Institute for Global Prosperity

FARMER LED REGENERATIVE AGRICULTURE FOR AFRICA

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EXECUTIVE SUMMARY

Regenerative Agriculture offers the potential to create a new farming future for Africa. The radical transformation of our agricultural systems presents the opportunity to revive ecosystems, amplify biodiversity and improve dietary diversity, positive impacts that will cascade across sectors and create new pathways to more prosperous, resilient and sustainable futures (Moore 2021).

The window of opportunity to undertake such a transformation is now. The future of industrial agricultural practice looks bleak, with food production oriented around market growth and global food security through high yields. These contribute to the erosion of ecosystems, depletion of biodiversity, reduction of dietary diversity and vulnerability to future climate extremes (IPCC 2018; IPBES 2019). When coupled with population growth, weak financial and welfare systems, widening inequalities and the persistence of malnutrition, humanity's future and its relationship with the planet looks dire. The need for an alternative farming future premised on Regenerative Agriculture has thus never been more imperative.

Regenerative Agriculture can be conceived as a broad suite of principles and practices aimed at regenerating soils and ecosystems through an array of considered agricultural activities. Through this report we summarise the existing state-of-the art and consolidate the climatic, ecological, social and economic case for Regenerative Agriculture in Africa. While scientific research has validated the positives of regenerative techniques, there remain major challenges with formalising and scaling Regenerative Agriculture across the continent.

Our findings demonstrate that a major barrier sits at the intersection between 1) the general validation of broad principles and diverse techniques and 2) the need for context specific Regenerative Agriculture at the farm level. We argue that what is needed to breach this barrier is not a specific formulation of Regenerative Agriculture *per se*. Instead, there needs to be a replicable and scalable process for farmers to design and produce Regenerative Agriculture on their own terms with communities and policymakers across ecosystems.

This approach does not envisage a wholesale restructuring of agricultural practice in Africa under the technical expertise of agronomic specialists. Instead, if farmers are empowered to iteratively design the management of their own regenerative systems, then this will enhance existing good practice and counter the negative impacts of an increasing reliance on external inputs and industrial models of production.

The findings of the report have led us to the eight recommendations outlined below. The recommendations are ranked under three nodes of action; **Design, Support and Facilitate**. Each node of action loosely pertains to different levels of scale – local/farmer, regional/national, and pan national respectively – and offers a range of entry points through which different actors and institutions may be engaged.

The Design node emphasises the re-centring of farmers in the process of designing and actually producing Regenerative Agriculture, and their necessary embeddedness in wider processes of policy design at the ecosystem or landscape level.

The Support node focusses on the systems and technologies of knowledge that will reinforce a design centred approach to building Regenerative Agriculture.

The Facilitate node draws out the necessary socio-economic and socio-political changes that are required to facilitate the production of regenerative agriculture at the farm and ecosystem level and considers how these can be driven by reconfigured roles for science, technology, business and government.

DESIGN

Recommendation 1: Position farmers at the centre of a design process for building localised Regenerative Agricultures.

Farmers need to be the primary architects for designing new agricultural futures (Chapter 3.2-3.6). This starts not with the transfer of expert recommendations, but by prioritising farmers' own extensive knowledge and practice that is secondarily buttressed by technical input (Recommendations 3, 4, and 5).

Constructing locally contextual Regenerative Agriculture must involve developing a qualitative understanding of a farming livelihoods in order to build a holistic, non-harmonised programme of design (Chapter 3.6). Here, farmers become the centre of a design process where they build systems and processes constructed around regenerative agricultural principles and through which activities are carried, monitored and assessed (e.g. by applying a suite of soil maintenance or water management techniques). This also offers the potential to scale and speed scientific practice by harnessing farmers vast potential as ongoing experimenters (Recommendation 3), feeding back into stores of best practice (Recommendation 4; Chapter 2.2).

Recommendation 2: Design on-going links between wider policy planning and localised farmer activity so that there is ecosystem regeneration at a landscape level.

There is a need to work across multiple scales and employ 'ecosystemic' thinking that requires wider policy implementation and intersectoral collaboration. Where biophysical processes and key mechanics behind ecosystem services operate over large geographical regions (e.g. water sheds and river basins), the holistic management of environments cannot solely be undertaken by practitioners operating on a farm level separately from one another. Rather, it must involve broader processes of co-design and collaboration between neighbours, communities and policy makers. We explore this process of building Policy Led Regenerative Design in Chapter 3.5 and 4.4.

SUPPORT

> **Recommendation 3:** Develop standardised measures/indicators to evaluate successful regenerative food production.

In contrast to current industrial agricultural food production systems that measure success in terms of commodity output, new ecological indicators need to be created that frame agricultural success in terms of ecosystem services enhancement, increased biodiversity and soil regeneration. These indicators will serve as a basis for the creation of new value chains (Recommendation 6) and policy design at the regional, national and pan national levels (Recommendations 2 and 8; Chapter 3.5, 4.5).

This needs to happen on two levels. Firstly, farmers need access to affordable simple methods of evaluating on-farm regeneration so that they can monitor their own regenerative activities. This allows for the assessment of specific practices in local contexts and offers empirical validation for farmers advocating particular techniques on knowledge sharing platforms (Recommendation 5; Chapter 3.6). Secondly, the mapping and monitoring of the wider landscape will create ecological baselines that will inform broader forms of Policy Led Regenerative Designs (Chapter 3.5; Recommendation 2).

> **Recommendation 4:** Build an open access knowledge store of validated Regenerative Agriculture resources.

There is a need to establish an open access, scientifically-validated knowledge store for Regenerative Agriculture that farmers can draw upon in the design process (Recommendation 1; Chapter 3.6). A centralised knowledge store co-designed with farmers and drawing on farmer's own empirical validation (Recommendation 3) will allow farmers to become the primary agents of design rather than being recipients of imposed agricultural trials led by external experts.

This centralised platform should be built from the resources of potential partners at research institutes founded on the key principles of accessibility (e.g. comprised of freely available information accessible via smartphones) and scientific validation as well as from the ongoing acts of farmers' own experimentations. An open access knowledge store needs to be complemented by a knowledge sharing platform where farmers can discuss and share experiences of applying and experimenting with different techniques in different ecological contexts.

> **Recommendation 5:** Create demonstration farms and farmer-led extension programmes.

Informed both by local farmer led regenerative designs and technical experimentations, demonstration farms will act as extension facilities and research hubs for farmers wanting to transition to Regenerative Agriculture (Chapter 2.6; 3.6). These farms may act as centres for experimentation and validation of particular techniques within specific ecological, climatic and socio-political contexts, but also as demonstrations of the more widely applicable design processes.

Locally trained farmers operating model farms should be technically and financially supported so that they have unprecedented scope to experiment with new crops and agroecological techniques with minimal risk to personal livelihoods (Chapter 2.6; 4.5). In this way, regional model farms can bear the risk of new and emerging technologies rather than surrounding farmers who may otherwise be wary of failure and financial setback.

FACILITATE

> **Recommendation 6:** Reconfigure the economics of food production and value chains to reward regenerative practices.

Future economic models must incorporate the value of regenerated ecosystem services and multifunctional agriculture systems (Chapter 2.6, 3.3). These forms of economic valuation need to be integrated into future value chains and food production markets while remaining attuned to the needs and requirements of farmers (Recommendations 1 and 2). To balance these longer-term and wider ecological and public values against shorter-term fluctuations in farmers livelihoods, policies need to be designed that provide business opportunities/financial incentives (for example, taxes on ecologically detrimental practice and/or subsidies for regenerative practices) to further enable Regenerative Agriculture. Such ideas have been trialled through Payment for Ecosystem Services (PES) schemes that contribute to household income if on-farm ecologies are protected/enhanced (Chapter 3.5).

Recommendation 7: Mainstream Regenerative Agriculture as a new pathway to livelihood prosperity by raising public awareness and support.

Facilitating transitions to new Regenerative Agricultural futures must build on Recommendation 6 by raising public awareness and shifting support to diversified agricultural systems. As argued in Chapter 1.2, the adoption of Regenerative Agriculture can produce ecological and socio-economic outcomes that create new pathways to globally prosperous futures defined by descent livelihoods, healthy households and well-functioning resilient ecosystems.

Raising public awareness must thus also involve creating health campaigns oriented around the promotion of nutritiously diverse diets and clean environments (Chapter 2.2; 4.4). Mainstreaming principles and practices of Regenerative Agriculture into education agendas and curriculums will also be paramount for supporting a new generation of regenerative farmers. This should be undertaken in schools as well as within specialist agricultural training courses/diplomas and extension programmes in order to equip aspiring farmers with the necessary knowledge and skills to transform our food systems from the ground up.

Recommendation 8: Develop new holistic food policies between multiple sectors at different scales.

Existing policies and regulations that are designed to support industrial food systems (e.g. global value chains, seed legislation, food prices, output measures) need to be reformed and replaced with policies and measures that facilitate what Rockström et al. (2017) call a ‘livelihood-centred paradigm’. Here, new food production systems need to be facilitated by national and international policy that operate within the biophysical boundaries of the planet’s finite resources, increase food security, create nutritionally balanced diets and support farmer sovereignty (Chapter 1.3; 3.3).

New policies must be systemic in nature, transcending political boundaries and election cycles and bringing together multiple partners, including different ministries (agriculture, environment, education and health), businesses, NGOs and global governmental structures (UN, World Bank etc) (Chapter 3.5, 4.4). In turn, thinking across different sectors and markets in a systemic manner can help create circular bioeconomies at multiple scales (household, schools, businesses, towns, industries, countries), thus operating within ecological limitations of local and global systems whilst simultaneously reducing waste (Chapter 2.6).

Recommendation 9: Build new coalitions and amplify existing positive partnerships between science, technology, business, government and citizen farmers to enable farmer led design.

There is a need to build new partnerships in a manner that re-centres the focus of action from non-farming stake-holders to the farmers themselves (Recommendation 1; Chapter 3.3). An integral part of this process must involve re-positioning the assumed locus of knowledge from external experts to those who produce the food. As well as this, there is a need to shift the role of stake-holders from drivers of change themselves to facilitators and enablers of farmer led change. This may be achieved by focussing the attention of stakeholders on the production of the enabling conditions, policies, and technologies expressed in Recommendations 3-8.

IMMEDIATE ACTIONS

The above recommendations highlight the main steps that we argue need to be taken to scale up Regenerative Agriculture across Africa (see also Appendix D for a summary). Here we outline immediate actions that might take place to kickstart this process for the delivery of Recommendations 1-5. In taking these actions, a strong foundation will be laid for fulfilling Recommendations 6-9. These steps are explored in more detail in Chapter 4.5.

1. **Pilot methods of Farmer Led Regenerative Design** – There is a need to pilot methods of co-design through a series of scoping studies

and community workshops. We advocate working with a select range of farming communities across Africa, undertaking workshops that explore what Farmer Led Regenerative Design may look like in practice and how these can be supported and facilitated by wider policy structures and businesses. These need to be complimented by on-the-ground pilot studies and experiments that work with existing farming community partnerships to trial and refine processes of co-design. This work will provide the foundations for addressing **Recommendation 1**.

2. **Co-design an online knowledge store** – Pilot studies should contribute an account of what farmers want and need from an online validated knowledge store and how it should be accessed and used. This work would explore existing platforms (e.g. WeFarm, Farm Africa, M-Farm) and how these may be improved to better serve farmers' needs. Information gleaned from these immediate actions can then be used to co-design and pilot an open access online platform for the delivery of **Recommendation 4**.

3. **Build partnerships with technology providers** – There is a need to develop a series of simple on farm measurement kits to base-line and record on farm conditions, including moisture, temperature, basic soil chemistry and structure, yield measurement and identification of disease and pests. This would work immediately towards proof of concept for **Recommendation 3**.

4. **Work with local government institutions to identify entry points for supporting Farmer Led Regenerative Design** – Immediate actions can be undertaken at the policy level to build the foundations for **Recommendation 2**. Such work would explore how farmers' needs may be mainstreamed within ecosystem management plans and elucidate the market constraints currently faced by farmers. Pilot incentives may be developed to reshape markets, for example by increased taxation on synthetic inputs alongside subsidies for organic inputs.

As history has so often shown, any attempt to design climatic and ecological actions without the broad consensus of those who dwell, know, manage and rely on such environments is likely to be doomed to failure and to reproduce longstanding patterns of marginalisation, inequality and degradation (*c.f.* Leach and Mearns 1996). At the Institute for Global Prosperity we are committed to working with farmers across Africa to help them re-gain the centre ground in the design and implementation of their own agricultural futures. We see this process as essential to the health and prosperity of future generations in Africa and beyond, as well as to the very functioning of the planet on which we live. We are already in a position to begin work towards our Recommendations, particularly the four Immediate Actions outlined above (see also Appendix C). In the detailed report that follows we explain how we have come to our Recommendations, offer a wide range of empirical evidence to support our conclusions, and elaborate on how the Recommendations may be implemented.

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CHAPTER 1

INTRODUCTION

1.1 RATIONALE AND ARGUMENT

The most recent IPCC (2018) report offers a gloomy vision of our climatic future. Similarly, the recent IPBES (2019) Global Assessment on Biodiversity and Ecosystem Services offers a worrying account of reduced biodiversity, decreased resilience and the loss of critical ecosystem services. Coupled with major population growth, financial and welfare systems that fail to address widening inequalities and the persistence of malnutrition and diet related non-communicable disease, these assessments paint a dire picture of humanity's future in the absence of radical transformation.

There are, however, nodes of opportunity around which these interlinked challenges coalesce. Food production is one of these. Targeted concerted action to transform food systems will result in major positive impacts across this range of complex global challenges (Gordon et al. 2017; Caron et al. 2018). While industrialised agricultural production is a primary emitter of green-house gasses, a major culprit in ecosystem degradation and a contributor to reduced dietary diversity, the radical transformation of agricultural practice offers not only the opportunity to halt this range of negative effects, but to also reverse them by absorbing carbon, enhancing biodiversity and ecosystem function, extending dietary diversity and re-formulating markets and livelihoods. The creation of a **new farming future** will thus cascade a series of positive impacts across sectors, creating a pathway to more prosperous, resilient and sustainable futures (Moore 2021).

In multiple government, NGO and scientific discourses, Regenerative Agriculture (RA) is increasingly promoted as the framework for such transformation (Soloviev and Landua 2016; Rhodes 2017). Through this report we summarise the existing state-of-the art with regards to RA in Africa and consolidate the climatic, ecological, social and economic case for RA. We then move beyond this case to consider how the uptake of RA principles may be dramatically scaled-up in Africa.

Considerable scientific research has validated the positive effects of a wide array of regenerative techniques and multiple major examples and initiatives have promoted the primary concepts of RA. Africa already leads in this process. However, as this report outlines, there remain major challenges with formalising, disseminating and scaling RA.

Building from our review of the current state of RA, we argue that there remains a major barrier to widespread adoption that sits at the intersection between 1.) the general and widely accepted validation of broad principles and diverse techniques and 2.) the need for context specific implementation at the farm level which makes any particular RA formula difficult to apply in practice. We argue that what is required to breach this barrier is not a specific formulation of RA *per se*, but rather a replicable and scalable method or process for designing and producing RA with farmers, communities, policymakers and across ecosystems. This approach does not envisage a wholesale restructuring of agricultural practice in Africa under the technical expertise of agronomic specialists, but rather aims to enhance existing good practice and counter the negative impacts of increasing reliance on external inputs and industrial models of production, by empowering farmers to design the management of their own regenerative systems.

As we outline below, current attempts to scale RA focus on increased empirical scientific testing and the dissemination of established principles. This approach largely focusses on projecting emergent knowledge in the hope that others will take it up. We argue that such an approach is likely to be too expensive, too time consuming and too slow given the urgency of the situation. It is also an approach that is largely only accessible to relatively wealthy and well-connected farmers able to access online resources, hubs and dissemination programmes. When applied to poorer farmers in the Global South, this knowledge-transfer approach can seem disenfranchising and alienating, thus hindering uptake.

Instead we propose the development of a co-design methodology to harness the power of famers themselves to act as experimenters and empirical validators in their own right, and at the same time as they are empowered to design, build and deploy RA systems in real time and with immediate impacts. We argue that the development of widely applicable co-design methods must be the first step in accelerating the uptake of RA while simultaneously refining RA practices and principles for the future. We also focus on why diverse actors from government, international organisations, NGOs and business will be required to play a crucial role in building and establishing regenerative co-design and make suggestions as to how such actors may be engaged in this process.

1.2 WHY REGENERATIVE AGRICULTURE FOR AFRICA?

Across Africa the expansion of intensive agriculture (characterised by increased mechanisation, synthetic chemical inputs and the commodification of crops) is currently depleting soils and eroding the ecosystems that regulate agricultural production including the collapse of soil structures, loss of micronutrients and crop genetic diversity and pollinators as well as degraded carbon capture and water purification (Olssen *et al.* 2019). These trends are exacerbated by the uncertainties and extremes of climatic change and the increasing demands of growing populations both in Africa and beyond. Particular impacts are being felt on soils with nearly 40% low in nutrient capital reserves, 25% suffering aluminium toxicity, and 18% with high leaching potential and low buffering capacity (Tully *et al.* 2015). Current estimates of soil degradation show an increasing trend in both the rate and extent suggesting that we must act urgently if we are to avert the disastrous consequences of a failure of food systems and related effects on wider ecosystems (FAO and ITPS 2015).

At the same time however, there are increasing calls to treat Africa as ripe for a new Green Revolution (AGRA 2018). Such calls see Africa as relatively land and resource rich and argue that with the right technological inputs the intensification of food production in Africa can not only feed African populations and improve livelihoods, but can also take up the slack in global food production (McMichael and Schneider 2011). By focussing on high inputs, commercialisation and market economics, there is considerable concern that the effect of such calls will be to accelerate the negative impacts of intensive industrialised agriculture without effectively addressing the ecological, social or economic challenges that both Africa and the world currently face (Moore 2015, 2018).

The current moment is thus a crucial time in the debate over the future of African agricultural systems and the nature of the support, resources and influences that may be brought to bear to transform them. The industrial agricultural model underpinning calls for a new Green Revolution is a well-oiled machine with increasing traction and as such it is imperative that an alternative vision for the future of African agricultural systems is rapidly advanced and accompanied by a practical and scalable programme for delivery. This report aims to offer the first step in creating such a vision and programme.

1.3 THE IMPERATIVE OF REGENERATIVE AGRICULTURE: BUILDING PATHWAYS TO PROSPERITY

Despite being developed almost 30 years ago by researchers at the Rodale Institute, California (Francis and Harwood 1985), the term 'Regenerative Agriculture' has only recently begun to gain traction amongst practitioners and scholars aiming to address the ever-pressing issues of soil health and erosion, food insecurity and global climate change. Prior to this recent resurgence, RA has been somewhat eclipsed by a series of more established concepts, such as 'sustainable agriculture', 'climate smart agriculture' and 'conservation agriculture', that have taken centre ground in stimulating dialogue and promoting alternative pathways to sustainable agricultural futures (Burgess *et al.* 2019, 3). This raises the question: what is RA and why is it an imperative blueprint for designing new farming futures?

At its most basic, RA can be understood as a broad suite of principles and practices aimed not simply at *sustaining* the current state of soils and ecosystems, but rather *regenerating* and enhancing them through an array of considered agricultural activities (The Rodale Institute 2014, 7; Terra International 2017; Regeneration international 2019). In this sense, RA aims to go beyond the arguably outmoded rationale underpinning the 'do no harm' of sustainable agriculture (see Rhodes 2017). Instead, as explored by existing systematic reviews of RA (e.g. Burgess *et al*. 2019; Soloviev and Landua 2016; Toensmeier 2016), it has become an umbrella term covering communities of practice involved in agroecology, permaculture, agroforestry, silvopasture, restoration ecology and landscape rewilding, all of which aim to improve and rejuvenate ecosystem services through a diverse range of techniques and principles.

In encompassing these approaches, and as a part of a recent call for a 'soil revolution' (Montgomery 2017), RA holds as one of its core tenants the imperative to "improve the health of soil or to restore highly degraded soil" (Rhodes 2017, 105). In practice, this may include minimising or avoiding tillage in order to avoid disturbing established soil structures, and eliminating the exposure of bare soil to the elements through mulching and/ or the use of cover crops. Promoting on-farm biodiversity and minimising synthetic inputs by means of intercropping, crop rotation and the use of integrated pest management, also helps to maintain soil health, as does the employment of holistic forms of livestock management in agropastoral systems, such as rotational and multi-paddock grazing.

The principles and practices of RA stand in stark contrast to the industrial methods of farming characteristic of the Green Revolution that prioritise high yields of a few key commodities. As discussed further in the following Chapters, these methods of farming are inherently unsustainable, contributing to approximately 24% of greenhouse gas emissions, 33% of global soil degradation and 60% of global terrestrial biodiversity loss (UNEP 2016, 7). This is due of soil erosion, excessive fertiliser, pesticide and herbicide use, monoculture cropping and the expansion of farmland into wilderness areas.

In light of this, the imperative to change our agricultural systems has never been greater. RA has the potential to do so through its reframing of agriculture as a holistic system that serves multiple functions/purposes beyond unsustainable goals of high yield output. Regenerating soil health through the building of top soil, for example, not only helps to improve soil fertility and hydrology, but also locks atmospheric carbon into organic matter in the ground (Lal 2018), thus simultaneously tackling wider drivers of global change (Toensmeier 2016). Moreover, increased carbon sequestration can aid a reduction of synthetic inputs fertilisers, thus decreasing household expenditure on agricultural products whilst reducing health issues associated with chemical poisoning. Similarly, biodiverse farms, are not only ecologically resilient to extreme climate events, but also provide balanced diets for households, decreasing malnutrition and improving the overall health of communities.

Regenerative practices can thus be understood as multifunctional as they improve ecosystem services and increase biodiversity whilst sustainably generating agricultural produce (Robertson *et al.* 2014). Importantly, we argue here that by regenerating ecosystems and environments, the adoption of RA can set in motion a series of deeper processes for producing new pathways to prosperous livelihoods (Figure 1). This can be seen as a broader call for what Rockström *et al.* (2017) a 'livelihood-centred paradigm' of food production within the biophysical boundaries of the planet's finite resources. Here the reduction of poverty, increased food security, nutritionally balanced diets and farmer sovereignty, all need to be foregrounded as major objectives of a new farming future.

RA can therefore produce a series of ecological and socio-economic outcomes which are imperative to creating new pathways to globally prosperous futures, where prosperity is not defined by ever increasing yields and economic growth, but by decent livelihoods, healthy households and well-functioning resilient ecosystems. How we manage our agri-food systems is inherently interlaced with wider forms of social and ecological well-being. Understanding this nexus of interrelated impacts is essential if we are serious about improving the prosperity of citizens across Africa and elsewhere.

1.4 SUMMARY: A NEW DIRECTION

In bringing this Chapter to a close, we reflect briefly on the state of current farming systems and the imperative of RA to replenish ecosystems as we begin to carve pathways towards prosperous new farming futures. In short, we are at the edge of a precarious crossroad. In one direction lies the well-trodden road of industrial agriculture whereby food production is framed in terms of market

Figure 1: Regenerative Agriculture for Prosperous Futures

growth and global food security through high yield outputs and specialised farming techniques (Jarosz 2014). As we have described however, the future of this pathway looks barren, consisting of eroded ecosystems, decreased biodiversity, reduced dietary diversity and increased vulnerability to future climate extremes. In the opposite direction lies RA, existing as a diverse toolkit with the potential to not only enhance soils, improve ecosystems and build positive environmental futures, but to conterminously provide new and diverse pathways to improving social and ecological well-being across Africa.

The need for an alternative farming future premised on RA has thus never been more imperative, but as we argue below, current attempts to do so lack the urgency to counter the negative impacts of alternative approaches. This report is ground-breaking in that we argue not just for the dissemination of Regenerative Agricultural knowledge and practice, but for a scalable design methodology to directly produce RA with farmers in Africa alongside a program of targeted interventions that can be led by diverse actors and stake-holders.

With this narrative now in place, the remainder of this report aims to unpack these themes in more detail by exploring how RA may be successfully implemented. In Chapter 2, we offer a comprehensive examination of the distinct methods and techniques employed in RA and the scientific validation of those technologies. This is followed by an analysis of the current institutional landscape and the global agricultural initiatives that underpin current agri-food systems. We also explore the main actors participating in RA across the African continent and elucidate a series of case studies. In Chapter 3 we move beyond the scientific and institutional analyses to better understand social and economic barriers to RA and to outline a scalable and practical set of actions rooted in the development of a programme of regenerative co-design.

CHAPTER 2

REGENERATIVE AGRICULTURE THE STATE OF THE ART

2.1 INTRODUCTION

As discussed in Chapter 1, Regenerative Agriculture (RA) can be conceived as a broad suite of principles and practices aimed at regenerating soils and ecosystems through an array of considered agricultural activities. In this Chapter, we expound in more detail on the technologies and practices that are widely accepted as tools for achieving these goals. Following this, we explore the institutional landscape of global food production and outline the main actors promoting RA. We then provide case studies from Africa to illustrate the continent's existing leadership and how RA techniques have been implemented and the lessons that have been learned. Finally, in we summarise the broad principles of RA and consider how different organisations have attempted to disseminate and scale the uptake of RA. The analysis shows that while the broad principles and multiple interconnected social and ecological benefits of RA are unquestioned, the field still lacks a critical program for scalability.

2.2 STATE OF THE ART: TECHNOLOGIES OF REGENERATIVE AGRICULTURE

Table 1 presents the predominant practices of RA. Whilst such activities remain highly important, RA paradigms recognise that any one given practice cannot be applied as a fix-all solution. They instead acknowledge the context specific and locally integrated nature of agricultural landscapes, not as isolated entities cut off from the environments in which they are situated, but rather systems that are inherently interlaced with wider ecological webs (Soloviev and Landua 2016). As such, there are a whole host of technical considerations that need to be taken into account in relation to geographical location, climate, plant species and soil chemistry and structure (e.g. Swanepoel *et al.* 2018; see Appendix A). Nevertheless, when applied appropriately, the technologies of RA serve a number of ecological and social benefits that are well supported in a wealth of scientific literature. We briefly summarise these benefits across the following four thematic areas: 1) carbon sequestration; 2) Ecosystems, Biodiversity and Resilience; 3) Economy and Livelihoods; 4) Health and Nutrition. For a deeper technical summary of the science and debates behind these processes, refer to Appendix A.

1. *Carbon Sequestration* – One of the primary aims of RA is to view agricultural practice not as a driver of climate change, but rather as a potential solution. A predominant pathway to achieving this objective is through carbon sequestration. Here, plants absorb carbon dioxide from the atmosphere and convert it into biomass (Lal 2008). Through the employment of the techniques presented in Table 1, RA has the potential to increase soil organic carbon, whilst simultaneously reducing the emissions of carbon dioxide (Toensmeier 2016). Indeed, whilst it is estimated that anthropogenic activity may have depleted soil carbon by as much as 115–154 gigatons, it is thought that there is a global potential to sequestrate an average of 2.45 gigatons of carbon in our soils a year (Lal 2018, 3295).

2. *Ecosystems, Biodiversity and Resilience* – Regenerative Agricultural technologies aim to improve ecosystem services, biodiversity and the resilience of food production systems. In the first instance, improving soil health by intercropping and planting cover crops increases soil organic matter and helps to augment nutrient retention and cycling (Rhodes

2014, 2017). Reducing the amount of bare soil exposure through the planting perennial crops also helps to improve soil hydrological functions and overall water retention (Basche and DeLonge 2017, 2019). These techniques facilitate a series of collective mechanisms, including reduced runoff and decreased evaporation, that help to increase system resilience to rainfall variability and drought (Palm *et al.* 2014; Blanco-Canqui *et al.* 2015; Basche *et al.* 2016). Additionally, increasing on-farm biodiversity through the planting of diverse plant communities offers a wider range of ecological functions. Intercropping faba beans and chickpeas, for example, has been shown to increase phosphorus uptake in maize and wheat intercropped systems (Zhang and Li 2003).

3. *Economy and Livelihoods* – The immediate economic and social benefits of transitioning to RA are complex (see Appendix A). Research into yield increases in regenerative agricultural systems has been mixed, with evidence showing crop and animal yields decreasing, increasing or staying the same when compared to previous or conventional management systems (De Ponti *et al.* 2012; Ponisio *et al.* 2015; IPES Food 2016, 2017a; Burgess *et al.* 2019, 3). Debates surrounding lower yields of regenerative/agroecological techniques, however, are counteracted by the comprehensive argument highlighting how industrial methods of farming erode wider ecosystem services, resulting in the perpetual need to increase synthetic inputs in order to maintain unsustainable yields (Altieri and Nicolls 2012). These are wholly unsustainable practices, and technical studies displaying yield gaps need to be understood within wider agro-economic paradigms of potential ecological collapse. Viewing the economics of regenerative farming ecosystems more holistically illuminates the value of increased biodiversity through income diversification (i.e. selling a wider range of agricultural produce). As well as this, the enhancement of ecosystem services such as soil hydrology, nitrogen fixing plants and systems of integrated pest management all help to reduce input costs (i.e. purchasing fertiliser, pesticides and irrigation equipment) and offer the potential to transform agricultural value chains (Garibaldi *et al.* 2017).

4. *Health and Nutrition* – There are many emerging trends under current models of industrial agriculture that give cause for concern for human health. Firstly, there appears to be an inverse relationship between yields and measured nutrient. For example, as grain yields have increased through intensified and specialised farming, grain protein content has declined substantially – with wheat, rice and barley seeing a respective decrease of 30%, 18% and 50% (Rodale Institute 2020). Such observations are worrying, not least because two billion people around the world have a chronic deficiency of at least one micronutrient (Knez and Graham, 2013). In the global north, the growth of unhealthy diets through increased promotion and consumption of energy rich starch crops has significantly contributed to obesity and noncommunicable diseases (NDCs) such as diabetes and cardiovascular disease (IPES Food 2017b).

   Multiple studies have demonstrated that in order to combat these trends, diets need to be diversified (e.g. Powell *et al.* 2013; Jones et al. 2014). RA techniques such as intercropping, crop rotations and agroforestry practices provide important pathways to agricultural diversity and counters shifts to monocultures. Other important benefits to human health from the adoption of RA is the cessation or immense reduction of the use of chemical pesticides, herbicides and fungicides. Acute and chronic exposure to many of these chemicals can cause short and long-term health issues (Watts and Williamson 2015). Serious illness from pesticide poisoning can severely impact labour as well as cause financial distress from medical costs.

This brief synopsis offers a glimpse of the well-established and validated benefits of regenerative technologies. It must be noted that there are many nuances and contestations behind the science of these techniques that are explored in Appendix A. What emerges, however, is a set of broad trends that overwhelmingly demonstrate that regenerative agricultural techniques collectively bring a number of scientifically demonstrable ecological and social benefits.

Nevertheless, much of the scientific literature on RA has focussed on highly controlled trials of small combinations of practices and techniques often under rather specific ecological conditions. While validating the broad principles of RA they

Table 1: List of common RA practices

TECHNIQUE	EXPLANATION	POTENTIAL BENEFITS	KEY REFERENCES
Minimal/no tillage	Reduced disturbance of the soil by minimizing disruptive activities such as ploughing and weeding.	• Increases soil organic matter. • Acts as a form of carbon sequestration. • Improves soil structure.	• Burgess *et al.* 2019 • LaCanne and Lundgren 2018 • Toensmeier 2016
Intercropping	The practice of planting multiple plant varieties or species of in close proximity.	• Diversifies farm produce that can be used/sold. • Diversity lowers risk of disease. • Can stabilise soil structures. • Helps to reduce/manage pests.	• Herridge *et al.* 2008 • Kahn *et al.* 2014, 2017 • Zhang and Li 2003
Crop Rotation	Rotating the type of crop grown in a given plot from season to season	• Rotated legumes fix nitrogen back into the soil. • Reduces the rate of soil nutrient exhaustion. • Pest and disease cycles can be interrupted without the use of pesticides and fungicide.	• Herridge *et al.* 2008 • Reddy 2019
Cover Crops	Cover crops are grown for the purpose of reducing the amount of time that the soil is left bare or exposed.	• Protects the soil form wind and water erosion. • Increase overall carbon sequestration potential. • Reduces need for weeding.	• Blanco-Canqui *et al.* 2015 • Kaye and Quemada 2017 • Basche and DeLonge 2017, 2019
Integrated Pest Management (IPM)	A series of measures that encompass a wide variety of methods that try and reduce pest pressure without the use of synthetic pesticides and herbicides.	• Reduced dependency on synthetic inputs. • Increases on-farm biodiversity.	• Shelton and Badenes-Perez 2006 • Pretty *et al.* 2011 • Kahn *et al.* 2014, 2017
Sustainable animal grazing (e.g. rotational grazing or multi-paddock grazing).	Sustainably managing and rotating the land on which animals graze so that soils become fertilised from manure and pastures have time to recover.	• Increased soil fertility. • Improved water infiltration. • Reduced soil erosion and Greater potential of carbon sequestration.	• Savory and Butterfield 2016 • Hawkins 2017 • Brown 2018 • Gosnell *et al.* 2020
Permaculture	Practices food-production that attempts to mimic natural ecosystems and minimise soil disturbance, for example by planting perennial plants.	• Low tillage increases soil organic matter and fertility and • Increases potential of carbon sequestration. • Increased biodiversity	• Hathaway 2016 • Basche and DeLonge 2017, 2019 • Crews *et al.* 2018 • Toensmeier 2016
Agroforestry	Holistic farming practices that incorporate layers of woody perennials (trees, shrubs) with understorey crops	• Reduced soil erosion. • Increased water infiltration • Trees offer large potential for carbon sequestration. • Increased biodiversity	• Nair *et al.* 2010 • Pretty *et al.* 2011 • Toensmeier 2016 • de Jalón *et al.* 2018
Silvopasture	Systems of grazing that integrate trees and animals in mutually beneficial way.	• Soils are protected by trees from wind and water erosion. • Trees offer large potential for carbon sequestration.	• Jose and Dollinger 2019 • Toensmeier 2016

lack any more generalisable formulation to guide RA uptake in diverse contexts. To some extent the current situation positions scientific testing of RA as separate from the process and practices of being a farmer and doing farming. This in turn leads to challenges of scaling RA in a holistic manner where local contextual knowledge and the ability to constantly experiment and refine is key.

We argue below that new relationships between science, farmers and communities are required if we are to rapidly scale-up RA. These relationships need to empower farmers to make their own considered decisions drawing on combinations of existing valued experience and the latest scientific and technical knowledge. In the absence of costly and massively scaled-up scientific testing, these relationships also need to harness the power of farmers as experimenters and testers and to provide means for them to share their knowledge with each other and the scientific community. Given the current global situation, such relationships must be affected urgently to address the imperatives of climatic and ecological change, but as we show below, existing programmes to scale RA lack such mechanisms.

2.3 INSTITUTIONS AND ACTORS

The imperative to implement RA is being forged within a broader landscape of global actors, initiatives and climate change conventions, such as the Sustainable Development Goals, the UN Convention on Biological Diversity and the UN Convention to Combat Desertification. Notable here is the formation of the Global Alliance for Climate-Smart Agriculture (GACSA), a partnership of NGOs, businesses and international organisations, including the UN Food and Agriculture Organisation, the World Bank, Nature Conservancy and an array of governments from the Global North and South. In short, Climate Smart Agriculture aims to promote "agriculture that sustainably increases productivity, resilience (adaptation), reduces/removes greenhouse gases (mitigation), and enhances the achievement of national food security and development goals" (FAO 2013). However, despite best intentions to formulate innovative ways of mitigating climate change through agricultural practice, the GACSA has come under heavy criticism, being openly rejected by over 350 international and national civil society groups (Climate Smart Agriculture Concerns 2014). This is due to a multitude of reasons (Codur and Watson 2018), including the concern that Climate Smart Agriculture was becoming increasingly hijacked by large agribusinesses that are wielding a counterproductive influence and continuing to perpetuate the destructive practices characteristic of the Green Revolution (La Via Campesina 2014).

Yet, in principle, significant merit remains in the core foundations behind Climate Smart Agriculture – that we must start focussing our attention more closely on the intersection between agricultural systems, ecological well-being and wider drivers of climate change. There are, for example, enormous potentials for agricultural carbon sequestration schemes to play a part in the '4 per 1000 initiative' launched 2015 Paris Climate Change conference (COP21) that calls for an increase of existing carbon topsoil at a rate of 0.4%/year (Toensmeier 2016; Rhodes 2017; Lal 2019). Similar opportunities exist for agricultural systems and practices to play a pivotal role in leading a response to the United Nations' (2019) call for 2021-2030 to be a Decade of Ecosystem Restoration, an agenda currently fronted by the United Nations Environmental Programme's ongoing work on The Economics of Ecosystems and Biodiversity (TEEB) for agriculture and food (TEEB 2018).

Proponents of RA maintain that the principles and practices they uphold provide the necessary tools to address such targets and policies. The impetus to do so, however, stems not from top-down implementation from global institutions and governments, but rather from a grassroots network of non-profit organisations and individual farmers working at multiple scales. Most notably these organisations include: Common Ground, Terra Genesis International, the Rodale Institute, the Real Organic Project, Soil Capital, Carbon Underground, the Soil Health Institute, the Consultative Group for International Agricultural Research and the Gaia Foundation.

2.4 SCALING UP REGENERATIVE AGRICULTURE

This growing network of partners upholding the RA paradigm offers insight into a collective vision promoting diverse and productive agricultural futures that regenerate the planet's threatened ecosystems. Yet the multidimensional framework of

RA as systems that deal with complex ecological, economic and social relationships has in some ways stifled its attractiveness to funding from global governance bodies. In other words, large-scale projects with tangible goals and scalability are more likely to gain funding from development banks than smaller, agroecological projects that advocate complex, context specific interventions. Consequently, “regenerative agricultural projects… have so far only been allocated a fraction of the amount of money that is currently pledged to Climate Smart Agriculture at the global level” (Codur and Watson 2018, 6).

Also at play here is a politics of evidence, wherein funding and support pivots around certain forms of objective scientific validation and tangible actors (national and international institutions, NGOs, agri-business partnerships) able to navigate global networks of influence. Such approaches direct flows of finance and activity at institutional levels but often fail to fully engage famers or see them only as end users or consumers of pre-packaged knowledge. This approach significantly fails to value and harness the essential contextual knowledge of farmers themselves positioning them as unknowledgeable and unscientific despite an increasing body of evidence to the contrary (Chapter 3.2). It also fails to engage farmers themselves in scientific processes of testing and validation, thus greatly impeding not only urgent on-farm action, but also limiting the process of empirical analysis itself.

Clearly, then, the task of scaling up RA in context specific yet globally impactful ways is a challenging exercise. This is not only due to issues surrounding a lack of funding or formal advocacy by global governing bodies, but also to the potential pitfalls created by institutional formalisation where, as seen with Climate Smart Agriculture, forms of food production become depoliticised and integrated into pre-existing frameworks from which they were trying detach (Toensmeier 2016, 349).

That said, the vibrant community of practitioners, NGOs, businesses and communities fuelling the drive for regenerative agricultural futures clearly demonstrates that there is both an appetite and a need for wholesale change in agri-food systems. Major national and global actors are currently attempting to do so through a number of different avenues. In the first instance, the sustained building of scientific validation continues to add support for regenerative principles, demonstrating the benefits of diversified agroecological farming (Rhodes 2017; IPES Food 2016, 2018). The Rodale Institute, The Land Institute in Kansas and Carbon Action Program in Finland, for example, have ongoing experiments exploring the viability and efficiency of new techniques that improve wider ecologies and sequester carbon.

Actors also recognise how increasing the size and scope of knowledge networks is paramount for scaling up regenerative activities. Sharing and disseminating scientific studies and practitioner experiences is being achieved through the continued growth of international partnerships and the establishment of extended networks, hubs and training facilities. Regeneration International, for example, has created a network of over 250 international partners through the establishment of ‘Regeneration Alliances’ characterised by self-organizing communities of multiple stakeholders (farmers, business leaders, government officials etc) (https://regenerationinternational.org/what-we-do/). Regeneration International has also created an online hub that acts as an interactive platform connecting individuals, funders and projects promoting RA (https://www.regenerationhub.co/en/homepage/). Similarly, Terra Genesis International provides educational resources and stimulates open discussions on the principles, practices, and evolving definitions of RA accessed via its Learning Portal (http://www.terra-genesis.com/learn/).

It is also recognised that significant scaling up will need a much larger reconfiguration of agricultural value chains and broader economic models (The Food and Land Use Coalition 2019, 85-88). Although not yet realised, this may include government incentivisation for long term business investments through subsidies, the removal of policy barriers and the introduction new ecologically oriented tax regimes (Toensmeier 2016, 340-343; Burgess et al 2019; see Chapter 3.4). Certification schemes, such as the Regenerative Organic Agriculture certification programme run by the Regenerative Organic Alliance (DeFries *et al.* 2017; Regenerative Agriculture Certified 2019) and Savory Global’s ‘Land to Market’ (Savory Global 2020) scheme are one way of achieving this and may serve as a useful model for future initiatives (see for example Chapter 4.4 and Recommendation 6). The formal validation of farms and ranches that are regenerating their land helps to connect practitioners to conscientious buyers and retailers.

Many of these actions are increasingly finding traction in different parts of the world, particularly by practitioners and advocators of RA in the USA, Australia and Europe (e.g. Duncan 2016; Brown 2018; Perkins 2019). Similarly, successful agroecology movements in Latin America have been stimulated by community led political movements (e.g. La Via Campesina 2020a) as well as policy driven incentives such as Payments of Ecosystem Services schemes (Grima *et al.* 2016; see also Chapter 3.4). Payments for Ecosystem Services have also gained significant purchase in China (Pan *et al.* 2017).

As we now discuss, there are strong foundations for RA across the African continent, with many small holder subsistence farmers employing regenerative techniques (Chapter 3.2). While RA has yet to be widely adopted as the dominant paradigm for designing and scaling agricultural futures, the processes and practices of RA are broadly aligned with a wide array of existing small-holder techniques and thus offer considerable potential to recognise, build from, and enhance existing good practice. Several geographically restricted examples explicitly framed as RA also offer good evidence of the transformative potential of RA in Africa and point to how farmer or practitioner-led design and experimentation offer the most fertile avenues for scaling up RA.

2.5 REGENERATIVE AGRICULTURE IN PRACTICE IN AFRICA

It is important to emphasise here that Africa can already be considered a global leader in RA. Results from a recent web analysis indicate that there are over 900 organisations in Africa associated with RA, Agroecology and Conservation Agriculture (the latter of which contains many of the principles that underpin RA) (see Appendix B for a summary of the web analysis). A vast array of existing small-holder farming techniques also embody regenerative principles. Here we explore four key examples. The cases show how the most successful examples of RA do not stem from the application of a ridged set of techniques and processes, but rather from histories of experimentation and refinement. As argued in Chapter 3.2, it is these processes of experiment and practitioner-led design that should be harnessed to rapidly scale RA.

2.5.1 The African 'Push-Pull' Method

Integrated agricultural practices that draw upon the principles of RA have been implemented in multifarious ways by subsistence farmers across the African continent. One such example comes from the development of 'push-pull' systems in East Africa that offer insight into the uptake of agroecological forms of farming, specifically the harnessing of naturally occurring ecological processes in order to manage pests, weeds and improve soil structure (Khan *et al*. 2017; Midega *et al*. 2018).

In an attempt to address these interlaced issues, scientists at the International Centre of Insect Physiology and Ecology (ICIPE) and Rothamsted Research in the UK have worked with local farmers in western Kenya to develop an approach known as the 'push-pull system'. The principle is as follows: insect-repellent plants are interplanted in the crop and 'push' pests away while they are simultaneously 'pulled' towards insect-attractive plants at the edge. Maize, for example, is interplanted with *Desmodium*, a small flowering legume that produces chemicals which repel pests and attract predators (e.g. wasps). As the pests are deterred by the *Desmodium*, they are simultaneously attracted to Napier grass (*Pennisetum purpureum*) at the field edge which kills up to 80% of stemborer larvae that feed on it. As a nitrogen fixing legume, *Desmodium* also improves soil fertility and acts as a living mulch that retains moisture in the soil and restricts the growth of *Striga* and other weeds. Studies in western Kenya have demonstrated that push-pull systems dramatically enhance yields: Maize from < 1 tonne/hectare to > 3.5 t/ha; Sorghum from < 1 t/ha to > 2.5 t/ha; Finger millet from < 0.5 t/ha to > 1 t/ha. Around 80% of farmers who attended farmer field days adopted the technology (Kahn *et al.* 2014).

The development of push-pull systems under the rubric of 'climate smart agriculture' has facilitated new technical innovations suitable for wider climatic conditions. In East Africa, over 130,000 small holder famers have now adopted the technique into everyday practice (Khan *et al*. 2014, 2017). The adoption of this system appears to be most successful when farmers have a critical understanding of the ecological processes at hand, causing the dissemination process to be "a knowledge-intensive process that requires a strong emphasis to be on building farmers' capacities" (Kahn *et al* 2017, 196). As such, for the past fifteen years, the push-pull project has involved bringing a network of participant farmers into research programmes and extension activities, resulting in a knowledgeable extended community of local leaders and peer educators. As well as this, information packs including e-brochures, leaflets and comics are freely available to download in Swahili and English from http://www.push-pull.net.

2.5.2 The Centre for No-Till Agriculture, Ghana

The Howard G. Buffett Foundation Centre for No-Till Agriculture (HGBF | CNTA) is a partnership between Ghanaian farmer and agronomist Dr Kofi Boa, and the philanthropic group the Howard G. Buffett Foundation. With four locations throughout Ghana, HGBF | CNTA has been training and educating farmers on the benefits of regenerative and conservation agricultural practice since 2012. Local field trials run by Dr Boa have demonstrated how the employment of conservation agriculture and agroecological technologies (intercropping, crop rotations, permanent soil cover and minimal or no soil disturbance) have multiple benefits. Soil moisture increased by 45-60% when compared to traditional slash and burn practices. Mulching and reduced/no-tillage techniques also reduced in-field labour by an average of 45% over the first two years by minimising the need for labour intensive activities like tilling and weeding. Economically, HGBF | CNTA found that farmers' yields increased within the first two years which, when combined with the reduced labour demand, resulted in an increase in disposable income by 25%.

In light of these trials and wider bodies of literature offering scientific validation to RA (Chapter 2.2; Appendix A), HGBF | CNTA aims to train farmers on the benefits of conservation agriculture. The centre's training material focuses on the interconnected improvements that farmers can see in their fields associated with the soil conservation practices through five key modules: 1) Concept, Principles & Practices, 2) Land Preparation, 3) Soil Cover, 4) Soil Health & Fertility and 5) Weed Control. More broadly, HGBF | CNTA connects farmers, NGOs, industry and government to help expand the usage of RA techniques throughout the country through training sessions, peer-to-peer communication, field-level demonstrations and locally trained traveling technical staff who provide farmers with access to community, knowledge and technical advice (https://centrefornotill.org/training-center). The HGBF/CNTA training material offers a useful guide to the forms of farmer led design promoted later in this report (see Chapter 3.6; Recommendation 1).

2.5.3 Chololo Eco Village, Tanzania

The Chololo Ecovillage is a participatory, multi-disciplinary project in Tanzania that has helped the Chololo area and surrounding villages become more sustainable (both environmentally and economically) through the development and uptake of agroecological practices and associated activities. This project brought together researchers, NGOs, local and national leaders and politicians, regional research centres and institutions of higher education and the local community memebers in order to tackle interrelated issues. Before the project started in 2011, the people of Chololo village were facing a multitude of issues, including unpredictable weather patterns and a depleting groundwater supply. Deforestation from slash and burn agriculture techniques and the gathering of resources such as charcoal, fuel and building materials led to the subsequent desertification of the area. Food shortages were rife for an average of 7.3 months a year, and the number of households eating three meals a day was only at 29% (IPES 2018, 40). Villagers typically migrated elsewhere in order to find labouring opportunities in order to make ends meet.

The nature of the Ecovillage project was centred around participatory approaches and worked in a holistic, multi-disciplinary manner to tackle the interconnected issues facing the community through a series of ecological 'technologies' in agriculture, livestock management, water, energy, and forestry. Farmers were trained in, and encouraged to field test techniques for intercropping, crop rotations, ideal plant spacing, ecological pest management and integrating livestock into their farms for improved tilling, manure and additional, diversified sources of income. Tree planting was also encouraged in public spaces such church yards and schools. These practices were used in varying combinations in conjunction with landscape alterations such as contour ridges and grassy strips to help reduce soil erosion and increase groundwater recharge. Other technologies introduced and developed with the community included rainwater harvesting systems, sand dams to increase the recharge of the local aquafer and provide drinking water and trade skills like leather work and improved fuel use efficiency.

Since the advent of the Chololo Ecovillage project, community members have identified drastic, positive changes in their livelihoods, with the average household income rising by 18%. Results from the project also show yield increases in the range of 37.5% to 70%, with harvests even doing well in drought years (IPES 2018, 40). The farmer led experimental methods deployed in the Chololo case study offer a strong guide for the development of farmer led design processes and the role of demonstration plots advocated later in this report (Chapter 4.4, 4.5; Recommendations 1 and 5).

2.5.4 Savory Global

A major proponent of RA comes from the holistic land management techniques developed Allan Savory in Zimbabwe. Whilst Savory's methods have come under scrutiny in technical studies (Appendix 1; see also Gosnell *et al*. 2020), continued experimentation with holistic land management techniques on his 3,200-hectare Dimbangombe Ranch, now site of the Africa Centre for Holistic Management, appears to have yielded major positive ecological and financial results. In comparison to adjacent communal rangelands, the Africa Centre for Holistic Management has a 42% higher grazer density, yet vegetation monitoring and landscape function analysis shows the rangeland condition (composition, cover, standing crop and soil health) was superior to neighbouring rangelands (Peel and Stalmans 2018). The pathway to this success has involved years of on-farm experimenting, including considerable amount of financial planning, designing of grazing charts as well as consistent forms of ecological monitoring – including documenting changing water and mineral cycles and biological community dynamics (Butterfield *et al*. 2019).

The Africa Centre for Holistic Management now exists as an education centre amongst an international network of Savory Global hubs. These hubs, of which there are currently three on the African continent (with four more in development) act as regional examples and training centres for surrounding farmers wishing to transition to regenerative practices. Regional hubs also assess farms that are a part of the Savory Global's 'Land to Market' certification programme. This scheme is based upon an Ecological Outcome Verification (EOV) process where certification is granted on an outcome basis rather than a portfolio of farmer practices, a process that understands how pathways towards ecological regeneration will vary depending on environmental and economic contexts.

2.6 LESSONS FROM CASE STUDIES

There are important lessons to be learned from the above case studies. Firstly, as demonstrated through the 'Push-Pull' technique and HGBF | CNTA, the effective scaling up agroecological techniques must involve farmers and equip them with the principles of RA (see Chapter 2.7) in a manner that gives them the autonomy to experiment with their own agricultural designs. Major steps to achieving this involve localised training exercises and collaborative research programmes in order to create robust and locally produced knowledge networks and peer educators. Secondly, as with Savory Global and HGBF | CNTA, demonstration farms and physical research hubs act as important extension centres for exhibiting RA in different ecological and climatic contexts and allow for experimentation with new and emerging agroecological and technological methods of farming (Chapter 3.6, 4.4; Recommendation 5).

Thirdly, as in the case with Chololo Eco-Village, the employment of RA must be a collaborative process that employs holistic and systemic thinking behind the interrelated nature of different sectors, including water management, energy production, forest regeneration, and crop production (Recommendation 8). Holistic approaches such as this contribute to recent calls for a **'biocircular economy'**, where activities across sectors operate within the ecological limits of the environment whilst viewing waste products as a valuable resource to recycle back into the system (e.g. using methane from livestock as a biofuel). From this systemic thinking, the positive changes in ecological wellbeing and food security cascade into other areas of social life, including women's empowerment, increased employment opportunities and the amplification of a collective community voice in future decision-making processes (Moore 2021).

Underpinning these immediate lessons is perhaps a more important observation. Many successful individual cases of adopting RA, including the above examples as well as other others from across the world (e.g. Duncan 2016; Brown 2018; Perkins 2019), exemplify principles of experimentation, review and adaptation through time and across space. Agricultural landscapes are complex entities, and it is the people who dwell within them who best understand the health of their farm ecologies. The real-life success of regenerative activities has not been led so much by external scientists and technical reports, but rather by farmers who use scientific and technical support to buttress their own agricultural designs. The question then becomes, why are these farms able to work in fluid ways and how do they have the ability to consistently adapt? We bring this Chapter to a close by reflecting on this question and exploring the principles of scaling up RA.

2.7 SUMMARY: RA PRINCIPLES, SCIENCE AND SCALE

As this report has demonstrated thus far, RA currently exists as a patchwork of technical processes and repertoires, focussed context specific scientific experiments and validation, and more holistic practitioner led experiments. There is a diverse array of actors, from major international programmes such as Climate Smart Agriculture, to non-governmental research and advocacy organisations.

There is clear scientific evidence for the benefits of certain Regenerative Agricultural techniques with major impacts on carbon sequestration, biodiversity, ecosystem services and yields, livelihoods and wellbeing. However, these studies often remain contextual in nature (Appendix A). This is to say that much scientific validation does not focus on holistic land management and agronomic techniques as a systemic whole, but rather on specific techniques examined under highly controlled circumstances. Consequently, it is not uncommon to find specific instances where certain techniques have been shown to be less than effective, with most studies subsequently noting that it remains difficult to standardise the efficacy of a range of techniques in an integrated and formalised manner over large areas.

It might be said therefore that there is no fix-all 'Regenerative Agriculture' per se. but rather that there are diverse 'regenerative practices' and 'regenerative agronomies' plural. That said, it is possible to outline a series of broad principles towards which any Regenerative Agricultural initiative should aim, though the specific techniques and practices to be deployed will be necessarily highly variable in each context (e.g. The Carbon Underground and Regenerative Agriculture Initiative; Brown 2018).

In light of this, we here conceive the broad principles of RA as (see also Figure 2):

1. **Restoring/enhancing soil health in order to improve nutrient content, structure, chemical properties and carbon sequestration potential;**

2. **Restoring/enhancing primary biodiversity and ecosystem services including water capture, drainage and purification, sustainable fuel biomass, livestock grazing, pollination and marine stocks;**

3. **Reducing or eliminating synthetic inputs;**

4. **Creating new input-output value chains that reduce input and extractive/depletion costs and enhance long term combined economic, social, health/nutrition, ecosystem and climatic benefits;**

5. **Building long term socio-economic/socio-natural sustainability, resilience and adaptive capacity alongside a wider range of public and ecosystem values.**

This Chapter has expounded how the most effective examples of scaling up RA recognise holistic processes of land management and work with these broad principles to design local regenerative systems. Importantly, these come not from controlled experimental studies, but from practitioner-led working farms characterised by constant processes of experimentation and refinement aided by regular testing and scientific validation. These examples do not so much represent the implementation of a prescribed set of regenerative techniques, but rather the application of a broad set of principles within the context of a longstanding history of on-farm experimentation.

Current approaches to scaling RA, however, struggle to move beyond the dissemination of knowledge to restricted constituencies. This deficit emerges from the difficulty of linking broad principles to the need for highly contextual sets of regenerative practices at the local level and the lack of a mechanism to build regenerative agronomies (Figure 3). In the next Chapter we work from this observation to argue that the success and widespread uptake of RA must not simply involve applying science and technology *to* recipient farms, but rather enable and empower farmers to draw on existing knowledge to conduct and deploy their own science within a broad set of guiding aims and principles. This is framed as a need to develop a *method of design* for building context specific RAs.

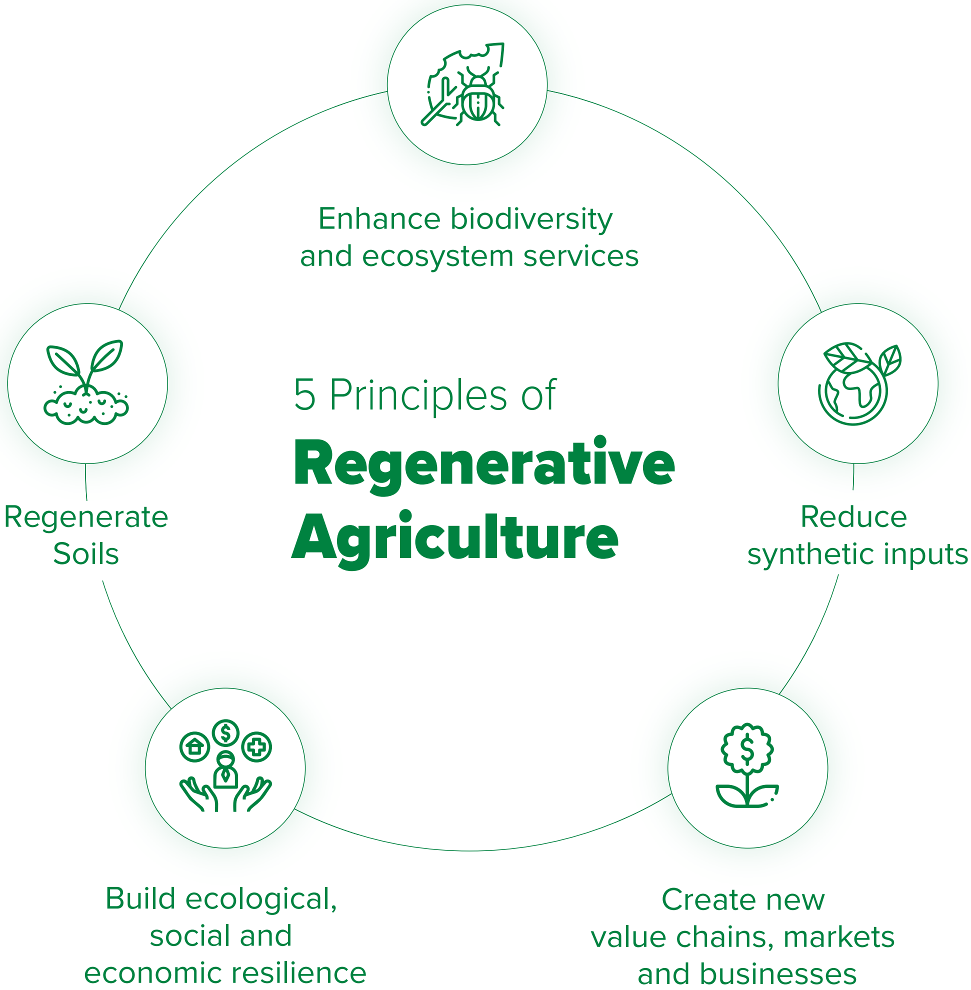

Figure 2: Five Principles of Regenerative Agriculture

CHAPTER 3

A NEW APPROACH TO REGENERATIVE AGRICULTURAL DESIGN

> "Organic life...is active rather than reactive...not the realisation of pre-specified forms but the very process wherein forms are generated and held in place"
>
> **(Ingold 2000:19)**

3.1 INTRODUCTION: GENERATING REGENERATIVE AGRICULTURE

In this Chapter we argue that in order effectively create and scale localised forms of Regenerative Agriculture (RA) across the African continent, farmers need to be placed at the centre of a co-design process.

The quote above highlights a key assumption that is rarely challenged, namely that there is a timeless, singular and optimal way to live, work, and interact. This supposition often carries over into wholesale attempts to address problems and design solutions by creating fixed models, templates and constellations of processes, techniques and policies that can be designed, tested and deployed wholesale – what we might call 'pre-specified forms'. Yet life is messier; however hard you try to realise ideal forms, life generates its own forms, some of which are fleeting, others persistent.

In what follows we focus on the challenges of standardising, universalising and scaling-up RA as both a set of principles and practices. We argue that what is required is not a 'fixed' or systematic solutions approach, but rather a holistic design method that empowers farmers to harness their own experimental potential to design and continually refine context specific Regenerative Agricultural systems. In other words, we envisage a design process that steers the continual generation of forms rather than being beholden to a specific single form, framework or structure.

We first explore the rationale for Regenerative Design in Africa (3.2) before unpacking why new design approaches must address the political economy of food production (3.3), enhance farmer livelihoods and assess the economic value of future agricultural systems beyond reductive yield measurements (3.4) and involve individuals, communities, policy-makers and businesses working across multiple scales (3.5). Following this, we begin to imagine what such a design process may look like (3.6) and how this intersects with the roles of existing knowledge, technical and scientific expertise, and processes of measurement and validation.

3.2 EXISTING GOOD PRACTICE AND THE RATIONALE FOR REGENERATIVE DESIGN

Most institutions who promote RA point to the need for the application of a context specific range of practices. Indeed, the Rodale Institute (2014, 10) highlight how regenerative agricultural "practices are not intended to be judged or implemented in isolation. RA is, above all else, a holistic systems approach to appropriate farming in context". Similarly, Savory Global (2019: 5) observe how successful regenerative agricultural outcomes "depend on how and when practices and tools are used, and that depends on contextual variances in cultural, environmental, and economic conditions".

As discussed in Chapter 2.7, scaling up nuanced regenerative approaches that are tailored to specific ecological and socioeconomic conditions remains a challenging task. In light of this, we maintain that there remains a weak link between the broad

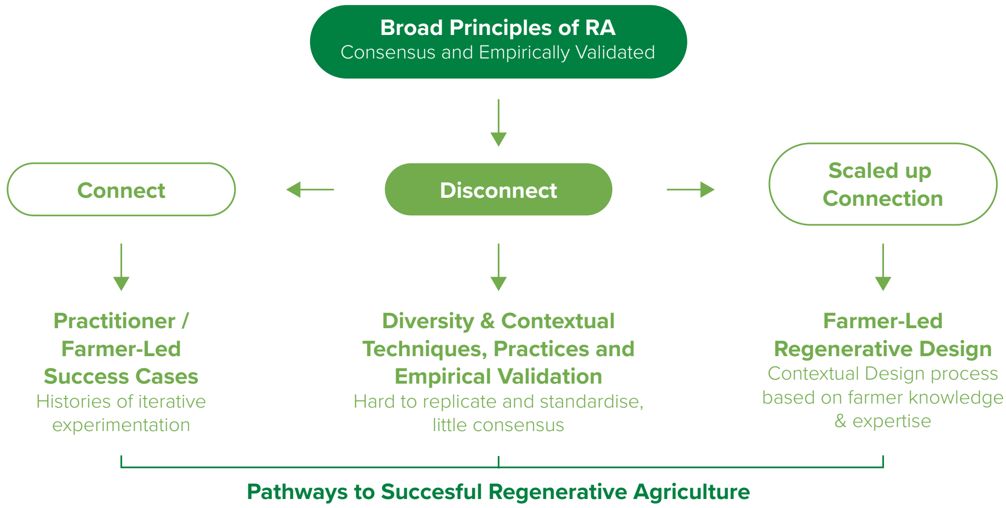

Figure 3: The Regenerative Agriculture Problem: Three pathways from principles to Successful Regenerative Agriculture.

principles of RA, which are well attested to in the scientific literature, and the implementation of holistic practice on the ground (Figure 3). Whilst the best examples of RA come from farmers themselves (e.g. Brown 2018), the promotion of successful techniques tends to overemphasise the science and technology and, in the process, distil practitioner examples into ahistoric forms of best practice. This emphasis neglects the key observation that the lived-realities of successful agricultural regeneration stem from *histories of iterative experimentation and refinement*.

In other words, success is not the result of implementing a pre-existing, technically refined regenerative blueprint onto recipient agricultural landscapes, even if this blueprint is tailored to local ecologies. Rather, effective pathways to new agricultural systems that rejuvenate environments are constantly being moulded by the people who dwell within those landscapes through processes of learning, experimenting, designing and being. Consequently, the most effective route to scale RA is to build a method of enabling and empowering farmers to undertake their own iterative experiments. This starts not with the transfer of expert recommendations, but by prioritising farmers own extensive knowledge and practice that is secondarily buttressed by technical input.

Simply put, we propose the development of a process of co-design where new economic systems, policies and technologies serve to encourage and reinforce farmers ability to augment their own regenerative practices on their own terms.

Developing this form of co-design in Africa with both small-holder farmers and larger farming businesses is imperative, not least because it recognises and builds upon a rich history of innovative, diverse and resilient food production systems that have emerged across the continent over several millennia. Small-holder farmers in particular, who account for approximately 85% of total agricultural output across the African continent (AGRA 2018: 4), already embody aspects of RA and act to innovatively design and adapt their farms on a daily, seasonal and annual basis. These practices are a part of a long but often overlooked history of sustainable agriculture across the continent (Davies 2015; Davies *et al.* 2016).

The potential for sustainable highly productive African agricultural systems can be particularly seen in the oft overlooked but wide-ranging number of 'intensive' agricultural systems from across the continent, that often long pre-date the imposition colonial systems of land management (Widgren and Sutton 2004; Davies *et al.* 2016). These include many regions with ample evidence of longstanding irrigation and soil conservation techniques, including the building of major canal systems and vast terraced landscapes. Prominent examples include the terrace systems of the Konso in Ethiopia, the irrigation systems of the Marakwet and Pokot in Kenya, the sediment capture canal and terrace system at Engaruka in Tanzania, the canals of the Chagga of Kilimanjaro, the terraced landscape of

Inyanga in Eastern Zimbabwe and Bokoni in South Africa, and the intensive yam cultivation of many parts of West Africa (Davies 2015; Davies *et al.* 2016).

Indeed, deeper archaeological evidence demonstrates how indigenous African crops (sorghum, millets, yams, oil palm) and domestic animals (cattle, donkey, Guinea fowl) developed several thousand years ago (Fuller and Hildebrand 2013). These were later augmented by new domesticates coming from inter-continental exchange systems with Asia and the New World that saw individuals experimenting and diversifying existing agricultural systems through exchange networks and innovations in local production. Such processes continued into the 19th century when, with the formalisation of colonisation, new waves of domesticates and concepts surrounding soil and forest conservation were introduced by colonial agricultural officers. While devastating acts of land appropriation, coupled with draconian colonial environmental and conservation processes based on 'received environmental wisdoms' (Leach and Mearns 1996) irrevocably damaged older systems of sustainable land-use, small-holder farmers also selectively adopted and propagated these colonial novelties into food complexes in a diverse multitude of creative acts. For good or bad, these multiple influences come to constitute the small-holder agricultural systems of today.

While these damaging historical acts must not be overlooked, we must nevertheless come to recognise contemporary African farmers as diverse in their knowledges, influences and skills; the self-made products of a creative interplay of a myriad of historic trajectories. As well as this, many farmers across Africa are taking advantage of emerging networking infrastructures and technologies. Predominant examples of such activity can be seen in the recent rise of app-based platforms such as FarmAfrica, WeFarm and M-Farm, that serve to directly connect buyers and sellers and act as knowledge sharing platforms. The ability of farmers to innovate and adapt is also clear in the dynamic self-organised communities of practice found across the continent. For example, in Kenya the Digital Farmers Facebook group contains some 400,000 members who share diverse best practices and knowledge often combining a range of 'modern' and 'traditional' inputs, crops, techniques, and practices. Indeed, given the continent's continued reliance on small-holder production combined with the vast population growth experienced in the decades since independence, there is good reason to be optimistic about the ability of African farmers to respond to and address the challenges of the future.

We argue then that the potential for adaptation and innovation among small, medium and independent large farmers should be harnessed, and that RA must begin from the African farmers themselves rather than the transfer of knowledge and technology from 'experts' in the global North. As such, scaling-up RA is not about whole sale replacement of existing practice but about building from and amplifying existing regenerative activities and rolling back the influences of negative industrial food production models.

3.3 CO-DESIGN AND THE POLITICS OF FOOD PRODUCTION

Dominant development paradigms have all too often marginalised indigenous voices and failed to build alternative, locally created pathways towards prosperous futures (Leach and Mearns 1996; Briggs and Sharp 2004; Moore 2018). This narrative is particularly evident in the politics of food production (Holt-Giménez and Shattuck 2011; Holt-Giménez and Altieri 2013; Spann 2017). Indeed, Food Sovereignty and Indigenous Rights movements have challenged current modes of agricultural production, highlighting how extant food regimes have led to land grabbing, the privatisation of seeds and the monopolisation of markets, resulting in the dispossession of small-holder farmers and increasing farmer dependency (McMichael 2008, 2009; Altieri and Nicholls 2012; La Via Campesina 2020b).

Many of these criticisms stem from the unsustainable development paradigms of the Green Revolution, embedded in 'food security' narratives stimulated by rapid global population growth (FAO 2013; IPES-2016, 54). Whilst food security remains an important issue, the paradigm of needing to feed the *world* pre-disposes us to approach agriculture in terms of commodity net production and in the process side-line problems surrounding distribution, access to food and nutritional diversity. Indeed, while total food production remains globally sufficient, the current productivity of industrial systems has not translated into global food security, with around 800 million people globally remaining undernourished (FAO 2015). The principles of RA require a re-evaluation of values not solely based on the quantifiable production of a few key commodities, but rather based on a system that prioritises the localised needs and concerns of the farming communities (Friedmannn and McNair 2008).

We thus need new design processes for creating diverse futures that are locally formed rather than imposed upon by western development ontologies (Escobar 2018). A process of co-design led by farmers in collaboration with NGOs, government initiatives, universities or simply with neighbouring communities/individuals will empower farmers to create their own agricultural futures. Here, practitioners become the main actors within food production systems rather than the bottom of the 'food regime pyramid'. Pragmatically, this imperative to re-centre and empower farmers hinges on the need to ensure farmer uptake and buy-in. Farmers who lead their own processes of regeneration are far more likely to embody those principles than farmers who are asked to simply implement external technical recommendations. As the following section explores, these aims cannot be achieved without scrutinising current economic models and reconfiguring new economies.

3.4 DESIGNING REGENERATIVE SOCIO-NATURAL ECONOMIES

There is a need to design new socio-natural economies built upon the principles of RA (Chapter 2.7). The future of farming needs to be conceived as multifunctional, where regenerative practices can improve ecosystem services (Robertson et al. 2014), improve human health and crucially provide secure livelihoods, all while generating a diverse array of agricultural products (IAASTD 2009). Producing economic evaluations of future agricultural systems must thus include these factors. Current approaches of doing so stem from the systemic thinking postulated by The Economics of Ecosystems and Biodiversity for Agriculture and Food (TEEB 2018) and the System of Environmental-Economic Accounting (SEEA 2012). These frameworks have developed models for calculating the natural, built, human and social capital of new agri-eco-food systems (Obst and Sharma 2018).

These methods stand in stark contrast to current measurements of successful agricultural systems that prioritise total yield output (IPES Food 2016). An overemphasis on yields, however, is tantamount to the prioritisation of commercial productivity at the cost of improving wider ecologies and human health, where using "one-dimensional metrics such as 'per hectare productivity' ignores the negative consequences and the trade-offs across multiple domains of human and planetary wellbeing and fails to account for the various dimensions of sustainability" (Zhang 2018, 19).

This said, there is a very real need to acknowledge that a transition to RA may well reduce yields for famers at local levels in the short term, with potentially serious consequences for household incomes and subsistence/nutrition. Economic modelling thus needs to demonstrate that the enhancement of on-farm ecosystem services such as soil hydrology, nitrogen fixing plants and integrated pest management systems reduce input costs (i.e. purchasing fertiliser, pesticides and irrigation equipment) and therefore potentially counteract loss of profits from reduced yields (Garibaldi *et al.* 2017). Furthermore, increased on-farm biodiversity helps to produce income diversification (i.e. selling a wider range of agricultural produce). It also increases the overall resilience of the farm and reduces the risk of total crop failure in extreme weather conditions and the spread of pathogens.

Building new RA value systems will also need to involve providing business opportunities/financial incentives (taxes on ecologically detrimental practice and/or subsidies for regenerative practices). These ideas have been trialled through Payment for Ecosystem Services (PES) schemes that contribute to household income if ecologies are protected/enhanced. Such schemes have been instigated in Kenya's Tana River catchment area by Nature Kenya, where multiple stakeholders are contributing to the improvement of highland forest hydrological functions through a Water Payment for Ecosystem Services initiative (Nature Kenya 2018). Here businesses using water from the Tana River catchment area are paying Community Forest Associations to manage and regenerate highland forests. Similar PES schemes aimed at preventing of on-farm deforestation have been trialled in Uganda (Jayachandran 2016).

Incentivisation schemes need to be more broadly complemented by the creation of new value chains and opportunities that prioritise regeneratively produced agricultural products and activities. Potential pathways to achieving this include supporting shorter value chains, direct marketing schemes, establishing cooperative marketing and purchasing structures, and supporting local exchange schemes (e.g. Community Supported Agriculture, farmers' markets, sustainable local public procurement, community gardens and seed-saving and machinery cooperatives) (IPES Food 2016).

With an appropriate methodology, these socio-ecological benefits can be designed with farmers at the local level, but they will also require wider policy planning and support to re-shape food policies, value chains, market opportunities and to compensate farmers for managing essential ecosystem services.

3.5 POLICY DESIGN AND INTEGRATING REGENERATION ACROSS SCALES

It is widely recognised that farmers have an important part to play in the wider regeneration of ecosystems and landscape restoration, particularly through Farmer Led Natural Management schemes (see Birch *et al.* 2016). Yet, whilst such initiatives must start with farmer practices, they must also work across multiple scales and employ 'ecosystemic' thinking that requires wider policy implementation and intersectoral collaboration. Indeed, where biophysical processes and key mechanics behind ecosystem services operate over large geographical regions areas (e.g. water sheds and river basins), the holistic management of environments cannot solely be undertaken by practitioners operating on a farm level separately from one another.

With this in mind, there is a need to map out interconnected ecosystem properties across wider landscapes, including hydrological processes and watershed dynamics, regional geologies and soil composition, interactions between different ecological/vegetation zones (e.g. forests, savannah, wetlands) and climatic variation across space (e.g. altitudinal difference) and through time (e.g. seasonal rainfalls). This analysis not only forms an economic foundation for reconfiguring value chains and economic policy (as discussed above), but also informs environmental policies that helps to create regenerative programmes operating at a landscape level (e.g. TEEB 2018).

Rather, effective design must involve broader processes of co-design and collaboration between neighbours, communities and policy makers. With this in mind, there is a need to map out interconnected ecosystem properties across wider landscapes, including hydrological processes and watershed dynamics, regional geologies and soil composition, interactions between different ecological/vegetation zones (e.g. forests, savannah, wetlands) and climatic variation across space (e.g. altitudinal difference) and through time (e.g. seasonal rainfalls). This analysis not only forms an economic foundation for reconfiguring value chains and economic policy (as discussed above), but also informs environmental policies that help to create regenerative programmes operating at a landscape level (e.g. TEEB 2018). This process requires innovative thinking around infrastructural planning (e.g. building keyline water management systems (*sensu* Yeomans 1958), creating protected biological corridors for wildlife movement), the relationship between urban centres and food production landscapes (e.g. FAO and RUAF Foundation 2015), and the redesign of conservation policy and natural resource management programmes.

This latter point is particularly important in light of 'fortress conservation' implemented by Colonial governments throughout the twentieth century that saw the political capturing of resources that often left many Indigenous communities dispossessed from their ancestral lands (Neumann 2002; Lunn-Rockliffe 2020). Inspiration to move away from exclusionary forms of conservation can be taken from community-based natural resource management projects (CBNRM), which advocate a pluralist approach between local communities, the state and the private sector (Adams and Hulme 2001; Barrow and Murphree 2001; Measham and Lumbasi 2013). Similar activities that work across multiple scales can be seen in Integrated Landscape Initiatives that exist as coalitions between farmers, NGOs and government entities that work to restore ecosystems, increase biodiversity and improve agriculture systems and local livelihoods (Milder *et al.,* 2014). Here, planning and policy design is highly participatory, occurring through intersectoral coordination and often within a social learning framework (e.g. Talbot and van den Broeck 2016; see also Common Land Foundation 2017).

3.6 DESIGNING A REGENERATIVE DESIGN PROCESS

In light of the above discussion, we may begin to imagine how to build a process of co-design for RA in Africa. We propose that this might happen at two levels. The first level must start with farmers, allowing them to design their own agricultural systems through ongoing forms of experimentation informed by validated stores of knowledge. The second needs to occur at the policy level, being informed by wider ecological mapping and landscape dynamics that feed into environmental planning.

3.6.1. Farmer-Led Regenerative Design

Building a method of design that can be used by practitioners and multiple stakeholders aiming to improve food production systems, must start with farmers themselves (Figure 4):

1. *Build a qualitative understanding of local farming livelihoods* – Any process of designing locally contextual RA must first involve developing a qualitative understanding of a farming community's world through interviews and workshops with farmers, allowing them to set their own priorities and actions. This may include investigating local assessments of on-farm and wider ecological health, evaluations of causality behind agricultural practices, and what is being done in anticipation of ever shifting environmental and socioeconomic conditions. There is also a need to map out existing knowledge networks and explore what farming communities need and want to improve local food systems rather than what experts perceive they need.

2. *Co-Design a modular programme* – From this qualitative baseline, we suggest co-designing a holistic, non-harmonised modular programme that is underpinned by regenerative principles. Here, a series of interrelated topics and practices are discussed and placed into modules by the farmers themselves. These individual/community designed modules then act as the framework through which agricultural activities are carried. Modules may include soils, crops, water, ecosystems and economy and are used to compartmentalise context specific practices and allow for long term planning and documentation for processes of iterative experimentation.

3. *Build an open access knowledge store* – There is a need to establish an open access, scientifically validated knowledge store and knowledge sharing platform for RA that farmers can draw upon at their own discretion. Importantly, the structure and content of this platform must be designed by farmers themselves so that it accurately reflects what they want and need. Accompanying this platform is a need for farmers to have access to standardised methods of baselining and

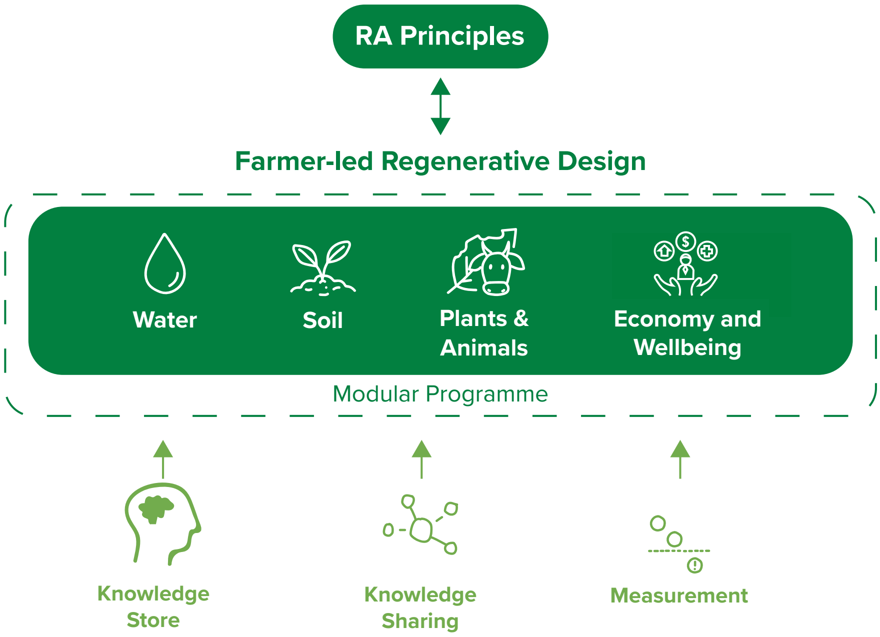

Figure 4: Modular Farmer Led Regenerative Design

evaluating on-farm regeneration so that they can experiment, monitor and assess a variety of regenerative activities. This may include inexpensive RA compliant technologies such as drip systems, cheap testing/baselining kits and simple mulchers or composters. Simple on farm measurements allow farmers to then validate and share successful/unsuccessful methods on the knowledge sharing platform. In this way, a centralised knowledge store co-designed with farmers and drawing on farmer's own empirical validation will allow farmers to become the primary agents of design rather than being recipients of imposed agricultural trials led by external experts.

3.6.2. Policy-Led Regenerative Design

For the successful regeneration of ecologies, Farmer Led Regenerative Designs need to feed into larger regenerative initiatives at the regional level. Wider forms of policy design must be created collaboratively with communities in order to create inclusive forms of management for multiple stakeholders. For example, policy-level planning systems should explicitly refer to farm-level/ farmer led regenerative designs and ensure that landscape and ecosystem level planning is able to accommodate localised priorities and practices (Figure 5).

These processes should also be iterative and ongoing, responding to a constant interplay of factors, rather than fixed systems or mechanisms – in short a process rather than goal or end point. These processes may take various shapes and forms, emerging from various entry points:

1. *Landscape management planning* – Landscapes need to be managed holistically and connect Farmer Led Regenerative Design with Policy Led Regenerative Design. This may involve redesigning inclusive forms of conservation policy in a manner that both empowers local communities and understands how conservation areas are entangled with wider socio-material dynamics. Landscape management may also need to incorporate new infrastructures to the city-region level, applying 'systemic' thinking to connecting agricultural regions and urban areas.

2. *Standardised processes of ecosystem mapping and modelling* – Ecosystem service mapping needs to be in place in order to inform environmental policies at the regional level. The creation of wider ecological baselines will in turn link individual Farmer Led Regenerative Designs into holistic forms of ecosystem management that take into account biophysical processes occurring across large geographical areas (see Chapter 3.5).

3. *Market and supply chain reconfigurations* – informed by baseline mapping, policies and financial incentives that reward regenerative activities need to be created. These may appear as taxes on synthetic inputs and non-

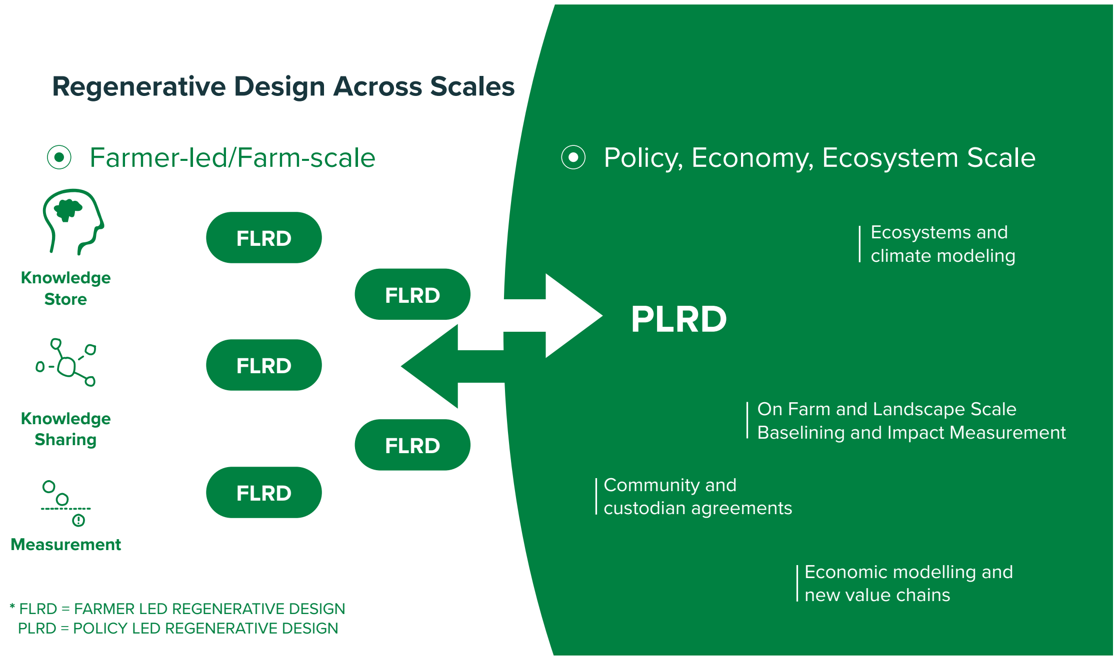

Figure 5: Regenerative Design Across Scales

organic outputs, subsidies for organic produce, or payments for practices that enhance ecosystems. The creation of validation/certification schemes will further connect regenerative farmers with conscientious buyers.

4. *Creation of demonstration farms and extension programmes* - Collaborative extension programmes that are themselves informed by the Farmer Led Regenerative Designs may act as local outreach and research hubs for farmers wanting to transition to RA.

5. *Long term, inter-governmental planning* – Forms of policy design that transcend political boundaries and election cycles should be put in place to bring together multiple ministries (agriculture, environment, education and health). New policies that emerge from different ministries that support Regenerative Design may include the creation of new agroecological curriculums in education programmes and the raising of public awareness of nutritional diversity through health led initiatives.

3.7 SUMMARY

In this Chapter we have explored some of the immediate barriers to implementing RA brought to attention in Chapter 2, namely that there is a lack of an operationalizable method to design regenerative agricultural systems across a wide range of contexts. The remainder of the Chapter has sought to explore how a new design process may address this problem and what it must include: the co-designing the politics of food production (3.3); co-designing regenerative socio-natural economies (3.4); co-designing RA across scales (3.5). Particular attention has been paid to how a design process aims to overcome some current barriers to scaling RA, including an attention to the politics and economics of food production and the need empower action and focus support on the farmers who will actually produce RA. This is explored in greater detail in Chapter 4. Finally, we have begun to imagine what a new design process may look like (3.6). We propose that this must first and foremost be carried out at the farm level through a Farmer Led Regenerative Design process. This then needs to be supported by Policy Led Regenerative Design aimed at holistically managing ecosystems across landscapes.

CHAPTER 4

OPPORTUNITIES FOR A TRANSITION TO REGENERATIVE AGRICULTURE

4.1. INTRODUCTION

The aim of this Chapter is to build upon the previous Chapter's focus on co-design processes to explore the wider challenges of scaling RA and how these may be overcome and supported by a series of actions and by diverse actors and stakeholders. We focus first in 4.2 on summarising the barriers to the widespread adoption of RA before outlining nine recommendations structured through three nodes of action to address these barriers. We then move onto the ways in which different actors and institutions can act to facilitate regenerative design (see also Appendix D). We conclude by offering the next steps for immediate action in support of scaling-up regenerative agricultural design.

4.2. BARRIERS TO SCALING REGENERATIVE AGRICULTURE

Drawing on Chapters 2 and 3 we here summarise the key barriers to the widespread adoption and scaling of RA as:

Barrier 1: The powerful narrative, products and practices of the Green Revolution and industrial agricultural production fuelled by concerns over food security and strong economic imperatives (Chapter 1.3, 3.3, 3.4).

Barrier 2: A disconnect between scientific validation, broad principles and top-down expert-led dissemination of RA from actual farmer/practitioner-led experience and practice (Chapter 2.4, 2.6).

Barrier 3: Lack of an operationalizable method to design regenerative agricultural systems across a wide range of contexts and to scale up the process of scientific learning and validation (Chapter 3.2, 3.6)

Barrier 4: The need to ensure farmer buy-in by addressing issues of power and sovereignty (Chapter 3.3).

Barrier 5: The need to address the disconnect between the wider social and ecological values of RA which are well attested with the likelihood of immediate and short-term decreases in yields which will directly impact already marginalised farmers (Chapter 3.4).

Barrier 6: The need to move from on farm approaches to landscape and ecosystem approaches (Chapter 3.5).

4.3 NODES OF ACTION AND RECOMMENDATIONS

In order to address these barriers, the findings of this report have led us to the nine recommendations outlined below aimed at addressing the six barriers presented above. The recommendations are ranked under three nodes of action; **Design, Support and Facilitate.** Each node of action loosely pertains to different levels of scale – local/farmer, regional/ national, and pan national respectively – and offers a range of entry points through which different actors and institutions may be engaged.

In contrast to reports that often begin with policy makers, governments and business partnerships as the agents and drivers of change, we intentionally foreground African farmers as those who do and who will produce RA. This does not diminish the role of wider stakeholders in the support and facilitation of this imperative change, but rather aims to initiate what we consider to be a critical change in mind-set that helps to addresses some of the broader disabling affects inherent in the socio-economics and politics of current food production systems (Chapter 3.3).

4.3.1. Design

The Design node emphasises the re-centring of farmers in the process of designing and physically producing RA, and their necessary embeddedness in wider processes of policy design at the ecosystem or landscape level:

> Recommendation 1: Position farmers at the centre of a design process for building localised Regenerative Agricultures.

Constructing locally contextual RA must involve developing a qualitative understanding of farming livelihoods in order to build a holistic, non-harmonised programme of design (Barrier 3). Here, farmers become the centre of a design process where they build systems and processes constructed around regenerative agricultural principles and through which activities are carried, monitored and assessed (Chapter 3.6). This also offers the potential to scale and speed scientific practice by harnessing farmers' vast potential as ongoing experimenters (Recommendation 3), feeding back into stores of best practice (Recommendation 4).

> Recommendation 2: Design links between wider policy planning and localised farmer activity so that there is ecosystem regeneration at a landscape level.

There is a need to work across multiple scales and employ 'ecosystemic' thinking that requires wider policy implementation and intersectoral collaboration (Barrier 6). Where biophysical processes and key mechanics behind ecosystem services operate over large geographical regions areas, the holistic management of environments must involve broader processes of co-design and collaboration between neighbours, communities and policy makers (Chapter 3.5, 3.6).

4.3.2. Support

The Support node focusses on the systems and technologies of knowledge that will reinforce a design centred approach to building RA.

> Recommendation 3: Develop standardised measures/indicators to evaluate successful regenerative food systems.

In contrast to current industrial agricultural food production systems that measure success in terms of commodity output, new ecological indicators need to be created that frame agricultural success in terms of ecosystem services enhancement, increased biodiversity and soil regeneration (Barriers 1 and 5; Chapter 3.4). These indicators will serve as a basis for the creation of new value chains (Recommendation 6) and policy design at the regional, national and pan national levels (Recommendations 2 and 8).

> Recommendation 4: Build an open access knowledge store of validated Regenerative Agriculture resources

There is a need to establish an open access, scientifically-validated knowledge store for Regenerative Agriculture that farmers can draw upon in the design process (Recommendation 1) and at their own discretion. In this way, a centralised knowledge store co-designed with farmers and drawing on farmer's own empirical validation (Recommendation 3) will allow farmers to become the primary agents of design rather than being recipients of imposed agricultural trials led by external experts (Chapter 3.6).

This centralised platform should be built from the resources of potential partners at research institutes founded on the key principles of accessibility (e.g. comprised of information accessible via smartphones), scientific validation and being freely available as well as from the ongoing acts of farmers' own experimentations. An open access knowledge store needs to be complemented by a knowledge sharing platform where farmers can discuss and share experiences of applying and experimenting with different techniques in different ecological contexts.

> Recommendation 5: Create demonstration farms and farmer led extension programmes

Complementing online knowledge stores and exchange networks discussed in Recommendation 4, there is a need to create regional demonstration farms. Informed both by local farmer led regenerative designs farms and technical experimentations, these farms will act as extension facilities and research hubs for farmers wanting to transition to RA (Barrier 2; Chapter 2.6 and 3.6). These farms may act as centres for experimentation and validation of particular techniques within specific ecological, climatic and socio-political contexts, but also as demonstrations of the more widely applicable design processes. Locally trained farmers operating model farms should be technically and financially supported so that they have unprecedented scope to experiment with new crops and agroecological techniques with minimal risk to personal livelihoods. In this way, regional model farms can bear the risk of new and emerging technologies rather than surrounding farmers who may otherwise be wary of failure and financial setback.

4.3.3. Facilitate

The facilitate node draws out the necessary socio-economic and socio-political changes that are required to facilitate the production of RA at the farm and ecosystem level and considers how these can be driven by reconfigured roles for science, technology, business and government.

> Recommendation 6: Reconfigure the economics of food production and value chains to reward regenerative practices

Future economic modelling for a new farming future must incorporate the value of regenerated ecosystem services and multifunctional agriculture systems (Barriers 1, 4, 5, 6; Chapter 2.6, 3.3). These forms of economic valuation need to be integrated into future value chains and food production markets while remaining attuned to the needs and requirements of farmers (Recommendations 1 and 2). To balance these longer-term and wider ecological and public values against shorter-term fluctuations in farmers livelihoods, policies need to be designed that provide business opportunities/financial incentives (for example, taxes on ecologically detrimental practice and/or subsidies for regenerative practices) to further enable RA. Such ideas have been trialled through Payment for Ecosystem Services (PES) schemes that contribute to household income of on-farm ecologies are protected/enhanced.

> Recommendation 7: Mainstream Regenerative Agriculture as a new pathway to livelihood prosperity by raising public awareness and support.

Facilitating transitions to new Regenerative Agricultural futures must build on Recommendation 6 by raising public awareness and shifting support to diversified agricultural systems (Barriers 1 and 2; Chapter 4.4.1). This is because, as argued in Chapter 1.2, the adoption of RA can produce a series of ecological and socio-economic outcomes that create new pathways to globally prosperous futures. Here, prosperity is not defined by ever increasing yields and economic growth, but by decent livelihoods, healthy households and well-functioning resilient ecosystems.

> Recommendation 8: Develop new holistic food policies between multiple sectors at different scales.

Existing policies and regulations that are designed to support industrial food systems (e.g. global value chains, seed legislation, food prices, output measures) need to be reformed and replaced with policies and measures that facilitate what Rockström et al. (2017) call a 'livelihood-centred paradigm' (Barriers 1 and 4). Here, new food production systems need to be facilitated by national and international policy that operate within the biophysical boundaries of the planet's finite resources, increase food security, create nutritionally balanced diets and support farmer sovereignty (Chapter 1.3, 2.6, 3.3).

> Recommendation 9: Build new coalitions and amplify existing positive partnerships between science, technology, business, government and citizen farmers to enable farmer led design

There is a need to build new partnerships in a manner that re-centres the focus of action from non-farming stakeholders to the farmers themselves (Barrier 1-6; Recommendation 1). An integral part of this process must involve re-positioning the assumed locus of knowledge from external experts to those who produce the food. As well as this, there is a need to shift the role of stake-holders from drivers of change themselves to facilitators and enablers of farmer led change. This may be achieved by focussing the attention of stakeholders on the production of the enabling conditions, policies, and technologies expressed in Recommendations 3-8.

4.4. THREE DRIVERS FOR REGENERATIVE AGRICULTURE

At its foundation, we see the design process as the principle method for the scaling up of 'citizen' scientific and technical experimentation. Institutional actors can enable and innovate within and to facilitate this process. Here we make suggestions for possible points of entry for different institutions and actors to help drive this forward (Figure 6), these are also summarised in Appendix D.

4.4.1 The role of government and international institutions

International institutions, national government and local authorities can take a leading role in supporting and a facilitating Farmer Led Regenerative Design. Where government policy often underpins the operation of health, education and ecosystems management, they can establish legislative frameworks that support the pursuit of Recommendations 6, 7, 8 and 9. Suggestions include:

- World Bank, FAO, IFAD, UNEP and other global institutions should orient funding/research programmes around the RA paradigm.
- International institutions such as the World Health Organisation can support national governments in raising public support for RA through health campaigns built around the promotion of nutritiously diverse diets and clean environments.
- National governments and local authorities can mainstream principles and practices of RA into education agendas and curriculums. This will be paramount for supporting a new generation of regenerative farmers. This should be undertaken in schools as well as within specialist agricultural training courses/diplomas and extension programmes in order to equip aspiring farmers with the necessary knowledge and skills to transform our food systems from the ground up.
- Legislation may be developed that helps to create a level playing field between regenerative farmers and industrial farms through regulatory pressures on industrial practices, such as taxing the use of synthetic fertilisers and pesticides.
- Policies can be implemented that create financial incentives for farmers to transfer to RA. (e.g. Payment for Ecosystem Service schemes).
- Local authorities may use public procurement to

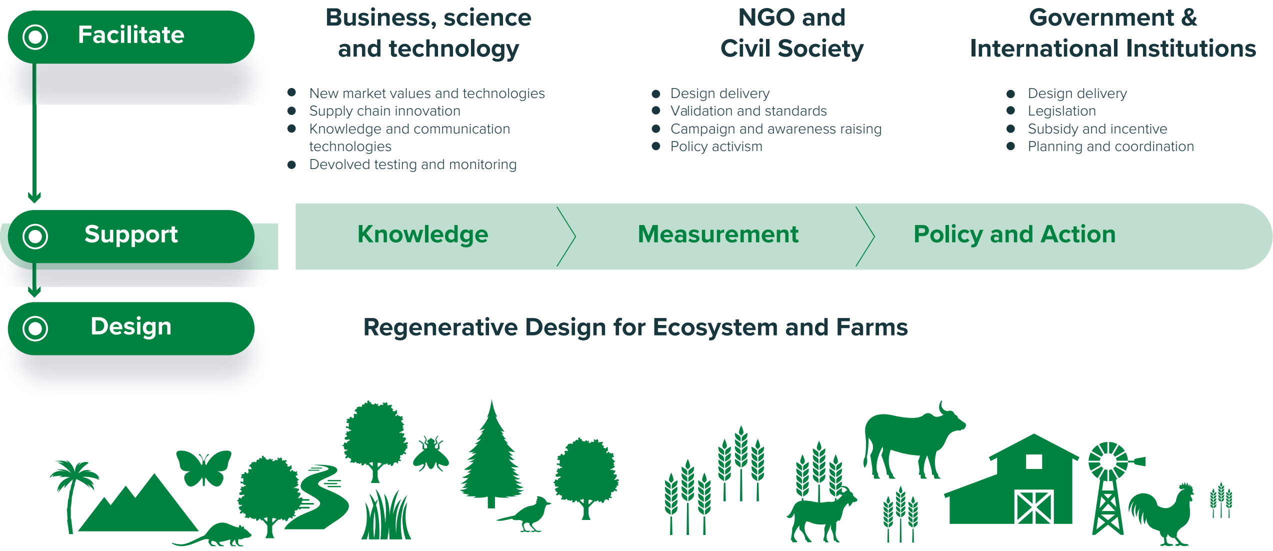

Figure 6: How Diverse Actors can Support the Scale-Up of Regenerative Agriculture in Africa

support regenerative food systems. i.e. sourcing food for schools, hospitals and government institutions from regenerative farmers.

- Governments should facilitate access to land for regenerative farming by through monitored regulation of large-scale land acquisitions from international agribusinesses that accentuate industrial modes of production.

- Food policy councils at the city/municipal level and regional food policy and planning processes could be used to define priorities in terms of connecting producers and consumers in given regions, (e.g. identifying zones with poor availability of fresh food as priority locations for new farmers' markets).

4.4.2. The role of NGOs and Civil Society

NGOs and CBOs and other organisations have a pivotal role to play in mainstreaming Farmer Led Regenerative Design (Recommendations 6, 7, 8 and 9). Suggestions include:

- Continued building of partnerships and collaborations between grassroots CBOs, NGOs and individual practitioners helps to shift public consumer patterns and place pressure on businesses to operate in a more conscious manner of their regenerative/sustainable practices.

- NGOs can help establish collaborative extension programmes and demonstration farms that act as centres for outreach and contextual research.

- NGOs and civil society can provide the person-power, funding and coordination in the operationalisation of a Farmer Led Regenerative Design process and in the creation of knowledge stores, sharing platforms and measurement kits and standards.

- Building civil society cooperatives (e.g. community seed banks) is likely to be a crucial element in strengthening farmer autonomy and unification around regenerative systems.

4.4.3. The role of Business, Science and Technology

Business, science and technology can play a pivotal role in supporting Farmer Led Regenerative Design. The entry point for these actors will predominantly help to Recommendations 3,4,5,6. Suggestions include:

- Businesses can support farmers that practice RA by procuring products from regenerative farms and implementing policies that promote RA produce and work against industrial food production.

- Business and science innovators can build accessible toolkits and services for measuring ecological regeneration, such as soil and water testing kits and facilities.

- Business leaders, entrepreneurs and investors can develop RA focussed support businesses designed to re-form food production value chains. For example working on business models for producing organic fertiliser, for the supply of essential RA compliant technologies (i.e. drip-feeders; measurement kits), or technologies for farmer-to market supply chains.

- Food system businesses both locally and internationally can work with governments to establish new supply chain and production principles and standards, cantered on equity and justice for both people and ecosystems.

- Technology providers can help to develop innovative communication infrastructures and online platforms that can form the basis of an online knowledge store and sharing.

- Universities can play a pivotal role not only in stimulating further research into new knowledge gaps in RA and creating new curriculums, but also building equitable partnerships between farmers, technical experts and international partners.

4.5. IMPLEMENTING IMMEDIATE ACTION: BUILDING COALITIONS AND DEMONSTRATING POTENTIAL

The above discussion has highlighted the different entry points multiple actors may take in order to drive the scaling of RA across Africa. Our suggestions are purely illustrative and non-exhaustive. However, here we outline a series of immediate actions that might take place to kickstart this process and begin the delivery of our wider recommendations. In particular, immediate action addressing recommendations 1-4 is needed to develop the basis for Farmer Led Regenerative Design. Simultaneously, stakeholder coalitions must be built to facilitate the wider scaling-up of RA as outlined in Section 4.4 above. These immediate actions will refine the methods of farmer led design and provide an essential proof of concept for up-scaling.

In the first instance, there is a need to build a community of practice centred on farmers, to demonstrate the transformative potential of our recommendations. This community of practice should pilot *a method of co-design* through a series of scoping studies and community workshops. The foundations for this type of work have already been laid by existing work at the Institute for Global Prosperity and in its work on building community led prosperity measures (Woodcraft and Anderson 2019). There are also considerable potentials to learn from the engagement methods of other organisations, for example Farm Africa.

Here we advocate working with a select range of farming communities across the African continent, undertaking workshops that explore what Farmer Led Regenerative Design may look like in practice and how these can be supported and facilitated by wider policy structures and businesses. These activities need to be complemented by on-the-ground pilot studies and experiments with existing farming community partnerships to trial and refine processes of co-design. Such engaged pilot studies would begin to build the basis for the delivery of **Recommendation 1**. As explored in Appendix X, the foundations for this first step are already being undertaken by the Institute for Global Prosperity and PROCOL Kenya in Elgeyo-Marakwet, Kenya.

Pilot studies and workshops should also contribute a detailed account of what farmers want and need from an online validated knowledge store and how it should be accessed and used. This work would explore farmers' use of existing platforms (e.g. WeFarm, Mkulima Young) and how these may be improved to better serve farmers' needs. Information gleaned from these immediate actions can then be used to co-design and pilot as open access online platform as the basis for the delivery of **Recommendation 4.**

As explored in Appendix C, work on this has already begun through the trialling of farmer focussed smartphone applications in Elgeyo-Marakwet Kenya and the development of a Web Analytics platform. We also strongly suggest looking to build immediate relations with a range of technology providers to develop a series of simple on farm measurement kits using accessible citizen science technologies to base-line and record on farm conditions, including moisture, temperature, basic soil chemistry and structure, yield measurement and identification of disease and pests. This would work immediately towards proof of concept for **Recommendation 3.**

Immediate actions can also be undertaken at the policy level, building the foundations for **Recommendation 2.** We advocate working with a select range of local government institutions to more strongly consider how Farmer Led Regenerative Design can be incorporated into public policy making and prioritised in concrete actions towards a range of ecosystem, environmental and market and livelihood policies. Such work might explore how farmers' needs may be mainstreamed within ecosystem management plans, working to better integrate watershed management (including for example forest products like timber, medicines, and hydrology) with requirements to access watershed resources and enhancing their role as custodians.

This initial work will simultaneously elucidate the market constraints currently faced by farmers and why they often resort to synthetic inputs and high-tillage mono-cropping in order to meet short-term economic demands. Following these observations, we propose piloting incentives that might be deployed to reshape markets, for example by increased taxation on synthetic inputs (in many places these could be implemented by simple devolved business taxes), alongside subsidies for organic inputs and organic or locally validated RA producers and produce. This would lay the foundations for work toward **Recommendation 6.**

The wider benefits of such actions could further be valued not just through economic measures but through wider systems of ecosystem valuation and modelling (Chapter 3.4) and used to inform and justify holistic policy. As outlined in Appendix C, work with several County Governments in Kenya is ongoing and offers a strong foundation for developing Policy Led Regenerative Agricultural Design. In taking these immediate actions, a strong foundation will have been laid for fulfilling **Recommendations 6-8.**

4.6. FINAL CONCLUSIONS

Regenerative Agriculture offers the potential to new pathways towards prosperous livelihoods and healthy environments. In this report, we have summarised the existing state-of-the art technologies and consolidated the climatic, ecological, social and economic case for RA. Africa currently has strong foundations in Regenerative Agriculture, but there still remain multiple barriers to the widespread adoption of regenerative principles by farmers, policy-makers and other organisations alike. These barriers include the increasing momentum of new calls for more industrialised forms of agriculture. Countering such calls makes the case for Regenerative Agriculture all the more urgent.

Our analysis has argued however that current strategies to promote and disseminate Regenerative Agriculture lack the required urgency. We argue that a scalable method for co-producing regenerative agriculture, led by farmers themselves, is essential if a new productive, resilient and healthy farming future is to be realised. We offer pathways to such a future through nine core recommendations beginning first with building a method for Farmer Led Regenerative Design, moving to the development of support systems to underpin such design and ending with suggestions for the considerable roles of government, business and NGOs in facilitating this transition.

We hope that this report offers inspiration, guidance and a strong call to action, but also recognise it as a tentative and partial step in the necessary work to come.

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APPENDIX A

TECHNICAL SUMMARY OF THE BENEFITS OF REGENERATIVE AGRICULTURE

1. CARBON SEQUESTRATION

One of the primary aims of Regenerative Agriculture (RA) is to view agricultural practice not as a driver of climate change, but rather as a potential solution. A predominant pathway to achieving this objective is by through carbon sequestration. Here, plants and organic matter in soils absorb carbon dioxide from the atmosphere and convert it into biomass (Lal 2008). Through the employment of the techniques presented in Table 1, RA has the potential to increase soil organic carbon, whilst simultaneously reducing the emissions of carbon dioxide. Indeed, whilst it is estimated that anthropogenic activity may have depleted soil carbon by as much as 115–154 gigatons, it is thought that there is a global potential to sequestrate an average of 2.45 gigatons of carbon in our soils a year (Lal 2018, 3295).

The practice of no/minimal tillage is integral to achieving this potential, where reducing the break-up of soil structures decreases processes of decomposition and volatilization that release carbon into the atmosphere (Burgess *et al.* 2019). Comprehending the rate at which soils can absorb carbon by adopting no till techniques is challenging, not least because results are affected by soil depth, composition, water holding capacity, wider landscape dynamics and antecedent organic carbon. Nevertheless, different analyses of the relationship between no till methods and carbon stock have demonstrated a largely positive correlation (West and Post 2002; VandenBygaart *et al.* 2003; Mathew *et al.* 2012; Toensmeier 2016), with one recent meta-analysis produced by Haddaway *et al.* (2017) indicating that that soil organic carbon could increase in the top 30cm of soil by around 4.6 Mg/ha over ≥ 10 years. No till farming can also be complemented by the use of cover crops where, rather than leaving the soil bare in fallow periods, plants help to trap and store atmospheric carbon by maintaining the soil's structure through the plants' root systems (Kim et al. 2016; Kaye and Quemada. 2017; Bai *et al.* 2019). The global potential of using cover crops could be as much as 0.12 gigatons of carbon per year (Poeplau and Don 2015). Annual soil organic carbon sequestration estimates produced by collective practices of no-till, crop cover and intercropping (often called conservation agriculture) in African agricultural soils amounts to 0.143 gigatons of carbon per year, approximately 93 times the current sequestration figure (Gonzalez-Sanchez *et al.* 2019).

Offering great potential of carbon sequestration in both soil organic carbon and above ground biomass are forms of farming that prioritise perennial cropping systems (Dal Sasso *et al.* 2012; Kim *et al.* 2016; Nair 2012; Nair *et al.* 2010). However as above, systematically measuring and comparing how such systems sequester carbon remains a challenging task, often revealing mixed results due to methodological constraints (e.g. Nair *et al.* 2011; De Stefano and Jacobson 2018). The amount of carbon to be captured can also vary wildly depending on crop types, with woody perennial crops such as fruits and nuts having more potential than their herbaceous counterparts. Multistrata agroforestry systems appear to have the highest potential, with some estimates suggesting lifetime soil carbon accumulation (carbon sequestered over a 20- to 50-year period until saturation is reached) can be up to 300 tons/ha (Toensmeier 2016, 45). These systems typically incorporate multiple perennial crops growing at different levels, with shrubs and small trees growing under a canopy of tall timber or crop trees, and sequester by the woody overstory.

More highly debated levels of carbon sequestration surround the effectiveness of sustainable grazing methods (Briske *et al*. 2013; Cibils *et al*. 2014; Teague 2014; Teague et al. 2016; see also Gosnell et al. 2020 for recent summary). The argument for animal grazing and sequestration are built upon the premise that some of the healthiest grasslands on earth are those which sustain migratory herds of wild game moving across the landscape in tightly bunched groups as a defence against predators. Throughout this process, hooves break up compact ground allowing water to penetrate, grasses become trampled and cover exposed earth, dung and urine further enrich the soil and, most importantly, constant movement prevents over grazing and keeps perennial grasses healthy benefits (Savory and Butterfield 2016). Savory (2013) claims that if livestock management processes mimic these patterns, we can vastly increase soil organic carbon, although this claim been challenged on the basis that it does not consider the effects herd methane emissions (e.g. Carter *et al.* 2014; Nordborg and Röös 2016).

Controversy surrounding the role of livestock management in carbon sequestration likely stem from non-standardised methods of research as well as a misuse of terminology from technical experts and practitioners working in different fields (Teague et al. 2013; Gosnell et al 2020). Nevertheless, one meta-analysis observed that context specificity is key to understanding sequestration potentials, where annual grassland carbon sequestration potentials could reach a rate of 1.5 t/ha/yr (McSherry and Ritchie 2013) in appropriate ecosystems and climates. They conclude that their "suggest a future focus on why C3- vs. C4-dominated grasslands differ so strongly in their response of SOC [soil organic carbon] to grazing, show that grazer effects on SOC are highly context-specific and imply that grazers in different regions might be managed differently to help mitigate greenhouse gas emissions" (McSherry and Ritchie 2013, 1347). As well as this, clearer results exist in the potentials of carbon sequestration when livestock management is incorporated into wider agroforestry systems such as silvopasture. Here trees are planted and managed within pastures and are estimated to sequester between 10 t/ha/yr globally (Toensmeier 2016, 106).

This brief synopsis of the carbon sequestration rates of different agricultural techniques clearly demonstrates the difficulties in trying to assess what methods have the most potential for mitigating atmospheric CO_2. What emerges, however, is a set of broad trends that overwhelmingly demonstrate that regenerative agricultural techniques can sequester carbon with major impacts on climate mitigation. As will become clearer throughout this chapter, however, the application of best practice must take into account contextually specific soil types, ecosystem dynamics, climate and socio-economic factors.

2. ECOSYSTEMS, BIODIVERSITY AND RESILIENCE

A key aim of RA is to improve the overall ecosystem services, biodiversity and resilience of food production systems. This can be achieved by intercropping, planting cover crops and reducing tilling activities. These approaches are markedly different from intensive agricultural practices that prioritise high yield output through the planting of monocultures and reliance on synthetic inputs. It is now widely recognised that many of these methods simplify on-farm ecologies, exhaust soil nutrients, intensify problems associated with pathogens and increase the risk of crop disease (Altieri and Nicolls 2012; IPES Food 2016).

In light of this, improving soil health is an imperative activity of RA. Plants require 12 essential nutrients from the soil with nitrogen, phosphorus and potassium being the most important (Tully and Ryals 2017). Whilst, pastures under rotational grazing see these essential nutrients recycled through the decomposition of animal manure and grass fires, cropland requires more attention as plant residues containing these nutrients are removed from the field in the form of food, fibre and feed. Several regenerative agricultural practices can be used to return these lost nutrients to the soil and minimize future unnecessary nutrient losses. Legumes used in a crop rotation or in an intercropping strategy can fix an estimated 23-176 kg N/ha/year depending on the legume plant (Herridge *et al.* 2008). Additionally, minimal soil disturbance can build soil organic matter and carbon by protecting the soil's structure (Chivenge et al. 2007; Li *et al.* 2019), ultimately helping to augment soil aggregate stability and improve soil hydrological functions through higher water holding capacities and infiltration rates (Libohova *et al.* 2018; Verhulst *et al.* 2010). Where forms of nitrogen are water soluble and phosphorus binds to soil particles, increasing the soil's water holding capacity become important aspects of nutrient retention (Tully and

Ryals 2017). Similarly, reducing the amount of bare soil exposure through the planting of cover crops and perennial plants can also help increase soil organic matter, soil porosity and overall water retention (Basche and DeLonge 2017, 2019; Crews et al. 2018). These techniques facilitate a series of collective mechanisms, including reduced runoff and decreased evaporation, that help to increase system resilience to rainfall variability and drought (Palm *et al.* 2014; Blanco-Canqui *et al.* 2015; Basche *et al.* 2016). In a study in Iowa, USA, Schilling *et al.* (2014) demonstrated how even minimal strategic planting of perennial crops in a large watershed could reduce the frequency of downstream flooding events by frequency of downstream flood events by 25–35%.

Aside from improving soil structure and health, increasing on-farm biodiversity has a number of benefits. In the first instance, diverse plant communities offer a wider range of ecological functions, such as nitrogen fixation or the capacity to draw water from greater depths to the soil surface through hydraulic lift (e.g. Cardon *et al.* 2013). Intercropping faba beans and chickpeas, for example, has been shown to increase phosphorus uptake in maize and wheat intercropped systems (Zhang and Li 2003). 'Trap crops' can act as a 'sacrificial lamb' and attract insects that would be detrimental to the desired target crop, thus reducing the need for synthetic pesticides (Shelton and Badenes-Perez 2006). Certain intercropped plants can also attract predators for pests as a part of Integrated Pest Management systems, further reducing the need for synthetic pesticides. These interrelated technologies have been used effectively in the 'push-pull' technique – a system where insect-repellent plants are interplanted in the crop 'push' pests away whilst being simultaneously 'pulled' towards insect-attractive plants at the edge (Kahn *et al.* 2014, 2017). Maize, for example, is interplanted with *Desmodium*, a small flowering legume that produces chemicals which concomitantly repel pests and attract predators (e.g. wasps). As the pests are deterred by the *Desmodium*, they are simultaneously attracted to Napier grass (*Pennisetum* purpureum) planted around the field edges which kills up to 80 percent or stemborer larvae that feed on it. As a nitrogen fixing legume, *Desmodium* also improves soil fertility and acts as a living mulch that retains moisture in the soil and restricts the growth of Striga and other weeds, thus further reducing soil disturbance from weeding activities (Kahn *et al.* 2014).

3. ECONOMY AND LIVELIHOODS

The wider ecological improvements brought about through regenerative agricultural practices indicate clear benefits of transitioning to agroecological methods. What remains more complex, however, are the immediate economic and social benefits of transitioning to RA. Research into yield increases in regenerative agricultural systems has been mixed, with evidence showing crop and animal yields decreasing, increasing or staying the same when compared to previous or conventional management systems (Burgess *et al.* 2019, 3). De Ponti *et al.*'s (2012) meta-analysis of different food production systems has demonstrated yields from organic agriculture are on average 20% lower than those of conventional agriculture, with Ponisio *et al.* (2015) similarly observing an overall difference of 19.2%. Another global meta-analysis noticed the complexities of measuring yields obtained from no-till practices in comparison to conventional ploughing (Pittelkow *et al.* 2015). Whilst the authors note that yields of legumes, oil seeds and cotton were unaffected by no-till methods, rice, wheat and maize all produced lower yields (-7.5%, -2.5% and -7.6% respectively) in the short to midterm, although it is possible that this could significantly improve over the long term as soil health recovers (Garibaldi *et al.* 2017).

This said, there is a growing body of evidence that suggests adopting agroecological and regenerative techniques can in fact significantly augment yields in the correct circumstances (Rodale Institute 2014). Strong evidence of this can be seen in the push-pull systems developed in western Kenya, where yields have been dramatically augmented with its adoption: Maize from < 1 tonne/hectare to > 3.5 t/ha; Sorghum from < 1 t/ha to > 2.5 t/ha; Finger millet from < 0.5 t/ha to > 1 t/ha (Kahn *et al.* 2014). Similarly, Pretty *et al.* (2011) compared case studies across Africa and found improvements in the mean yield ratios of various projects: +1.96 with agroforestry and soil conservation projects, +2.20 with conservation agriculture projects and +2.24 with projects involving IPM. Additionally, the authors found that the projects increased food security through 'multiplicative' (increases in yields/ha) and 'additive' (increases through diversification) ways.

Debates surrounding lower yields of regenerative techniques are in part counteracted by a broader argument that highlights how industrial methods of farming erode wider ecosystem services, resulting in the perpetual need to increase synthetic inputs in order to maintain unsustainably yields (Altieri and Nicolls 2012). These are wholly unsustainable practices, and technical studies displaying yield gaps need to be understood within wider agro-economic paradigms of potential ecological collapse. In this vein, it is more important to conceptualise agricultural landscapes as entire ecosystems that are not "concerned with high yields of a particular commodity but rather with the optimization of the system as a whole" (Altieri 2018, 89). Viewing the economics of regenerative farming ecosystems more holistically illuminates the value of increased biodiversity through income diversification (i.e. selling a wider range of agricultural produce). As noted in above, the enhancement of ecosystem services such as soil hydrology, nitrogen fixing plants and systems of integrated pest management all help to reduce input costs (i.e. purchasing fertiliser, pesticides and irrigation equipment) and offer the potential to transform agricultural value chains (Garibaldi *et al.* 2017).

Ecosystems that provide such services can be conceived of as 'natural capital' under the general definition of "capital as a stock that yields a flow of services over time" (Costanza 2020, 1). Valuing natural capital and ecosystem services is a complex process built on the premise that sustainable prosperity is unachievable without the wellbeing of the natural environment. In this vein, Constanza *et al.* (2014) have argued that ecoservices contribute more than twice as much to human well-being as global GDP. Assessments have shown that global losses of ecosystem services due to land degradation equated to $US 4.3–20.2 trillion/yr between 1997 and 2011 Constanza *et al.* 2014). Given that one of the corner stones of regenerative agricultural practice aims to reverse such trends in environmental degradation, adopting RA can help to increase the natural capital held in agricultural landscapes.

4. HEALTH AND NUTRITION

There are many emerging health and nutrition trends under current models of industrial agriculture that give cause for concern. Firstly, there appears to be an inverse relationship between yields and measured nutrient. For example, as grain yields have increased through intensified and specialised farming, grain protein content has declined substantially – with wheat, rice and barley seeing a respective decrease of 30%, 18% and 50% (Rodale Institute 2020). Such observations are worrying, not least because two billion people around the world have a chronic deficiency of at least one micronutrient (Knez and Graham 2013; IFPRI 2016). As well as this, the promotion of energy rich staple cereals reducing the is consumption of pulses and other crops with high nutritional value (IPES Food 2016). The economic spill overs of poor diets can be substantial, where child undernutrition in African countries have incurred losses of up to 16.5% of GDP (African Union Commission *et al.,* 2014). In the global north, the growth of unhealthy diets has significantly contributed to obesity and noncommunicable diseases (NDCs) such as diabetes and cardiovascular disease (IPES Food 2018).

The practice of increasing on-farm biodiversity through regenerative and agroecological techniques has also been linked to improved household diets and nutrition (Romeo *et al.* 2016). Powell *et al.* (2015) found that six out of eight studies included in their analysis reported a positive correlation between increased crop diversity and increased dietary diversity either on the individual or household level. In Malawi, Jones *et al.* (2014) found that "farm diversity demonstrated a consistent positive association with household dietary diversity independent of differences in household wealth and social standing". RA techniques such as intercropping, crop rotations and agroforestry practices provide important pathways for achieving these aims and countering shifts to monocultures which may reduce dietary diversity.

Another clear benefit to human health from adopting RA is the cessation or immense reduction of the use of chemical pesticides, herbicides and fungicides. Acute and chronic exposure to many of these chemicals can cause short and long-term health issues. Moreover, the risk of exposure is heightened among smallholder farmers who often lack the proper personal protective equipment as well as engage in the mixing and spraying of the crops themselves (Williamson 2003, 56). The Pesticide Action Network (PAN) found in a 2007 survey of farmers in Tanzania that over 65% of respondents "reported some form of poisoning in the previous season, with 22% experiencing symptoms more than three times and 58% had been admitted to the hospital for poisoning"

(Williamson 2011, 32). Serious illness from pesticide poisoning can severely impact labour as well as cause financial distress from medical costs. Another case study from PAN, this time conducted in Benin, found that cotton farmers experiencing ill health after applying pesticides claimed to be spending approximately 10% of their income on medical costs caused by the pesticide application (Watts and Williamson 2015, 114). The adoption of RA strategies like Integrated Pest Management not only help in eliminating exposure to some of these harmful chemicals, but also frees the farmer from purchasing another synthetic input (Williamson 2003, 102).

APPENDIX B

REGENERATIVE AGRICULTURE WEB BASED INTELLIGENCE SEARCH

A web-based intelligence search platform was used to search websites, research papers, institutions, individuals and businesses involved in regenerative agriculture in Africa. The search collates information from numerous public sources, including the Web of Science Core Collection, the UN, national governments, local administrations, news outlets, social media and NGOs. Preliminary results from the search are presented below.

Search Domains Regenerative Agriculture; Conservation Agriculture; Agroecology

Academic research - Web of Science Core Collection (2015 - 2020).

- Research papers for conservation agriculture CA = 21,716 sources,
- Regenerative Agriculture RA = 231 sources
- Agroecology AE = 1384 sources
- CA and RA 1499 sources,
- CA and AE = 2829
- These overlapping definitions have a regional bias; RA is more common in North America and Asia; CA in Africa and AE in Europe.
- For (CA, RA, AE) Africa 434 papers – 91 Kenya, 87 RSA, Zimbabwe 81, Ethiopia 42, Malawi 28, Tanzania 19, Ghana 17, Madagascar 17 Uganda 12, Zambia 12, Nigeria 9, Cote d'Ivoire 7, Rwanda 7, Benin 6, Tunisia 6, Mali 5, Mozambique 5, Senegal 4, Algeira 3, Cameroon 3, DRC 3, Egypt 2, Togo 2.
- African key topics farmers 286, soil 315, water 123, tillage 116, farming practices 116, carbon communities 64, agricultural extension services 40, ecosystem services 36, soil health 33, knowledge 13.
- African R&D key funders - USAID, CGIAR, EU, Gates Foundation, Governments (UK, FR, NL, DE, ES, NO, AU, IR, CH, BE, JP, PRC, IN)

Knowledge Networks and Solutions

- Early results indicate >900 organisations in Africa associated with CA, RA and AE. Some examples include:
- ACTs African Conservation Tillage Network http://www.act-africa.org/.
- ABACO Agro-ecology based aggradation-conservation Agriculture, targeting innovations to combat soil degradation and food insecurity in semi-arid areas of East (Kenya, Tanzania), West (Mali, Burkina Faso) and Southern (Zimbabwe, Mozambique, Madagascar) Africa.
- CA2Africa Conservation Agriculture in Africa: analysing and foreseeing its impact comprehending its adoption
- CA-CoP Conservation Agriculture Communities of Practice to deliver the work of ACTs CARWG & Conservation Agriculture Regional Working Group & National Conservation Agriculture Task Forces
- CAWT Conservation Agriculture With Trees: Scaling-Up the Science And Practice Of Conservation Agriculture In Sub-Saharan Africa, Zambia, Kenya and Tanzania and Ghana.

- SCAP Smallholder Conservation Agriculture Promotion, implemented to strengthen livelihood strategies and socio-economic growth among farming communities in Western and Central Africa.

- CA4CC Up scaling conservation agriculture for increased resilience to climate change and improved food security in Kenya, Tanzania, South Sudan, Zimbabwe.

- TCCP Networking and capacity building of stakeholders in implementation of COMESA-EAC-SADC tripartite climate change programme in Eastern and Southern Africa.

- CASARD Conservation Agriculture for Sustainable Agriculture and Rural Development Project, in Kenya and Tanzania

- HGBF Howard G. Buffett Centre for No-Till Agriculture supporting the adoption of conservation agriculture and partnering with farmers in Ghana build a network of local farmers to replicate no till agriculture practices https://centrefornotill.org/about-1-1

News and Social Media – Regenerative Agriculture search from 1.9.2019 to 22.5.2020

- English Language 900 items: News 71%, NGOs 29%

- Sentiment Analysis: 69% positive, 23% negative, 8 % neutral. News consistently positive, NGOs significant periods of negative sentiment.

- Negative sentiments associated with: BBC, Reuters, weatherzone, Canberra Times.

- Positive Sentiments associated with: NZ Herald, Guardian, ABC, NY Times, Wired, Scoop, Globe and Mail. Top 10 locations USA, NZ, AUS, UK, FR, CAN, PRC, California, IN, Paris.

- Africa News: Positive 12 national news; negative 2 national news

- Keyword graphs (see below) (5) - soil health, organic matter, crops; organic farming; fertilisers, compost; climate change, crisis, food production, climate action; carbon, sequestration, greenhouse gases; Greenpeace, Ardern, zero carbon and fertiliser.

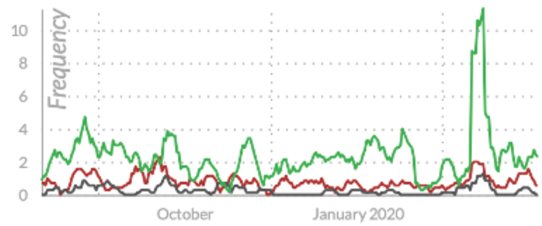
- Tag Cloud – (see below) (positive examples) organic, nitrogen, Greenpeace, composting, Gaia, greenhouse cases, grass-fed, Navdabya, Ardern, biodiversity, nutrition, unfccc, usda, ecology, (negative examples) erosion, drought; export, deforestation, wheat, waste, soils.

TRENDS AND ASSOCIATIONS

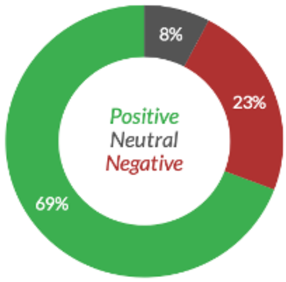
Search Term	*Date Range*	*Content Sources*	*Content Language*
Regenerative Agri...	01 Sep 2019 – 22 May 2020	News NGOs	English
Positive 623 / Neutral +69 / Negative +208 / Total =900			

Daily Frequency by Sentiment

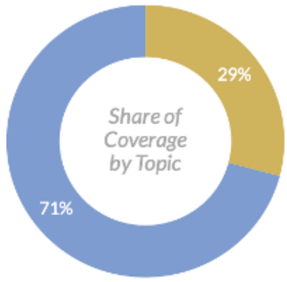
2.3 ↑+1.4 0.26 ±0 0.79 ↓−0.14



Sentiment Distribution

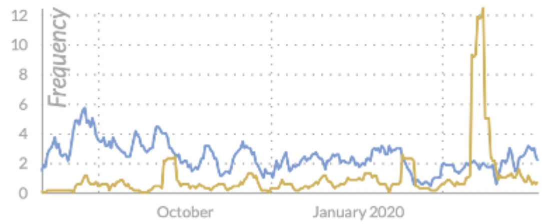


Source Distribution



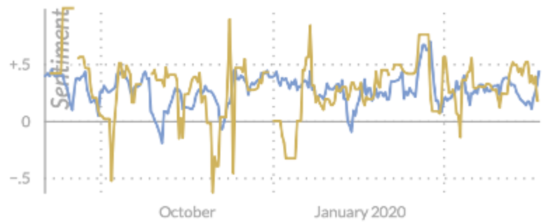
Daily Frequency by Source

2.4 ↑+0.71 0.99 ↑+0.57



Sentiment by Source

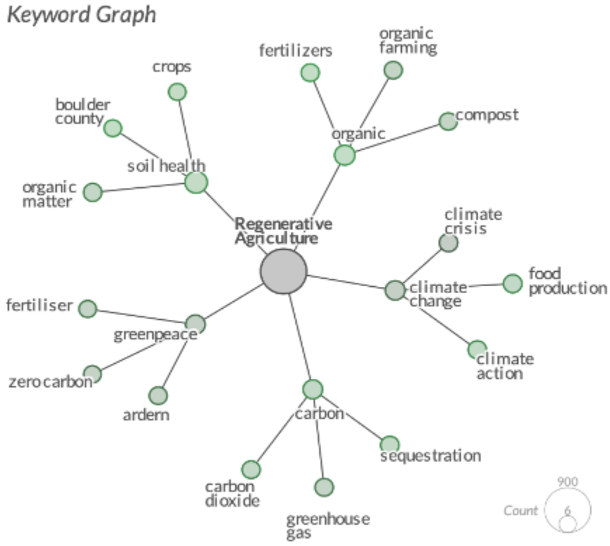
+0.27 ↑+0.05 +0.28 ↑+0.18



Tag Cloud

acre agribusiness agricultural ardern barley biodiversity cap carbon cbd change climate compost composting corn cotton country cow crops cultivation dairy danone deforestation dioxide drought ecological ecology erosion export extinction fao fernandez fertiliser fertility fertilizer fertilizers forests freshwater gaia ghg grain grass-fed grazing greenpeace harvest hemp hunger hutton intensification iucn kirchner livestock maize manure meat navdanya nitrogen nutrient nutrition organic organics oxide pan pasture pesticide pesticides planet potato produce reforestation resilience seed sequestration smallholder soils sorghum sustainability synthetic unfccc usda waste wheat youth

Keyword Graph



APPENDIX C

PILOT WORK AND DEMONSTRATION FARMS

Prosperity and Innovation in the Past and Future of Agriculture in East Africa (PIPFA)

Under a GCRF funded project, IGP and PROCOL Kenya have begun important work in laying the foundations for piloting Farmer Led Regenerative Design. In the first instance, we have built a multisectoral partnership with a diversity of academic and policy-oriented institutions, including Elgeyo-Marakwet County government, the University of Eldoret, British Institute in Eastern Africa, East Africa Herbarium and The Economics of Ecosystems and Biodiversity TEEB project (UNEP), as well as Pesticide Action Network (PAN-UK) and the Royal Botanic Gardens at Kew (KG) in the UK. These partners all work in food systems delivery and are open to questioning prevailing agricultural modernisation interventions and establishing a new basis for supporting small-holder farmers as the architects of a new regenerative agricultural future.

Through this partnership, PIPFA is currently undertaking farmer workshops and interviews in order to understand the shortcomings of existing agricultural systems and co-design new farming futures. Participatory mapping of farm diversity, the identification of exemplar farms and the creation of video stories of exemplary regenerative practice has also commenced. This work lays the foundation for selecting and documenting demonstration farms and creating accessible information for a knowledge store. As well as this, a four-part Webinar series was undertaken with Elgyeo-Marakwet County government between May and June 2020 in order to explore long-term initiatives aimed at improving the livelihoods and designing new farming futures in Elgeyo-Marakwet.

Purko Demonstration Farm

One of the post-COVID recovery strategies is to establish an agri-food-forestry circular bioeconomy region across the Mara-Mau-Cherangani of the Rift Valley. The aim is to reverse the cumulative negative effects of the decades-long loss of biodiversity and regulating services due to deforestation and land degradation, estimated to be costing in excess of 1 million KSh per hectare per year. To put this in context, the average small scale farmer in the Mau Forest owns on average 5 hectares which generate annually approximately 40,000 – 100,000 KSh per hectare per year from crops and livestock (as well as generating food for the household). To encourage farmers to switch to regenerative farming practices there is a need for demonstration farms where communities and farmers can learn about the benefits of specific techniques and gain access to extension services. One such demonstration farm is managed by the Purko Development Trust (http://www.purkotrust.co.ke), an agricultural organisation aiming to provide relief from poverty and improve education within the Purko Community in Narok County. The trust has a total of 5,500 acres of land within the county, 3,200 acres located in the Tipis Area – Entiani and 2,300 acres located in the Kisheldka Area – Naroosura.

The Purko Trust has agreed to work with PROCOL Kenya to develop demonstration areas for regenerative agriculture and to establish a training hub involving support engagement networks and roundtables with universities and training institutions (e.g. Strathmore, Eldoret, Nairobi, Maasai Mara, TVET and local county training centres), government research institutes (e.g. KEFRI, NMK, KALRO, RCMRD), international research networks (e.g. CGIAR centres), social enterprises, business and environmental associations (e.g. Riparian

Users Associations, Kenya Fashion Council, Kenya Manufacturer Association, various coffee and tea co-operatives) to identify and take forward research and skills training needs for local communities.

Immediate Action and Next Steps

Based on the webinars, workshops and discussions from the above projects, the immediate next steps have been agreed upon in order scale up Farmer Led Regenerative Agriculture:

1. Create intersectoral sub team with policy makers in Narok and Elgeyo-Marakwet Counties to work closely with PROCOL Kenya on the array of issues and topics discussed throughout the series.

2. Examine existing policy papers to identify entry points where PROCOL Kenya can work with county officials to implement positive change.

3. Embed co-design approach to RA within IGP's prosperity framework

4. Collate and make accessible for policy makers existing spatial, ecological and geochemical and physical data and information on pollution and resource use, including land tenure, water and ethnobotany (medicinal, construction, firewood etc).

5. Commence future scenario building and natural capital modelling to inform discussions on how to finance and implement the payment for ecosystem services.

6. Establish demonstration farms of regenerative agriculture practice and exhibit the potentials of the bio-circular economy.

7. Re-think waste management strategies to focus more on waste as a resource.

8. Rethink energy systems to improve health and empower women (e.g. more efficient jiko stoves, use of biogas from waste etc) and to transition to a greener future based on renewables.

9. Identify youth engagement opportunities for skills training and curriculum development in regenerative agriculture.

RECOMMENDATIONS	WHY	WHO	NEXT STEP
DESIGN			
1. Position farmers at the centre of a design process for building local Regenerative Agricultures.	African farmers are creative people who know their needs and situation best. Top-down agricultural development has a history of failure.	Farmers. Government Non-Governmental Organisations Universities	Pilot methods of Farmer Led Regenerative Design through a series of scoping studies. Workshops will explore what Farmer Led Regenerative Design may look like in practice and how these can be supported and facilitated by wider policy structures and businesses. Undertake on-the-ground pilot studies and experiments with existing farming community partnerships to trial and refine processes of co-design.
2. Design links between wider policy planning and localised farmer activity so that there is ecosystem regeneration at a landscape level.	Key ecosystem services operate over large geographical regions. As such, the holistic management of environments needs wider policy structures.	Local and National Government Non-Governmental Organisations Universities	Work with local government institutions to identify entry points for supporting Farmer Led Regenerative Design. This work will explore how farmers' needs may be mainstreamed within ecosystem management plans and elucidate the market constraints currently faced by farmers. Following the above, begin piloting incentivisation schemes to reshape markets.
SUPPORT			
3. Develop standardised measures/ indicators to evaluate successful regenerative food systems.	Farmers need access to affordable methods of evaluating on-farm regeneration so that they can monitor their own regenerative activities. The mapping of the wider landscape will create ecological baselines that will inform broader forms of Policy Led Regenerative Designs	Farmers African Assembly Businesses Universities	Build partnerships with technology providers to develop a series of on farm measurement kits to base-line and record on-farm ecological conditions, including moisture, temperature, basic soil chemistry and structure, yield measurement and identification of disease and pests.
4. Build an open access knowledge store of validated Regenerative Agriculture resources.	A centralised knowledge store co-designed with farmers and drawing on farmer's own empirical validation will allow farmers to become the primary agents of design rather than being recipients of imposed agricultural trials led by external experts.	Farmers African Assembly Universities/Research institutes	Pilot studies and workshops from Recommendation 1 should contribute a detailed account of what farmers want and need from an online validated knowledge store and how it should be accessed and used. This work would explore farmers' use of existing platforms (e.g. WeFarm, Farm Africa, M-Farm) and how these may be built upon to better serve farmers' needs.

RECOMMENDATIONS	WHY	WHO	NEXT STEP
SUPPORT			
5. Create demonstration farms and farmer-led extension programmes.	Demonstration farms act as centres for experimentation and validation of particular techniques within specific ecological, climatic and socio-political contexts. They also act as demonstrations of the more widely applicable design processes.	Farmers African Assembly NGOs Local government Universities	Work with existing project partners, including Elgeyo Marakwet County government and the Purko Development Trust in Kenya to pilot demonstration regenerative farms and extension programmes (see Appendix C).
6. Reconfigure the economics of food production and value chains to reward regenerative practices.	Future economic models must incorporate the value of regenerated ecosystem services and multifunctional agriculture systems. Shorter term incentivisation schemes need to be in place to encourage transitions to RA and provide livelihood support to counteract any short term decrease in yields.	African Assembly TEEB Local and National Government Businesses	Undertake natural capital modelling and ecosystem service valuations to provide a framework for trialling Payment for Ecosystem Services (PES) schemes. Businesses to support farmers that practice RA by procuring products from regenerative farms and implementing policies that promote RA produce and work against industrial food production.
FACILITATE			
7. Mainstream Regenerative Agriculture as a new pathway to livelihood prosperity by raising public awareness and support.	Raising public awareness and consumer conscience will be paramount for shifting behaviours, attitudes and understandings of systems of food production away from industrialised systems.	International institutions (e.g. FAO, WHO) African Assembly Government NGOs	NGOs and Governments to undertake health campaigns built around the promotion of nutritiously diverse diets and clean environments National governments and local authorities need to mainstream principles and practices of RA into education agendas and curriculums Local authorities to use public procurement to support regenerative food systems. i.e. sourcing food for schools, hospitals and government institutions from regenerative farmers

RECOMMENDATIONS	WHY	WHO	NEXT STEP
SUPPORT			
8. Develop new holistic food policies between multiple sectors at different scales.	New food production systems need to be created that are sustainable, increase food security, create nutritionally balanced diets and support farmer sovereignty.	International institutions (e.g. FAO, WHO) Government NGOs Businesses	Build partnerships between multiple sectors in order to hold roundtable discussions on developing holistic food policies.
9. Build new coalitions and amplify existing positive partnerships between science, technology, business, government and citizen farmers to enable farmer led design.	The building of new and amplifying of existing partnerships that are committed to new agricultural sysems will have positive impacts that cascade into Recommendations 1-8.	International institutions (e.g. FAO, WHO) Government CBOs/NGOs Businesses Universities	African Assembly to engage the existing partnerships on what they need to flourish.

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