption, but that more is needed; maintenance of the bunds and *zaï* also require financing.

In the 1980s, government departments had substantial resources to implement local projects using agents who covered a cluster of villages. These relied on Village Associations that, although often unrepresentative and poorly organised, facilitated the purchase of agricultural equipment, community granaries, and received support for the development of small earth bunds. The central government has since receded in many areas of the country (see Box 6), but as noted earlier, the national farmers' union and other CSOs have sought to fill this gap. Even so, according to some reports there is an acute shortage of relevant advice for farmers on most agricultural enterprises, perhaps with the exception of certain cash crops where a contract-farming system is in operation (interview with agricultural researcher).

In addition, research organisations such as INERA, CIRAD and other action-research projects offered approaches to tackle the main obstacles to uptake. Where there was a need for labour-saving technologies, they have more recently offered small donkey mechanisation (pictured above) and ploughs; where there was inadequate organic matter, they suggested improved composting methods.

4. What are the challenges?

Photo: © Amanda Lenhardt

The evidence of progress in soil and water conservation in the Central Plateau is impressive, but there is still a very long way to go. While the development of sustainable agriculture techniques has been successful and while diffusion of these techniques has been almost universal, adoption rates are still far from what they ought to be. Moreover, the human gains from better conservation, reclaimed land and higher agricultural outputs are hard to distinguish, presenting a complex and somewhat contradictory picture of the progress achieved.

Burkina Faso continues to experience severe crop damage from flooding – the result of torrential rains over a period of several months. In 2010, for example, excessive rainfall from July to October caused extensive damage across the Central Plateau and other regions of Burkina Faso, affecting an estimated 133,000 people (PreventionWeb, 2014). Agro-climatic changes involving not only decreasing annual rainfall, but also the greater variability and unpredictability of rain patterns, are still placing tremendous strain on agricultural production in the Central Plateau.

That resource-constrained farmers in the Central Plateau region have made significant strides in sustainable agricultural development and the reclamation of unproductive lands in such a climatically vulnerable region by resource constrained farmers is an achievement by any standards. But the breadth of progress in the region has yet to reach a transformative scale. Our analysis suggests four main challenges to address in order to further scale up land reclamation.

- Limited co-ordination has slowed down large-scale improvements.
- The need for continued improvement and innovation in land reclamation and sustainable maintenance techniques.
- More investment is needed, but particularly more strategic investment focused on the most vulnerable.
- A more integrated approach is needed to address the social, environmental and economic processes that promote sustainable development.

Bringing these four aspects together would constitute what one interviewee described as a systems approach to land reclamation and sustainable development which

integrates resources (financial, natural and human) in such a way that costs and benefits are accounted for across each, and brings individual and institutional efforts together to achieve a transformative level of land reclamation (interview: Kasent, INERA, Ouagadougou, 2013).

4.1 Limited co-ordination slowing down large-scale improvements

A common finding from research interviews is that the lack of co-ordination among the various parties involved has limited the scale of adoption of sustainable farming techniques. The successful adoption of soil- and water-conserving techniques on a large scale requires a high level of organisation and a broad diffusion of technical training. Farmers need to be mobilised to invest in their own lands where resources are available, and financially supported where they are not; and social cohesion at a village level is needed for the successful implementation of community-wide projects (PATECORE & PLT, 2005).

Government ministries in particular have been identified as not just failing to co-ordinate with each other, but also inconsistent, given that a myriad policies have been defined and projects implemented without a clear set of priorities, and many are cancelled before they have even started (MAFAP, 2012). Recent policy commitments suggest that the government is prepared to make a concerted effort and investment in sustainable agriculture, such as the SCADD (government 'Strategy for Accelerated Growth and Sustainable Development 2011–2015') or nationwide programmes such as the 'Projet Aménagement des Terroirs et Conservation des Ressources dans le Plateau Central' (PAPSA) (translated as 'Project to Improve Agricultural Productivity and Food Security'), but interviewees pointed out the need for careful co-ordination across ministries and different levels of government to scale up outcomes (personal interview Bologo, Ouagadougou, 2013; personal interview, representatives of Ouahigouya local council, Ouahigouya, 2013).

International agencies including bilateral donors, NGOs and the United Nations specialised agencies have played a crucial role both in terms of financing but also in the implementation of projects over the past 30 years. These agencies have interacted with government bodies, local groups, and to some extent with one another (e.g. bilateral agencies and WFP), but co-ordination across each of these levels has been described as highly unstructured (personal interview, donor representative, Ouagadougou, 2013). More strategic planning and co-ordination at this level could hugely raise the impact of interventions, particularly where these need to be collective (e.g. village-wide, or watershed-wide as in the case of water conservation). Much of the success of PATECORE, for example, has been attributed to the project's long-term vision and collaboration with local and international NGOs and WFP.

Collective action at the local level is fundamental. Community-scale interventions in water conservation, for example, are far more effective when they are adopted across watersheds rather than on an individual farm basis. While local groups may have the capacity to organise communities around shared objectives, they are unlikely to have the resources to invest in public infrastructure. Government, bilateral agencies and international NGOs will need to continue to explore opportunities to work with these groups, not only to disseminate technical

Farming in the Sahel. Photo: © M. Tall (CCAFS West Africa)

information but also to garner support and engagement in larger-scale improvements.

4.2 The need for further technical innovation

Research, training and practical projects continue to develop innovations to promote the integration of sustainable agricultural practices into farm-operating systems. But several of those interviewed in the course of this case study highlighted the technical weakness of many of the parties involved in the development and dissemination of soil- and water-conservation techniques. The techniques as such, despite being highly effective from an environmental perspective, still have room for improvement in order to be more viable for adoption, particularly for the poorest farmers. The main technical solutions that emerge from the literature, confirmed by our interviews, are aimed at removing household-level constraints:

- *Transport:* This is a particular problem for the stone bunds, while the *zaï* and *demi-lunes* require fewer inputs. Transporting stones requires light equipment such as donkey carts or trucks. Poorer households are unlikely to have access to such means of transport, which means that innovations that minimise transport requirements will increase their abilities to adopt sustainable techniques. For example, where there are too few stones or areas are too remote to transport stones to the site, vegetated filter hedges have been used as an alternative (see Spaan (2003) for an extensive overview of how these alternatives can best be applied).
- *Labour:* The use of small machines or draft animals (cattle or mules) for the construction of *zaï*, *demi-lunes* and the regeneration of degraded soils have had very promising results. Equipment can be reasonably affordable and there is far less need for labour, reducing it from 300 hours/ha to just 50 hours (Barro et al., 2005a).
- *Organic fertilisation:* The increased production of biomass and compost will be essential to ensure future improvements in agricultural production. As noted earlier, soil-nutrient depletion is a worldwide problem, and for progress to continue in Burkina Faso there will need to be significant innovations in organic fertilisers. A representative of Oxfam GB in Burkina Faso cited this as the number one challenge to achieving continued progress in sustainable agriculture in the country and the NGO is currently piloting a number of approaches to improve compost production (interview with Oxfam GB representative, Ouagadougou, 2013).

4.3 Not just more investment, but more strategic investment

There seems to be a need for financial investment to promote the adoption of the sustainable agriculture techniques set out here, particularly among poorer communities. While many farmers have adopted the techniques with little financial support, the relatively low adoption rates despite widespread diffusion of the techniques imply that financial barriers are important, a conclusion supported by the interviews we conducted. The cost of transporting stones, of small pieces of machinery, and of labour are significant for many farmers.

According to analyses of the various dissemination initiatives in the Central Plateau region, information about techniques for soil and water conservation is widely accessible and is not dependent on prior knowledge or association with externally funded projects. However, limited investment, along with a short-term vision, particularly on the part of donors (exemplified, with the notable exception of the PATECORE project, by repeated pilot projects) can restrict diffusion from reaching a threshold beyond which information can transfer further.

Several interviewees pointed out a targeting problem, i.e. the most vulnerable farmers do not overcome poverty, with information and financial support largely benefiting the richest or those who already had some social and political power. An alternative explanation could be that wealthier families are better educated and are therefore better able to avail themselves of the support provided by government and NGO schemes (Reij et al., 2005).

At the regional level, incomes are lowest in the northern part of the Central Plateau, exactly where the most progress in sustainable agriculture was achieved. The adoption of improved techniques has also been partly dependent on social structure and power relations within communities. Many projects have used existing social networks and community structures to disseminate information (indeed this contributed to these projects' success). However, there is the danger that in doing so these projects served to reinforce inequitable power relations within communities, and where there was some financial gain to accrue from their adoption, resource inequities could also be affected. Only those farmers who were directly supported through financial inputs and labour or who had the resources to adopt these new techniques themselves were able to benefit from these innovations.

During the 2008 drought and the food crisis that followed, the government of Burkina Faso and international agencies became even more aware of the need to strengthen the resilience of rural populations. The Burkinabé government has reached the Maputo target of increasing public investment in agriculture to 10% of national budgets every year, but cereal production, apart from rice, tends not to receive specific support. While meeting this target is a significant milestone, there is little evidence to suggest that this investment is being focused on small-scale sustainable farming techniques, and in fact a number of interviewees questioned the way in which finance for agriculture was measured to reach this target.

Box 7: UNEP's integrated approach to the planning and management of land resource

Expanding human requirements and economic activities are placing ever-increasing pressures on land resources, creating competition and conflicts and resulting in suboptimal use of both land and land resources. If, in the future, human requirements are to be met in a sustainable manner, it is now essential to resolve these conflicts and move towards more effective and efficient use of land and its natural resources. Integrated physical and land-use planning and management is an eminently practical way to achieve this. By examining all uses of land in an integrated manner, it makes it possible to minimize conflicts, to make the most efficient trade-offs and to link social and economic development with environmental protection and enhancement, thus helping to achieve the objectives of sustainable development. The essence of the integrated approach finds expression in the co-ordination of the sectoral planning and management activities concerned with the various aspects of land use and land resources.

Source: UNEP, 2014c

Support for resource management and sustainable agricultural practices (which mainly concern the production of cereals for the local market) remains at the level of projects aimed to enhance food security, counter the effects of drought and provide emergency relief. Some donors have also been criticised for focusing on big agricultural interventions aimed at larger-scale economic growth and higher value-added products (like cotton), rather than assisting small farmers and supporting the production of food crops.[10]

The cash- or food-for-work schemes that were part of many projects in the past 30 years have proved their worth but appear to be reducing in scope, noted by local government leaders in Ouahigouya with whom we spoke as a major barrier to progress. The FNGN national coordinator agreed that 'we need more means', i.e. financial support. Given the clear success of the bund and *zaï* techniques, among others, it is likely that significantly greater finance for such schemes would lead to a major expansion in the amount of land recuperated annually. The rising interest in climate finance may be a way to attract international support.

4.4 Lack of an integrated approach

Folke et al. (2002) identify two common but erroneous assumptions in natural resource policy: first, that ecosystem responses to human use are linear, predictable and controllable; and second, that human and natural systems can be treated independently. Discussions with farmers in the Central Plateau region suggest they are all too aware of the first error. The irregularity of rainfall patterns, for example, is now widely understood to be the norm (Interview: FNGN, Ouahigouya, 2013). However, the discontinuity and short-termism of policies and programmes aimed at building resilient ecosystems and communities have not been aligned with the challenges of an unpredictable and uncontrollable climate. Only an integrated and long-term approach to the rehabilitation and maintenance of lands can cope with the non-linear nature of natural systems.

The next step for this kind of systems thinking will be in watershed management which is needed to achieve better protection against erosion (see the new GIZ strategy) but this will require far better planning and management across several villages and a process of joint resource management through the establishment of a development plan. It will be a long and complex process.

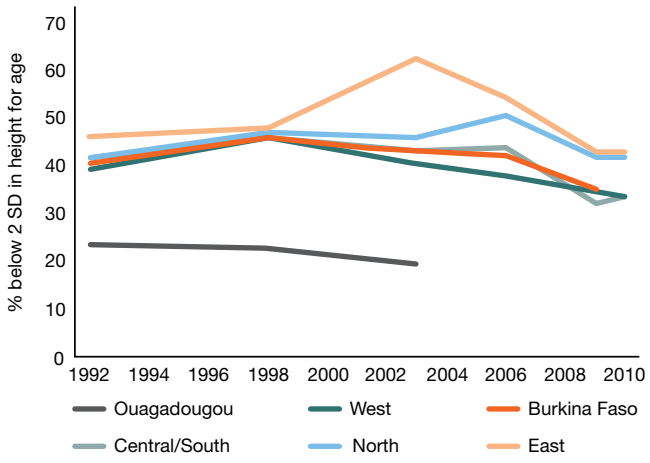
4.4.1 Linking better nutrition to sustainable agriculture

A number of compounding factors that have been discussed earlier have meant that improvements in agricultural yields have not translated into the improved nutritional status of the population. For example, the 'growth–poverty paradox' noted in Section 1, which is linked to erratic climate patterns and spikes in food prices has meant that the purchasing power of households has changed very little over the last 20 years. This remains a serious problem in terms of the food security of poor households when food is short. Furthermore, Burkina Faso's high population growth has placed additional pressure on limited resources. The return of migrants from neighbouring countries that have recently experienced conflict has added to this pressure. This study maintains that higher agricultural yields achieved through land reclamation and the adoption of improved farming techniques have helped to mitigate these challenges, but the next hurdle is to take this progress to a level that moves the country from simply mitigating crisis to attaining sustained improvements in food security and the population's nutritional status.

Reij et al. (2009a) calculate that the increased yields in the Central Plateau have led to an increase in cereal production of between 80,000 and 120,000 tons per year, which they claim is enough to ensure the food security of between 0.4 and 0.6 million more people. And yet, according to official statistics, most people's nutritional status has not significantly improved over the period either

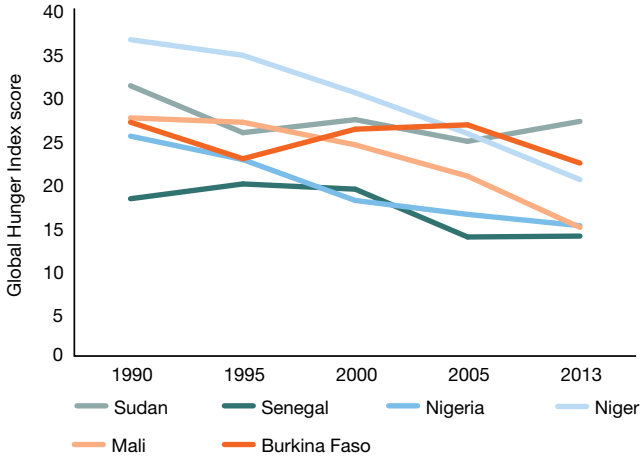
10 See also the New Alliance for Food Security report for Burkina Faso, which has little to say on supporting dryland agriculture, available at: http://feedthefuture.gov/resource/burkina-faso-new-alliance-cooperation-framework-english

Figure 9: Stunting in Burkina Faso 1990–2010



Source: WHO, 2013

Figure 10: IFPRI Global Hunger Index 1990–2013



Source: IFPRI, 2013

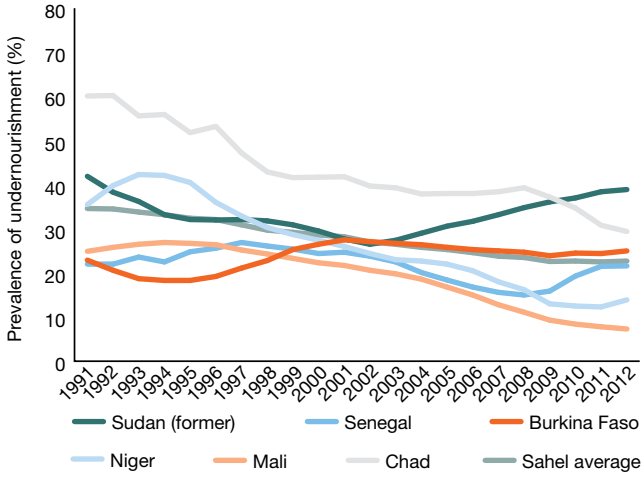
in Burkina Faso as a whole or in the Central Plateau region specifically. Stunting (a low height-for-age measure), which is generally considered to be a longer-term indicator of nutrition and feeding than wasting (a low weight-for-height measure) (WHO, 2014), has not been reduced substantially in Burkina Faso. Figure 9 shows fairly stable rates of stunting across the northern region in the Central Plateau and in Burkina Faso as a whole over the 1992–2010 period, with some improvements in recent years.

More worrying still is the fact that other countries in the Sahel region have achieved greater improvements in nutritional status and food security than has Burkina Faso. The International Food Policy Research Institute's (IFPRI) Global Hunger Index, which tracks countries' standing in terms of the prevalence of hunger in their population, found that while Sahelian countries have, on average, steadily reduced the prevalence of hunger, Burkina Faso has at times experienced a deterioration in the 1990s and 2000s (see Figure 10).[11]

Figure 11 shows that Burkina Faso's performance in the early 1990s was significantly better than the regional average, recording the lowest rate of undernourishment among the Sahelian countries. Between 1995 and 2000, however, the situation declined in both absolute and relative terms, and Burkina Faso is now below the regional average. A similar trend is observable in the country's food deficit, measured in Kcal (1000 calories) per person per day (Figure 12, overleaf). In 2012 around 2 million people were affected by food shortages and high food prices (IRIN, 2012).

Clearly more needs to be done to help the progress achieved in adopting sustainable farming techniques to support an adequate and nutritious food supply for the

Figure 11: Prevalence of undernourishment (%) in Sahelian countries



Source: FAO, 2013

country. The gap between improved yields and inadequate food security suggests that poor distributional and market mechanisms are preventing greater gains from taking root.

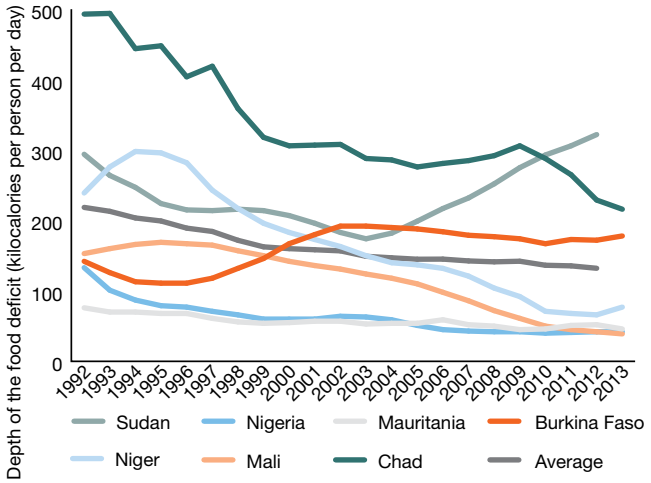
It is important, however, not to let the apparent lack of progress in human indicators overshadow the impressive gains achieved through the adoption of sustainable agriculture in the Central Plateau. While positive outcomes in human indicators, like health and nutrition, are certainly the desired goals for interventions such as the one that took place in the Central Plateau, the relationships connecting food production with nutritional well-being are complex, and many factors might prevent improvements in

11 The scores are aggregated across three dimensions: the prevalence of undernourishment, underweight children and child mortality.

Pounding millet into flour. Photo: © EC-ECHO/Anouk Delafortrie

one sphere from translating into gains in the other. These factors include food prices, access to markets, national development policies, macroeconomic and agricultural policies, poverty, and the prevalence of diseases and lack of access to health services (FAO, 1992; 1997). Even migration is identified as a critical factor in people's nutritional well-being (FAO, 1997), and given that several hundred thousand Burkinabé were repatriated from Côte d'Ivoire in the late 1990s, it is easy to see that this might have placed further strain on the food system of an already overpopulated area. Gender relations are also a critical element of access to food at the household level, and factors like men's control over household finances and cash generated from the sale of surplus production can affect the food security of the entire household. In this sense, achieving progress in agriculture and food production in Burkina Faso is best considered as a necessary but insufficient step to achieving more profound gains in nutrition and food security.

Figure 12: Depth of food deficit 1990–2010



Source: World Bank, 2013

'In the past, we followed the trees to help us predict the rains. Today, if you followed the trees you would get lost' – Food security representative, local village association

Watering the vegetable garden in Ninigui Village, Yatenga. Photo: © P. Casier/CGIAR

5. What lessons can we learn?

Burkina Faso is seldom turned to for clues on how to respond to development challenges. Indeed, in most ways it is not a typical success story. The country ranks 183 out of 187 countries in the Human Development Index, and it remains one of the world's poorest countries with 45% of the population living on less than $1.25/day (UNDP, 2013; World Bank, 2011). However, in one particular area – sustainable agriculture, specifically in soil and water conservation – Burkina Faso has made tremendous progress in the face of adverse circumstances. This achievement holds important lessons on how to increase agricultural production while conserving natural resources such as soil and water, and even adapting to environmental and climatic changes.

To conclude, in this section we briefly summarise the main lessons and recommendations based on our analysis of this extraordinary progress. Although the case we have looked at is specific to the context and theme, we believe that certain key lessons can be useful for many other types of development intervention, especially those that attempt to embed an important technology in the lives of poor communities. We suggest four:

Low-cost and effective technologies are fundamental, with bottom-up participation of local communities and farming leaders needed to ensure they are appropriate to local conditions.

None of this progress would have been possible if the appropriate technology had not been developed, no matter what support was given to it. Diffusion and adoption occur to some extent naturally when technology is seen to work, notwithstanding the constraints on uptake discussed earlier. It took many years to develop the most appropriate and effective technology in this case, but when it came, the impacts were significant.

It would be tempting to conclude that locally developed solutions are likely to be most appropriate, but that would not seem to be a sensible lesson. External, hi-tech solutions (such as mobile phones and solar panels) are very much in evidence in the Central Plateau region of Burkina Faso, undoubtedly supporting development objectives, and the *zaï* and bund techniques have been disseminated in neighbouring regions and countries where they are not indigenous.

It does appear, however, that in some circumstances locally developed solutions, building on traditional practices, may have a higher chance of adoption than foreign techniques. In the case of the Central Plateau, given previous failures in introducing new foreign techniques, the fact the *zaï* and stone bunds were an improvement of existing practices meant that farmers were more open to adopting them.

Engaging existing organisations and local networks in the dissemination of information on new (or adapted existing) technologies and to channel support for their uptake can be an effective extension strategy.

In this case, the pre-existence of strong social and community networks and organisational capacity made the dissemination and adoption of the appropriate techniques much more successful. It is hard to make recommendations about what to do when there are no such historical ties since it is impossible to implant them. But it does appear that building as far as possible on existing networks, even if they are weaker than those in Burkina Faso, should be a core strategy in the dissemination and adoption of appropriate technologies.

We can see from the case of Burkina Faso that there are great benefits to working with existing social organisations and supporting their development initiatives. We have also seen, however, that some initiatives cannot be fully realised, at least beyond individual plots or disconnected pilot initiatives, without the broad-based buy-in of local residents. Existing networks can mobilise people to work together, to invest time or resources in community-wide projects, or to share collectively in the benefits (e.g. tool sharing, rotating micro-credit).

In doing so, it is important to recognise the potential to intensify inequalities by channelling information and resources through local elites. While leading farmers may be the best placed to reach the largest number of people, there is a need to understand the nature of local social dynamics to ensure that engaging them as promoters does not entrench existing power differentials.

More financing is needed to support smallholder famers in adopting improved sustainable techniques, and the available funds need to be targeted appropriately.

One of the main findings of this report is that despite the apparently low cost of introducing the sustainable agriculture techniques described, adoption has been more limited than might have been hoped. The major constraint

is that poorer farmers lack the necessary resources. If the projects had not been funded, adoption rates would have been lower still. By the same token, more and better targeted funding would almost certainly lead to greater uptake. Co-ordination among the funding agencies would also go a long way towards linking up projects so they can be collectively more effective, learning from successful interventions and avoiding duplication.

As we have seen, although there may be more funding for agricultural development – whether through the government's commitments to the Maputo declaration of 10% public spending on agriculture or from international donors – these resources are increasingly being targeted towards higher-value crops in less fragile areas and away from smallholder food production. Although incomes clearly need to rise in order to overcome Burkina Faso's 'growth–poverty paradox', food security and nutrition are still pressing issues that require funding to be directed specifically to smallholder farmers. Diverting funds to large-scale production and cash crops endangers sustained efforts to support these farmers.

International context.

While unsustainable agriculture needs to be addressed at the national level, it may be hard to make progress in some contexts without international financial and technical support. In a very poor country like Burkina Faso, there are many calls on a very limited public budget, but even in richer countries, funds are not always directed to small-scale farmers, especially when the techniques being supported are low-tech. At the dawn of the Sustainable Development Goals that are likely to succeed the MDGs after 2015, donors should be even more interested in directing attention and funding to land reclamation, given its nature as a global public good, as well as being part of an anti-poverty strategy.

There are emerging opportunities for climate finance to play a role in supporting farmers to mitigate climate change. Some initiatives have been aimed at smallholder farming, such as IFAD's 'Adaptation for Smallholder Agriculture Programme'. However, there remains a huge gap between the potential for these resources to assist farmers and what has been possible given the way these funds are currently structured. A recent FAO report found that low demand for such credit, high transaction costs in obtaining it, and the potential conflict between mitigation and development objectives are significant in preventing these funding sources from working effectively (Lipper et al., 2011). Resolving these issues and unlocking the potential of climate finance initiatives to reach those in the frontline in addressing the impacts of climate change could have immense returns.

Woman carrying cotton outside Zorro village, Burkina Faso. Photo: © Ollivier Girard for Center for International Forestry Research (CIFOR)

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Woman making flour. Photo: © Amanda Lenhardt

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Development Progress

Overseas Development Institute
203 Blackfriars Road
London SE1 8NJ

Tel: +44 (0)20 7922 0300
Email: developmentprogress@odi.org.uk

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