Restoring forested landscapes for climate resilient and circular food systems

The case of Ghana's Bono East Region

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Ministry of Agriculture, Nature and Food Quality

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Contents

Preface

This study explores the contours of what is one of the most popular nature-based solutions of the decade: Forest and Landscape Restoration (FLR). As the world has recently entered the UN Decade on Ecosystem Restoration, FLR is strongly promoted worldwide. FLR is widely accepted as an appropriate solution to the dangers of climate change and biodiversity loss. It is however less considered an appropriate solution to solve the global food crisis. Nevertheless, we believe that FLR can contribute solving the food crisis, if implemented from a food system perspective, and in synergy with other nature-based solutions such as rainwater harvesting. It is this belief that is reflected in this research, which aims to build bridges between multiple nature-based solutions within their socio-spatial and institutional context.

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The Netherlands based team wishes to thank the Ghana based colleagues and partners for the great collaboration that has helped us through the COVID-19 pandemic in which no traveling or fieldwork was possible. The Ghana based team did a great job in connecting with farmers, policy makers and practitioners, thus assuring that the research outcomes are evidence based and co-created.

Together with the Ghana based team we also acknowledge the Districts and Municipals that have been involved in the study: Kintampo North District, Atebubu Amantin Municipal, Nkoranza South Municipal and Techiman North District, who all contributed valuable time and knowledge. We also wish to acknowledge the great contributions of Tropenbos Ghana and the Forest Services Division of the various Districts, for taking the time to share with us their knowledge and experience.

Meda w’ase papaapa!

Ir H.I.J. Bruggeman
Director
Wageningen Centre for Development Innovation, Wageningen University & Research

1 Introduction nature-based solutions

The research project *Nature-based Solutions for Climate Resilient and Circular Food Systems* examines a range of nature-based solutions (NBS) and their potential for raising climate resilience and circularity of food systems within various contexts. One of these contexts is the Bono East region in Ghana, and is carried out in collaboration with the Technical University of Sunyani and Solidaridad Ghana, which is part of the international NGO Solidaridad based in the Netherlands.

Based on a context analysis and after stakeholder consultation, two specific NBS were selected to be studied, as these were considered relevant to the food system problematics in the Bono East Region. These two NBS are 1) rainwater harvesting (RWH) and 2) forest and landscape restoration (FLR). A detailed background paper on rainwater harvesting is provided in a separate document, while this document focuses on the second NBS, that is forest and landscape restoration (FLR). It examines the potential of FLR as a NBS that potentially contributes to enhancing food system performance, within the context of climate change. It focuses on the Bono East Region in Ghana, where FLR, in conjunction with other NBS such as rainwater harvesting, could make a difference in terms of climate resilient food systems. It assesses the way in which FLR can contribute to food security in theory, and how it actually does contribute to food security in practice, in Bono East. It zooms into the challenges that are related to FLR for food, and examines the policy requirements that are required to maximise its potential.

Chapter one of this document provides a general introduction to nature-based solutions, and how these serve to both enhancing climate resilience and circularity of food systems. The second chapter zooms in on FLR as a particular nature based solution that is most effective when carried out at the landscape scale. Chapter three highlights the potential of FLR for food systems, highlighting the direct relation between FLR and the various components of food systems. The fourth chapter zooms into the specific situation of Ghana, and of Ghana's Bono East Region in particular. It sketches the context of forests, deforestation and restoration in Ghana, and sketches the current practice of FLR for food in Bono East.

The fifth chapter examines the future of FLR for food in Bono East, by exploring its potential, but also its challenges which are mainly related to the availability of water. It assesses the potential of creating synergies between FLR and other NBS such as rainwater harvesting, as an attempt to build combined NBS strategies to arrive at stronger climate resilience and circularity of Bono East food systems. It finalises with sketching the potential ways forward for Bono East's food system, based on the literature, and on the reality on the ground. This final chapter leads to the conclusion that combining multiple NBS, in this case FLR and rainwater harvesting offers the highest potential for climate resilience and circularity for food systems in Bono East, in Ghana and beyond.

This document it is part of a series of research papers on NBS and their potential to solve problems related to climate, circularity and food. The series provide answers to questions such as which problems related to climate and circularity do they solve, what are the relations between NBS and food, what would be the best way to have NBS implemented, and how can geo-spatial data analysis can be of help. The scientific aim of the papers is to contribute to the growing body of knowledge on NBS, how they are conceptualised, and how they work. The practical aim of the papers is to help practitioners and policy makers in choosing the right NBS for the right spatial context, and develop the most effective implementation frameworks to scale NBS to higher levels of implementation. With this, the papers aim to contribute to the ambitious targets that the world has set for combatting climate change, biodiversity loss and food insecurity in an integrated manner.

2 Forest and landscape restoration: a nature-based *landscape* solution

Within the literature on nature based solutions, forest and landscape restoration is frequently mentioned as a NBS having the potential of solving multiple problems at the same time. It builds on the proposition of FLR that it follows the natural dynamics of forests and ecosystems, while aiming for achieving larger benefits within a landscape, its ecology, its economy, and the general wellbeing of its inhabitants. This assumed triple-win makes FLR an attractive NBS to invest in, as it claims to provide multiple benefits for nature, food and people within a landscape, while taking into account the full consent of the inhabitants that live, work or otherwise depend on the landscape. It offers opportunities for both adapting to and mitigating the negative impact of climate change, while enhancing biodiversity and meeting the growing global food demand. Criticasters however warn that framing FLR as a NBS reduces the value of FLR to yet another silver bullet approach, which is bound to fail if not carefully contextualised. The following chapter therefore provides an overview of FLR, where it comes from, what are the general discourses behind, and how FLR can realistically contribute to food system performance, climate resilience and circularity.

2.1 Landscape approaches: multiple views

FLR stems from a larger body of landscape literature and is captured in what is generally referred to as '*landscape approach'* – or, more accurately, '*landscape approaches*': a range of more or less spatially oriented approaches aimed at multifunctional land use, each highlighting a particular dimension of a landscape (van Noordwijk et al., 2003; Colfer, 2011; Sayer et al., 2013; Reed, 2015). Landscape approaches are part of the much wider defined place-based or area-based approaches which do not address one particular sector but a larger geographic area instead. Landscape approaches have gained momentum over the past decades, as they offers a broad perspective on the relations between nature and society, and call for more integrated of conservation, natural resources management and spatial planning. In doing so, they claim to reconcile conservation and development objectives within a single landscapes, by spatial planning and policy integration within space (Sayer et al., 2013; Arts et al., 2017). This optimistic view makes them very attractive for practitioners and policy makers who have been searching for win-win solutions to respond to long standing resource conflicts, especially in the Global South (van Oosten, 2021).

Landscape literature is divided over various disciplines, each of which highlighting different dimensions of a landscape. The socio-cultural dimension describes landscapes as unique places where natural and social dynamics are strongly integrated. It builds on the view that the lifestyle of a people is not only embedded in their immediate ecological environment, but also the economic, social, ideological and psychological characteristics of their place (Arts et al., 2018). The economic dimension highlights landscapes as being providers of ecosystem services to satisfy human needs (Termorshuizen et al., 2009). These environmental services can be quantified in monetary or non-monetary terms, and herewith be subject to scenario modelling, as input for spatial negotiation and decision making (Termorshuizen et al., 2009; Opdam et al., 2015; van der Sluis, 2017). The productive dimension views landscapes as providers of livelihoods and commodities. Landscape approaches, so it is said, helps producers and planners to integrate natural resources management and rural economic development, taking into account both local needs and global demands for food. Finally, a political dimension challenges the assumption that landscapes can provide all the multiple benefits for all stakeholders involved, and states that such win-win solutions may be naïve or even false. Instead, it acknowledges the boundaries of what nature can provide, and takes into account the competing claims on scarcely available resources. Landscapes, so they say, are arenas for political contestation and strive, which harbour the political power plays between different stakeholders having diverging interests and power positions, and adhere to different discourses regarding natural resource use (Arts and Buizer, 2009; Buizer et al., 2016). The sum of these four diverging dimensions lead to a broader and more realistic view on landscapes, arguing that landscape approaches are not to be seen as instruments to solve all the world's problems, but that landscapes represent an appropriate spatial level for analysing multiple challenges, understanding their interrelations, and creating integrated pathways to have these

solved. It is the level where multiple land uses come together and synergies and trade-offs can be discussed, while ensuring that the rights of local populations are put in the front. This may imply *'win-less-loose-less'* scenarios, while securing the rights of people and nature simultaneously.

2.2 Forest and landscape restoration: a practical application of a landscape approach

Around the turn of the century a group of landscape scholars introduced the term forest and landscape restoration (FLR) as *'a planned process that aims to regain ecological integrity **and** enhance human wellbeing in deforested or degraded landscapes'* (Lamb et al., 2005, 2012; Mansourian et al., 2019). In doing so, they challenged the hitherto classical nature conservation approach that tended to be concerned with the ecological dimension of landscapes only (Sayer et al., 2013; Arts et al., 2017). They criticised the large-scale ecological restoration programmes of the 20th century, and pleaded for a stronger focus on the drivers of degradation which are rather connected to the power of market forces (Sayer et al., 2008; Scarlet, 2016). They proposed a much stronger integration of conservation and development, expressed in locally practiced forms of multifunctional land use. This would help in combining ecological interests with local food demands, and build on the environmental behaviour of inhabitants with their multiple needs and demands (van Oosten, 2012).

2.3 The climate crisis as a political momentum for forest and landscape restoration

It was the growing climate crisis that brought FLR to the front. FLR allows for both adaptation to and mitigation of climate change, as it protects forests and ecosystems from further deterioration. It can help protecting humans adapt to droughts and floods, while at the same time mitigate climate change by enhancing carbon stocks. It is this double benefit that has made FLR a priority issue in multiple international conventions, such as the Convention on Biological Diversity, the UN Framework Convention on Climate Change, and the UNCCD Convention to combat desertification and degradation caused by drought. The *Bonn Challenge,* initiated by the Global Partnership on Forest and Landscape Restoration[1] in 2011, became a major vehicle for countries and companies to pledge the restoration of their territories, to fulfil their international obligations towards the various conventions at the same time. The increasing political momentum for restoration led to the declaration of the decade 2020-2030 as a *UN Decade of Ecosystem Restoration* in June 2021. Within the operationalisation of this Decade, landscape approaches are heavily promoted as a most effective way to *'fight the climate crisis and enhance food security, water supply and biodiversity[2].* The Decade has been further shaped by the UN Food Systems Summit in September 2021, and the UN IPCC COP26 in November 2021. Since then, FLR is attracting a growing support from both the public and private sector, and financial sector actors in particular. Regarding the latter, FLR fits in the private sector discourse as reflected in the New York Declaration on Deforestation (2014) and its resulting Zero Deforestation Movement. Most recently, this discourse has been echoed by the World Economic Forum and its One Trillion Trees initiative which was as launched in 2020 (World Economic Forum, 2020). Since then, FLR is considered a NBS 'at scale', as it aims to restore larger areas for the benefit of people, planet and profit (Reinecke et al., 2017; Pistorius et al., 2017; Nijbroek et al., 2020).

Although the wide international popularity of FLR has to be appreciated, it also raises eyebrows among criticasters who argue that such an optimist approach may not meet the expectations on the long run. Although FLR currently triggers large scale investments, its operationalisation may be simplistic and largely 'top-down', putting the needs of private investors at the fore. Without having the mechanisms for global targets to trickle down to local implementation, so they say, there is a risk of failure, because of the complex political ecologies of restoration including conflicting interests and competing claims. This risk has given

[1] The Bonn Challenge, September 2011, initiated by the Global Partnership on Forest and Landscape Restoration.

[2] United Nations General Assembly adopted resolution A/RES/73/284, which declares 2021- 2030 the UN Decade on Ecosystem Restoration, 1 March 2019.

space for yet another debate, that on what to restore, how to restore, and – most importantly – for whom to restore (van Oosten, 2013, 2021).

2.4 Governing forest and landscape restoration: who decides on what to restore, where and how?

The evolution of the global restoration discourse as sketched in the previous section led to a small yet growing body of literature on the g*overnance* of landscape restoration. This new literature is pragmatic in nature, and questions the way in which restoration decisions are being taken, as well as the costs and benefits that these decisions entail (Chazdon et al., 2016; Mansourian, 2017; Reinecke and Blum, 2019). It follows the frequently quoted '*The Ten Principles of a Landscape Approach to Reconciling Agriculture, Conservation and Other Competing Land Uses*' (Sayer et al., 2013), in which it is stated that landscape restoration needs to be considered '*a long-term collaborative process bringing together diverse stakeholders aiming to achieve a balance between multiple and sometimes conflicting objectives in a landscape*' (Sayer et al., 2016). The Ten Principles are intended to guide the process of decision making, emphasising the importance of stakeholder engagement, negotiated choices and spatial decisions based on the rights and responsibilities of actors involved (Sayer et al., 2013). This new thinking on the governance of landscape restoration discards technocratic and conservation oriented landscape restoration, and opens the door to a more open-ended type of landscape restoration which places people's wellbeing on the forefront. With this, FLR has gained recognition as a valuable nature-based solution that contributes to climate resilient and circular food systems, driven by the needs and aspirations of local actors as agents of transformative change.

2.5 Forest and landscape restoration: a renewed interest in participatory spatial planning

The above described debate triggered renewed interest in participatory spatial planning, to secure inclusive, democratic and transparent implementation of new restoration efforts. This in turn led to renewed thinking on the role of spatial planning, stakeholder participation, and inclusive spatial decision making in order to make restoration efforts more inclusive. This opened the door for spatial planners to move away from jurisdictional approaches to spatial planning, and become more sensitive to the socio-ecological boundaries of landscapes as appropriate units for spatial planning. This resulted into renewed attention for *Strategic Environmental Assessment (SEA)* as an instrument that brings various stakeholders together, and increase the transparency of spatial decisions. It highlights the role of public participation in spatial planning, and strengthens the position of civil society actors to take part in spatial decision making and be more stringent in holding governments accountable for the potential impacts of the decisions taken. Instead of interpreting 'good governance' as the outcome of effective and transparent *implementation* of sectoral policies, the interpretation of 'good governance' changed into the *process* of spatial planning and decision making in which the legitimacy of spatial decisions is key. Spatial decisions within such landscape level governance are not necessarily legitimised by democratic endorsement through formal administrative processes, but rather through the social acceptance of stakeholders, as well as the sustainability of landscapes themselves (van Oosten, 2021). The role of novel mechanisms for participatory scenario planning and GIS based decision support returned to the forefront of this debate.

As a result, a wave of collaborative multi-stakeholder platforms and partnerships at the landscape level saw the light, often developed by external donors, with the aim to assemble multiple stakeholders to design programmes, develop bankable projects, and channel international funding closer to the ground. A new market for climate finance emerged, which gave rise to a multitude of financial instruments including carbon credits, green bonds, climate funds and impact investment schemes. Many of these instruments are based on the principles of blended finance, in which public funds are set aside to 'de-risk' private investments, in which the public share is spent on the creation of project portfolios and the development of enabling environments for private investors to invest. Especially since the Paris Climate Agreement in 2015, many new players appeared on the landscape scene, and large funds have been pledged to develop and implement

nature-based solutions. FLR, so it seems, represent a relatively safe investment as it builds on solid assets such as land, trees and improved access to water. However, many of these new players, however their strong financial skills, have hardly any knowledge about the socio-spatial processes within landscapes. As a reaction, a new research agenda emerged on the need for appropriate tools for participatory spatial decision making related to the governance of FLR (Ros Tonen et al., 2021).

Figure 1 *Collecting geospatial data in the field.*

3 Forest and landscape restoration and food

FLR as *a planned process that aims to regain ecological integrity and enhance human well-being* (see previous section) directly refers to the potential of FLR to restore the productivity of degraded areas, leading to enhanced food production and increased food security. FLR potentially restores the interaction between soil, land, water and biodiversity, and aims to create microclimates in which planted or regenerated trees can thrive. It increases the water retention capacity and fertility of soils, enhances food production, raises new market opportunities, and triggers new investments in regenerative or ecologically sustainable agriculture. Improving the food environment as well as an enabling environment for investment, FLR connects to policies, markets and technology, and even contributes to stronger social organisation and agency within a landscape. But regarding all these potential connections, the effectiveness of FLR for food depends on the way in which FLR is designed, planned and implemented.

It is in this context that FAO and others highlight the need to restore forested landscapes, as part of the fight against combat food system failures. FLR, so it is underscored by FAO, provides an excellent opportunity to reinforce global food systems in all its components of primary production, processing, trade, nutritional quality, market mechanisms and global food policies, and connect these to the diverse stakeholders and institutions that play a role in food systems. According to FAO, restoring landscapes aims at restoring local food systems and global food supply chains. FLR helps landscape economies to build resilient and productive food systems, and bring together those stakeholders that are well positioned to inform decisions that lead to restored food system (ibid). Better framing of FLR, so it is argued, will help directing FLR towards more deliberate targeting of food system outcomes, and align restoration practice and monitoring mechanisms accordingly (FAO, 2021).

3.1 Conceptualising FLR from a food system perspective

The multiple linkages between FLR and food systems can best be done by using the well-known food systems model developed by van Berkum et al. (2016), which pictures the multiple components of a food system, and highlights those components where FLR could play a role. Figure 2 illustrates these manifold connections, and visualizes that FLR directly contributes to food system outcomes as it directly connects to the environmental drivers that drive primary production, consumption and the wider enabling environment of food. Approaching FLR from a food systems perspective therefore offers multiple opportunities for tailoring FLR models to respond to local, regional or global food needs and demands.

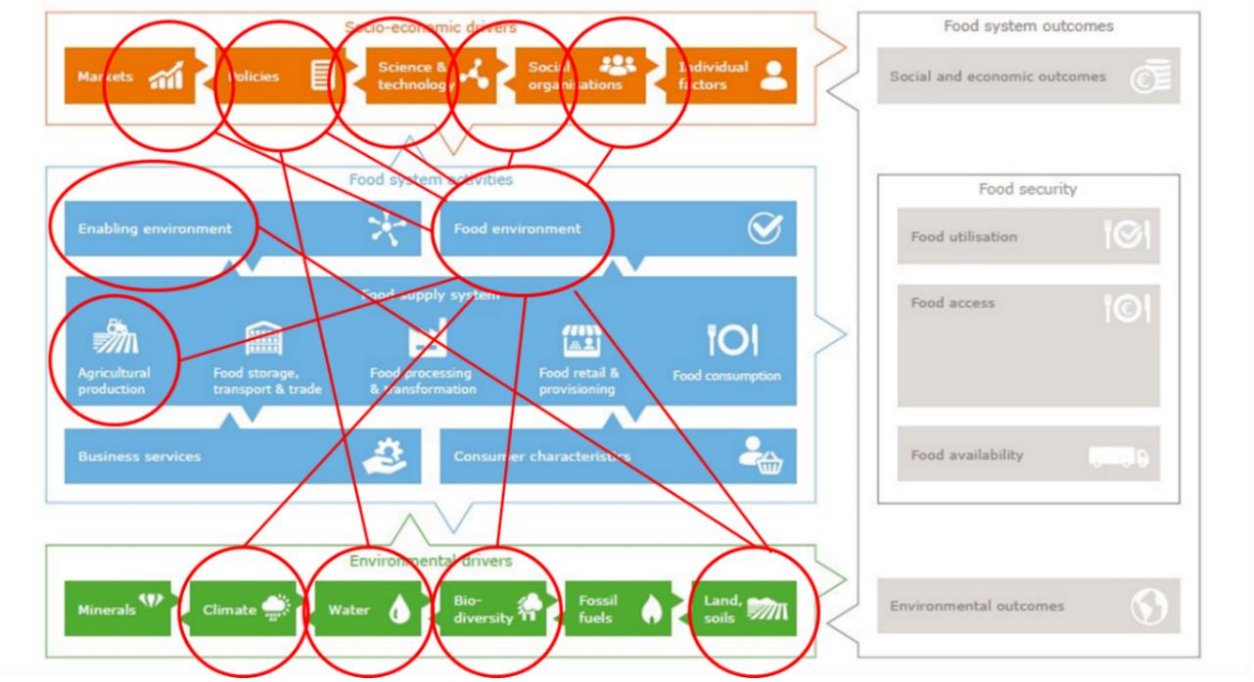

Figure 2 *The food system model, combined with FLR influences on food. Free after van Berkum et al., 2016.*

3.2 A typology of FLR and food

Building on this framing it is IUCN that has analysed the multiple opportunities for FLR for Food. According to IUCN, most of the opportunities to restore degraded or fragmented land are found on or adjacent to agricultural or pastoral land. This means that restoration not necessarily has to focus on forests, but can also be part of a patchwork or mosaic of integrated land uses including agriculture, agroforestry systems and improved fallow systems, ecological corridors within agricultural lands, areas of forests and woodlands, and river or lakeside plantings to protect waterways (IUCN info on FLR, accessed on 23-11-2021). Restoring productive landscapes is *forward-looking,* and it creates or strengthens the resilience of landscapes by optimising ecosystem goods and services for society for now and in future (ibid).

Many of the identified types of FLR for Food are based on the principles of *'land sharing',* which implies that agricultural land use is combined with forest protection or restoration, leading to integrated agroforestry systems or agro-silvo-pastoralism (van der Schalie, 2021). These models enable agricultural production with FLR in a way that woody plants are grown along with crops or cattle (Giudice Badari et al., 2020). Such agroforestry or agropastoralism has the potential to secure food and nutrition for farmers while also mitigating climate change (Adams et al., 2016). The possibility of combining FLR with agricultural production has motivated many to promote agroforestry and agropastoralism as a popular type of FLR, and there is growing evidence that FLR has the potential to enhance food security and contribute to climate resilient and circular food systems (IUCN, 2015). Recent studies show that the integration of crop production and FLR can significantly increase agricultural production, as it enhances soil fertility, decreases run-off and enhance the retention capacity of soils. These combined benefits imply that the higher yields obtained by integrating FLR with agriculture may partly or completely cover the restoration costs. Indirect benefits from FLR relate to the fact that enhancing productivity may lower the pressure on agricultural land and on forest land, herewith releasing pressure on the total available land. Moreover, integrating FLR on farm land restores the connectivity within larger production systems, increase carbon sinks, and enhances the overall provision of ecosystem services (de Pinto et al., 2020; Giudice Badari et al., 2020).

Figure 3 illustrates the different types of FLR that relate to food production, all of which can be found in Ghana, and to a lesser extent also in Bono East Region.

Land Use	General category of FLR option		Description
Forest land	Planted forests and woodlots		Planting of trees on formerly forested land. Native species or exotics and for various purposes, fuel-wood, timber, building, poles, fruit production, etc.
	Natural regeneration		Natural regeneration of formerly forested land. Often the site is highly degraded and no longer able to fulfil its past function – e.g. agriculture. If the site is heavily degraded and no longer has seed sources, some planting will probably be required.
	Silviculture		Enhancement of existing forests and woodlands of diminished quality and stocking, e.g., by reducing fire and grazing and by liberation thinning, enrich-ment planting, etc.
Agricultural land	Agroforestry		Establishment and management of trees on active agri-cultural land (under shifting agriculture), either through planting or regeneration, to improve crop productivity, provide dry season fodder, increase soil fertility, enhance water retention, etc.
	Improved fallow		Establishment and management of trees on fallow agricultural land to improve productivity, e.g. through fire control, extending the fallow period, etc., with the knowledge and intention that eventually this land will revert back to active agriculture.
Protective land and buffers	Mangrove restoration		Establishment or enhancement of mangroves along coastal areas and in estuaries.
	Watershed protection and erosion control		Establishment and enhancement of forests on very steep sloping land, along water courses, in areas that naturally flood and around critical water bodies.

Figure 3 *Typology of FLR systems in relation to food. IUCN, 2016, available at www.InfoFLR.org.*

3.3 Mapping the potential of restoration options: a global restoration atlas

In 2014, a joint effort of the World Resources Institute, IUCN, FAO and other partners under the umbrella of the Global Partnership on Forest and Landscape Restoration developed a global Restoration Atlas that visualises the opportunities for FLR around the world. The Atlas represents the result of a deep analysis of globally available data bases, which show that more than two billion hectares worldwide – which is an area larger than South America - offer opportunities for restoration. Most of these lands, so the Atlas states, are in tropical and temperate areas. Among these two billion hectares, approximately one and a half half billion hectares would be best-suited for mosaic restoration, in which forests and trees are combined with other land uses, including agroforestry, smallholder agriculture, and settlements (WRI, accessed in November 2021).

Whereas croplands and densely populated rural areas on former forest lands may not offer extensive restoration opportunities in terms of total surface, they would benefit from having trees planted in strategic places to protect and enhance agricultural productivity and other ecosystem functions (ibid.).

An interactive map with an open data portal with high resolution data plus a link to expert advice was created and made freely accessible at www.InfoFLR.org. The Atlas, the map and the data are meant to be used by global and national stakeholders, policy makers and practitioners as an information management tool, to help stakeholders and decision makers identify opportunities for restoration.

Figure 4 *Atlas of Forest and Landscape Restoration Opportunities, WRI-IUCN, 2016. Available at www.InfoFLR.org.*

4 Forested landscapes, degradation and restoration in Ghana and Bono East

Ghana offers a wide variety of landscapes, covered with continuous forests, semi-continuous forests, scattered forest patches and isolated remnants of forests. The forest types range from dryland forest and shrubland in the North, to tropical rainforest and mangroves in the Central and very South of the country. Most of Ghana's forests are under pressure by agricultural activities and urban expansion, and suffer from various degrees of degradation and deforestation. Since the 1990's, 34% of Ghana's forests has been lost, which brings Ghana into the top ten of high deforestation country in the world (FAO, 2010; Acheampong, 2020). The main cause of deforestation and forest degradation is the ever growing competition for farm land, due to the rising demand for food, both locally and regionally. At the same time, there is a global rise in demand for commercial products such as timber, cocoa, coffee and more (Acheampong, 2020). According to Ghana's Forestry Commission, the main drivers of deforestation and forest degradation in Ghana are agricultural expansion (e.g. permanent cultivation, free range cattle ranching, traditional slash and burn or shifting cultivation), wildfires, logging and fuelwood harvesting, mining, and infrastructural development (roads, settlements and other infrastructural development, Ghana Forestry Commission, 2016).

4.1 Mapping forest and landscape restoration potential in Ghana

In order to provide a solid basis to Ghana's restoration strategy, the Ghana Forestry Commission in collaboration with the World Resources Institute and IUCN worked together on the identification of Ghana's potential for FLR in its various forms. Building on the Global Atlas of FLR Opportunities (see previous section) a country level assessment of FLR opportunities was carried out, which resulted into an interactive land use map of Ghana. This interactive map, together with all the resource maps and meta data, is freely available at: Ghana National Land Use/ Land Cover Map Interactive Map 2014 (ourecosystem.com).

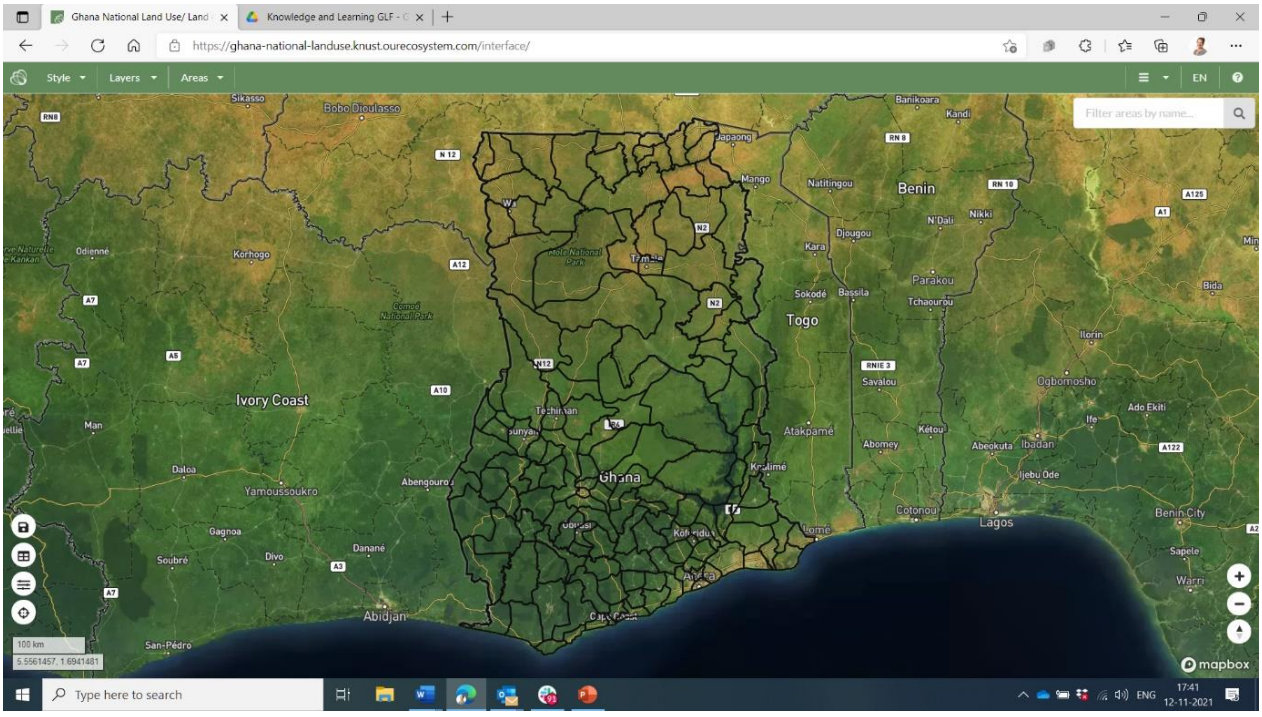

Figure 5 *Interactive land use map, WRI, 2020, available at www.InfoFLR.org.*

Building on this map, a Restoration Opportunities Assessment (ROAM) was carried out in 2016, which outcomes now serves as a blueprint for the restoration of all Ghana's deforested and degraded landscapes for the next 25 years. This ROAM exercise led to four broad conclusions (IUCN, 2020):

1. In Ghana, almost 14 million ha of potential areas can be identified as being suitable for restoration;
2. Agroforestry offers the greatest net benefits per ha, estimated at approximately 346,000 Ghanaian cedis per ha;
3. The carbon abatement curve of Ghana helps securing a considerable proportion of the upfront investment that is needed for this.

Based on these outcomes, Ghana pledged to the international Bonn Challenge to restore 2 million ha of its forests by 2030. In order to do so, a policy process was started to develop an enabling policy framework for restoration, which was reflected in the Ghana Plantation Development Strategy 2016-2040. This strategy is in full alignment with the Aichi Biodiversity Targets, the nationally determined contributions to the Paris Agreement under UNFCCC, the land degradation neutrality targets under UNCCD, and the REDD+ goals (IUCN info on FLR, accessed on 23-11-2021). According to the Plantation Development Strategy, implementation is to be done through public and private planted forests and woodlots of indigenous and exotic species, natural regeneration, silviculture, improved fallow and fire control, mangrove restoration, watershed protection and agroforestry, the latter including conservation agriculture, farmer-managed natural regeneration, silvo-pastoral systems, apiculture, and tree intercropping.

4.2 Forest and landscape restoration in Ghana: a multi-sectoral approach

Since the elaboration of the ROAM exercise with its maps and the development of Ghana's Plantation Development Strategy 2016-2040, the restoration of degraded forests and landscapes remain high on Ghana's national policy agenda. Ghana has always been a proactive proponent to the international forest debate, and has firmly committed itself to the targets set in the IPCC Paris Agreement, the Sustainable Development Goals with its Zero Hunger campaign, and the Bonn Challenge with its Africa Forest and Landscape Restoration Initiative AFR100. Ghana aims to arrive at zero-deforestation in 2040 through a combined approach of commercial forest plantations, smallholder plantations, enrichment planting of degraded forests and the incorporation of trees within farms, in order to fully align its restoration policy with its aim of Zero Hunger by 2030 (Ghana Forestry Commission, 2016). By combining different restoration practices, Ghana hopes and expects to relieve the pressure on the existing natural forests, enhance the connectivity between agricultural land and forest land within landscapes, and enhance agricultural production through the introduction of nature-inclusive agriculture such as agroforestry, conservation agriculture and climate smart agriculture. With this, Ghana recognises the potential of forest-farm mosaic landscapes, while at the same time removing the barriers to commercial forest plantation investments to generate income opportunities for rural communities and the national economy (Ghana Forestry Commission, 2016; Acheampong, 2020). The National Plantation Strategy 2016-2040 deliberately highlights the potential of *Trees-on-Farms (ToF) interventions*, with the aim to optimise the productivity and sustainability of smallholder farming systems though small-scale agroforestry, conservation agriculture and climate smart agriculture practice. To this end, millions of seedlings of suitable tree species were and are being provided to farmers for incorporation into and around their farms, to provide environmental benefits, enhance land productivity, raise additional income and provide jobs (ibid.).

Despite the high potential, Ghana also recognises the challenges to FLR, particularly those which are related to the combined effort of restoration for food. One of the main challenges has been identified as the unclarity of land tenure and tree tenure, including the ownership of naturally occurring trees, planted trees, trees in forests and trees on farms. To tackle these challenges, new policies for regulating land tenure and tree tenure were and are being developed, with the aim to provide more legal security for farmers and companies to invest in trees (Acheampong, 2020). Nevertheless, the process of legalizing land and tree tenure is still cumbersome and often conflictive, because of the multiple claims on land and trees. Until today, there are challenges around unclear land and tree tenure arrangements, and although the procedures for acquiring

land and trees are legalized and unambiguous, the interpretations vary and the general level of awareness remains low. As a result, competing claims and conflicts over land and trees pertain. This is an important issue that deserves attention within the FLR debate. As FLR has increasingly become a profitable business, it has led to an increase of the value of land and trees. This implies that there is an increased demand for investment opportunities in land and trees, which in turn will lead to an acceleration of the competition and conflict on tenure rights (IUCN, 2020). Despite this commonly felt challenge, the issue of land and tree tenure remains underscored within the global FLR debate, something that needs to be changed.

Figure 6 *Four months old teak plantation intercropped with ginger in Kintampo Forest District. Ghana Forestry Commission, 2019.*

4.3 Forest and landscape restoration in Bono East

Bono East is considered to be the food basket of the country, as a large part of Ghana's commercialised food is produced in Bono East. Bono East is therefore important for securing Ghana's national food security for now and in future. It is however doubted whether Bono East can keep playing this strategic role in future, as the region is increasingly vulnerable to climate stress. An important question is therefore how to secure Bono East's position as a net food provider to the country, and to what extent FLR can play a role in doing so (van Oosten et al., 2020). The major challenge to Bono East food production is that of periodic water shortage, as climate change is increasingly leading to capricious rainfall and unpredictable times of drought and floods. This puts pressure on the agricultural sector, and demands higher levels of technological development to secure productivity of the land. Besides better management of water resources, FLR is increasingly suggested to be a solution to declining soil fertility and water shortage. Great is therefore the interest in FLR, and the way in which this could be promoted in Bono East. A hypothesis is that FLR, if well integrated in improved agroforestry systems, can contribute to securing Bono East's future as a net food provider. This hypothesis however leads to a number of questions regarding the biophysical, ecological, social and economic conditions that need to be in place for this, and what would be the policy implications of expanding FLR in agroforestry systems throughout the region.

Desktop research shows that in Bono East there already are multiple types of FLR being practiced, either spontaneously done by farmers, or introduced by the Ghana Forestry Commission, the agricultural extension services and the various NGOs operating in the region. If compared to the FLR typology presented in Figure 3, several of its types are already present in the region. A majority of FLR initiatives are implemented in Bono East's forest reserves, mainly driven by commercial purposes and to comply with Ghana's international pledges to enhance carbon stocks, financed through international climate funds. There are also some examples of FLR practice for food, either initiated by farmers themselves, or by government agencies following Ghana's major policy framework of reducing food insecurity and arriving at Zero Hunger by 2030 (Acheampong, 2020).

According to van der Schalie, Bono East harbours three main FLR approaches for food, all based on the principles of agroforestry. These approaches are 1) the Modified Taungya System, 2) community based forest rehabilitation, and 3) cocoa based agroforestry (van der Schalie, 2021). In the following sections each of these three systems will be briefly described. Each of these systems have advantages and disadvantages, as they are all three embedded in different legal frameworks, and implemented on different types of land (ibid.).

4.3.1 Modified Taungya system

The original Taungya system is an agroforestry system in which farmers combine woody species with crops in the early years of a forestry plantation formation (Acheampong et al., 2020). It was introduced in the 1930s by the colonial government, as a response to the increased shortage of farmlands around communities, and deforestation rates were high. Farmers were given an area of degraded state owned forest land where they were instructed to plant trees along with crops. The farmers were allowed to cultivate the forest land for three years, reflecting the period which was needed for the forest canopy was closed, and the land became less suitable for crop production. This system however was stopped in 1987, because of the insecure tenure rights, the lack of farmer knowledge on forest management, and general land reform. The system was modified and adapted to the changed circumstances and then reintroduced in 2002, in the form of the Modified Taungya System (MTS). In this modified system, farmers do not have to abandon the land after three years, but are allowed to continue cultivating until the trees reach full maturity. Once the trees are harvested, the farmers can keep 40% of the value of the harvested trees. In this system, farmers do not own the forest land, but can equally share in the benefits derived from forest land, both in the form of crop land, and in the revenues derived from the harvested trees.

4.3.2 Community-based forest rehabilitation

Community-based forest rehabilitation has emerged as a method for combining the goals of livelihoods improvement of rural households, and stronger community engagement in sustainable forest management. In this approach, farmers are introduced to sustainable farming models where crops are grown together with trees. In the early 2000s, only a few projects involving community-based forest rehabilitation claimed to be successful, and local commitment seemed to remain low (Blay et al., 2008). After improvement however, several community-based forest rehabilitation projects emerged in Bono East, which are based on the principle of restoring degraded forests both inside and outside of the forest reserves, by establishing small-scale plantations and woodlots as well as agroforestry, managed and owned by communities living in the forest fringe. These projects have led to considerable increase in both the income and the food security of rural communities, yet they have been less successful in reducing forest degradation and expanding forest cover(ibid.).

4.3.3 Cocoa based agroforestry

Cocoa is not widely grown in Bono East, but it is gaining importance, as it is a valuable cash crop which generates relatively high revenues and offers opportunities for agroforestry (Nunoo et al., 2015). Cocoa grows better if planted in the shade, which means that combining cocoa production with forestry works very well. In cocoa agroforestry systems commercial cocoa production is combined with food production and reforestation at the same time. The different components of this three-pronged approach is built on the mutual synergies between trees, cocoa and food crops, as trees provide timber and shade for the cocoa to thrive, while it also provides nutrients and soil protection for the production of food. The combined system enhances climate resilience and increases farmers' incomes. One persistent problem remains to be that of tree tenure. Pertaining unclarity of tree tenure discourages the cultivation of trees, as farmers do not have the legal rights to harvest the trees on their farms. However, the newly developed legislation on tree ownership helps farmers to obtain legal ownership over the trees, which is a great incentive for them to plant and maintain trees.

A comparative analysis of the three agroforestry systems carried out by van der Schalie shows that each of the three systems provide different benefits to food security. They are implemented on different types of land (government land, forest reserve land, private land, customary land); they depend on different combinations of crops; and therefore have different implications for household's food security, nutritional status and household income (see Table 2).

Table 1 *Analysis of Acheampong et al. (2020), Blay et al. (2008), and Nunoo et al. (2015).*

Paper	System type	Land type	Number of farmers	Crops	Food security benefits
Acheampong et al. (2020)	MTS	Degraded forest	31	Food crops	Direct
Blay et al. (2008)	MTS	On- and off-reserve degraded forest	431	Food crops	Direct
Nunoo et al. (2015)	Cacao agroforestry	Agricultural land	40	Cash crop: cacao	Indirect

5 The reality of FLR for Food in Bono East

As part of this research a field study was conducted in the four Districts/Municipals: Kintampo North, Atebubu-Amantin, Nkoranza South, Techiman North, and Sene West. The tables 2 and 3 provide an overview of the respondents that took part in this field study, while Figure 7 provides insight in the areas that were visited. Each of the visited sites were photographed and inserted in a Polarsteps data base, for the Netherlands based team to be able to follow and take part in the field work. Moreover, the pictures were geo-tagged, for them to be integrated in the maps that were produced and which are presented in a separate document.

Table 2 *List of field respondents for survey.*

Stakeholder	Male	Female	Total Respondents
Farmers	37	14	51
Forest Guards	6	0	6
Forestry Managers	4	2	6
MOFA Officers	1	1	2
Tropenbos-Ghana	1	0	1
YAP-YEA	5	2	7
Charcoal Producers Association executives	1	0	1
Total	**55**	**19**	**74**

Table 3 *Focus Group Discussion (FGD) held in the study area.*

District/ Muncipality	Male respondents	Female Respondents	Total Respondents
Kintampo North	3	1	4
Sene West	10	1	11
Techniman North	3	2	5
Ateebubu-Amantinin	7	5	12
Kintampo South	1	2	3
Total	**24**	**11**	**35**

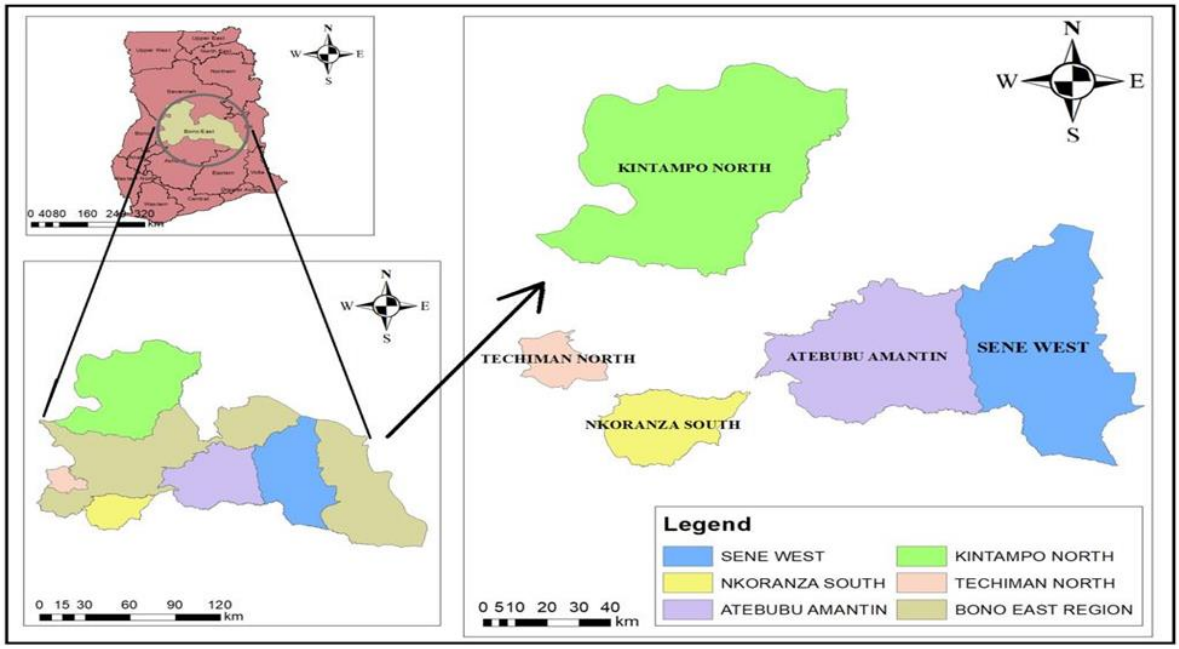

Figure 7 *The five Districts and Municipalities that were visited during the field trip.*

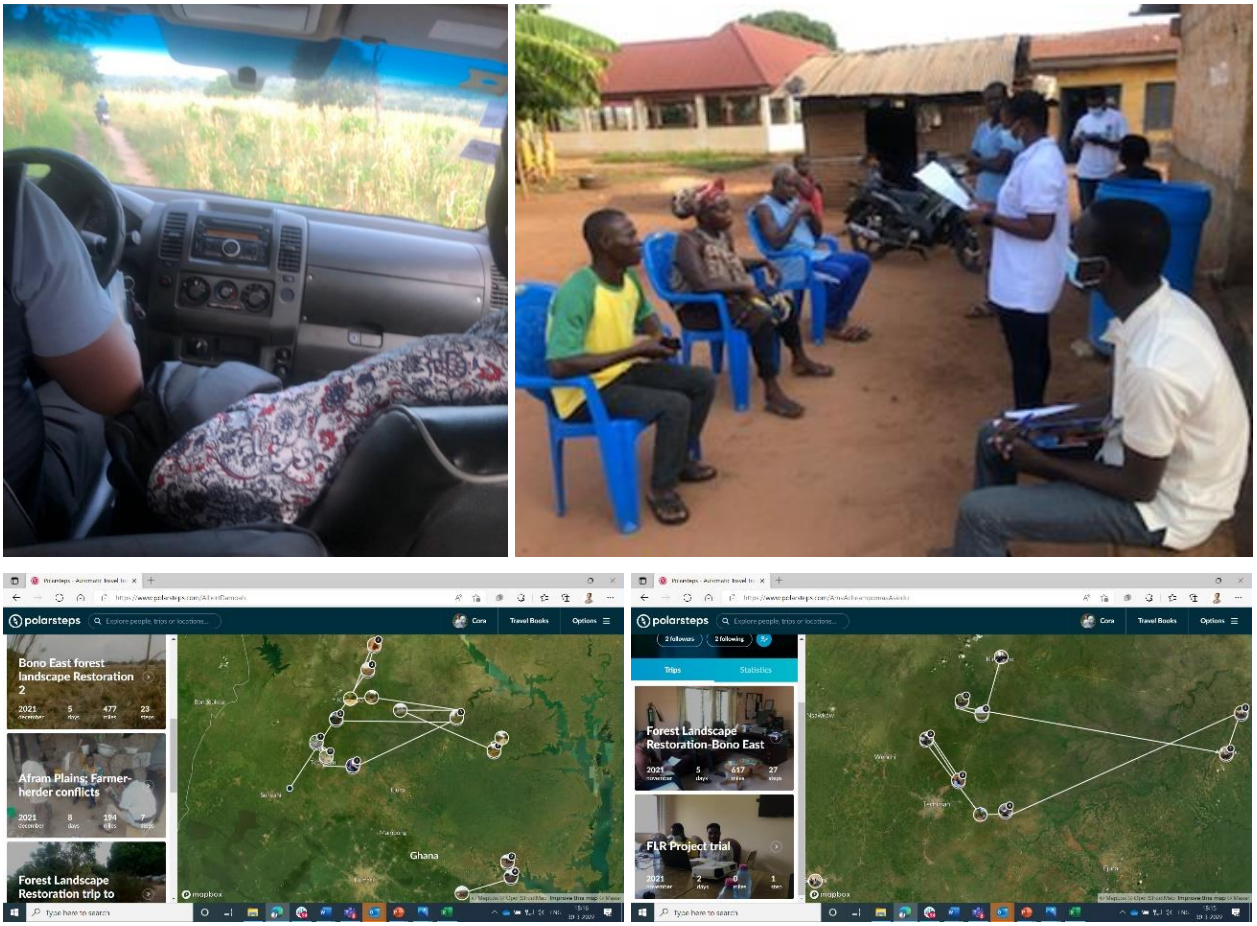

Figure 8 *An impression of the field trip team in action, and the routes that they followed. It also provides an overview in the journeys that were created and reflected in Polarstep https://www.polarsteps.com/).*

5.1 Exploring the potential of FLR in Bono East

The field study in Bono East focused on five Districts and Municipals in the Bono East Region, which are Kintampo North, Techiman North, Nkoranza South, Atebubu Amantin, and Sene West. All these Districts and Municipals are located in the transitional zone between the Wet Semi-equatorial and Tropical Continental climates, with a vegetation falling under the Woodland Savannah Zone.

The five Districts differ in their environmental and socio-economic context, which means that they offer different contexts and conditions for FLR. Kintampo North District is the most northern, and does not exhibit typical savannah conditions due to its transitional nature. It harbours two central Forest Reserves which are Buru Forest Reserve and Bosomoa Forest Reserve. The tree species prevalent in the District include Mahogany, *Milicia excelsa*, *Daniella Ogae*, *Cola gigantae*, Shea, *Triplochiton scleroxylon* and Dawadawa, all species which have adapted well to the environment. The District has extensive fertile land coupled with favourable climatic conditions. Due to these factors, agriculture has been and continues to be the leading economic venture in the District. It employs about 72.7% of the workforce and contributes about 60% of household incomes. Major crops cultivated include yam, cassava, millet and sorghum, cowpea, rice, groundnut, watermelon, cashew, mango, and tobacco. Vegetable farming has also taken root, with the leading crop being tomato, followed by garden eggs.

The prevalent farming practice in Atebubu-Amantin Municipal District is the slash and burn method of clearing the land. Years of slash and burn practice has left the farm land bare and exposed to erosion, leading to a gradual destruction of the vegetation and a change of the ecology of the District, which has turned a large part of the forest vegetation into savanna grassland. The crude farming method has had a devastating effect on the environment, which has led to a high incidence of bushfires caused by the activities of farmers, charcoal

producers, game hunters and more. Charcoal production has been one of the major causes of environmental degradation in the District. The District Assembly has put in place stringent measures to overcome that problem, but uncontrolled charcoal production activities persist, especially in those parts of the District which are poorly accessible and enforcement agencies cannot reach. Streams and rivers are increasingly drying up during the dry season, due to increased human activities in and around watersheds and river banks. Poor farming practices and management of open water bodies have led to the exposure of riverbanks to erosion, and evaporation of water in the rainfall dependent streams. There are no Forest Reserves in the Municipal, but amenity planting is practised in the towns, and is supported by the Forest Services Division.

The Nkoranza South Municipal is characterized by many small rural settlements. The District is well-drained by several streams and rivers having their sources in the North-East, and flowing South and Northwestwards. The dominant occupation of Nkoranza inhabitants is agriculture, with the main staple crops of maize, yams, vegetables, cassava, groundnut, cowpea, cocoyam and plantain. Cotton and tobacco grow well in some parts of the District. Also in Nkoranza the prevalent farming practice is the slash and burn method, which leaves the farming land bare and exposed to erosion, leading to gradual degradation of vegetation and soils, and changing the forest vegetation into savanna grassland. Like in Atebubu-Amantin Municipal District, there are no forest Reserves in the Nkoranza South Municipal, hence all restoration activities take place in off-reserve areas.

The Techiman Municipality where both semi-equatorial and tropical conventional or savanna climates dominate, there is a relatively high level of rainfall, more than anywhere else in Bono East. The highest rainfall of over 1650 mm annually is recorded in the Southwest and declines northwards to about 1250 mm in the North West around the Offuman area. The major agricultural activities are crop production and animal production, similar to the other three Districts. Aquaculture is on the traces, and a small fraction is under reforestation, joining Asubima Forest Reserve. Techiman is noted as the largest market centre in the Region. It hosts traders from Togo, Benin, Cote d'Ivoire, Burkina Faso and Mali, and is therefore recognised as an international market centre, illustrating the importance of Bono East as regional food supplier.

Unlike the other districts and Municipals the vegetation of the remote Sene West District's is predominantly Guinea Savannah Woodland with high undergrowth and scattered trees, and high occurrence of trees like hea butter, Dawadawa, Baobab (***Adansonia digitate)***, *Swietenia macrophylla (American mahogany)*, Papao (*Afzelia africana*), Senya, Kane, Onyina (*Ceiba pentandra*), Kubre, Kyenkyen (*Antiaris Toxicaria*), Watapuo (*Cola gagantia*), Wama and Neem (*Azadirachta indica*). Some of these trees have high economic and domestic value, and can be used for medicinal purposes, cosmetic skin preparations and food. The economy of Sene West District is predominantly agricultural, with vast arable land conducive to cultivating crops such as maize, yam, cashew, cassava, groundnut, cowpea, watermelon, mangoes, onion, plantain, cocoyam, and vegetables. Several non-traditional crops like cabbage, carrot, pineapple, sweet potato, sesame, sunflower, cashew and soya are cultivated, while the valleys of the two major rivers (the Volta and the Sene) have potential for the development of scale irrigation schemes (GSS, 2010).

5.2 FLR action on forest and in agricultural land

As stated before, FLR in Bono East is implemented in forest reserves and on agricultural land, but more on agricultural land, as the forest reserves are scarce. FLR in Forest Reserves and on agricultural land differ in terms of environmental, socio-economic and institutional conditions, all of which have implications for the potential contribution of FLR to enhanced food system performance.

5.2.1 FLR in forest reserves

Originally, much of the FLR practice has been implemented in the forest reserves of Bono East, where FLR falls under the responsibility of the Forestry Commission which is the sole owner of the country's forest reserves. FLR, so it was seen, was an appropriate way to restore the country's degraded forests through reforestation and afforestation, and managed by the State or commercial forestry companies having a concession on state land. However, with the growing pressure on forests and the shrinking of the country's forest reserves, new approaches were developed to allow farmers to produce some crops in the forest

reserves under strict conditions, while increasing the number of trees on farm land. Currently, multiple FLR methods are currently employed, in both forest reserves and on farm land.

REFORESTATION

FLR in forest reserves is usually guided by the District Forest Services Division of the Forestry Commission of Ghana, which carries out a larger reforestation programme focused on Buru and Bosomoa Forest Reserves in Kintampo North. Within these forest reserves, the Forestry Commission focuses on the reforestation of the most degraded parts. The trees planted include Terminalia superba, Terminalia ivorensis, Mahogany, Techtonal grandis and Gmeliana, all of which being highly drought-resistant, and grow relatively fast. The labour for these reforestation projects is usually provided by the Youth in Afforestation program under the Youth Employment Agency (YIA-YEA). The main objective of these projects is to enhance the quality of the forest, to increase its productivity and to increase their ability to sequester carbon within the light of climate change. The projects are part of Ghana's pledge to the Bonn Challenge, AFR100 and other international climate commitments, and funding is provided through mechanisms of international climate finance. The projects are rather successful, although a frequently encountered challenge is water shortage in crucial periods of tree growth, which means that the seedlings have to be kept in a nursery for a long time before being transplanted into the field.

MODIFIED TAUNGYA SYSTEM

A frequently used method to restore the forest in the forest reserves is the Modified Taungya System, which allows farmers to farm underneath the planted forest until the canopy closes (see section 4.3.1). In Bosomoa Forest Reserve, the Forest Services Division works with six farmers who have been allowed to use the newly planted Forest Reserve area to cultivate crops alongside the trees. The trees that were planted are Terminalia superba, Terminalia ivorensis, Mahogany, Techtonal grandis and Gmeliana, while the farmers have been planting plantain, cassava, vegetables, maize and yam underneath. Moreover, cattle are grazing within and along the trees in a controlled manner (to avoid cattle eating the seedlings or the crops). This agro-silvo-pastoralism is a good way to combine the restoration of the forest reserve while at the same time responding to farmers' need for land to grow food. It is a form of multifunctional land use which takes advantage of the complementarities between the forest (shade), the food crops (food security), and the cattle ranging (manure, food security and income). Although farmers to not own the land or the trees in the MTS, they are allowed to share in the benefits derived from forest land, both in the form of crop land, and 40% of the revenues derived from the harvested trees. Water remains problematic for both the reforestation and the agricultural activities, as there are no facilities for using underground water or harvesting rainwater in the forest.

ENRICHMENT PLANTING IN FOREST

Another popular FLR method which is used in forest reserves is that of enrichment Planting. Tropenbos Ghana, which is part of Tropenbos International, is using this method to enrich the forest with tree species like Terminalia superba and Techtonia grandis, while allowing farmers to farm food crops underneath the trees. In this way, they help farmers to get access to farm land within the forest, and increase their food security. The resulting agroforestry practice is good for the forest, while it is good for the farmers at the same time. But also here, water availability is a challenge, as the forest reserves are far from the rivers and streams, and no mechanical water supply system is available. This hampers both the nursing of the trees as well as the productivity of the farms.

5.2.2 FLR on agricultural land

Whereas the forest reserves are limited to Kintampo North, FLR is frequently practiced on agricultural land throughout the area. Some FLR initiatives are located near the forest reserves but on private or community farm land, while others are far from the forest, and aimed at increasing the number of trees on farms, through random tree planting or more deliberate agroforestry techniques. Enrichment planting is practiced in and around some isolated forest remnants, and woodlots are being established near the communities where firewood and charcoal is in high demand. Most restoration initiatives have been taken and/or are supported by either the Forestry Commission (in and outside the forest reserves), and by the major NGOs in the region which are Tropenbos Ghana and A Rocha Ghana. Most initiatives have not been driven by food systems concern, but by climate change concerns, and have been funded through some form of climate finance. Most tree planting initiatives are based on the planting of rapidly growing trees that sequester carbon in both the trees and the soil, while at the same time provide commercial value through the timber and the charcoal that they produce. Although not deliberately planted for food system performance, the indirect positive effect of tree planting on food systems is relatively high, as trees improve soil structure and fertility, reduce run-off, and increase soil moisture and shade. Moreover, well designed agroforestry systems generate fruits and other eatable tree products for human consumption and for fodder. Even if not primarily aimed at food system performance, FLR is generally considered an interesting co-benefit for families living in Bono East.

AFFORESTATION

The Forest Services Division of Nkoranza manages the Sessiman Aprowa Afforestation project. This site is not in a forest reserve, but the land was acquired by the Forest Services Division from the Traditional Chiefs. Ownership remains with the Chiefs, but an agreement was reached to use it as a restoration site for the planting of economically valuable trees such as Terminalia superba, Terminalia ivorensis and, Cassia fistula, all with the purpose of providing timber and sequestering carbon, and under the auspices of the Chiefs. Irrigation is being practiced by fetching water from a nearby River (Aprowa) while the seedlings are young. Yet water shortage is experienced regularly, as well as disturbance from grazing cattle, as the site is near to a community.

The Atebu-Amantin Municipal does not have any forest reserve. Nevertheless, also here the Forestry Commission promotes FLR by working with communities and Traditional Chiefs to set up their small-scale FLR projects. Successful restoration projects were set up near New Amanfrom and the Kwame Danso road. Near New Amanfrom a 43 sqkm plantation was established in 2010, under the National Forest Plantation Development Project, with labour provided by the Youth in Afforestation program under the Youth Employment Agency (YIA-YEA). The trees grown are Techtonia grandis and Gmeliana sp, which are drought resistant and resilient to climatic variability, as no water source is available. Similar projects have been established in Bepoase, near Atebubu, were farmers are supported to plant trees on their farms with the help of non-governmental organisations Tropenbos Ghana and A Rocha Ghana, as part of their climate change mitigation programmes. The trees planted are Mangifera indica, Anacardium occidentale, Cassia fistula, Terminalia sperba, Swietenia macrophylla and cashew, each having a high commercial value (timber, cashew nuts), enrich the quality of the soil, and have the premise to raise carbon credits which will contribute to a family's income. Farmers are well aware of these advantages, including the benefit of carbon sequestration. One farmer said "*We plant for future purposes, for the unborn generations to enjoy a good environment*. *We sequester carbon in the soil, which will lead to financial return within just a few years".* The planting of trees is done under a legal contract between the farmers and the NGOs which regulates the benefit sharing of the carbon credits. While adding an economic value to the trees, the farmers can continue planting food crops such as yam, rice, cassava, beans, soybeans and pepper, for home consumption and additional sales of surpluses grown.

In Bunso, multiple trees are planted outside of the forest reserve. Species planted are Terminalia superba (oframo), Swietenia macrophylla (mahogany), Terminalia ivoriensis (emire), and Ceiba pentandra (onyina), all having high commercial value (timber), but also enhance biodiversity and sequester carbon. Moreover,

additional areas are planted with Coconut, Oil Palm and Plantain, to enhance the food security of the families living in the area. These combined restoration efforts are successful, although they are challenged by erratic rainfall which is sometimes too little and sometimes too much. As there is no alternative water source in the area, it is hard for farmers to irrigate the crops and the trees, which have been affected by periodic floods and droughts. Technical assistance is provided by the Forestry Service Division, which maintains ownership over the trees but grants occasional permission to farmers to harvest the trees. The overall yields of trees and crops however are low, and there is a lack of capital to invest in mechanic irrigation methods such as pumps or wells.

A major constraint to all these afforestation initiatives is the recurrent water shortage. The government tried to support by constructing two dams for irrigation purpose near the towns. But without constructing appropriate channels to bring the water to the farms which are far from the towns. For this reason, the dams are used for domestic purposes only. Moreover, farmers experience rising temperatures, which exacerbates the water shortage and lead to lowering incomes and food security of households.

Afforestation through planting of Cassia trees (Cassia siamia) is practiced by individual farmers in Sene West's Menko Community. One farmer says that he received the seedlings from the Forest Service Division in 2013. His motive to plant Cassia is that the pruned tree branches can be used for charcoal production, while the remaining trees play their role in mitigating climate change. He receives technical support from the Forest Resource Guard in the area, and he wishes to grow more trees, especially along the river banks, to prevent erosion and promote biodiversity.

COMMERCIAL TREE PLANTING

In Sene West District there is commercial tree planting at small and medium scale. Teak trees have been planted by individual farmers who are motivated by the commercial value of Teak, who consider Teak plantation as an interesting long term investment. Besides investment, the trees add value to the agricultural land in terms of soil fertility, water availability and shade. According to one tree farmer: *"I planted Teak tree species in my farm because I believed I could obtain timber after harvesting. These trees could also help restore biodiversity and support climate change mitigation".* It was the Forest Service Division that gave him the seedlings, which he nursed himself.

A larger commercial tree plantation is found along the Atebubu and Kwame Danso Road, also in Sene West, which his owned by the African Plantation for Sustainable Development (APSD). This is a private company that planted a sizable portion (no figures available) of Eucalyptus grandis. Unfortunately there is no detailed information available, as the management of the plantation did not want to interact with the field trip team, and pictures could only be taken from a distance.

ENRICHMENT PLANTING

Nkoranza is well-known for its Sabrekyeso Sacred Groove, where enrichment planting is practiced. The Sacred Groove is about 4,5 ha, and it harbours a combination of trees and crop fields. Sacred grooves are areas where traditional and spiritual leaders perform important rituals. These areas are highly respected areas, and people sacrifice their time to maintain and protect the biodiversity within. Several tree planting programmes are focused on sacred grooves that may not be in forest reserves, but on farm land, where forest remnants are protected and maintained by the surrounding communities. Such tree planting programmes have been established to encourage farmers to maintain and restore the grooves with the ultimate purpose to enhance biodiversity and sequester carbon, but also to serve as a green belt that can protect the sacred grooves. The Tano Sacred Groove covers about 100 ha, and harbours precious species which are naturally grown or planted over the years. The species planted are Daniella oliverii, Pseudospondias macrocarpa, Swietenia macrophylla (mahogany), Tectona grandis (Teak), Terminalia superba (ofram), many of which have high medicinal value. It also harbours multiple fruit trees such as Pawpaw and Oil Palm. The Forestry Service Division has a special programme to support communities to plant, care for saplings and protect the grooves from illegal harvesting and theft.

In Drobe and Kontoh Community, in Sene West District, enrichment planting is done by the Youth Employment in Afforestation (YEA) which is planting Cassia trees. The Kontoh plantation covers a total land area of 3 acres, while the Drope plantation covers 2 acres. Before the plantations were planted the land was highly degraded and no longer suitable for either forestry or agriculture. The degradation was caused by unsustainable charcoal production and farming, and restoration is done with the aim to restore the land and improve its biodiversity. Some of the trees will be harvested for charcoal production, while others will remain, to further restore the land. In Kwaku Donkor Community enrichment planting is done by planting Cassia and Mahogany and Cassia. The Dansor Tree Planters and Charcoal Producers Association planted and manages an area of 50 acres, with seedlings obtained from the Forest Service Division. The main reason for planting is carbon sequestration and the production of charcoal. The land on which the trees are planted belongs to the Chiefs, who are happy to contribute to the project. When temporal water shortages are experienced, the water from a nearby constructed dam is used to irrigate.

WOODLOTS FOR FUELWOOD AND CHARCOAL

In Bepoase, communities established a woodlot of about 30 ha in 2021, with the support of Tropenbos Ghana. The woodlot is located very close to the community, so that it can serve as a source of firewood, and help reducing the rate at which trees are felled for charcoal production. The management of the woodlot is in the hands of the community which assigned some woodlot managers to do the job. The tree species planted in the woodlot is Cassia fistula, which grows quickly, and can be harvested within a few years. Technical assistance is provided by Tropenbos Ghana, which also facilitated access to a permanent water source (pump). A 3,5 ha Cassia fistula woodlot plantation established by the Forest Services Division is near and for the Nkoranza Senior High School. The land was given to the Division by School authorities, and the labour is provided by the Youth in Agriculture group (YAP-YEA). The harvested wood is used for the kitchen service and school canteen. It also serves for cattle feeding and milk production to raise the nutritional status of the school children.

AGROFORESTRY

Agroforestry is increasingly popular, not only because it is promoted by the Forestry Service Division and multiple projects, but also because it delivers positive results. Many agroforestry projects started during the government funded *Green Ghana Project*, that aimed to afforest and reforest the country's territory and fight the symptoms of climate change. However successful, many of these projects face the challenge of erratic rainfall and lack of irrigation measures as well as illegal logging of the trees. Nevertheless, agroforestry is gaining ground, as it visibly enriches the soil, provides shade for the food crops, and restores the water balance. Many farmers choose to practice agroforestry near to a water source, a river bank or in the vicinity of streams, or otherwise invest in water pumps or fetch water manually. Several forms of rainwater harvesting are being practiced, in the form of small dams, wells, pipes and digging channels to bring the water from a far away water source to the farms. Otherwise, farmers anticipate on erratic rainfall by lengthening the crop growth period, or starting as early as possible with planting trees and crops. In terms of investments, some farmers hire labourers to take care of the farms and, when irrigation is necessary, pay for vehicles that fetch water in gallons to their farms.

Near the Forest Reserve in Hyiresu (Kintampo North), farmers own farm land just next to the forest reserve. They practice agroforestry, combining food crops such as yam, cassava and beans with tree crops such as Mahogany, Terminalia superba, Ceiba pentandra, and Milicia excelsa. The farmers take care of the trees, as it raises the fertility of the soil and the productivity of the crops. The crops provide an important source of food for the farming families, while surplus is being sold on the market. The market is not far, and middlemen with cars visit the farms to buy the products directly from the farmers. Since the farms are close to the forest reserve, most of the technical support is provided by the Forestry Division, that also provides seedlings, as well as some basic tools to help the tree seedlings to survive.

In Tano Boase, agroforestry is practiced by farmers who combine commercial trees like Ofram, Teak and Mahogany with crops such as cassava, yam, plantain and more. The Forestry Service Division provides seedlings of these trees to be planted on the farms, with technical assistance is provided to take proper care of the trees.

In Offuman (Techiman), farmers increasingly practice agroforestry for multiple purposes. First of all, they appreciate the commercial value of trees which are provided by the District's Ministry of Food and Agriculture: Terminalia superba (oframo), Swietenia macrophylla (mahogany), Terminalia ivoriensis (emire), and Ceiba pentandra (onyina). In addition, they see the benefit for the food crops that they grow underneath the trees, such as vegetables, yam, plantain, maize, cocoa, cashew, and cocoyam. These crops grow better under the shade that is provided by the trees, and because of the better soil structure and soil moisture that is created by the trees. They are increasingly interested in growing more trees on their farms, to protect the river banks, and raise an additional income by growing economically interesting trees.

In Menkor Community (Sene West), there is an interesting agroforestry scheme combining food crops such as groundnut, maize, beans, yam, cassava, plantain, cocoyam, tomatoes, pepper, with commercial tree crops such as Cashew, Mango, Mahogany, Wawa and Ofram. Farmers adhere high value to the growing trees which provides them with a long term investment opportunity, while growing crops underneath to be harvested for satisfying their short term food demands. The reason for combining food crops with cash crops is that these crops have mutual advantages (soil fertility, water retention, shade), and provide additional benefits of food and cash. One farmer explains "*When we plant only the cashew trees, it will be challenging for us to control the weeds and manage the cashew. However, when we grow food crops such as yam or maize with the cashew, we can control the weeds, and by so doing, we maintain the cashew".* Farmers consider cashew to be increasingly interesting as the prices are high. Some of the farmers obtained the cashew seedlings from the Ministry of Food and Agriculture (MoFA) in Kwame Danso, while others also obtained theirs from individual friends and family members. Some farmers report a gradual decline in rainfall and regular water shortage, yet they feel that irrigation would be too capital intensive, while agroforestry is not rewarding enough to cover the costs. More problematic is the uncontrolled grazing of cattle, and the frequent incidence of wildfire.

5.3 FLR in Bono East: the challenges encountered

In the Bono East Region there are multiple forms of FLR being practiced, including aafforestation, reforestation, enrichment planting, trees-on-farms, and agroforestry. Restoration projects can be found in forest reserves and on agricultural land. Many farmers are engaged in either of these, supported by government agencies as well as NGOs operating in the Region. Nevertheless, FLR in Bono East is not without challenges. Some of these challenges are directly related to land degradation and the first impact of climate change. Others are related to a low adaptive capacity of farmers to adapt their farming practice and investment pattern to the changing environmental conditions. Additional challenges relate to the low access and ownership of farmers to resources such as land and trees, as well as the institutional challenges that are related to overlapping and contradicting policies and plans. These multiple challenges hamper the uptake of nature-based solutions such as FLR that could help farmers to cope with climate change, and maintain food system performance to the level that is needed now and in future.

CLIMATE CHANGE

According to the Government of Ghana, Ghana is experiencing the first signs of climate change, as expressed in temperature increases and net decline of rainfall and resulting into prolonged droughts and more frequent incidences with bush fires (Government of Ghana 2012). The overall water availability largely depends on precipitation which is increasingly unreliable (ibid.). Variability of rainfall has serious consequences for farmers in the forest and the transition zones such as in Bono East Region, where the impact of climate change is directly observed by farmers who report a net decrease of production and farm income over the past few years.

FARMERS MOTIVATION TO PLANT TREES

Farmers are well aware of the growing impact of climate change, and their first worry is to maintain their food security under these changing conditions. They value the planting of trees, but do not see this as a first priority in maintaining their subsistence level under the threat of climate change. Many farmers wish to raise their crop yields by ploughing their fields, which is not easy if there are trees on the farm. They want to invest in drought resistant crop varieties or the purchase of water pumps, not in purchasing seedlings, unless they directly contribute to food and nutrition security. Farmers experience a shortage of land, which does not stimulate them to reserve land for trees which, according to them, does not directly contribute to the family's food security or income. A frequently used method for obtaining and securing farm land is through the burning of land. In combination with drought, this practice leads to bush fires which are destructive to trees. Moreover, increasing numbers of Northern herdsmen enter the region to graze their cattle on farm land, leading to damage to recently planted trees. Restoration and reforestation projects are often implemented in

collaboration with the Youth in Afforestation Project under the Youth Employment Agency, with the premise to create jobs. But the salaries are low, which undermines the motivation of the youth to take part.

LACK OF INNOVATIVE FARMING PRACTICE AND INVESTMENT

The Ghana National Climate Change Adaptation Strategy (NCCAS) developed for the period 2010–2020 has the primary goal of enhancing Ghana's current and future development to climate change impacts by strengthening its adaptive capacity and building resilience of society and ecosystems' (Government of Ghana 2012). It recognises the importance of strengthening the adaptive capacity of the agricultural sector, by investing in novel techniques of climate smart agriculture, including precision agriculture and investment in small and large scale irrigation. Irrigation however requires considerable financial investments, something which is out of the scope of many small scale farmers in Bono East. Whereas other countries experiment with multiple forms of rainwater harvesting, collection of rainwater through roof tops and dams is largely restricted to urban areas where rainwater harvesting is used for domestic water use. Few are the examples of rainwater harvesting for small scale irrigation of farms and/or forests (Linderhof et al., 2022). The national programme 'One Village One Dam' is largely focused on domestic water supply and WASH in urban and peri-urban areas, and does hardly contribute to irrigation of either crops or trees.

TENURE ARRANGEMENTS AND PROPERTY RIGHTS

Throughout Bono East, land ownership is problematic. Although in principle all farm land has been allocated and farmers have obtained their title deeds, there still are many issues with overlapping or contradicting land rights. Land can be owned by the State, by the Chiefs, or by individual farmers, and often there are multiple claims on the land, leaving it unclear who has the formal right to own and invest in the land. A growing rural population and rapid expansion of towns increase the pressure on farm land, leading to stronger competition and claims on land. Formally, all the forests belong to the State, and so do the individual trees. This has frequently led to farmers encroaching on the forests to cut trees and plant crops, with forest degradation as a result. In order to restore degraded forests and ease the pressure on farm land, the State has developed the Modified Taungya System that allows farmers to farm underneath planted trees until the canopy closes. Farmers are happy with this opportunity to occupy extra farmland, but they illegally cut the trees before these are matured, to avoid the canopy to close and to keep them farming (see section 4.3.1). Even in cases where farmers enjoy tenure security on land, insecurity on tree tenure remains. Farmers do not have the guarantee that they can benefit from the trees as long as these are not legally owned. Although legislation on tree tenure is in the making, it will take a long time before all trees are registered and farmers will be able to reap the benefit of planting trees.

OVERLAPPING AND CONTRADICTING POLICIES AND PLANS

As described, there are several policy measures related to forestry, agriculture, water and food security that aim to stimulate restoration, reforestation, agricultural improvement and water management. Yet these policy measures are poorly aligned, which means that there is little synergy between the different policy measures. The vast majority of FLR initiatives are implemented by the Ghana Forestry Commission, which follows its mandate to produce timber and sequester carbon as part of the country's climate policies and supported by global mechanisms of carbon finance (Ghana's Plantation Strategy, see section 3). Few are the restoration initiatives which are focused on food. The Agricultural Division of Bono East follows the country's policy framework on reducing food insecurity and arriving at Zero Hunger by 2030 which is high on the national agenda (see section 3). It actively promotes climate smart and regenerative farming through trees-on-farm methods and agroforestry. However, the tree seedlings for this are provided by the Forestry Commission, which trees are mostly fast growing timber species that do not provide food. Moreover, there is no overarching agroforestry policy framework which causes confusion in the role division between the Forestry Commission and the Agricultural Division's extension work, creating misunderstanding among farmers as the government does not have a single message on agroforestry. Ghana's Water management falls under the responsibility of the Ministry of Water Resources, Works and Housing, which first priority is the provision of urban water supply for domestic use. It's national campaign 'One Village One Dam' has a close connection to Ghana's WASH policy, which aims at providing safe drinking water, sanitation and hygiene to the rural and urban population. Dams are constructed in the vicinity of towns, not in the vicinity of farms, hence farmers in the need of irrigation services have to invest themselves in the construction of boreholes, the purchase of water pumps, or the construction of micro dams, which is hardly done.

6 FLR for climate resilient and circular food systems: the way forward

Forest and Landscape Restoration (FLR) is one of the most popular nature-based solutions which are promoted worldwide. In order to leverage the thousands of small and local initiatives, the decade 2020-2030 has been declared as UN Decade on Ecosystem Restoration, to raise the ambition and restore the world's degraded ecosystems by planting trillions of trees. Public and private funding has been pledged under the UNFCCC climate negotiations, and national and regional programmes are being rolled out on all continents, especially in Africa, under the regional AFR100 programme. Indeed, FLR is a nature-based solution to climate change, but it is more than just that. If designed well, FLR can contribute to multiple policy objectives at the landscape level, including climate adaptation and mitigation, food security, reduced biodiversity loss, generate employment, and more.

Ghana's Bono East Region is at the brink of experiencing the triple challenge of climate change, food insecurity and massive biodiversity loss. This triple challenge is recognised and acknowledged by the Region's policy makers, its farmers, and its population at large. In Bono East there are several programmes implemented through international climate funds, mostly through its forestry sector and guided by Ghana's Plantation Strategy. Most FLR is therefore implemented with the aim to sequester carbon and contributing to the global fight against climate change, while generating income from commercial timber production. Kintampo North harbours some larger Forest Reserves where restoration in the form of afforestation, reforestation, amenity planting, and the typical Modified Taungya System is implemented. Commercial tree planting takes place in the less densely populated area of Sene West, where small and medium size plantations are managed by individual farmers and larger forestry companies.

In the rest of the Region most FLR is implemented on off-reserve areas or farm land, where reforestation and afforestation have to compete with agricultural practices of the rural population. Although the idea of tree planting is highly valued by Bono East farmers, FLR in the form of afforestation and reforestation is not very popular among farmers who are mostly concerned with their food security. They therefore prefer FLR for Food methods like trees-on-farm practice and agroforestry, the latter often referred to as nature-based solution in itself. Agroforestry restoration projects are mostly combining cash crops such as cashew and mango, intertwined with food crops such as maize, yam, cassava, soya beans, vegetables and additional commercially interesting trees in between.

Agricultural production in Bono East is increasingly hampered by unreliable and capricious rainfall, and periodic water shortage. The region has a high potential for another nature-based solution which is rainwater harvesting, but wherever rainwater harvesting is practiced in Bono East, it is used for urban and domestic water supply. Investment in rainwater harvesting would be greatly appreciated, not only to increase farm yields but also to implement FLR in the form of trees-on-farms or agroforestry. Rainwater harvesting would increase the survival rates of the trees and increase the crop yields, which would raise the level of food security as well as its resistance to climate change. Higher rates of tree and crop survival would make FLR more profitable, and offer opportunities for farmers to invest in small scale rainwater harvesting techniques. Simultaneous investment in nature-based solutions FLR and RWH would therefore be mutually beneficial, as it raises the impact of both.

Creating synergies between multiple nature-based solutions (FLR, agroforestry, RWH and possibly more) would fit in the traditional farming practice of the region and therefore be appreciated by farmers. Yet it would imply more intense collaboration between government agencies, in particular between those agencies which are working on the various forms of FLR. Creating synergies between the different policy domains related to FLR, agroforestry, water management and rainwater harvesting would lead to a more systemic approach of FLR for forests and food, and channel the investment funds to there where the leverage could be highest. Collaboration between different policy domains however is difficult, as each of the implementing agencies has sectoral mandates and is directly steered from national Ministries in charge. Whereas at the local level extension workers and forest guards often collaborate, their collaborative efforts are not

necessarily translated into more integrated policies that stimulate the innovative use of nature-based solutions. Therefore, farmers are not encouraged to combine several nature-based solutions on their own land, and experiment with agroforestry and other integrated methods.

Conceptualising FLR from an integrated food systems perspective would be in the interest of farmers, as it would help them to raise their level of food security while strengthening their resilience to climate change. Stronger food system performance decreases farmers' vulnerability to climate change and raises their motivation to invest in a more sustainable future. At the regional level, combining FLR with agroforestry and RWH would lead to stronger food system performance which is good for the region and good for the country. It would allow for combining sectoral objectives of forestry, agricultural production, biodiversity, food and nutrition security and water availability in a more coherent policy direction. Adopting a FLR for Food approach would stimulate the collaboration between producers, consumers, civil society organisations, companies and research institutes, for Ghana's Bono East Region to be a pioneer in creating a climate resilient and circular future.

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Wageningen Centre for Development Innovation
Wageningen University & Research
P.O. Box 88
6700 AB Wageningen
The Netherlands
T +31 (0)317 48 68 00
wur.eu/cdi

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Wageningen Centre for Development Innovation
Wageningen University & Research
P.O. Box 88
6700 AB Wageningen
The Netherlands
T +31 (0) 317 48 68 00
wur.eu/wdci

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