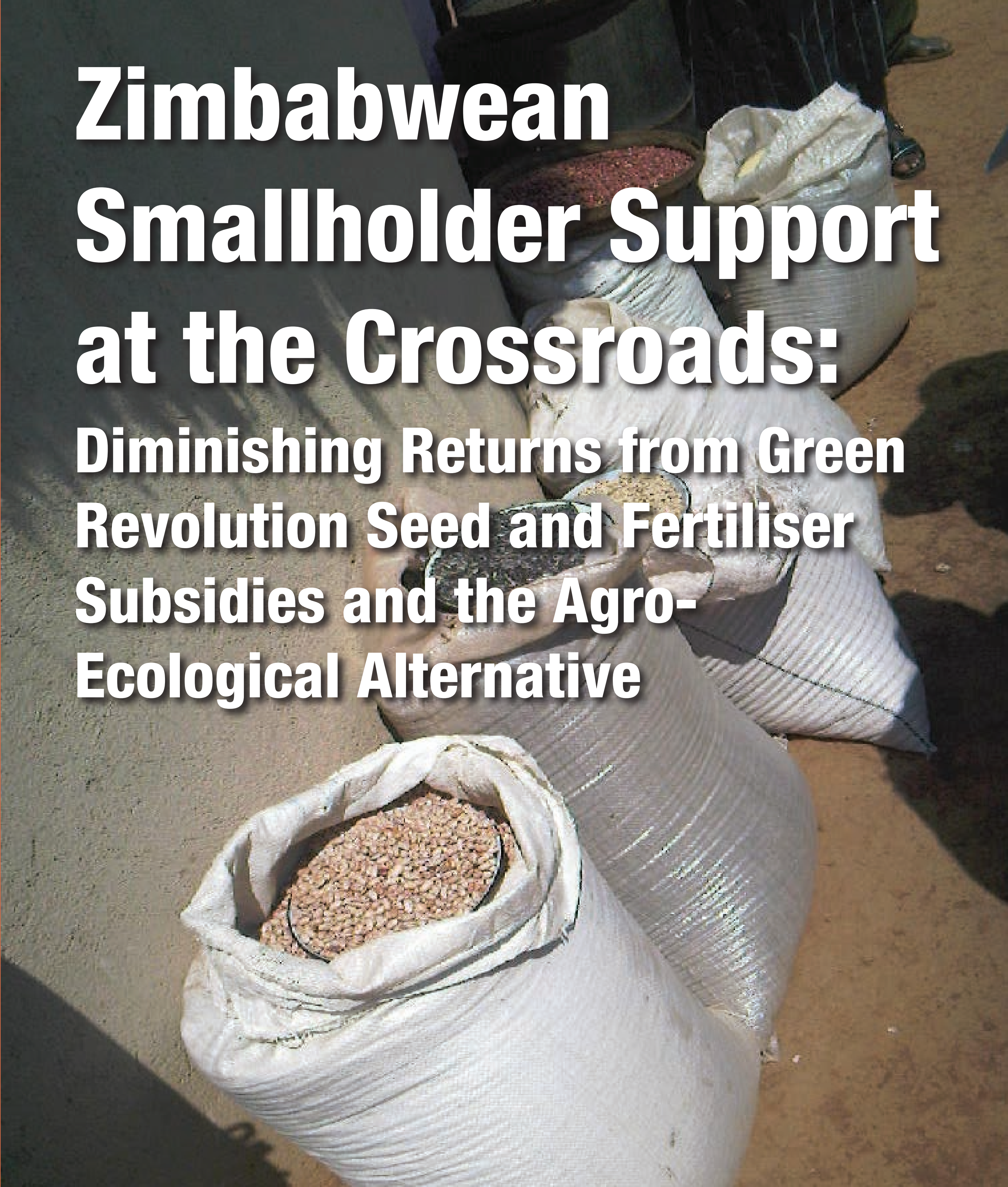
Zimbabwean Smallholder Support at the Crossroads:

Diminishing Returns from Green Revolution Seed and Fertiliser Subsidies and the Agro-Ecological Alternative



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Zimbabwe Small Holder Organic Farmers' Forum (ZIMSOFF)

CONTENTS

On 7 April 2015 the African Centre for Biosafety officially changed its name to the African Centre for Biodiversity (ACB). This name change was agreed by consultation within the ACB to reflect the expanded scope of our work over the past few years. All ACB publications prior to this date will remain under our old name of African Centre for Biosafety and should continue to be referenced as such.

We remain committed to dismantling inequalities in the food and agriculture systems in Africa and our belief in peoples' right to healthy and culturally appropriate food, produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems.

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Zimbabwe Small Holder Organic Farmers' Forum (ZIMSOFF)

The Zimbabwe Smallholder Organic Farmers Forum (ZIMSOFF) grew out of the East and Southern African Farmers' Forum (ESAFF), which 300 farmers from across the region formed at the WSSD in South Africa in 2002. ZIMSOFF mission is to influence policies and public awareness towards agro-ecology and smallholder farmers' rights. While Zimbabwe remains very much a country driven by industrial agriculture and the green revolution approach, people from across the world, including in Zimbabwe, are beginning to recognize the need for a transition to agro-ecology. Many stakeholders have a role in the transition to agro-ecology but this process needs to be led by the smallholder farmers' voice. Those most affected should be at the forefront of this transition. In this regard, ZIMSOFF is needed now more than ever. Zimbabwe's land reform has meant that Zimbabwe is now primarily a nation of smallholder farmers. However, this land reform has not been translated into full agrarian reform that truly empowers smallholder farmers. The danger is that smallholder farmers continue to become cheap labour in the various agro-food value chains. A strong ZIMSOFF can counter this trend.

ACRONYMS and ABBREVIATIONS

ACB	African Centre for Biodiversity
ADRA	Adventist Development and Relief Agency
AGRITEX	Agricultural, Technical and Extension Services
AN	Ammonium nitrate
ARC	Agricultural Research Council
ARDA	Agricultural and Rural Development Authority
ARIPO	African Regional Intellectual Property Organisation
AU	African Union
AusAID	Australian Agency for International Development
BMGF	Bill and Melinda Gates Foundation
BMZ	Federal Ministry for Economic Development (Germany)
CA	Conservation agriculture
CAADP	Comprehensive African Agriculture Development Programme
CADS	Cluster Agriculture Development Services
CBI	Crop Breeding Institute
CELUCT	Chikukwa Ecological Land Use Management Trust
CFU	Commercial Farmers' Union
CGIAR	Consultative Group of International Agricultural Research
CH_4	Methane
CIMMYT	International Maize and Wheat Improvement Centre
CO_2	Carbon dioxide
COMESA	Common Market for East and Southern Africa
COMRAP	Regional Agriculture Inputs Programme
CRI	Cotton Research Institute
CRS	Catholic Relief Services
CSOs	Civil society organisations
CSRI	Chemistry and Soil Research Institute
CTDT	Community Technology Development Trust
DfID	Department for International Development
DR&SS	Department of Research and Specialist Services
DRC	Democratic Republic of Congo
DSS	Department of Seed Services
DUS	Distinct, uniform and stable
EDV	Essentially derived variety
EPA	US Environmental Protection Agency
ESAP	Economic Structural Adjustment Programme
EU	European Union
EC	European Commission
FACHIG	Farmers Association of Community Self-Help Investment Groups
FAO	Food and Agriculture Organisation of the United Nations
FCTZ	Farm Community Trust of Zimbabwe

FFS	Farmer field schools
FGD	Focus group discussion
FISP	Farm input subsidy programme
GAP	Good Agricultural Practice
GDP	Gross Domestic Product
GIS	Government Input Scheme 2000
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GM	Genetically modified
GMB	Grain Marketing Board
Ha	Hectares
HHs	Households
ICRAF	World Agroforestry Centre
ICRISAT	International Crop Research Institute for the Semi-Arid Tropics
IPM	Integrated Pest Management
ISFM	Integrated Soil Fertility Management
ISTA	International Seed Testing Association
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
K	Potassium
LU	Livestock unit
MAMID	Ministry of Agriculture, Mechanisation and Irrigation Development
MFED	Ministry of Finance and Economic Development
MLARR	Ministry of Lands, Agriculture and Rural Resettlement
MNC	Multinational corporation
MOU	Memorandum of Understanding
NAFSN	G8's New Alliance on Food Security and Nutrition
NDUS	New, distinct, uniform and stable
NEPAD	New Partnership for Africa's Development
NGO	Non-governmental organisation
N	Nitrogen
N_2	Molecular nitrogen
N_2O	Nitrous oxide
NO_3	Nitrates
NPK	Nitrogen, phosphorous, potassium
Nr	Reactive nitrogen
NR	Natural Region
NTS	National Tested Seeds
ODI	Overseas Development Institute
OFDA	Office of US Foreign Disaster Assistance
OPV	Open pollinated variety
ORAP	Organisation of Rural Associations for Progress
P	Phosphorous
PBRO	Plant Breeders' Rights Office
PBRs	Plant breeders' rights
PELUM	Participatory Ecological Land Use Management

PISP	Presidential Input Supply Programme
POS	Point-of-service
PPB	Participatory plant breeding
PPP	Public-private partnership
PVP	Plant variety protection
PVS	Participatory variety selection
QDS	Quality declared seed
R&D	Research and development
RBZ	Reserve Bank of Zimbabwe
SADC	Southern African Development Community
SDC	Swiss Agency for Development and Cooperation
SNV	Netherlands Development Organisation
SOM	Soil organic matter
SVF	Seed vouchers and fairs
TCB	Tobacco Control Board
UK	United Kingdom
UPOV	Union for the Protection of Plant Varieties
US	United States of America
US$	United States Dollar
USAID	United States Agency for International Development
VCU	Value for cultivation and use
WVI	World Vision International
ZAIP	Zimbabwe Agricultural Investment Plan
ZAMFI	Zimbabwe Association of Microfinance Institutions
ZAR	South African Rand
ZCFU	Zimbabwe Commercial Farmers' Union
ZFC	Zimbabwe Fertiliser Company
ZFU	Zimbabwe Farmers' Union
Zim ACP	Zimbabwe Agricultural Competitiveness Programme
Zim AIED	Zimbabwe Agricultural Income and Employment Development
Zimphos	Zimbabwe Phosphate Industries
ZIMPREST	Zimbabwe Programme for Economic and Social Transformation
ZIMSOFF	Zimbabwe Smallholder Organic Farmers' Forum
ZTS	Zimbabwe Technological Solutions

TABLES and FIGURES

Tables

Figures

SUMMARY

Introduction

This research report is the first piece of research being conducted in Zimbabwe by the African Centre for Biodiversity (ACB). It follows on from initial engagements with Zimbabwean civil society organisations (CSOs) regarding seed policy and is a preliminary scan for orientation and the identification of possible areas for further work, together with organisations in Zimbabwe. It forms part of a regional research programme which aims to engage directly with farmers, farmer associations, farmer support organisations, extension workers, scientists, donors and government officials, to explore the complex impacts on small-scale farming households of the introduction of Green Revolution technologies, as well as their socio-ecological contexts in the region.

The Zimbabwean situation is unique in the region primarily because of the fast track land reform that took place from 2000. This programme significantly altered the agrarian structure of the country but also contributed to input and output supply disruptions, with a sharp decline in the volume of production. External support was provided in the form of aid, including seed aid, and sponsorship of agricultural inputs to small-scale farming households. Throughout this period government also played a major role in subsidising Green Revolution input packages. These subsidy programmes performed an essential function in maintaining a commercial hybrid seed and synthetic fertiliser industry in Zimbabwe.

The report is based on a combination of secondary desktop research and primary field research in the form of interviews with key informants and focus group discussions (FGDs) with farmers in nine sites, mainly in communal areas on the east side of the country.

The agricultural economy of Zimbabwe

Zimbabwe is divided into five agro-ecological zones known as Natural Regions (NRs). The quality of the land and natural resource base declines from NR I through to NR V. Small-scale farming households tend to be concentrated in zones that are less amenable to agricultural production.

Prior to the fast track land reform programme, communal farmers farmed on about 50% of the country's agricultural land. Roughly 30% of the agricultural land was under large-scale private ownership which comprised about 5 000 large-scale commercial farmers with very sophisticated production systems. Most of the remainder of the land was under resettlement or utilised by smallholder farmers outside the communal areas, with the state holding a very small portion of land. While land reform has altered the agrarian structure this has not been a complete transformation as the communal areas have remained the same. The resettlement programme more than doubled its share of the land area by 2007. There was a 20% rise in the land area under medium-scale farms, off a relatively low base, but the area under large-scale farms dropped sharply. It had already dropped by 25% from independence to 1999, but in the period from 1999 to 2007, the land area under large-scale farms decreased by a further 58%. While the fast track land reform programme has led to important redistribution, the overall agrarian structure inherited from Zimbabwe's colonial era—primarily the schism between communal and commercial land—remains intact.

Fast track land reform overall appears to have resulted in a shift towards smaller and more diversified production units than in the past, which has implications for agricultural technologies and their dissemination. This shift has taken place during the period of Zimbabwe's extensive economic and political crisis, which has not yet relented. Appropriate agricultural support is essential for a productive sector, but external investments are few and far between and systems and institutions have shrunk or decayed.

Agriculture plays a key role in the Zimbabwean economy, contributing 14–18% of the formal gross domestic product (GDP), over 40% of recorded national exports, close to 60% of raw materials to agro-industries, and generates livelihoods for over 70% of the population.

Commercial agriculture employs around a third of the population in formal employment. Maize is the staple food crop and is eaten mainly with vegetables and groundnuts. Cash crops are cotton, soya beans, wheat, tobacco and horticulture (flowers, vegetables). Consequent to the economic and political crisis which followed the Economic Structural Adjustment Programme (ESAP) in the early 1990s, followed by the land reform programme, the formally recorded agricultural production of all crops has dropped dramatically—and has not yet recovered.

Overview of the Green Revolution in Zimbabwe

Zimbabwe has a long history of Green Revolution interventions, including those for small-scale farmers, which started in the 1980s. As with the rest of the region, these interventions focused on hybrid maize and synthetic fertiliser. Input subsidies and seed aid programmes have played a crucial role in sustaining commercial input markets throughout the political and economic crisis. Government and farmers are now locked into a Green Revolution input subsidy regime. This is very difficult to crack politically and is entrenched in the relationship between the state and society, even beyond individual governments. The context remains very fluid and is difficult to analyse because many variables have changed very rapidly. It is evident, however, that the smooth unfolding of the Green Revolution has been disrupted.

Since 2000 the Green Revolution has been sustained through external aid and government input subsidy programmes, based on the delivery of hybrid maize seed and synthetic fertiliser to small-scale farming households. These programmes have had minimal apparent effect but must be understood in the context of the wider political and economic crises. After 'dollarisation' and the subsequent macro-economic stabilisation in 2009, efforts were made to shift from straight input subsidies to delivery mechanisms that could potentially allow the re-establishment of market-based relationships. Input vouchers and the channelling of inputs through private agro-dealers are examples of approaches that have been adopted in Zimbabwe. More broadly, following the signing of the Comprehensive African Agriculture Development Programme (CAADP) Compact in 2013, the Zimbabwe Agricultural Investment Plan (ZAIP) (2013–2018) was finalised to take the CAADP process forward at country level.

Agricultural input subsidies

Government has administered a variety of input supply programmes since independence. Almost all hybrid seed and synthetic fertilisers were delivered to farmers through either government relief or donor programmes, particularly after 2000. Farm input subsidy programmes (FISPs) are based on the assessment that seed and fertiliser shortages hamper farmers' ability to produce. Part of the challenge is to boost supply, part is to develop the channels to reach farmers, and part is to advertise and share information to raise awareness about the benefits of improved products. While both government and NGO programmes share similar broad objectives and justifications for interventions, they have often differed regarding targeting, organisation and wider politics. A core of companies in seed and synthetic fertiliser tend to be the main beneficiaries of input subsidy programmes. These include Seed Co, Pioneer Hi-Bred/Pannar and Monsanto, for seed; while the four dominant fertiliser companies, Zimbabwe Phosphate Industries (Zimphos), Zimbabwe Fertiliser Company (ZFC), Sable Chemical Industries and Windmill.

Following fast track land reform, the economy plummeted and for various reasons the resettlement areas failed to perform according to expectations, including input shortages. The government formulated a plethora of programmes to remedy the situation and address an assumed need for hybrid seed and fertilisers. The implementing agencies have changed with time, from the Grain Marketing Board (GMB) to the Reserve Bank of Zimbabwe (RBZ), to the army and the Agricultural, Technical and Extension Services (AGRITEX), but the targeted groups have remained pretty much the same, i.e. communal and newly resettled farmers. The interventions were also more or less consistent—free hybrid seed and fertilisers.

During the years of Zimbabwean economic recession, 2000 to 2008, but especially from the 2003/04 agricultural season, donors also implemented agricultural input assistance programmes, alongside the government's programmes. Government programmes generally have been significantly larger than donor programmes. From 2001–2006, government distributed almost 403 000 tons of fertiliser and 112 000 tons of seed. In comparison, from 2003–2009, donor programmes distributed around 48 000 tons of fertiliser and 27 000 tons of seed. Since 2009 the main Green Revolution donors have all conducted input subsidy programmes, including USAID, the Bill and Melinda Gates Foundation (BMGF), the Europeans, Britain, Australia and the United Nations Food and Agriculture Organisation (FAO).

When the macro-economic situation began to show signs of recovery in 2009, development agencies reviewed the rationale for free direct input distribution and identified the need to move away from free input distribution to market-based mechanisms. Input assistance programmes moved to a system based on vouchers redeemable at participating agro-dealers. There are a number of implementation issues with the voucher programmes and FISPs generally met with an increased number of shortcomings. However, these are operational issues rather than a fundamental critique of the programmes. The wider critique is that input subsidy programmes channel resources into a narrow set of technologies, whether these are locally appropriate or not. They are standardised and largely inflexible, and absorb public resources that could be used in other ways to support smallholder farmers.

Small-scale agriculture is a challenging and essential task in most of Africa, including Zimbabwe. It is appropriate to support farmers in their efforts to produce food. The question is: what form does the support take? It is very clear that the input subsidy programmes cater for the expansion of Green Revolution technologies. However, evidence indicates the input subsidy programmes have not been particularly effective, even with regard to increasing maize yields—which is one of their fundamental stated objectives.

As in other countries in the region, input subsidies have become entrenched politically and there are no apparent plans to phase them out. In this context, the immediate research task may be to look at what support is provided to farmers by other government programmes, in particular on seed production and exchange, and alternative sources of nutrients, including increasing organic matter. There is evidence that such programmes exist, although mainly in civil society only. A more comprehensive view of these activities would go a long way towards informing possible future directions for farmer-managed seed and agro-ecological soil fertility practices, as an alternative pathway of support for the FISPs.

Overview of the Zimbabwean seed sector

As with the rest of the continent, most of the seed used by small-scale farming households in Zimbabwe is produced and reproduced locally, without formal regulation. Farmer-produced and exchanged seed is the oldest and most important supply of planting materials in Zimbabwe. Apart from maize, over 95% of the seed sowed by farmers in Zimbabwe comes from the farmer seed system. On-farm and local production of seed is an integral part of the country's agro-ecology. Such farmer-managed seed systems are diverse, localised and non-reducible. By contrast, the formal commercial seed system is unitary, with centralised control, technological standardisation and has exclusivity of ownership at its core.

Farmer-managed seed systems include the ways farmers themselves produce, distribute and obtain seed. This may be directly from their own production; acquisition from local grain markets, traders or sellers; and from barter and gifts among relatives, neighbours and friends, both within and beyond their immediate surroundings. Farmers' seed is usually not produced separately but is selected from the grain stocks or harvests, and local technical knowledge, social structures and standards maintain these farmer-managed systems. These systems gained prominence after the fast track land reform, when certified seed was erratically available, until 2008 when farmer-managed seed became the sole source of seed planted by most smallholder farmers.

The processes of in situ seed selection, production, storage and exchange between farmers are integrated in farmer-managed seed systems. Crop production and the selection and storage of seed bring to bear selection pressures on local varieties that are genetically diverse. Together with the natural selection pressure, these farmer practices contribute to local level seed enhancement. The extensive utilisation of traditional crop varieties (landraces) by smallholder farmers has good results on agro-biodiversity. However, the commercialisation of agriculture has resulted in the implementation of intensive cropping methods, using Green Revolution technologies. The adoption of hybrid maize varieties in Zimbabwe is very high. For example, in 2006/07, more than 80% of the maize area in the country was planted to hybrids, while close to 10% was planted to improved open pollinated varieties (OPVs). This has come at the expense of diversity and that of small grain production in particular.

Plant breeders' rights (PBRs)

Theoretically, plant breeders' rights (PBRs) are granted to allow for returns on investment in research and development (R&D). According to the logic, no enterprise will invest in developing technologies if there is no possibility of reaping profits at the end of the process. The Plant Breeders' Rights (PBR) Act 22 of 2001 regulates the plant variety ownership regime in Zimbabwe. The Act is currently based on the 1978 version of the Union for the Protection of Plant Varieties (UPOV). Zimbabwe is in the process of revising the legislation to conform to UPOV 1991, which reduces farmer control over the seed in their possession. The Act follows the essential template of all PBR Acts aligned with UPOV. PBRs establish the exclusive right to sell, reproduce and multiply reproductive material of the plant concerned for the period of the PBR. The normal term of a right is 20 years. Public institutions as well as private companies are involved in breeding in Zimbabwe, although private sector activities have come under pressure, especially since 2000.

Zimbabwe has one of the more progressive PBR laws in the region. A farmer who cultivates less than 10 ha of land may use the harvest from any prescribed plant for the purpose of propagating the plant on that land, where the harvest was obtained by propagating the plant concerned or from an essentially derived variety. A farmer who derives at least 80% of her/his annual gross income from farming on communal or resettlement land may multiply the seed of any prescribed plant and exchange with any other such farmer. This is essentially an exemption for small-scale farmers to the breeders' rights granted.

Zimbabwe is also party to the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). Amongst other things, this treaty explicitly recognises farmers' rights to "save, use, exchange and sell farm-saved seed and other propagating material, and to participate in decision-making regarding, and in the fair and equitable sharing of the benefits arising from, the use of plant genetic resources for food and agriculture". It places the responsibility for realising farmers' rights on national governments.

In July 2015, members of the African Regional Intellectual Property Organisation (ARIPO), including Zimbabwe, adopted the ARIPO Plant Variety Protection (PVP) Protocol. The Protocol is modelled on the 1991 Act of UPOV, which was developed to accommodate the demands of established domestic seed industries from developed countries (particularly in Europe) and the agricultural systems of such countries. It is widely recognised today that UPOV 1991 is an unsuitable PVP regime for developing countries, where farmer-managed seed systems form the bulk of seed production and distribution, and recycling of seeds is widely practiced. Zimbabwe's PBR Act is based on UPOV 1978 and as such contains at least some provisions that balance the rights of breeders and farmers, as well as the public interest. In contrast, the Protocol promotes breeders' rights to the detriment of farmers' rights and national and public interests. In these aspects, the Protocol is inconsistent with the Zimbabwean PVP Act and the ITPGRFA. The Protocol does not recognise the right of farmers to freely save, exchange and sell protected varieties, even in small quantities.

The land reform process in 2000 interfered significantly with plant breeding programmes in Zimbabwe and a number of the larger companies lost all or some of the farms on which they were operating breeding programmes. In-country breeding programmes became unprofitable because of seed price controls, particularly for maize and wheat. Some of the international research institutions and companies transferred their breeding programmes from Zimbabwe to neighbouring countries, together with some of their scientists, and funding for breeding programmes within the Department of Research and Specialist Services (DR&SS) plummeted as a result of the economic challenges. Nevertheless, a recent assessment found Zimbabwe's formal sector to be extremely strong regarding the availability of foundation seed and the number of active breeders.

Seed certification and multiplication

Private sector certified seed activities focus on hybrid maize, although there is also production of commercial crops, such as soya beans and sunflowers, and the intermittent production of other crops—cowpeas, pearl millet, sorghum and finger millet. In 2013 38 seed companies were registered in Zimbabwe. Since 2000 Zimbabwe has been a net importer of certified seed, with maize coming mainly from South Africa, Zambia and Malawi, while vegetable seed is imported mostly from the Netherlands and South Africa. The commercial seed sector in Zimbabwe almost shut down between 2005 and 2008, as a result of the unfavourable policy/regulatory environment, hyper-inflation, price controls and foreign currency shortages. After the removal of large-scale commercial producers following land reform, new contract seed growers had to be established. In addition, almost all retail channels for certified seed closed down.

The introduction of a multi-currency system and liberalisation of the economy in early 2009 saw the renewed expansion of seed companies, their grower networks and the re-opening of retail outlets, and the rebound of certified seed production to 48 000 tons. The country has been able to meet all its hybrid maize seed requirements since then. During this period there was significant consolidation in Zimbabwe's seed sector as a result of global mergers and acquisitions, with changes in the ownership of companies like SeedCo, Pannar, Prime Seed, Agriseed and Quton. Although there are opportunities to produce certified OPV maize seed and some of the self-pollinating pulses and cereals—sorghum, millets, cowpeas and others—many seed companies in Zimbabwe are not particularly keen to do so. As a result the availability of certified seed of these crops will probably continue to be limited.

Seed aid and seed subsidy programmes

The 'relief seed system' is a fairly new term, created to distinguish seed supply systems that aim to maintain recurring emergency seed distributions. The relief system follows a clear sequence of declaring a crisis, a disaster or an emergency, then assuming seed is needed, and putting into motion a well-established chain of suppliers. Systems such as these are completely dependent on, and prefer perennial emergencies, for their financial solvency. This system has been in full operation in Zimbabwe for most of the years since 1980, and for every year from 2002 to 2008. The system continued after 2009 until 2013 but was modified to include market-based modalities for the delivery of subsidised seed.

Direct seed distribution has been confined mainly to a narrow range of varieties and crops, especially those produced by the commercial sector, which are extensively adapted. A large part of the relief in Zimbabwe is maize based and frequently includes hybrids. Thus it functions as a conduit for commercial seed and serves a market-building purpose. Direct seed distributions have been implemented on a chronic and often near-continuous basis. An emergency is declared almost year after year, and as a routine agricultural response, seed aid is provided. In addition to frequently not addressing the actual problem, the chronic delivery of seed aid undermines other forms of seed sourcing, whether farmer-managed or commercial.

In 2009 the macroeconomic situation in Zimbabwe began to show signs of recovery.

There was a rethink concerning the way in which agricultural input subsidies (seed and fertiliser) had been implemented by the donor and NGO community since 2010. The new dispensation aimed to deliver seed aid in more market-friendly ways, most notably through voucher-based systems. Since 2010 the broad aim of programmes has been to re-establish the commercial supply chain for seeds, with agro-dealers at the heart of the seed business.

In the years since 2000 seed fairs have become a regular practice in Zimbabwe. They have their origins in safeguarding cultural heritage and biodiversity, and are structured to help farmers preserve their seed diversity and increase awareness of its value. In biodiversity-focused fairs, although very small quantities of seed change hands, the exchange of many varieties takes place. These fairs do not aim to supply seed but rather to transfer genetic material, with its attendant cultural heritage and knowledge, as well as to bring seed sellers together in the same place, to minimise the misuse of vouchers and to simplify logistics. Some seed fairs simply bring farmers together to exchange seed and knowledge, while others include agro-dealers and seed enterprises.

Seed fairs facilitate timely access by farmers to seed of the crops and varieties they want. They allow poor households, including women-headed households, to sell seed and they offer economic support to local seed systems. An estimated 65–85% of aid resources go back into the local economy during a fair. Seed fairs also offer opportunities for knowledge exchange among farmers and between farmers and traders, on a wide range of topics including crop varieties and seed quality. Fairs can face some challenges, which can include the quality of the genetic material on offer, the limited reach of the fairs, logistics, sufficient knowledge and capacity.

The concept behind seed fairs is powerful and it may be possible to work with existing processes to widen their scope beyond their localities. For example, the facilitation of farmer exchanges between fairs, enabling farmers to exchange diverse genetic materials and learn from one another. This could begin quite simply by matching farmers in similar agro-ecological zones, but who are far from one another geographically. This will enhance the diversity of local seed supplies.

Small-scale farmer involvement in seed production

Maize production from large-scale commercial farmers decreased during the 1980s and 1990s, although the sector continued as a significant maize seed producer, thanks to its diversification into higher value products, such as horticulture and flowers. Increasingly, government targeted the smallholder sector as producers. Smallholder farmers worked with seed companies, international agricultural research centres, AGRITEX and non-governmental organisations (NGOs) to produce most of the certified non-maize food crop seed that was sold for relief seed in the early 2000s, and even today there are various government, donor and NGO programmes that support small-scale farmer certified seed multiplication.

Where local level seed production for community-based seed multiplication groups was supported technically and organisationally—for example, in farmer field schools (FFSs) there was an abundance of seed for small grains, groundnuts and cowpeas. FFSs, as well as individual farmers who still held stocks of small grains produced a long time ago, cited the marketing of produced seed as a major constraint.

In Zimbabwe quality declared seed (QDS) is termed standard grade seed. QDS is seed which meets the minimum standards set for selected crop species and which has undergone stipulated germination, analytical purity and varietal purity quality control measures. While the QDS system intends offering less demanding quality control during seed production, it also aims to produce good quality seed for both in-country use and cross-border trade. QDS may arise from varieties developed through breeding, landraces or from alternative plant breeding approaches, such as participatory plant breeding (PPB).

There is a list of crops eligible for production as standard grade seed. Most of the listed crops include the seed of self-pollinating crops such as rice, sunflowers and others; the seed of crops with high seed rates but low multiplication rates, such as groundnuts, cowpeas, sugar beans, bambara nuts and others; and OPV maize, sorghum, and pearl and finger millets. Crops on this list are also called 'non-compulsory', which refers to the fact that it is not mandatory to apply the distinct, uniform and stable (DUS) system for variety identification. It is illegal to sell standard grade seed of crops on the compulsory list that require DUS testing, although there are exemptions for farmers who produce seed on their own land that is not for a formal system.

Farmers identified a number of concerns about the hybrid maize dominance of the commercial seed system, including: loss in agricultural biodiversity, deforestation, changes in production in terms of crops grown, areas planted to maize and other crops, varieties grown, yields obtained over time; the associated costs of production; marketing and income issues in terms of policy support to different crops; input and output prices and markets; and consumption issues in terms of dietary diversity and the processing of various foods.

Soil fertility

Zimbabwe's agrarian structure is historically dualistic, with large-scale commercial farming on the one hand and small-scale subsistence production on the other. Seventy per cent of Zimbabwe's soils are sandy and inherently infertile, low in organic matter and prone to leaching. Nitrogen (N) and phosphorous (P) are the most limiting factors, with multiple micro-nutrient deficiencies in degraded areas. Soils are largely low pH (acidic) which reduces the effectiveness of nutrient inputs. Three quarters of small-scale farmers are located on sandy soils in semi-arid areas.

A number of methods have been used historically by smallholder farmers for soil fertility management in Zimbabwe. The most important of these include the addition of soil organic matter (SOM) through a variety of sources including soil from ant heaps; animal manure especially from cattle and humus from rotting leaves; and nitrogen fixing including through agroforestry, rotations with grain legumes like groundnuts, tree legumes like faidherbia albida, and intercropping of cereals with grain legumes such as cowpeas and bambara nuts. These soil fertility practices are combined with other land management practices such as fallow cropping.

Synthetic fertiliser use has a long history in Zimbabwe, starting in the 1930s. From the outset until well into the 1990s, the focus of synthetic fertiliser use was the large-scale commercial farming sector. However, from the 1980s investments were made in extending synthetic fertiliser use amongst small-scale farmers, including through agricultural loans. Prior to 2000, about half the fertiliser provided was used on maize, followed by tobacco (12%), wheat (11%), then cotton, sugar, horticulture and soya beans. Small-scale farmers utilised 90% of all fertiliser on maize, while the commercial sector used about 33% on maize. About one-fifth of small-scale farmers were using fertiliser prior to 2000. The 2000 fast track land reform severely disrupted these markets as commercial production was interrupted and restructured, and the demand for synthetic fertiliser dropped.

Zimbabwe is one of the biggest fertiliser producers in sub-Saharan Africa. In 2009 Zimbabwe produced 100% of sub-Saharan ammonium nitrate (AN), 28% of nitrogen, phosphorous, potassium (NPK), 18% of ammonia and 5.5% of phosphoric acid. Zimbabwean companies export these products into the region. Historically the country has relied on domestic production to meet domestic demand. However, in recent years, about 32% of fertiliser and chemicals were produced domestically and the rest were imported. After 2000 and until 2009 there was a three-quarter drop in the production of NPK blends and AN. Capacity utilisation at fertiliser manufacturers was under 30% in 2008, although it started recovering from 2009. However, figures show that consumption was already dropping from the mid-1990s at least, and that there was not a particularly significant shock decline after 2000, but rather a continuation of a longer downward trend in consumption. This suggests land reform with its subsequent disruption of the Green Revolution was not the only factor resulting in declining fertiliser use. Zimbabwe also faced a series of droughts during the 2000s. In addition, global prices skyrocketed during the speculative commodities boom that contributed to the global economic crash in 2008.

The market is dominated by four local companies: Zimphos (owned by Chemplex Corporation); ZFC; Sable Chemical Industries and Windmill. These companies have a cross-linked ownership structure. Sable imports ammonia for the production of AN, which it sells to Windmill and ZFC. Zimphos uses domestic sources of phosphate rock and pyrites, imports sulphur, and manufactures and sells superphosphates to Windmill and ZFC. The latter two companies combine the products from Sable and Zimphos with imported potash to produce NPK compounds and AN top dressing. Other players in the industry comprise traders who do not produce their own fertilisers from scratch but either buy them locally or import them in bulk, and then repackage or blend and sell. Such traders include Omnia from South Africa, Farmers' World of Malawi, and Nutrichem, a Zimbabwean company which imports products in bulk from South Africa.

Significant investments in input subsidy programmes, as shown above, indicate government's orientation towards increasing synthetic fertiliser use. The fertiliser and chemical industry is identified by government as one of four priority pillars in the industrial development plan for 2012–2016. In an effort to support domestic fertiliser production, government proposes a zero tariff for raw material imports for fertiliser production, while tariffs will be imposed on finished products. Trade and tariff structures, business financing and land tenure are some of the key policy issues identified and there is a call to develop a clear fertiliser policy. These aspects mirror the wider Green Revolution agenda which can be seen clearly in the G8's New Alliance on Food Security and Nutrition (NAFSN) programme, even though the programme is not operating directly in Zimbabwe.

Integrated Soil Fertility Management (ISFM) and Conservation Agriculture (CA)

Extensive research into soil fertility enhancement and management, based on organic and synthetic fertilisers has been conducted in Zimbabwe. This research has spanned many decades and involved fertiliser types, the rates and timing of applications for the different soil types, cropping and farming systems and rainfall regimes in all the agro-ecological regions.

Integrated Soil Fertility Management (ISFM) is essentially about blending appropriate external inputs based on scientific recommendations with practices that increase SOM. In practice, proponents tend to emphasise synthetic fertiliser as the priority element in this process. Conservation agriculture (CA) is a broad term that categorises a number of farming practices intended to enhance the sustainability of fibre and food production through water, soil and energy conservation. Conceptually, CA evolved from an initial concern with the decreasing or removal of inversion tillage, as described by earlier terminology such as "stubble-mulch tillage, zero tillage and reduced tillage", into a broad concept comprising a package of three fundamental principles. These principles include the preservation of soil cover with crop residues or cover crops, the utilisation of crop rotations or inter-cropping, and the reduction or elimination of soil disturbance by adopting reduced or zero tillage techniques.

There may be fruitful paths to pursue in relation to ISFM/CA approaches on issues such as detailed soil testing; the localisation of soil testing technologies to bring them closer to farmers' control; R&D/extension/farmer interactions and the role of farmers in R&D; the analysis of missing nutrients; and a deeper understanding of the science of prescription micro-dosing and synthetic fertiliser blends targeted to specific areas. These could go hand in hand with practical work with farmer associations to systematise and share local knowledge that identifies which nutrients the soils and plants require, and identifies and assesses possible local sources of inputs.

Conclusions and possible areas for further work

This scoping report offers a first sketch of the situation in Zimbabwe. There are many areas for further investigation. On a broad level more work can be done on updating current Green Revolution interventions, especially those by the United States Agency for International Development (USAID), the European Union (EU) and the United Kingdom (UK). These interventions could explore Zimbabwe's alignment with the regional agricultural corridors approach, and identify the various public-private partnerships (PPPs) that are involved. Further work can be done to map the various public programmes related to agro-ecological support to identify possible points of intersection. With regard to seed, responses by civil society and farmer organisations to the domestication of the Arusha PVP Protocol will be required. Further study may be required on the workings of the PBRs and the seed laws, including who benefits, how do these regulations impact on the seed sector, how do they facilitate corporate expansion, and related questions.

A more thorough scoping of farmer involvement in seed production could be of value, including: farmers' own seasonal seed saving and storage practices for own use and support needs; participation in participatory variety selection (PVS), PPB and QDS; and fully certified seed production. This could include a more detailed mapping of specific instances: how are the programmes working, have they benefited farmers and how, which crops, what are the constraints, should it be supported, etc. This could take the concrete form of identifying and working with specific farmer associations to identify support needs to build their specific breeding, seed enhancement, production and storage requirements, and to scan the public sector for existing programmes and possible channels of support. It may be interesting to look in more detail at the seed fairs approach as a potential mechanism for farmer-to-farmer exchange of germplasm and knowledge.

Similar work could be pursued on agro-ecological practices in soil fertility. A focus still needs to be determined for this work, but ISFM/CA programmes may warrant deeper investigation, both to develop a critique and in order to learn. It would be valuable to connect the research to specific farmer associations, to embed the research and to identify key priorities for further work.

Figure 1: Map of Zimbabwe showing districts and major towns

INTRODUCTION

This research report is the first piece of research being conducted in Zimbabwe by the ACB. It forms part of a regional research programme which aims to engage directly with farmers, farmer associations, farmer support organisations, extension workers, scientists, donors and government officials, to look at the complex impacts on small-scale farming households and their socio-ecological contexts in the region, of the introduction of Green Revolution technologies.

The Zimbabwean situation is unique in the region primarily due to the fast track land reform that took place from 2000. This programme significantly altered the agrarian structure of the country, but also contributed to input and output supply disruptions which resulted in a sharp decline in the volume of production. Since 2000, Zimbabwe has been in a permanent state of political and economic crisis. Following land reform donor funds and investments were withdrawn. As the economy plummeted, so did state resources. In agriculture external support was provided in the form of aid, including seed aid and sponsorship of agricultural inputs to small-scale farming households. Government also played a major role in subsidising Green Revolution input packages throughout this period. These subsidy programmes performed an essential function in maintaining a commercial hybrid seed and synthetic fertiliser industry in Zimbabwe.

Zimbabwe has a history of Green Revolution technologies which stretches back into the first half of the 1900s among commercial farmers, and then expands to small-scale farmers from the 1980s. This produced a commercial core in both certified seed production and synthetic fertiliser production, especially after the ESAP in the early 1990s. Although the commercial seed and fertiliser sectors have suffered serious declines in production volumes since 2000, some of the bigger regional entities have survived and even thrived as the Green Revolution expands in neighbouring countries. SeedCo is an example of this success in the seed sector, and Zimbabwe is one of the top five African producers of synthetic fertiliser.

Small-scale farmers rapidly adopted Green Revolution technologies, in particular hybrid maize seed and synthetic fertiliser. This was facilitated by input subsidy programmes for more than three decades. The existence of these programmes today suggests that the objective of creating a mass class of financially self-sufficient farm entrepreneurs has not been successful. Instead, resource-poor small-scale farming households are trapped on a technological treadmill, spending money to produce, but not having the resource reserves to return to less expensive forms of production. This may manifest as a demand for Green Revolution technologies; for example, the primary complaint across the region, as in Zimbabwe, is that synthetic fertiliser is too expensive.

Since 'dollarisation' and the consequent stabilisation of the economy from 2009, efforts to resuscitate the new Green Revolution project in Zimbabwe have got under way. The new project is distinguished by PPPs, physical infrastructure, institutional development, finance, policy and markets as areas of concentration. This aims to resuscitate and boost the flows of agricultural input commodities, such as hybrid seed and synthetic fertiliser. These are identified as a profitable stream for investment. Although there are risks involved in such investments, there are also means by which the risks can be protected against with a hedge. This particular version of the Green Revolution is strongly driven by the United States (US) and its global development arm, the United States Agency for International Development (USAID). USAID is very active regionally in building this agenda, together with many other allies including national governments. This report is an initial scoping exercise to trace some of the contours of the project, based on a combination of secondary desktop research and fieldwork comprising direct engagement with farmers, farmer associations and others working in agriculture, agro-ecology, seed and soil fertility. Zimbabwe has a long history of deep agricultural research and practice and we cannot do it justice in this initial report. The objective of the report is mainly to facilitate internal discussion between ACB and various organisations in Zimbabwe, starting with the civil society network involved in seed work.

The report begins with this introduction which provides a brief description of the research methodology used and the sites visited. This is followed by the first main section which presents a brief background to Zimbabwe's agricultural economy, looks at agro-ecological and agrarian structures and changes over time, and includes an overview of national agricultural production patterns and farming systems in the study sites. The second section provides an overview of the Green Revolution in Zimbabwe, including a brief history and review of Green Revolution efforts since 2009, with a more in-depth consideration of the various government and donor farm input subsidy programmes. The third section comprises an investigation of the seed systems in Zimbabwe, looking at farmer-managed seed systems and the commercial system. Some further detail is provided on plant breeding R&D and PVP in law and practice, seed certification and multiplication, seed aid and seed subsidy programmes, farmer involvement in aspects of the commercial seed system including quality declared seed (QDS), and also considers some farmer assessments of the commercial system. The final section explores soil fertility, with a review of agro-ecological soil fertility practices, a look at synthetic fertiliser production and use, and includes a few initial comments on ISFM, CA and the ecological impacts of excess and imbalanced nutrient supply. The report concludes with a summary of the analysis and suggests areas for possible further work.

Methods

The report is based on a combination of secondary desktop research and primary field research in the form of key informant interviews and FGDs with farmers. Interviews were held with government officials including economists from the Ministry of Agriculture, Mechanisation and Irrigation Development (MAMID); seed specialists and technologists from the Department of Seed Services (DSS) and the national gene bank; crop specific specialists (maize, legume and small grains specialists) and agricultural extension officers from AGRITEX; depot managers from the Grain Marketing Board (GMB); and soil scientists from the Chemistry and Soil Research Institute (CSRI). Interviews also included personnel from technical institutions such as the University of Zimbabwe, the International Maize and Wheat Improvement Centre (CIMMYT), the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT), the Agricultural Research Council (ARC), the World Agroforestry Centre (ICRAF), seed and fertiliser companies, agro-dealers and agro-ecological and civil society organisations (CSOs), including Participatory Ecological Land Use Management (PELUM), the Tsuro Trust, the Zimbabwe Smallholder Organic Farmers Forum (ZIMSOFF), the Community Technology Development Trust (CTDT) and Cluster Agricultural Development Services (CADS).

Field visits, farmer interviews and FGDs were conducted in nine sites (Table 1) which offered a diverse spread of smallholder farming areas in Zimbabwe. The study made an effort to link assessment to practice in the sites selected. The sites ranged from high potential agricultural zones in NR II (Mutoko, Murehwa and Goromonzi) to very low potential cropping zones in NR V (Chiredzi and part of Chipinge). Wards and districts were selected using the following criteria:

Sufficient contrast between areas so as to embrace a diversity of agro-ecological conditions, crops under production, production practices and impacts of Green Revolution interventions on farming households;
Areas of NGO interventions where people were interested in considering alternatives to Green Revolution interventions; and
Districts in which either the government's Presidential Input Support Programme (PISP) or the FAO's Market-Based Input Assistance Programme were implemented.

Goromonzi and Murewa districts and, to a lesser extent, Mutoko, correspond to a higher production potential region which is the most important zone for hybrid maize production. Zvishavane, Masvingo and Zaka are districts with medium potential for maize but high potential for small grains. Chiredzi district and the lower parts of Chipinge and Chimanimani districts are mostly small grain zones with very low potential for maize, although it is still grown in these areas.

Table 1: Research sites

Ward number	District	Province	Date of visit	Participants		Natural Region	Programmes
				Women	Men		
Ward 9	Mutoko	Mashonaland East	17/03/15	7	7	II	PISP
Ward 14	Murewa	Mashonaland East	16/03/15	12	0	II	PISP
	Goromonzi	Mashonaland East	18/03/15			II	PISP/FAO
Ward 18	Zvishavane	Midlands	30-31/03/15	8	10	III and IV	PISP/FAO
Ward 6	Masvingo	Masvingo	1-3/04/15	3	5	III	PISP/FAO
Ward 9	Zaka	Masvingo	4-6/04/15			III and IV	PISP/FAO
	Chiredzi	Masvingo	7/04/15			V	PISP/FAO
	Chipinge	Manicaland	7-8/04/15			I and V	PISP
	Chimanimani	Manicaland	9/04/15			I	PISP

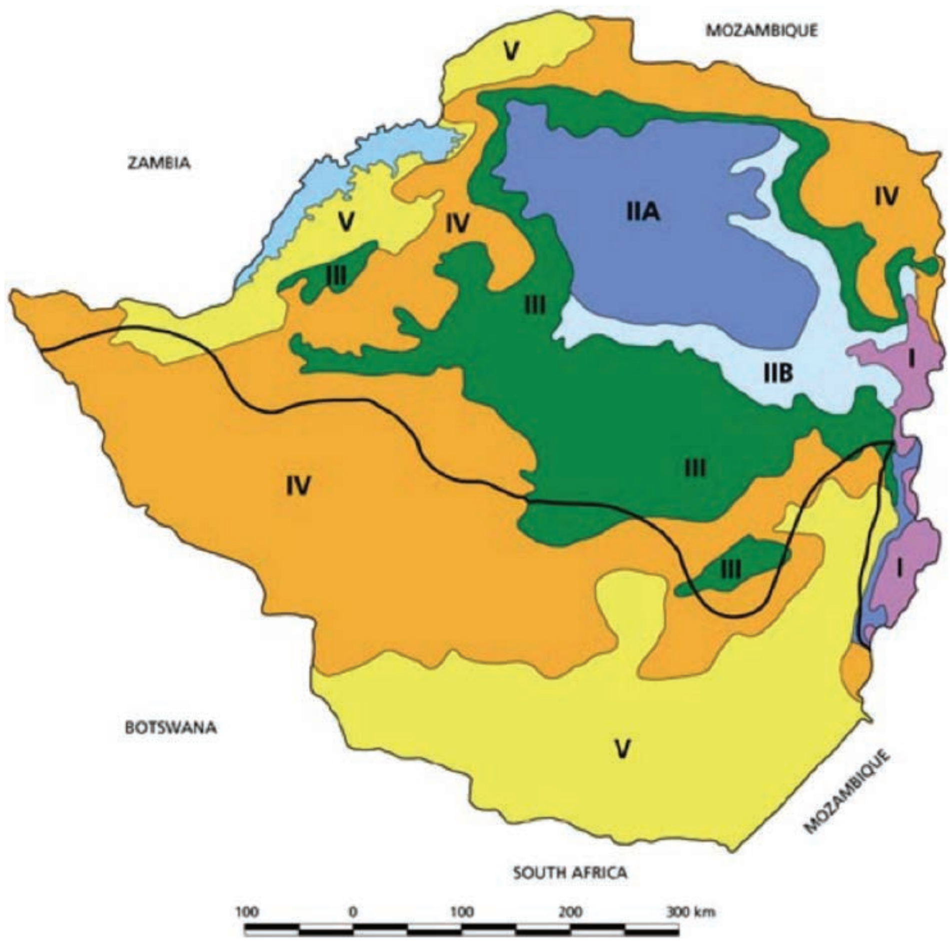
THE AGRICULTURAL ECONOMY OF ZIMBABWE

Overview of agro-ecology and agrarian structure

Zimbabwe's total land area is over 39m ha with an estimated 16m ha of agricultural land.[1] Urban settlements, national parks and wildlife conservancies comprise around 6m ha. Based on soil quality, vegetation and rainfall regime, among other factors, the country is divided into five agro-ecological zones known as Natural Regions (NRs) (Figure 2). The quality of the land and natural resource base declines from NR I through to NR V (Moyo, 2000).

Table 2 indicates the different zones. From the east—bordering on Manica and the Beira Corridor in Mozambique—and moving towards the north and centre of the country are the better agro-ecological conditions for agriculture. The southern half of the country, bordering on Botswana and the Limpopo Province in South Africa, is dry. The major determinant of agricultural production patterns in Zimbabwe is rainfall. Generally crops are planted at the beginning of the rains in November/December and harvested between April/June of the following year. In the dry season various horticultural products and barley and winter wheat grow under irrigation. Irrigation schemes are also key in enhancing tobacco, maize, cotton, soya beans, groundnuts and coffee production.

Figure 2: Natural Regions in Zimbabwe



Source: FAO, 2006.

1. http://www.fao.org/countryprofiles/index/en/?iso3=ZWE.

Table 2: NRs (agro-ecological zones) of Zimbabwe and actual/recommended farming systems

Natural Region	Area (km^2)	Rainfall ($mm\ yr^{-1}$)	Farming system
I	7 000	>1 000 year round	Specialised and diversified farming: dairy, forestry, tea, coffee, fruit, beef, maize
II	58 600	750–1 000 summer	Intensive farming: maize, tobacco, cotton, livestock
III	72 900	650–800 volatile, i.e. infrequent, heavy, prone to drought	Semi-intensive farming: livestock, fodder and cash crops with good management
IV	147 800	450–650 prone to drought	Semi-extensive farming: livestock, resistant fodder crops, forestry, wildlife/tourism
V	104 400	<450 erratic	Extensive cattle farming, forestry, wildlife/tourism

Source: FAO, 2006.

Fast track land reform has had a major impact on agricultural systems. We will not go into too much detail about the land reform itself since many others have researched that topic (e.g. Tshuma, 1997; Moyo, 2000; Moyo, 2009; Scoones et al., 2010; Matondi, 2012). Instead we will briefly consider the consequent changes in the agrarian structure, since this has implications for agricultural production technologies and methods of dissemination.

Table 3 shows some features of the Zimbabwean agrarian structure in 1999, just prior to the fast track land reform. Smallholder farms are those in communal areas, resettlement areas (pre-2000 land reform) or other categories of small-scale farmers. Sales into markets occur across all these categories, although those oriented towards commercial production as a business are clustered into the third category.

Table 3: Main aspects of farming subsectors in Zimbabwe in 1999 prior to fast track land reform

Aspect	Unit	Smallholder farms			Large-scale farms	
		Communal	Resettlement	Small-scale	Private	State
Total land area	m ha	16.34	3.29	1.38	10.74	0.42
Share of total agric land	%	50.8	10.2	4.3	33.4	1.3
Average farm size	ha	18	58	162	2 223	7 644
Average arable land size	ha	3.5	3.5	10–40	Very variable	
NRs I & II	% of land	9	19	19	35	4
NR III	% of land	17	38	35	22	32
NR IV & V	% of land	74	43	46	43	64
Irrigated area	000 ha		7.2	3.6	126	13.5
Estimated population	Thousands	5 327	421	166	1 160	38
Population density	Persons/m2	32.6	12.8	12.0	10.8	9.0
Farms/households (HHs)	Thousands	1 500	56.8	8.5	4.8	0.06
Cropping intensity	% planted area of total	14.0	5.8	4.3	4.2	2.3

Source: FAO, 2006.

Table 4: National land distribution pattern change ('000 ha)

Sector	1980	1999	2007
Communal areas	16 400	16 400	16 400
Agricultural land, of which:	16 900	17 500	15 300
Medium scale farms	1 400	2 000	2 400
Large-scale farms*	15 500	11 800	5 000
Resettlement	–	3 700	7 900
State farms	300	300	300
	17 200	17 200	15 600
Urban land	196	250	250
Parks/forests	5 800	5 800	5 800
Total	**39 596**	**39 650**	**38 050**

* Large-scale farms include agro-industrial farms, conservancies and down-sized farms.

Source: Moyo, 2000; Utete, 2003; Moyo and Yeros, 2005; Moyo, 2009.

Together these farmers held just under two-thirds of agricultural land. Average arable land sizes were around 3.5 ha for most small-scale producers, although some households held substantially more land than this; average land holdings were between 18 ha and 58 ha for communal and resettlement (pre-2000 land reform) farmers. There is some unevenness in land distribution within the smallholder category. Broadly, these farmers occupied areas of lower agro-ecological and economic potential, far away from markets and with poor communication and social infrastructure (FAO, 2006). A million and a half communal farming households farmed on about 51% of the country's agricultural land, and three-quarters of this occurred in NRs IV and V.

One third of land was under large-scale private ownership, comprising about 5 000 large-scale commercial farmers with very sophisticated production systems, occupying about 11m ha of land, primarily located in areas of high economic and agricultural potential (Table 3). The state held a very small portion of land.

The fast track land reform from 2000 altered the agrarian structure, although not completely. Table 4 shows the national land distribution pattern by sector and over time since independence in 1980. It shows also the main changes that have taken place on agricultural land outside the communal areas, which have remained the same size (although we will need to investigate further for changes in tenure in the communal areas). State farms also did not expand. It shows an increase in agricultural land from 1980 to 1999, followed by a decline from 17.5m ha in 1999 to 15.3m ha in 2007—a decline of one sixth. But there was also significant redistribution within the agricultural land category. Land for the resettlement programme more than doubled its share, to 7.9m ha in 2007. There was a 20% rise in the land area under medium-scale farms but off a relatively low base. The area under large-scale farms dropped sharply. The area under large-scale commercial farms had already dropped by 25% from independence to 1999, and in the period from 1999 until 2007 there was a further drop of 58%, down to 5m ha. While the radical land reform programme led to important redistribution, the overall agrarian structure inherited from colonialism—primarily the schism between communal and commercial land—remains intact. Mamdani (1996) has much to say on this subject, especially regarding the role of traditional authorities in systems of post-colonial rule.

Two new farming categories were formed—A1 and A2 farmers. A total of 127 192 households were settled under the A1 model and every household in selected villages received 5 ha of arable land, together with communal grazing land. The average farm size for A1 farms was 1 364 ha, with an average of 18.7 ha per household. A total of 12 943 individuals were allotted A2 model farms, which were based on self-contained farming units. The average

Table 5: A1 and A2 farms from previously large-scale commercial farm land by 2003

Province	A1		A2		A1	A2
	Number of farms	Area ('000 ha)	Number of Farms	Area ('000 ha)	% of area	% of area
Mashonaland West	573	684	424	452	56.4	43.6
Mashonaland East	358	291	350	251	60.9	39.1
Mashonaland Central	344	382	295	200	65.6	34.4
Matabeleland South	246	846	65	187	81.9	18.1
Manicaland	227	181	140	76	70.5	29.5
Total	**1 748**	**2 384**	**1 274**	**1 166**	**67.2**	**32.8**

Source: Utete, 2003.

size of A2 farms was 915 ha and these were all individual farms. Table 5 shows the distribution of the resulting A1 and A2 farming units for five of the eight provinces in the country, as at March 2003.

The Zimbabwean government published Structural Instrument No. 288 of 2000 which prescribed maximum farm sizes for all the Natural Regions. Table 6 shows the resultant farm classifications and prescribed farm sizes, following the land reform programme in 2000. These still apply to day although they may not always be realised in practice.

Fast track land reform overall appears to have resulted in a shift towards smaller and more diversified production units than in the past. This has implications for agricultural technologies and their dissemination. This has occurred in the context of a much larger economic and political crisis which has swept Zimbabwe and has not yet relented. Appropriate agricultural support is essential for a productive sector but external investments are few and far between, and systems and institutions have shrunk or decayed.

Agricultural production

Around 14m people lived in Zimbabwe in 2014 and roughly 60% were rural dwellers.[2] Gross Domestic Product (GDP) was US$ 13.7bn[3] for a *per capita* income of US$ 979. In 2013 both Zambia and Mozambique had larger formal economies than Zimbabwe. Zimbabwe's *per capita* GDP was about half that of Zambia but a third higher than that of Mozambique.

Table 6: Classification of farms and maximum farm sizes following 2000 land reform programme

Natural Region	Small-scale commercial farms	Medium-scale commercial farms	Large-scale commercial farms	Peri-urban commercial farms
	(ha maximum)			
I	15–25	100	250	
IIA	25–40	200	350	
IIB	40–50	250	400	15–50
III	60–80	300	500	
IV	150–200	700	1 500	
V	250–350	1 500	2 000	

Source: Ministry of Lands, Agriculture and Rural Resettlement (MLARR), 2000.

2. Index Mundi "Zimbabwe demographic profile, 2014" http://www.indexmundi.com/zimbabwe/demographics_profile.html.
3. World Trade Organisation (WTO) http://stat.wto.org/CountryProfile/WSDBCountryPFView.aspx?Country=ZW.

Maize cultivation in the highlands of Chipinge district

However, Zimbabwe's GDP was on a slow upward curve, at least until 2013.[4] Agriculture plays a key role in the Zimbabwean economy, contributing 14–18% of formal GDP, over 40% of recorded national exports, close to 60% of raw materials to agro-industries, and generates livelihoods for over 70% of the population. Commercial agriculture employed around a third of those in formal employment (MAMID, 2012).

Expansion of cultivation into ecologically sensitive areas including *dambos*—grass-covered but treeless valleys predominantly covered with water—has seen the drying up of many such places in Zimbabwe, and in almost all the areas visited during the research. Locally, *dambos* are also known as *matoro*, *mapani* or *vleis*. Communal areas have about 260 000 ha of wetlands in Zimbabwe and about 30 000 ha of these are cultivated, using seasonally high water tables for planting a variety of grains like maize, vegetables and rice (Matiza, 1994).

Even though legislation forbids the cultivation of the *dambos*, vegetable gardening in and around them is widespread in communal areas. The sale of garden produce from these gardens is a key source of revenue for households living in areas close to urban centres, such as Murewa and Mutoko, which were visited during the current study. All the FGDs indicated that rice was traditionally grown in these areas by some households who had access to or ownership of them. Nowadays, because of mismanagement of these dambos and the breakdown of social traditional structures that control access to them, they do not contain as much water and rice is no longer grown in them.

Expansion of agriculture into ecologically sensitive areas has also resulted in cultivation of maize in the highlands of districts like Chipinge and Chimanimani whose terrain and climate would not favour maize production. This may be related to input subsidy programmes that prioritise and encourage the growth of hybrid maize.

Maize is the staple food crop, and is mainly eaten with vegetables and groundnuts. Cash crops are cotton, soya beans, wheat, tobacco and horticulture (flowers, vegetables) (FAO, 2006). Following the economic and political crisis since the 1990s, and the land reform, formally recorded agricultural production of all crops has dropped dramatically. During this period Zimbabwe's total exports declined by 27% between 2000 and 2009, with a drop in agricultural exports of 52% (RBZ, 2010). In the period 1995–1999, annual maize production averaged 1.93m tons.[5] From 2001 to 2009, average annual production had dropped by more than 50%, to 934 000 tons. The area under maize production has remained relatively the same over the decade, at about 1.2m ha. This suggests that the production decline is mainly a yield decline. Maize yields

4. Google "Zimbabwe GDP" https://www.google.com/search?q=zimbabwe+gdp&ie=utf-8&oe=utf-8.
5. Figures from Index Mundi http://www.indexmundi.com/agriculture/?country=zw unless otherwise specified.

were between 1–1.2 tons/ha between 1995 and 2000. However, from 2000 to 2009 yields dropped below 1 ton/ha in most years (MAMID, 2012).

We have explored the extent to which disruptions in input supplies caused these yield declines. Average annual maize production in 2010–2014 crept up to 1.1m tons, although this was still just over half of pre-2000 production levels. Until structural adjustment in the early 1990s, Zimbabwe did not import maize; immediately after structural adjustment there was a huge flood of imports. The quantity of imports reduced substantially in the 1990s but Zimbabwe continues to import maize. Average annual maize imports from 1995–1999 were 180 000 tons. Annual average imports in the 15 years from 2000 to 2014 were 463 000 tons, indicating the sharp drop-off in domestic production.[6] Maize prices are currently set by the government, at around 20–25% above import parity prices (Commercial Farmers' Union (CFU), 2015:3–4). Import parity means the price at which a product arrives in the country. A controlled price above import parity constitutes a tariff. Neo-liberalism is in favour of reduced tariffs and hence 'free trade'.

Tobacco historically has been the main export crop from Zimbabwe, at 64% of the total value of agricultural exports in 2000. It contributed close to 12% of GDP and was the largest formal sector employer, engaging about one million people directly or indirectly (MAMID, 2012). Production declined from 200m kg in 1998 to just 60m kg in 2008. Since then it has risen to an estimated 216m kg in 2014 (Ministry of Finance and Economic Development (MFED), 2014). Given that it is an export crop, stabilisation of the economy after 'dollarisation' in 2009 doubtless supported the renewed tobacco production. Even though the value of tobacco exports dropped 45% between 2000 and 2009, other export sectors have fared even worse. The result is that tobacco's share of exports actually increased to 73%, which is a heavy reliance on a single export crop.

After tobacco, the next largest export category previously was horticulture, at around 14% of total agricultural exports in 2000. This dropped dramatically to less than 6% by 2009 (RBZ), 2010). During the 1990s horticulture was one of the fastest growing sectors in Zimbabwean agriculture, especially citrus, cut flowers and vegetables. At one stage Zimbabwe was the third largest global producer of export roses. A total of 20 000 tons of produce were exported in 1992 and this figure quadrupled to over 80 000 tons by 2001. Since then horticultural production has declined and exports had dropped to about 50 000 tons in 2007.

Among the smaller crops, the volume of cotton production dipped 15% immediately after 2000 but enjoyed some recovery until 2011, after which there was a very sharp drop in production. Global developments were the cause: global cotton prices had spiked very sharply in 2011 based on supply fears, but returned with a crash to lower prices after 2011 when the fears proved unwarranted (Cummans, 2011). Cotton was one of the better-performing of the field export crops after 2000. Being a predominantly smallholder crop it escaped the transient effects of the fast track land reform process. The production of soya beans experienced heightened volatility but production has been stable, more or less, at around 70 000 tons per year.[7] Wheat production was virtually wiped out in Zimbabwe after 2000. Like maize, wheat imports had also spiked after structural adjustment in the 1990s, but after 2000 they grew rapidly. Annual average wheat imports from 1995–1999 were around 82 000 tons, while in the 15 years from 2000 to 2014, annual average imports more than doubled to 186 000 tons. Millet production had already dropped sharply with the onset of structural adjustment in the 1990s. Sugar production dropped by about half after 2000, but recovered after 2010 so that in 2014 it was around 20% below the production peaks of the late 1990s. We need further crop specific investigation to understand the complex dynamics producing these changes and to update the data to the present.

6. Figures from Index Mundi http://www.indexmundi.com/agriculture/?country=zw unless otherwise specified.
7. Figures from Index Mundi http://www.indexmundi.com/agriculture/?country=zw unless otherwise specified.

In 2000 there were around 5.7m head of cattle in Zimbabwe and sheep, goats, pigs and poultry were widespread. There has been a gentle decline in livestock numbers since 1980 (FAO, 2006). In 2014 there were around 5.5m head of cattle and more than 90% were found in smallholder farming areas (CFU, 2015:14). Communal cattle production in Zimbabwe is extensive and indigenous cattle adapted to the local environment are predominant. Cattle are found in all provinces, but with a slight concentration in Masvingo, Mashonaland East and Manicaland, all on the eastern side of the country (Tavirimirwa *et al*., 2013).

Farming systems in the study sites

The nine study sites focus mainly on farming households in communal areas (Table 7). Only Shashe village, which is in a Model A1 resettlement area, is not in a communal area. These areas are characterised by coarse, sandy soils of very low inherent fertility, which pose a challenge to crop production. Granitic sands are dominant in the sites in Mutoko, Murehwa, Goromonzi, Zvishavane and Zaka. Parts of lowland Chipinge and Chiredzi have basaltic and alluvial clays, which are normally described as inherently fertile because of their strong capacity to hold water and nutrients.

The average size of land holdings for households was around 3 ha in most sites; sites in Chipingewere lower and sites in Chiredzi and Chimanimani were slightly higher. Murehwa, Goromonzi and Mutoko in Mashonaland East are in NR II, which receives between 750–1000 mm of rainfall/year and is deemed the bread basket region of the country, where most of the staple maize and grain legumes such as soya beans are grown. Zvishavane, Masvingo and Zaka districts (Midlands and Masvingo) are in NR III (with some sections in NR IV) and receive 450–800 mm of rainfall per year. Maize, groundnuts and bambara nuts are key crops in these districts, where small grains also are grown. Chiredzi (Masvingo), lower Chipinge and Chimanimani (Manicaland) are in the semi-arid zones of NR IV and V, which receive approximately 450 mm of rainfall per year. Sorghum and millets are widely grown, although maize still remains very common, despite its frequent failure under rain-fed conditions in these districts. Households in all the study areas generally rely on rain-fed agriculture, apart from Chipinge where there are some smallholder irrigation schemes.

In all the sites livestock, especially cattle, plays a number of important roles in the farming systems, including the provision of services like draught power, transport, food and manure. Livestock is also a store of wealth and provides diverse socio-cultural services in marriages, conflict resolution, and ritual and traditional ceremonies. Small livestock, like sheep and goats, whose larger populations are in the semi-arid districts where there is less competition with cropping, also provide meat and other social services. The timely execution of cropping operations is almost always linked to ready access to cattle. As a result, most crop residues from the fields are primarily used for feeding cattle.

Table 7: Description of farming systems in selected districts

District/site	Agro ecological region	Soil types	Crops cultivated
Mutoko, Mashonaland East	In NR II, rainfall more than 800 mm, more reliable rainfall, milder and shorter mid-season dry spells	Sandy, sandy loams, sandy clay loams,	Households own about 3 ha of arable land Dominant crop in rainy season is hybrid maize, also an early crop in dambos Sweet potatoes, groundnuts, bambara nuts and cowpeas are minor crops Market gardening conducted all year, but increasing during off season Fruits, especially mangoes, sold when in season
Murewa, Mashonaland East	In NR II, rainfall more than 800 mm, more reliable rainfall, milder and shorter mid-season dry spells	Sandy, sandy loams, sandy clay loams	Households own about 3 ha of arable land Dominant crop in rainy season is hybrid maize, also an early crop in dambos Sweet potatoes, groundnuts, bambara nuts and cowpeas are minor crops Market gardening conducted all year, but increasing during off season
Goromonzi, Mashonaland East	In NR II, rainfall more than 800 mm, more reliable rainfall, milder and shorter mid-season dry spells	Sandy, sandy loams, sandy clay loams	Households own about 3 ha of arable land Dominant crop in rainy season is hybrid maize, also an early crop in dambos Sweet potatoes, groundnuts, bambara nuts and cowpeas are minor crops Market gardening conducted all year, but increasing during off season Fruits, especially mangoes, sold when in season
Zvishavane, Midlands	In NRs III and IV, 450–650 mm rainfall, prone to recurrent seasonal droughts and harsh dry spells during the rainy season	Sandy, sandy loams, sandy clay loams	Households own about 3 ha of arable land Main crops are hybrid maize and some OPVs, sorghum and millets Groundnuts, bambara nuts, sweet potatoes and cowpeas are minor crops Market gardening conducted all year, but increasing during off season Small scale irrigation schemes supplement crop production
Masvingo, Masvingo	In NRs III and IV, 450–650 mm rainfall, prone to recurrent seasonal droughts and harsh dry spells during the rainy season	Sandy, sandy loams, sandy clay loams	Households own about 3 ha of arable land Main crops are hybrid maize and some OPVs, sorghum and millets Groundnuts, bambara nuts, sweet potatoes and cowpeas are minor crops Market gardening conducted all year, but increasing during off season Small scale irrigation schemes supplement crop production

District/site	Agro ecological region	Soil types	Crops cultivated
Zaka, Masvingo	Has parts in NRs III and IV, 450–650 mm rainfall, prone to recurrent seasonal droughts and harsh dry spells during the rainy season	Sandy, sandy loams, sandy clay loams	Households own about 3 ha of arable land Main crops are hybrid maize and some OPVs, sorghum and millets Groundnuts, bambara nuts, sweet potatoes and cowpeas are minor crops Market gardening conducted all year, but increasing during off season Small scale irrigation schemes supplement crop production
Chiredzi, Masvingo	Largely in NR V, less than 450 mm rainfall, very erratic	Sandy loams, sandy clay loams	Households own more than 3 ha of arable land Generally regarded as marginal for dryland cropping because of low rainfall Main crops are sorghum and millets but yields are often low
Chipinge, Manicaland	In NR V, less than 450 mm rainfall, very erratic	Dark grey or black vertisols	Households own more than 3 ha of arable land Though soils are relatively good, region generally regarded as marginal for dryland cropping because of low rainfall Main crops are sorghum and millets but yields are often low
Chimanimani, Manicaland	In NR IV, 450–600 mm rainfall, prone to recurrent seasonal droughts and harsh dry spells during the rainy season	Sandy, sandy loams, sandy clay loams	Households own more than 3 ha of arable land Generally regarded as marginal for dryland cropping because of low rainfall Main crops are sorghum and millets but yields are often low

OVERVIEW OF THE GREEN REVOLUTION IN ZIMBABWE

Background

Zimbabwe's current seed and soil fertility policies have been greatly influenced by the country's past, making it important to view developments in the fertiliser and seed sector in a historical perspective. During the colonial period, agricultural policy focused on obtaining land in the high potential areas, on which to settle white farmers (Rukuni, 2006). This policy was supported by a system of controls and laws that guaranteed whites economic control and political power through land allocation, research and technology, pricing policies and marketing and service institutions. Rural poverty had its roots in the dispossessions that contributed to producing the dualistic agrarian structure, as well as in the inequitable manner used to run the agricultural sector. This disparity encouraged support for the liberation struggle in the country.

Dominant views on agricultural development were based on a modernisation narrative which saw the implementation of the Native Land Husbandry Act in 1951 to 'modernise' and 'transform' African agriculture (Mutonodzo-Davies, 2010). This narrative frequently has been used to define understandings of agricultural development in Africa: in relation to economic productivity and growth (a shift from 'subsistence' to 'commercial' farming); technology (a shift from 'backward' to 'modern' practices) and markets (a shift from 'self-provisioning' to 'market-based production and consumption') (Scoones, *et al*. 2005). The Departments of Agricultural Research and Extension were mandated to accomplish this modernisation of agriculture and developed a research agenda that pushed Green Revolution-type research in the country, in particular for hybrid maize and the use of synthetic fertilisers.

Owing to their political importance for the apartheid and colonial state, the objectives and needs of white settler farmers influenced these institutions greatly (Herbst, 1990). Twenty years of continued investment in agricultural research laid the foundation for a hybrid maize Green Revolution in Zimbabwe in the 1950s. Imported seeds and agricultural knowledge framed knowledge and practice in specific ways and, as a result, came to shape the deployment of notions of agricultural production, soil fertility and seed production. Maize received most attention because of its importance as a commercial and food crop. Little research was done on other crops outside the 'closed' value chains of plantation/estate crops, such as coffee, tea and sugarcane. There was very little research support for smallholder agriculture and practitioners, whose problems were largely viewed as non-technical (Rukuni, 2006).

Following independence, in 1981 the agricultural institutions that formerly provided agricultural services according to race were merged into AGRITEX. The Department of Research and Specialist Services (DR&SS) introduced on-farm research for communal areas (Tawonezvi and Hikwa, 2006). The relationship between smallholder farmers, service institutions and research improved and produced a notable increase in maize production. The increase demonstrated that with the right kind of support—in different areas like service institutions, pricing and technology—smallholder farmers can produce a positive aggregate supply response.

During this time the government increased consumer food subsidies and maintained the colonial regime's 'cheap food policy'. Subsidised inputs and grain marketing boards ensured high food production at low prices for urban consumers. Minimum wages were introduced which increased the demand for manufactured foods like bread and vegetables oils., Overvalued exchange rates discriminated against traditional export crops while ensuring cheap inputs for domestic manufacturing. For many reasons, which we will not detail here, over time agricultural production declined and exports stagnated, while the fiscal burden of parastatals became unsustainable (Cabral and Scoones, 2006; Bates *et al*., 2007; Roe, 1991).

This laid the basis for the ESAP, launched in 1991. This made compulsory the withdrawal of the state from agriculture through streamlining and downsizing of the Ministry of Agriculture, which was no longer to have direct input into agricultural production and marketing activities, but was limited to playing a more regulatory and private sector enabling role, only. Thus the *locus* of power and patronage changed to new locations: the Ministry of Finance and the Central Bank were now at the centre of the reform processes, and financial resources were directed to new spending priorities, in line with the structural adjustment process (Mutonodzo-Davies, 2010). Nevertheless, the ESAP reforms did not generate the anticipated results of significant agricultural growth needed to contain rural poverty and increase food security (Dorward et al., 2005). Smallholder food producers lost access to crucial inputs during the process of market liberalisation (Birner and Resnick, 2005:24). The private sector did not move to occupy the spaces vacated by the state, as the plan proposed, and agricultural markets did not flourish as was expected from the introduction of macroeconomic stabilisation and structural adjustment measures (Friis-Hansen, 2000).

Zimbabwe's Economic Policy Framework from 1995 to 2000 was a reaction to the failure of the ESAP. Government delivered a follow-up proposal called the Zimbabwe Programme for Economic and Social Transformation (ZIMPREST), but it was never implemented as it failed to attract funding. In the meantime, from 1997 the economy continued to decline, following the sudden, unbudgeted pay-outs to war veterans and subsequent food protests in 1998, participation in the war in the Democratic Republic of Congo (DRC) and capital flight due to differences with aid agencies. Failure to raise resources at the 1998 donors' land conference, the rejection of the Draft Constitution in 2000 and, the rising wave of land occupations, all led to compulsory land acquisition after 2000 (Munyuki-Hungwe and Matondi, 2006). The combination of gathering crises from the ESAP and the fast track land reform programme resulted in an economic crash. Investors fled and state resources dwindled as the economy contracted. This meant fewer resources for anything, including agricultural support.

Zimbabwe and the Green Revolution after 2009

Zimbabwe, together with other African countries, is part of the CAADP which emanates from the African Union (AU). CAADP is a common framework that aims to speed up agricultural growth and reduce poverty and malnutrition in African countries through agriculture. The following principles and targets define the CAADP framework:

- The principle of agriculture-led growth as the key approach to attain the Millennium Development Goal of poverty reduction;
- The pursuit of a national level average annual agricultural sector growth rate of 6%;
- The allotment to the agricultural sector of 10% of the national budget;
- Utilisation of regional cooperation and complementarities to increase growth;
- The principles of policy dialogue, accountability, efficiency and review, common to all programmes within the New Partnership for Africa's Development (NEPAD);
- The principles of alliances and partnerships to embrace farmers, agribusiness, and civil society.

The Zimbabwe CAADP process advocates for a smallholder agricultural revolution that is premised on Green Revolution technologies, including the promotion of:

- The development of high yielding varieties of crops grown by smallholders such as cotton, millets, cowpeas, groundnuts and bambara nuts.
- Soil fertility enhancement practices such as liming, synthetic fertiliser application and conservation farming.

Following the signing of the CAADP Compact in 2013, the ZAIP (2013–2018) was finalised to take the CAADP process forward at country level. Copies of the ZAIP are not readily available but we can surmise that it follows the core approach of CAADP, which is very much based on the model of public-private investments to increase commercial agricultural growth, using Green Revolution technologies.

Zimbabwe also participated in the recently completed Common Market for East and Southern Africa (COMESA)-funded Regional

Agriculture Inputs Programme (COMRAP). The programme focused on financial services and insurance; multiplication of improved seed; regional harmonisation of seed laws and policies; and development of agro-dealers and agents in four COMESA countries, including Zimbabwe.[8] COMRAP was intended to counter rising food prices by boosting agricultural productivity through improved access to seed, fertiliser and finance. COMRAP's aim is to develop regional legal frameworks and the capacity building and training of national and regional input providers. In particular, COMRAP intended to support about 10–15% of smallholder farmers in participating countries, to access inputs through a network of 5 760 agro-dealers trained in trade and extension by experienced training institutions, and facilitated through improved credit access.

Table 8 indicates recent Green Revolution programmes in Zimbabwe. Embassies in Zimbabwe sponsored similar programmes when the situation became dire after a drought in 2007/08—shortages of both food and agricultural inputs in formal markets had worsened, and hyper-inflation was at its worst. Main donors were the US, the EU and individual European countries, the BMGF and FAO. USAID programmes in the agricultural sector increased significantly from 2009, with seven livelihood programmes, a food assistance programme and two agricultural economic growth programmes (Table 8). The main implementing NGOs were Catholic Relief Services (CRS), CARE International, World Vision International (WVI), Save the Children UK, Oxfam, Help Germany, Christian Care, Farmers' Association of Community Self-Help Investment Groups (FACHIG), CTDT, Lead Trust, Organisation of Rural Associations for Progress (ORAP), CADS and Dabane Trust, among many more. Given the size of operations in 2008/09, almost all NGOs in Zimbabwe were implementing partners of one programme or another.

8. http://www.comesa.int/index.php?option=com_content&view=article&id=38:comrap-winds-up&catid=5:latest-news&Itemid=41

Table 8: Donor activities in agriculture from 2009

Donor	Programme	Value $US million	Activities	Implementing partners
USAID	Livelihoods	20	Provision of technical assistance in business skills development, market linkages, agronomy and CA	Africare, CARE, Cooperative League of the USA (CLUSA), Financial Transactions & Reports Analysis Centre of Canada (FINTRAC), Mercy Corps, Restoring Economic Agricultural Livelihoods in Zimbabwe (REALIZ), ACDI-VOCA, World Vision
	Value chain development	8	Agro-dealer strengthening, provision of trade credit guarantees, training and certification, livestock assistance, supporting out-grower models, provision of technical assistance in CA, market linkages and supporting producer groups	Cultivating New Frontiers in Agriculture (CNFA), International Relief & Development (IRD), Land O' Lakes, Technoserve
	Credit guarantee scheme	20	Input support on cost recovery basis, quality control and market linkages	Standard Chartered Bank with large corporate agribusinesses
	Zimbabwe Agricultural Competitiveness Programme (Zim ACP)	15	Enhancing agro-business development services, agro-business skills and agro-production and productivity, strengthening representative institutions and advocating for improved market structure	Development Alternatives Incorporated (DAI)
	Zimbabwe Agricultural Income and Employment Development (Zim AIED) 2010–2015	35	Increased access to finance for small-scale farmers and agro-dealers especially for export, horticulture, technical assistance, linkages to input and output markets and training and standardisation	FINTRAC
EU EU	Extension activities		Input support, capacity building, market linkages and extension support in liaison with AGRITEX, farmers' unions, private sector and NGOs	CFU, Zimbabwe Farmers' Union (ZFU), Zimbabwe Commercial Farmers' Union (ZCFU)

Donor	Programme	Value $US million	Activities	Implementing partners
	Policy		Set up an agricultural policy support fund to assist in agricultural policy development, and support completion of a land audit to verify patterns of land ownership and use	Collaborating with FAO
	Productivity	2 170	Irrigation scheme support in Lowveld, urban community gardens, supporting small-scale sugarcane farmers to improve quality and the smallholder micro-irrigation development programme	
Department for International Development (DfID)	Protracted Relief Programme	50	Summer input support, CA, garden support and small livestock	
Netherlands Embassy			Funding free input support to vulnerable household, funded studies, jointly with DANIDA and FAO, funded a pilot agro-dealer restructuring programme, supported the "contract farming smallholder seed production project"	FAO, Netherlands Development Organisation (SNV), HIVOS International, Agriseeds
Deutsche Gesellschaft für Internationale Zusammen-arbeit (GIZ)	Sponsoring technical experts for capacity building		ZFU capacity building, Zimbabwe Association of Microfinance Institutions (ZAMFI) wholesale facility	ZFU and others
Swiss Agency for Develop-ment and Cooperation (SDC)	Regional food security programme		Improving seed security with Zaka Super Seeds, seeds adaptation project with CIMMYT, CA	
BMGF	Nitrogen to Africa		Input support, technical support	Technoserve and 8 other implementing partners
FAO			Coordination of agricultural activities, input support, training	A number of implementing partners

Source: MAMID, 2012.

Agricultural input subsidies

In Zimbabwe 70% of the population live in rural areas, derive their livelihood from agriculture and more than half of them are poor. Most of the farming households in high potential NRs produce hybrid maize and are net maize sellers; most of the households in low potential regions are net maize buyers. This reliance on market purchases for staple maize makes resource-poor households vulnerable to high prices. Hence, supporting maize production to boost smallholder self-sufficiency and reduce exposure to market risks is understood as a political imperative.

Government has administered a variety of input supply programmes since independence, including drought relief and agricultural recovery programmes in the 1980s and 1990s, respectively. In addition, there were regular seed aid programmes (and sometimes fertiliser progrrammes) of different types (Sperling et al., 2009). Almost all hybrid seed and synthetic fertilisers were delivered to farmers through government relief or donor/NGO programmes, particularly after 2000.

FISPs are based on the assessment that seed and fertiliser shortages hamper the ability of farmers to produce. Part of the challenge is to boost supply, part is to develop the channels to reach farmers, and part is to advertise and share information to raise awareness about the benefits of improved products. While both government and NGO programmes share similar broad objectives and justifications for interventions, they have often differed in their targeting, organisation and wider politics. A review of some of the programmes conducted by both government and NGOs in the period after 2000 follows.

From the output market side, government introduced price controls for both maize and wheat grain and hybrid maize and wheat seed from about 2002 (MAMID, 2012). Seed companies failed to pay seed growers which resulted in production disincentives and side-selling of seed. Maize and wheat grain price controls also influenced the demand for seed (Sperling et al., 2009). The regulation requiring the sale of all wheat and maize grain at fixed prices to the GMB, from about 2003 to 2008, also resulted in commercial production disincentives (MAMID, 2012). In addition, the proliferation of price controls resulted in the growth of a parallel market. Supplies of commodities such as hybrid maize seed, maize grain and fertiliser were offered in 'informal' markets at significantly higher prices than the controlled prices (Sperling *et al*., 2009).

Government agricultural input programmes after 2000

Following fast track land reform, the economy plummeted and the resettlement areas failed to perform according to expectations, for various reasons, including input shortages (Munyuki-Hungwe & Matondi, 2006).
The government formulated a plethora of programmes to remedy the situation and to address an assumed need for hybrid seed and fertilisers. The implementing agencies have changed with time, from the GMB to the RBZ, to the army and AGRITEX. But the targeted groups remained pretty much the same, i.e. communal and newly resettled farmers. The interventions were also more or less consistent—free hybrid seed and fertilisers.

The Government Input Scheme (GIS) was launched in 2000, spearheaded by the GMB (MAMID, 2012). Under this scheme farmers received inputs that included hybrid maize seeds, basal and top dressing fertilisers, and fuel. The scheme targeted mainly communal farmers. The inputs were distributed through the nationwide network of GMB depots. The idea was that farmers would borrow money to purchase the inputs and repay the loans, including interest of 50% after harvest, using either grain delivered through GMB or cash. Initially it was planned that the scheme would run for six years, but it lasted only until 2003 because of funding problems. In a state of panic government requisitioned all inputs available in-country in an effort to guarantee their availability—which resulted in severe shortages on the market. Until February 2009, government set prices for inputs distributed through the GMB. Table 9 shows the programme administered by GMB from 2001 to 2006. Supplies peaked just before elections in 2006, suggesting that the input programme was used at least in part for political purposes.

Table 9: GMB input scheme for maize and wheat from 2001 to 2006

Season	Summer maize crop programme			Winter wheat crop programme		
	Compound D (t)	Ammonium nitrate (t)	Hybrid seed (t)	Compound D (t)	Ammonium nitrate (t)	Hybrid seed (t)
2001/02	13 872	18 598	10 250	55 585	32 500	4 400
2002/03	7 300	0	26 525	4 000	1 500	5 272
2003/04	8 000	13 125	0	2 415	1 293	1 000
2004/05	65 000	20 000	32 680	22 450	83 000	6 500
2005/06	6 794	0	15 885	29 364	17 847	9 250
Total	**100 966**	**51 723**	**85 340**	**113 814**	**136 140**	**26 422**

Source: FAO Zimbabwe Information Unit

From 2004 to 2008 the RBZ managed the policy regime (Munyuki-Hungwe & Matondi, 2006). The RBZ governor resolved to use a cash budget financed through the printing of money to fund FISPs. During this period the government, through the RBZ, implemented two new programmes: the Productive Sector Facility and the Agricultural Sector Productivity Enhancement Facility. The Productivity Sector Facility provided farmers with loans for food crop production at a concessionary interest rate of 25%. This was very cheap money considering that the going interest rates at the time were 300–400% for such loans. The Agricultural Sector Productivity Enhancement Facility aimed to support other aspects of agriculture, such as irrigation rehabilitation and horticulture, as well as crop and livestock production.

In 2005 the Zimbabwean government implemented Operation Maguta, led by the military and financed by the RBZ. It aimed to accumulate national strategic grain reserves and boost food security through a 'command agriculture' approach (Munyuki-Hungwe & Matondi, 2006). Under this approach the army literally took over agricultural production, frustrated with what it considered the failure of the 'civilian' or 'soft' approach to agriculture, by the extension service which seemed not to deliver results (Mutonodzo-Davies, 2010). Farmers received inputs including hybrid seeds for targeted wheat and maize crops. The programme targeted Agricultural and Rural Development Authority (ARDA) farms and model A2 resettlement schemes.

Until this time government programmes focused on controlling input prices and ensuring that inputs were made available to smallholder farmers through the GMB distribution network. State-provided credit offered unintended and indirect subsidisation, of which less than 10% was recouped. From around 2005/06 government implemented the PISP, funded largely from the fiscus but augmented with funds from presidential 'well-wishers' (Munyuki-Hungwe & Matondi, 2006). This programme is seen by some as partisan, favouring recipients of the ruling party resident mainly in communal areas, and functioning as a vehicle for funding inputs in more contested areas, such as the new resettlements (Mutonodzo-Davies, 2010). PISP was designed as a US$ 52m programme with four components targeting 1.6m smallholder households:

- To build self-sufficiency in communal, old resettlement, small-scale farming areas and A1 resettlement through provision of agricultural inputs, with a focus on maize and small grain production (US$ 184m, 73% of the total programme budget);
- Provide livestock farmers with a 'vet kit' comprising tick grease, de-wormer and wound powder (US$ 51m);
- Provide a cotton input pack to 300 000 producers (US$ 9.9m); and
- Provide inputs to farmers for the production of soya beans (US$ 6.4m) (MAMID, 2012).

These various programmes, and the subsequent Champion Farmer programme (targeting 'viable' rather than 'vulnerable' farmers) which was implemented over the period from 2000 to 2008, delivered a significant amount of hybrid maize seed, together with fertilisers. However, government

Table 10: Government FISP for the 2014/15 season

Value of scheme	Households supported	Input	Pack size/ hh	Quantity (tons)
		Seed		
		Maize	10 kg	6 000
$27m	712 400	Sorghum/millet	5 kg	300
		Sugar beans	2 kg	150
		Cowpeas	5 kg	150
		Cotton	10 kg	964
		Fertiliser		
		Basal fertiliser	50 kg	500
		Top dressing	50 kg	1 740
		Livestock chemicals		# of packs
		Tick buster WP	1 kg	39 800
		Delta tick SC	1 litre	7 500
		Delta tick Pour On	1 litre	10 000
		Venton Wound heal	1 ml	18 000
		Beta tick grease	250 g	18 000
		Beta tick grease	500 g	7 500
		Closavet Deworming	200 ml	3 750

Source: MAMID, 2015.

programmes until 2008 were hampered by patronage and corruption, as well as poor management. The programmes also suffered from design failures: they were managed centrally, extremely politicised, had very limited technical contributions and were financed by printing money (Mutonodzo-Davies, 2010). This arrangement presented huge scope for leakages through seed diversion, export and illegal sales, rent seeking and corruption.

Since 2009 a considerably different approach has been employed. The government programme became more technically focused as a result of linking to MAMID/AGRITEX and was financed through loan facilities from banks, using vouchers, which possibly limited corruption and provided greater focus (Mutonodzo-Davies, 2010). For 2009/10 government reverted to the earlier strategy of targeting the vulnerable, and implemented the Crop Pack Input Scheme for 800 000 households through MAMID/AGRITEX. Individual households received targeted support of 10 kg maize/small grain seed, 50 kg Compound D and 50 kg AN. The programme offered a 100% input subsidy, theoretically worth US$ 115.50 per recipient household (MAMID, 2012).

Selection criteria, based on vulnerability indicators such as the presence of orphans, chronically ill or disabled persons in a household, were used to choose recipient households. Inevitably, there was a lot of variation in the actual selection of recipients among the sites we visited. Although there was general guidance based on vulnerability indicators, precise specifications were left to the discretion of traditional and ward leadership. In Zvishavane, for example, the ward committee worked backwards, starting from the amount of inputs received and dividing it by the number of villages in the ward, so that every village received something; then the inputs were divided by the targeted individuals in the villages. A household would get either a bag of fertiliser or seed, but not in the stipulated quantities. The approach was that everyone must receive something. Councillors in particular emphasised the challenges of distributing inputs because there was not enough in the face of high demand. Respondents described government input subsidy programmes as too little, too late, and for very few people.

Supply and delivery of the subsidised inputs is fairly centralised. There is a tendering process, but as with FISPs throughout the region, the

Table 11: Donor-funded agricultural input programmes from 2003 to 2009

Season	Recipients	Basal fertiliser	Top dressing	Maize		Sorghum	Millet	Cowpeas	Groundnuts	Sugar beans
				Hybrid	OPV					
2003/04	985 000	1 553	6 184	3 061	3 304	2,218	617	786	550	-
2004/05	422 000	962	4 866	291	1 972	776	71	545	66	175
2005/06	372 000	509	8 117	31	1 605	719	52	158	370	332
2006/07	315 000	1 929	7 120	175	696	706	276	312	737	251
2007/08	232 000	937	7 661	138	307	897	222	608	608	15
2008/09	310 000	5 287	10 222	54	1 282	822	117	208	247	173
Total	**2 636 000**	**11 177**	**37 270**	**3 750**	**9 166**	**6 138**	**1 355**	**2 617**	**2 578**	**946**

Source: FAO Information Unit.

same few large companies are awarded the tenders, year after year. Compound D, a type of basal fertiliser, is generally supplied by ZFC, in which government has shares. Contracts for AN, a top dressing fertiliser, are usually granted to the same two large private firms (Sable Chemicals and Windmill). As noted by Baltzer and Hansen (2011), this represents a trade-off in input subsidy programmes between the objectives of developing a more competitive private input supply sector, and the effective delivery of subsidised inputs to smallholders.

In 2013 government purchased 46% of total maize seed requirements (Mujaju and Jonga, 2014:4). In 2014/15, 712,400 households were reached using US$27m for both maize and small grain production and livestock support (Table 10) (MAMID, 2015). Budgetary constraints were cited as the reason for the drastic reduction in resources.

Donor agricultural input programmes

During the years of Zimbabwean economic recession, 2000 to 2008, but especially from the 2003/04 agricultural season, donors also implemented agricultural input assistance programmes, supplementing government programmes. The rationale was that formal marketing channels for agricultural inputs had collapsed, making inputs unavailable or inaccessible. Because of the 'urgency' of the issues at hand there was no adequate analysis of actual seed demand, the role of farmer-managed seed systems in providing seed, or the possible consequences of such interventions on the seed system as a whole. These emergency relief input programmes were typified by free distribution, based on set vulnerability criteria for targeted farmers.

FAO began keeping detailed records of donor-funded input programmes from 2003/04. Table 11 shows the overall picture and the types of inputs distributed. The main components of the package were Compound D and top dressing fertilisers, and hybrid and OPVs with maize and small grains predominating. If we compare this with Table 9 on government inputs above, it is apparent that the government programmes were significantly larger than the donor programmes. From 2001–2006, government distributed almost 403 000 tons of fertiliser and 112 000 tons of seed. By comparison, from 2003–2009, donor programmes distributed around 48 000 tons of fertiliser and 27 000 tons of seed.

Table 12 shows some of the input programmes which donors began implementing from 2010. The main Green Revolution donors have all proffered input subsidy programmes, including USAID, the BMGF, the Europeans, Britain, Australia and FAO. A significant number of these have included vouchers in an effort to resuscitate the market. The case study looks at one such effort, spearheaded by FAO in 2012.

Table 12: Donor input subsidy programmes after 2009

Donor	Implementing partner	Intervention mode	Recipients	Received inputs
USAID	CARE Southern African Trust (SAT)	Irrigation and establishment and/or rehabilitation of livestock assets	26 021	Food, training and infrastructure
		Farmer training	29 250	Crop related training
	SAT	Free direct inputs	200	Inputs (maize, cowpeas and groundnuts/sugar beans) for 0.5ha
USAID and the European Commission (EC)	Kaite	Subsidised in cash or vouchers	1 148	Crop vouchers
		Vouchers	375	High value crop seed
USAID and/or Office of US Foreign Disaster Assistance (OFDA)	Goal Global	Subsidised in cash or vouchers	7 500	Vouchers worth $120
EU	CARE Oxfam GB, Batanai and Midland Aids Organisations	Farmer training CA	2 900	
		Subsidised in cash or vouchers	2 600	Open voucher worth $160 for seeds, fertiliser, chemicals and implements
		Small livestock training	3 195	Supported with veterinary kits
		Business training	1 949	Market linkages training for community gardens
	CADS	Free inputs	9 900	Cereal and legume seed and fertiliser
		Subsidised in cash/vouchers	3 145	
	Help and CADS	Vouchers	95 924	Vouchers worth EU80 for inputs
	SAT	Free direct inputs	11 609	Seeds and fertilisers
	SAT	Farmer training CA		
EC	CARE, Christian Care, Leadtrust, WVI	Free inputs and CA training		Crop inputs

Donor	Implementing partner	Intervention mode	Recipients	Received inputs
	Basilwizi Trust	Subsidised in cash/ vouchers	5 029	Livestock—cattle and 5 goats. Recipients contributed 10% for drugs
BMGF	Wagenigen University	Free direct inputs	2 720	Legume seed and Single Super Phosphate (SSP)
FAO	Caritas Zimbabwe	Subsidised in cash/ vouchers	6 611	Subsidised stock feed at $6/ bag
DFID and Australian Agency for International Development (AusAID)	CARE, Adventist Development and Relief Agency (ADRA), Goal Global, Christian Care, World Vision, Farm Community Trust of Zimbabwe (FCTZ), Africare, CTDT, Southern Victorian Charitable Trust (SVCT)	Subsidised in cash/ vouchers	60 000	Crop and livestock vouchers
DfID	World Vision	Subsidised in cash/ vouchers	7 500	Stock feeds and training
AusAID, DFID and EC	World Vision	Subsidised in cash/ vouchers	1 500	Stock feeds and training
Federal Ministry for Economic Development—Germany (BMZ)	SAT	Free direct inputs	63 366	Seed packs, fertiliser and tools
	Help Germany	Free direct inputs	9 750	10 kg sorghum, 5 kg ground nuts, 50 kg sweet potato and vegetable seedlings

Case study: From free inputs to market-based delivery

When the macroeconomic situation began to show signs of recovery in 2009, development agencies reviewed the rationale of free direct input distribution. They identified the need to move away from free input distribution towards market-based mechanisms. This became the mode of input delivery for donor-sponsored programmes. With funding from the EU, DfID and AusAID, FAO implemented a market-based input assistance project during the 2012/13 season. Objectives were to improve farmers' access to agricultural inputs, reduce dependency on donor funding and resuscitate the agriculture input supply chain.

The input assistance programme was based on a voucher system. The vouchers were either paper-based (for areas where mobile phone network connectivity was limited) or electronic (for areas with good mobile phone network connectivity). Both types of vouchers were market-based and redeemable at participating agro-dealers. While the vouchers were open in terms of what could be bought—seeds, fertilisers or tools—they were not meant to be used for non-agricultural wares. Recipient farmers obtained subsidised vouchers worth US$ 160; the project paid 80% (US$ 128) and 20% (US$ 32) was an obligatory cash payment made by the farmer. In Goromonzi and Hurungwe, two high potential cropping districts, the project assessed the capacity of farmers to contribute more cash after obtaining a higher valued voucher. In these districts farmers received vouchers worth US$ 200 and made a cash contribution of US$ 80.

The FAO printed coupons centrally and distributed them to NGOs working at the district level. At the local level, traditional leaders, councillors and extension staff were responsible for identifying recipients. The official criteria for identifying recipients were not very specific—the criteria mainly required recipient households: to make a financial contribution, to hold at least two economically active household members, have access to land greater than 0.5 ha, and demonstrate a history of grain production. These criteria discriminated against women-headed households, which constitute the majority of farming households in communal areas. Interviews conducted for the current study suggest that coupons were disproportionately allocated to male-headed households with comparatively more land and assets. This finding is supported by Chibwana et al. (2010) who reported that female-headed and the most vulnerable households were less likely to receive vouchers.

Input vouchers used by FAO in 2012.

The FAO contracted a number of NGOs as implementing partners who worked closely with MAMID, financial institutions, input suppliers and agro-dealers. MAMID was responsible for training and extension provision, quality control, and evaluating the impact of the programme. NGOs were answerable for the implementation and coordination of field activities. Financial institutions managed the electronic voucher system, while input suppliers and agro-dealers were responsible for supply and distribution. A total of 77 800 households in 24 districts received either crop or livestock vouchers under the programme.

About 250 agro-dealers participated in the project; they were selected according to interest, the ability to stock sufficient quantities of a wide range of inputs, the suitability of storage space and security, and access to mobile networks and electricity. Agro-dealers signed a Memorandum of Understanding (MOU) with FAO that specified the stocking of appropriate inputs, the sale of inputs at market rates, and observance of the rules of redemption, especially the payment of the farmer contribution. Due to limited financial capacity and liquidity challenges, most agro-dealers received inputs on consignment from suppliers.

Paper vouchers were redeemed at participating agro-dealers; upon redemption, NGOs collected the vouchers to pass on to the FAO for payment. Agro-dealers were then supposed to settle payment with their suppliers, upon receiving payment from the FAO. Electronic vouchers took the form of electronic debit cards that farmers used to purchase inputs from agro-dealers. Unlike paper vouchers, the electronic vouchers allowed for instant drawing down of funds from the farmer's card to the agro-dealer's account. When an electronic voucher was swiped through the agro-dealer's point-of-sale (POS) device, information about the transaction was automatically recorded in a database and could be viewed online by the relevant project stakeholders. The electronic voucher thus offered a more secure and transparent system of making payments, and facilitated monitoring of these transactions.

A number of seed companies supplied mostly hybrid seed on consignment to the village-based agro-dealers. Participating seed companies included SeedCo and Pioneer for hybrid seed, and Agriseeds for OPV seed. Some key informants indicated that 90% of the maize seed supplied to agro-dealers was hybrid, while 10% was OPV. Hybrid maize may produce a yield higher than OPVs, making them more favourable to policy makers who want quick results. However, some individuals in academia, research and civil society argue that OPVs are more appropriate for smallholders, as they are more resistant to pests and diseases, more drought tolerant and more familiar to farmers. Importantly, harvested OPV maize may be retained as seeds for the next season, unlike hybrid seed which must be purchased from one season to another. Adopting subsidised hybrid seeds could generate a dependency on the formal seed market which may prove devastating for smallholders if subsidies are phased out. This locks the whole system into a dependency on the continuation of subsidies.

The intention was to run the project for three seasons, from 2012 to 2015, and to raise farmer co-payments from 20% in the first year to 50%, then 75% and finally 100% at the end of the programme. Each of the 78 000 recipient households was supposed to graduate from the programme after three consecutive years. In practice, however, the programme ran for only two seasons. Some farmers—estimated by key informants at 5–10% of the total—opted out of the programme, citing the problem of raising co-payments. Farmers who were included in error (including civil servants) were also dropped from the programme. The graduation mechanism did not work quite as intended, especially for those households who opted out. The responsibility of applying the graduation mechanism remained with the local extension service and traditional leadership—who identified beneficiaries and generated lists of selected farmers—as well as with NGOs, who endorsed the lists. However, they did not enforce the co-payment rule in the first year of the programme.

As expected, voucher recipients had better access to agricultural inputs than non-recipient farmers. However, even non-recipients took advantage of the improved availability of inputs in agro-dealer shops closer to them, thus reducing travel time and distance. The FAO reported that 44% of participating farmers purchased fertilisers, while 43% bought productive assets including ploughs, plough parts and other assets (FAO, 2013). Only 11% of the recipients elected to buy hybrid seed. This suggests a greater demand for synthetic fertiliser than certified seed.

Agro-dealers, including some interviewed for this study in Goromonzi district, reported improved business from income earned in commissions from input sales. Agro-dealers also reported benefiting from the ripple effects created by improved business which enabled them to stock a wider range of inputs and other products. The programme assisted in re-establishing links between agro-dealers and input suppliers, improved agro-dealers restocking capacity and helped the upgrading and expansion of retail outlets. Nevertheless, there was only seasonal availability of inputs in remote areas because suppliers were not confident of effective demand for agricultural inputs after the end of the project.

There are a number of implementation issues with the voucher programmes and FISPs more generally. There was a limited supply of crop inputs because suppliers were reluctant to supply goods on credit or on consignment to agro-dealers with no credit history. This resulted in supply bottlenecks which increased transaction costs for farmers. In some cases farmers bought less preferred inputs because agro-dealers did not stock the inputs they sought. Consequenty they held vouchers which could not be redeemed, a problem which was also experienced in neighbouring countries. For agro-dealers, any sale was better than no sale at all; to achieve this they chose to stock anything with an agricultural purpose. This limited farmers' choices to what was available, rather than what they preferred. Limited input supplies caused price increases and instances of agro-dealers hiking their prices in anticipation of the programme were reported. Poor network connectivity and system challenges such as faulty cards and faulty POS devices affected the redemption of e-vouchers in some places. Raising co-payment was not easy for some farmers, particularly given that the programme started in September, long after farmers had spent most of the money from marketing their crops.

Late deliveries represent one of the main challenges related to the distribution of subsidised inputs to farmers. Despite clear guidelines by government on how agricultural inputs support should reach farmers well before the farming season, farmer respondents in our research reported very late delivery of inputs. In all areas, some of the fertilisers reached farmers as late as January or February, which was too late for the current planting season. Reports indicated that this was the pattern with this programme every year. To make matters worse, the sequencing of delivery was poor and farmers sometimes received top dressing fertiliser before the basal fertiliser.

These are operational issues rather than a fundamental critique of the programme. The more serious critique is that input subsidy programmes channel resources into a narrow set of technologies whether these are locally appropriate or not. They are standardised and largely inflexible. They absorb public resources that could also be used in other ways to support smallholder farmers.

General commentary on FISPs

Small-scale agriculture is a challenging and essential task in most of Africa, including Zimbabwe. It is appropriate to support farmers in their efforts to produce food. The question is what form that support takes. It is very clear that the input subsidy programmes cater for the expansion of Green Revolution technologies and do not provide crucial support to small-scale farmers.

Evidence indicates that input subsidy programmes have not been particularly effective even in increasing maize yields, which is one of their fundamental stated objectives (Chirwa & Dorward, 2011). Government anticipated that recipient households would achieve yields of more than 1 ton/ha, almost doubling the current national maize yield. However, recipient farmers' yields are barely above the national average (FAO, 2013).

Concerns were noted about the relief approach to agricultural inputs provision in Zimbabwe, where the 'crisis' argument is used to promote programmes of seed dumping without addressing production constraints (Mutonodzo-Davies, 2010). This tactic fuels particular types of investment, as certain individuals or organisations have an interest in the promotion of a 'perpetual emergency' which justifies funding flows and field activities.

As with other countries in the region, input subsidies have become entrenched politically, and there are no apparent plans to phase them out. This means planned exit strategies have not been considered, resulting in permanent Green Revolution subsidies. Most recent literature on graduation and exit strategies refers to recipients 'graduating' from a dependence on subsidised inputs to commercially-profitable productive activities. Graduation is defined as the removal of access to a transfer programme in a way that enables current recipients to pursue sustainable independent livelihoods (Chirwa and Dorward, 2011).

Three broad approaches may be followed in implementing exit strategies: i) reducing the level of subsidy per household; ii) reducing the geographic coverage served by the programme, using a phased withdrawal from geographic areas; and iii) the withdrawal of the programme from particular households. The processes of reducing geographic coverage and withdrawing from households requires predetermined criteria for graduation or termination, which should be strongly related to the initial targeting criteria. However, such decisions are highly political and are shaped by existing power relations based on geographical, political, ethnic and religious lines.

Consequently, even unplanned exit strategies have been particularly difficult to implement. In their evaluation of agricultural input subsidies in Africa, Baltzer and Hansen (2011) did not find evidence of graduation in Malawi and Zambia, although they found some exit in Tanzania and, to a lesser extent, in Ghana. Chirwa and Dorward (2011), in their review of fertiliser input subsidies in Africa, found evidence of exit strategies or graduation in Tanzania and Zambia only, but indicated that actual implementation of these processes had faced serious difficulties.

Regardless of their often intense political differences, both government and the donor-NGO faction have shared a very similar narrative during the period under review. The assumption is of seed and fertiliser scarcity and the failure of alternative input systems, with the proposed solution being Green Revolution input support. Both groups use a top-down, transfer-of-technology approach for delivering seed (Mutonodzo-Davies, 2010). They are both susceptible to rent seeking/corruption and elite capture. Further, both government and donor initiatives have shown a tendency not to procure local seed, even in cases where OPV seed is available at the local level. In both cases there is no adequate analysis of the real input demand, the role of the farmer seed systems in seed provision, and the possible costs of such interventions on the entire input system.

Given that input subsidies are entrenched, the immediate research task may be to investigate what other government programmes provide support to farmers, in particular on seed production and exchange, and alternative sources of nutrients including the increase of organic matter. As indicated below, there is some evidence that such programmes do exist, but mainly in civil society. A more comprehensive view of these activities would go a long way towards informing possible improvements to farmer-managed seed and agro-ecological soil fertility practices.

OVERVIEW OF THE ZIMBABWEAN SEED SECTOR

Introduction

As with the rest of the continent, most seed used by small-scale farming households in Zimbabwe is produced and reproduced locally, without formal regulation. As indicated, the only exception is maize, where more farmers rely on the commercial system for hybrids. On-farm and local production of seed is an integral part of agro-ecology. We refer to these systems as farmer-managed seed systems, highlighting farmer control over production and exchange as well as seed selection and storage, as well as a diversity of systems based on socio-ecological context. These systems are also referred to as local or traditional seed systems (Sperling et al., 2008). These practices are diverse, localised and non-reducible (which does not, however, mean that participants cannot learn and share with one another). By contrast, the formal commercial seed system is unitary, with centralised control, technological standardisation and exclusivity of ownership at its core. Economies of scale, which reduce the cost per unit of production, rely on technological standardisation. Government and private sector rules and regulations govern the conduct of participants. While there are general efforts to ensure these rules are observed, in practice, corruption may well be part of these processes.

There are questions about the relationships between the diverse farmer-managed seed systems and the commercial core that dominates maize production, in particular, in Africa. This corporate nucleus is also expanding its reach in significant other crops, including soya beans and other legumes. These crops form the basis of cereal-legume crop rotations in mainstream CA, and maize and soya beans are also two of the primary genetically modified (GM) crops, globally. These crops are bred to perform maximally under intensive production conditions, including high levels of readily available nutrients in the form of synthetic fertiliser, irrigation where possible, and Good Agricultural Practice (GAP), as defined by Green Revolution modernisation standards. This distorts the entire rural economy and floods resources into particular technologies with questionable social and ecological effects. In this section we make a first effort at mapping the contours of seed systems in Zimbabwe, and seek to identify gaps where we require more knowledge.

Farmer-managed seed systems include the methods by which farmers themselves produce, distribute and obtain seed. This can be directly from their own production; acquisition from local grain markets, traders or sellers; and from barter and gifts from relatives, neighbours and friends, both within and beyond the immediate surroundings. Farmers' seed is usually not produced separately but is selected from the grain stocks or harvests, and local technical knowledge, social structures and standards maintain farmer-managed systems (McGuire, 2001). Generally, 80–90% of seed sown in developing countries stems from these systems although there are varietal and regional differences (FAO, 1997). It is worth noting that farmers acquire various seeds from both farmer-managed and commercial systems, making it necessary to pay attention to both. For example, while smallholder farmers in Zimbabwe routinely obtain maize hybrids from the commercial system (agro-dealers, companies, etc.), they acquire sorghum seed from their neighbours and friends, and groundnuts from their own harvest or local grain markets (van Oosterhout, 1996).

The commercial seed system consists of a sequence of actions leading to certified seed (mostly hybrid) of distinct varieties. Plant breeding develops new varieties or crosses with the ultimate aim of releasing these for use. Formal regulations seek to uphold varietal purity and identity in addition to guaranteeing sanitary, physical and physiological features. Once the seed is registered it may be multiplied for distribution to farmers. Distribution processes are also governend by regulations. The marketing of seed occurs through commercial seed channels, including national and other commercially recognised outlets (Louwaars, 1994). This includes seed aid and subsidy programmes which are the major buyers of commercial seed in Zimbabwe. Like commercial systems, farmer-managed seed systems also deal with the flow of genetic information and material, including seed selection, possibly some systemic in situ plant breeding, variety choice, storage, exchange and replanting, although processes may be more organic and less structured than the formal development and release process.

Zimbabwe has also seen the emergence of a 'relief seed system' which was particularly significant in the period prior to 2009. Relief seed aid has become recurrent and entails a rather different way of procuring and distributing seed (Bramel *et al*., 2004). Seed relief agencies often distribute hybrid seed from the commercial sector.

Until 1985, government prohibited the release of OPVs and even when it finally agreed to their release, it banned companies from producing and distributing them. Issues of seed affordability became important as structural adjustment affected the economy during the 1990s. Major droughts in the early 1990s affected seed supply and efforts to distribute imported seed resulted in seed relief programmes dispensing sometimes unsuitable varieties which damaged local ecosystems. It was only after this disaster that the government re-emphasised reliance on local seed systems (Takavarasha, 1993). Technical and material support is required to build and widen these systems.

The economics of seed use changed during this period as hybrid seed progressively became unaffordable for many (Rukuni, 2006). Many farmers began to recycle hybrid seed, thereby shrinking the commercial market. Some NGOs—CTDT, CADS, CRS and others—started encouraging local agro-biodiversity protection, seed fairs and farmer-to-farmer seed exchange, with an increasing focus on small grains such as millets and sorghums as key food security crops, particularly in drier regions (Monyo et al., 2003). With considerable lobbying from these NGOs, as well as from researchers and farmer groups, acceptance of improved OPVs was achieved. A number of varieties were released and some became commercial successes. For instance, CIMMYT released ZM521 and ZM421 and SeedCo released Matuba.

Farmer-managed seed systems gained prominence after the land reform programme of 2000 when certified seed was only erratically available, until farmer-managed seed became the sole source of seed planted by most smallholder farmers in 2008 (Sperling et al., 2009). Hybrid maize found its way to farmers through rechanneling into informal markets, or from seed company employees who were paid with hybrid seed during the hyper-inflationary period in Zimbabwe.

When the formal seed supply failed to deliver seeds, as was the case in Zimbabwe in 2008, farmer-managed seed systems delivered all the seed that was planted. Farmer-managed systems are therefore capable of supplying and maintaining varieties. This includes the integration of useful commercial seed into local systems, such as recycling hybrids or OPVs and mixing with local varieties. In addition to supplying seed and maintaining varieties, farmer seed production also plays a broader role, comprising a dynamic in situ conservation system that allows for continuous evolution. This makes these systems essential in the living management of plant genetic resources.

Adoption of hybrid maize varieties in Zimbabwe is very high. For example, in 2006/07, more than 80% of the maize area in the country was planted to hybrids, and close to 10% was planted to improved OPVs (Muungani et al., 2007). Although OPV promotion is continuing there are divisions between government and development agencies and farmers about whether they are a viable alternatives to hybrid and, if they are, who 'owns' the alternatives. Part of the problem has been the existence of a dominant narrative bordering on propaganda, for a very long time, on the use of hybrid seed to boost food self-sufficiency, through intensification made possible by using hybrids. It was almost unheard of, or forbidden, to plant OPVs in Zimbabwe until government policy reinstated them in 2002. This has made the country a 'maize country', where farmers grow mostly hybrid maize in all districts despite its record of failure in semi-arid NRs IV and V (Sperling et al., 2009). Even though maize is not the most important cereal in marginal areas, farmers still grow it as a back-up for crops such as millet and sorghum. There seems to be a contradiction between what is generally believed to be the objectives of smallholder farmers—low costs and food security—and this apparent obsession with hybrid maize seed for improved yields. This calls for a holistic way of looking at farmers' objectives and priorities, and for providing them with information on alternatives to hybrid seed.

Respondents in the research highlighted the boost in maize production in the 1980s, made possible through the use of hybrid seed and fertilisers. Following good seasons there was a serious drive to plant hybrid maize, until up to 90% of the planted area was under maize, including ecologically sensitive areas. Oral histories shared at FGDs in all the districts visited indicated that farmers used to produce enough food for their families, but not for sale, using landraces. Table 13 shows the timelines for changes to the technologies and inputs to raise productivity in farming and land management practices, in Ward 9, Mutoko district. This shows the introduction of hybrid maize, especially from the 1980s; expansion of the area planted to maize; a move away from maize OPVs; a decline in the area planted to other crops, including small grains and legumes; and a decline in the number of varieties in popular use. This general trend was apparent in all the districts visited. The Zvishavane group emphasised that there was no hybrid maize seed at all in their area in the 1940s, but that it was introduced in the 1960s and received a lot of support in the 1980s.

Incomes rose in the 1980s for all sites as a result of the opening of maize markets for local farmers. The government set up buying depots in the drier districts such as Zvishavane, Masvingo, Zaka, Chiredzi and lower Chipinge, while they built silos in Murehwa. This pushed maize production even more, all at the expense of small grains. The income boost did not last as soils became infertile and more expensive after subsidies were removed during the ESAP period. As Mr Mawara of Zvishavane recounted:

> *Production has been going down ever since and so are the incomes. You can imagine, as a family we harvested 22 tons in 1982, 9 tons in 1999 and I think it will be 0 tons in 2015. So incomes are going down because of our over-reliance on one crop which has mined the soil.*

Channels for the distribution of seed include informal exchange between farmers, the commercial distribution system (agro-dealers, general dealers) and other formal channels (government, seed aid, FISP, etc.), as discussed above. The main channels for certified seed are 29% through seed company distributors, 21% from government programmes, 18% given directly to farmers and farmers' associations, 16% through NGOs and relief programmes, 15% from rural stockists and 2% from contractors (Mujaju and Jonga, 2014:4)

Farmers may also obtain seed from relatives, friends and neighbours, both within and beyond their immediate surroundings, through cash or non-cash arrangements. This may extend to neighbouring countries such as Mozambique, Zambia, Malawi and South Africa, as was the case in 2008 in a resettlement area in Gutu district (Figure 3). Cash may be required for travel and middlemen may provide seed through non-cash arrangements, such as bartering, or through loans payable in cash or in kind upon harvesting. Social networks of seed exchange, including gift-giving and community exchanges, have a long history in Zimbabwe (Friis-Hansen & Rohrbach, 1993) and continue to function efficiently. Open markets also play a key role in providing seed for farmers. While these markets are frequently called 'grain' markets, traders and farmers apply substantial agency in choosing and managing grain supplies to guarantee that some grain can be used as potential seed.

Hybrids being used are not necessarily purchased but may also include recycled hybrids. For example, about 50% of the farmers in an FGD in Shashe village in Masvingo indicated they re-use maize hybrid seed from previous seasons. So while we talk of hybrid seed, in the farmers' fields it may be something totally different, with farmers doing their own breeding and mixing the seed.

Farmer-managed seed systems

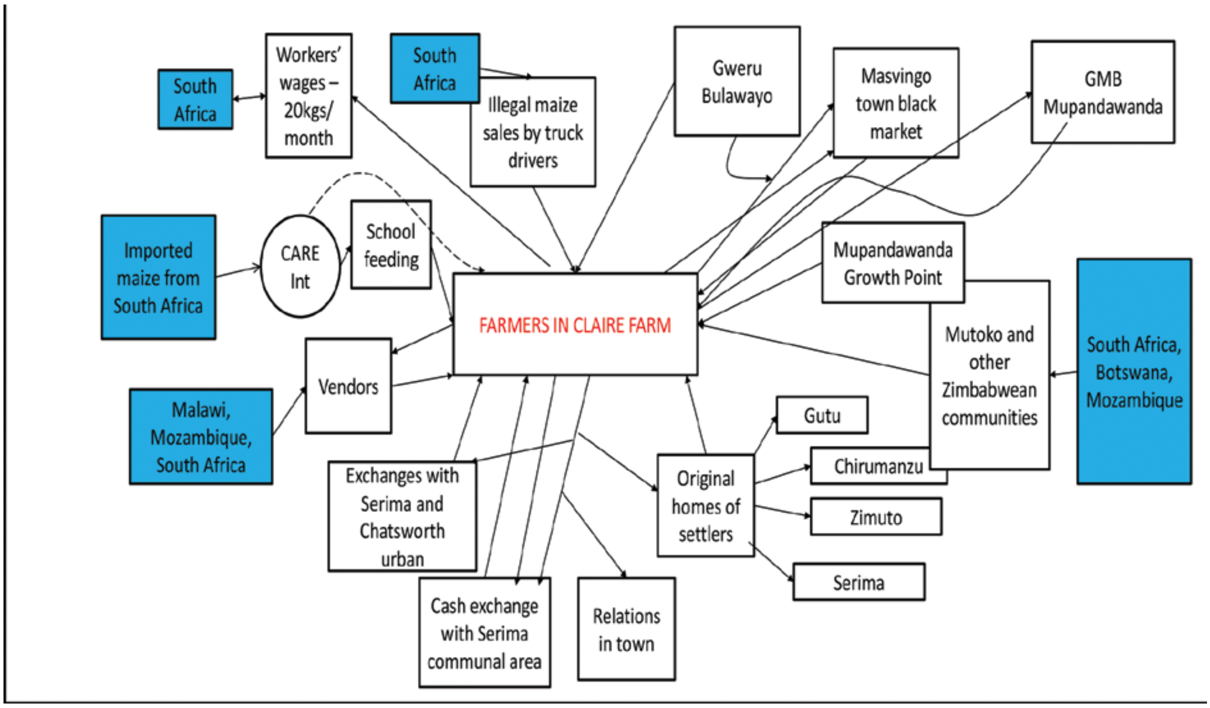
Farmer-produced and exchanged seed is the oldest and most important supply of planting materials in Zimbabwe. Apart from

Table 13: Changes in technologies, inputs and land management practices in Mutoko over time

Aspect	1970s	1980s	1990s	2000s
Tillage methods	Hand hoe and plough	Ox-drawn plough	Ox-drawn plough Tractor use is rare	Minimum tillage and plough
Area planted	XX	XXXXX	XXXXXX	XXXXXX
Crops planted	Sorghum, pearl millet, rapoko, ground nuts, bambara nuts, rice, cowpeas, pumpkins, squashes, OPV maize	Hybrid maize, sorghum, rapoko, ground nuts, bambara nuts, cowpeas, pumpkins, squashes—less OPV maize and rice	Hybrid maize, rapoko, ground nuts, bambara nuts, cowpeas, pumpkins, squashes—very little rice and OPV maize	Mostly hybrid maize; very little rapoko, ground nuts, bambara nuts, cowpeas, pumpkins, OPV maize
Area under maize	XX	XXXXX	XXXXXX	XXXXXXX
Area under pearl millet	XXXXXXX	XXXX	XXX	
Area under rapoko	XXXXX	XXX	XX	X
Area under sorghum	XXXX	XX	X	XX
Area under g'nuts	XXXXX	XXXX	XXX	XX
Area under bambara nuts	XXXX	XXX	XX	X
Area under rice	XXXX	XXX	X	
Area under horticulture	X	XXX	XXXX	XXXXX
Sources of seed	Mostly farmer exchanges, very few purchases	Mostly purchases and seed exchanges	Mostly purchases and seed exchanges	Purchases, seed exchanges, farmer hybridisations
Maize varieties	4 OPV, 1 hybrid SR52	SR52, R201, R215	SC 7 series, 6 series, 5 series, PHB varieties, Pannar varieties	SC 7 series, 6 series, 5 series, PHB varieties, Pannar varieties, Progene seeds, Monsanto, Prime seeds and many others
Pearl millet varieties	XXX	XX	X	X
Sorghum varieties	XXXXX	XXX	XX	X macia
Groundnut varieties	XXXX	XX	XX	XX

Source: FGD Ward 9, Mutoko District.

Figure 3: Maize seed flows in Gutu resettlement areas, 2008



Source: Scoones, *et al*., 2010.

maize, over 95% of the seed sown by farmers in Zimbabwe comes from the farmer seed system (Sperling *et al*., 2009). Bambara nuts, cowpeas, groundnuts, pearl millet, sorghum, sugar beans and sweet potatoes constitute the most important crops in the farmer-managed seed system. Other crops are OPV maize, finger millet, soya beans, sunflowers, and sugar beans. When there are no materials in the commercial breeding sector, as is the case with root crops like yams and sweet potatoes and indigenous vegetables, farmers' seed and genetic material is typically the only supply of planting material. These crops are very important for stabilising production, addressing equity issues (most of them are considered women's crops), and promoting nutrition.

The processes of *in situ* seed selection, production and storage, and exchange between farmers are integrated in farmer-managed seed systems. Crop production, selection and storage of seed bring to bear selection pressures on local varieties that are genetically diverse. Together with the natural selection pressure, these farmer practices contribute to local level seed enhancement (Almekinders and Louwaars, 2002). Farmer-managed seed systems are entrenched in the system of household crop production for food consumption and sale. The grains are harvested for consumption, seed for the next season, used by other farmers as seed, or for marketing as grain. In these systems, farmers produce seeds at the same time as they practice in situ crop development and preservation of crop genetic diversity. The farmer-managed seed system is thus entrenched in the crop production system for household food consumption and sale. The grains harvested can be used as seed for the next planting, marketed as grain, or used for seed or consumption by other farmers. It is a system in which farmers practice in situ crop development and maintenance of crop genetic diversity, while at the same time producing seeds.

Zimbabwe has a rich history of plant genetic resources within domesticated plant resources, including cereal, pulses, indigenous vegetables, root and tuber crops and medicinal plants. Wild relatives of some of the crops grown also exist, including pearl millet, sorghum, finger millet, rice, bambara nuts, cowpeas and cotton. Not much work has been done to establish the distribution and diversity of wild species although they are widely known to be on the decline, due to the intensification

Small grains in Chiredzi District community seed bank, 2015.

and commercialisation of agriculture. Meanwhile, the diversity of crop genetic resources is important to farming households as diverse crops perform multiple functions of consumption, use and sale, as well as helping farmers cope with unpredictable and variable market and environmental conditions.

The extensive utilisation of traditional crop varieties (landraces) by smallholder farmers has had positive impacts on agro-biodiversity. However, the commercialisation of agriculture has resulted in the implementation of intensive cropping methods using Green Revolution technologies. Respondents in our research, especially women, blamed agricultural intensification and commercialisation for the loss of diversity. They indicated that they used to grow a wide array of crops and many varieties of the same crop. For example, a group in Chiredzi district mentioned eight varieties of pearl millet. Generally, districts in marginal areas such as Zvishavane, Zaka, Chiredzi and drier Chipinge reported more diversity, compared with the high rainfall districts of Murewa, Goromonzi and Mutoko which have been the target of the Green Revolution over the years. Because of the diversity of seeds in Chiredzi district, a local NGO, CTDT, established a seed bank with many varieties of seeds, especially small grains.

In Shashe village respondents indicated that only about 10% of the farmers grow maize OPVs which include some landraces such as Hickory King, 8 lines, etc., and some improved lines such as ZM521 and ZM41. The group indicated that improved OPVs are cheaper and are bred for marginal areas because even if the cob is small, if it is supposed to have 8 lines it will have them (although they will be small), unlike hybrids which fail completely when conditions are not good. Another advantage is that they are short season varieties which mature in 90 to 100 days, compared with hybrids which take 120 to 150 days to mature. Also, they can survive on minimal rainfall, said the group. An FGD respondent emphasised that these improved and recycled OPVs are flinty, resulting in minimal attack from weevils and stalk borer. On the other hand, older OPVs are not necessarily short season varieties; some of them are actually long season varieties. The group indicated that OPVs are not uniform, which is an advantage, because uniformity is dangerous in that if attacked by a pest or disease the whole crop can be wiped out. The plants do not all tassel at the same time, which farmers called 'strategic tasseling' or 'negotiating with the climate'.

The same group had some small grains—sorghum and rappoko—that were being cured for seed in soot, as well as groundnuts and bambara nuts.

An elderly woman in the Murehwa focus group said:

> *When we were growing up, when people referred to* sadza, *the staple food, you would not rush to bring the maize one, but you would need to establish which one, because there was* remupunga *from rice,* rezviyo *from rappoko,* remapfunde *from sorghum and remhunga from pearl millet. There was such a wide variety of everything including cowpeas, bambara nuts, different*

OPV maize in Shashe village.

vegetables. But these days we only eat sadza from maize meal and vegetables grown in gardens only ... and you young people do not even want to taste what we grew up eating. That's why we have so many diseases that we didn't know growing up ... we used to cook vegetables with peanut butter or 'runinga'*, sesame butter.*

This observation was echoed by all focus groups who confirmed that their diets have become very monotonous and dependent on maize only. The Masvingo group said there is ample evidence around their homesteads that their great grandfathers used to grow, process and consume small grains. For example, there are a lot of millstones, some of which had been used so extensively that they had developed holes.

Mr Mavedzenge said that the droughts which Zimbabwe is experiencing should be named "maize droughts" rather than anything else, because while maize is being scorched small grains are faring well. He concluded by saying, "Victory for maize hybrids is a defeat for food security."

In addition to enhancing biodiversity, the practice of low-input low-output agricultural systems, such as organic farming, intercropping and agroforestry, had guaranteed food security in the past. The use of plant species such as marigolds and blackjacks, instead of chemicals, for the control of termites, aphids, cutworms and other insects, helped to reduce the adverse effects of manufactured poisons on the environment.

The Goodhope Farmer Field School in Murewa district indicated they use the Diversity Wheel to establish and track neglected and lost diversity, by looking at the sustainability of crops which a few farmers grow on large or small areas, versus those that many farmers grow on large or small areas. They confirmed that using this tool they have been able to establish diversity that has already been lost and have identified crops at risk of being lost.

Local varieties in Shashe.

Overview of the commercial seed system

The commercial system broadly can be divided into plant breeding and R&D on one side; and seed multiplication and marketing/distribution on the other. They work together as part of a system but are distinct activities within the system. These will be dealt with in turn, before looking at the extent of small-scale farmer involvement in the formal system.

Plant breeding R&D and plant variety protection (PVP)

Theoretically, PBRs are granted to allow for returns on investment in R&D. According to the logic, no enterprise will invest in developing technologies if there is no possibility of reaping profits at the end of the process. The rights essentially are for exclusive use for a period (usually 20 years for most crops) plus the right to receive royalties from, and set other terms, for use by anyone who uses that variety in that period. The Consultative Group of International Agricultural Research (CGIAR) holds significant germplasm which they make available for R&D purposes, in both the public and private sectors. In addition, varieties developed by farmers in their fields, as part of their farming practices, may be kept in seed banks and made available for further development. Farmers may be able to claim royalties if they can prove those varieties are theirs, but this requires a formal process. This is the basis of benefit sharing agreements, though in practice farmers have found it difficult, if not impossible, to secure benefits for their historical and ongoing work to develop and maintain agricultural biodiversity.

Most new certified varieties are a cross between external varieties with desired traits and locally adapted varieties. These local varieties may be privately owned if there is a regulatory system that recognises the private ownership of seed; otherwise they may be under public ownership or in the common realm (there may be claims by farmers regarding ownership of the specific seed they are using, but there are no ownership claims for an entire variety). PBR introduces a regulatory regime for the privatisation of germplasm and facilitates the growth of commercial production because investments are protected.

Millstone.

The Plant Breeders' Rights (PBR) Act 22 of 2001 regulates this regime in Zimbabwe (Republic of Zimbabwe, 2001). The Act was passed originally in 1973 and has been revised at various times, including to ensure conformity with the 1978 version of UPOV. Zimbabwe is currently revising this legislation, again, to conform to UPOV 1991 (Mujaju, 2010:26) which reduces farmers' control over the seed in their possession. The Act follows the essential template of all PBR Acts aligned with UPOV. PBRs can be granted only for a new variety of a prescribed kind (s3.2). The Act establishes a Registrar of Plant Breeders' Rights; in Zimbabwe this is the Head of Seed Services in the DR&SS. The Act sets out the application process. PBRs establish the exclusive right to sell, reproduce and multiply reproductive material of the plant concerned, for the period of the PBR (s12A.1). The normal term of a right is 20 years (s17A.1). The breeder may licence the right to another person, imposing whatever conditions they see fit (s18.3). There are defined conditions under which the Registrar may reject or cancel breeders' rights (s14 and s15). A compulsory licence may be issued if an applicant shows that the seed is not being made freely available and that it is in the public interest for it to be so (s19.2.ii). It is the responsibility of the rights holder to maintain the reproductive material (s16). Damages for the infringement of PBRs must be related to the market value of the loss to the rights holder (s25C.3).

A farmer who cultivates less than 10 ha of land may use the harvest from any prescribed plant for the purpose of propagating the plant on that land, where the harvest was obtained by propagating the plant concerned or from an essentially derived variety (s17.2.c). A farmer who derives at least 80% of her/his annual gross income from farming on communal or resettlement land may multiply the seed of any prescribed plant and exchange with any other such farmer (s17.2.d). This is essentially an exemption for small-scale farmers. On the other hand, although breeders' protection is enshrined in the PBR Act, it is silent on the rights and protection of the persons who supply seeds for landraces (CTDT, 2009).

In 2013 there were 21 active commercial breeders in maize (2 public and 19 private), 5 for cotton (2 public, 3 private), 7 for soya beans (1 public, 6 private) and 7 for sorghum (1 public, 6 private). About 80% of active breeders are employed in the private sector. Maize and soya bean breeders were rated as excellent by users, while sorghum and cotton were rated good (Mujaju and Jonga, 2014:3).

Most seed companies source their breeding material from public institutions, mostly from the Crop Breeding Institute (CBI) at the DR&SS and CGIAR centres like ICRISAT and CIMMYT (Mujaju, 2010:14). The CBI has programmes on a range of crops including cereals, oilseeds, pulse legumes and Irish potatoes. In addition, CBI is the sole maintainer of improved bambara groundnut varieties. CBI has been battling with land access, irrigation and other infrastructure and as a result is unable to supply adequate hybrid maize breeder seed (Mujaju, 2010:14). The CGIAR centres have active breeding programmes for improved sorghum, pearl millet, maize and wheat. Several seed companies, including SeedCo, Pioneer/Pannar, Progene and others, operate their own breeding programmes in Zimbabwe. CBI coordinates the Variety Release Committee that reviews data from their own breeders as well as from private companies for the release of new varieties in-country.

The land reform process in 2000 caused serious interference for these programmes. A number of the larger companies lost all or some of the farms on which they were operating breeding programmes. In-country breeding programmes became unprofitable because of seed price controls, particularly for maize and wheat. Some of the international research institutions and companies transferred their breeding programmes, together with some of their scientists, out of Zimbabwe, and funding for DR&SS breeding programmes plummeted as a result of the economic challenges. Nevertheless, a recent assessment found Zimbabwe's formal sector to be extremely strong on the availability of foundation seed and also on the number of active breeders (Mujaju and Jonga, 2014:2).

Both public and private breeding programmes sometimes invite farmers to research stations to evaluate varieties under development, in order to guide variety development work. This is a form of participatory variety selection (PVS). Farmers have occasionally requested and been given either small quantities or a few heads of the variety material (especially for small grains) to take away with them. Such material has been planted on a small-scale first and, if it showed traits in which farmers were interested, spread to the communities through exchanges, gifts, and sales. The traits which farmers usually look for include high yield gains, early maturity and tolerance to mid-season dry spells and droughts. Okashana, a pearl millet variety released in Namibia that was multiplied by farmers in Tsholotsho, before it was even released in Zimbabwe, provides a good example.

Variety release and registration is the bridge between plant breeding and multiplication and certification. In order for a variety to be registered, it must pass standardised DUS testing and minimum value for cultivation and use (VCU) testing. VCU data is based on at least 2 seasons in 5 sites (Mujaju, 2010:19). Seed Services oversees these tests based on data submitted by the breeder. DUS testing, including compulsory crop inspections, is mandatory for hybrid maize, wheat, soya beans, barley, tobacco, oat, cotton and potato seeds, which are all on the 'compulsory' list. Once a variety is released it is deemed available for commercial production. As of 2010 crop varieties released and granted variety protection included aster, apples, barley, beans, citrus, coffee, cotton, granadillas, groundnuts, hypericum, maize, millet, oats, paprika, peaches, Peruvian lily, potatoes, protea, rape, rose, sorghum, soya beans, statice, strawberry, sunflowers, tobacco, trachelium and wheat (Mujaju, 2010:25). Users rated the length of Zimbabwe's variety release process as excellent and better than the process in South Africa (Mujaju and Jonga, 2014:2).The Southern African Development Community (SADC) harmonised variety release system allows any variety released in two member states to be marketed in the rest of countries with similar agro-ecological conditions (Mujaju, 2010:20). Zimbabwe is party to this system.

Zimbabwe is also party to the ITPGRFA. Amongst other things, this treaty explicitly recognises farmers' rights to "save, use, exchange and sell farm-saved seed and other propagating material, and to participate in decision-making regarding, and in the fair and equitable sharing of the benefits arising from, the use of plant genetic resources for food and agriculture" (FAO, 2009:12). It places the responsibility for realising farmers' rights on national governments.

In July 2015, members of ARIPO, including Zimbabwe, adopted the ARIPO Plant Variety Protection (PVP) Protocol. The Protocol is modelled on the 1991 Act of UPOV (UPOV, 1991), which was developed to accommodate the demands of established domestic seed industries from developed countries (particularly Europe), and the agricultural systems of such countries. It is widely recognised today that UPOV 1991 is an unsuitable PVP regime for developing countries, where farmer-managed seed systems form the bulk of seed production and distribution, and recycling of seeds is widely practiced. It should be noted that even developing countries that are middle income/large agriculture producers are not members of UPOV 1991 (e.g. Brazil, China), or have developed alternative *sui generis* models (e.g. India, Thailand). Those that have joined UPOV 1991 have usually done so under pressure from the US or the EU.

The exent to which which breeder's rights and intellectual property rights promote innovation in developing countries is contentious (see for example Correa, 2013). It has been argued that the low threshold established by the new, distinct, uniform and stable (NDUS) requirements under UPOV 1991, 'virtually guarantees' that PVP systems play no more than a meagre role in plant variety improvement (Janis and Smith, 2013).

There are a number of concerns with the Protocol. First, it will put in place a centralised PVP system where the ARIPO Plant Breeders Rights Office (PBRO) will supplant national PBROs. The PBRO office will grant PBRs, (subject to there being no objection from a contracting state), which will be legally binding and enforceable in all states that have contacted to the Protocol. The PBRO, acting under the aegis of the ARIPO Secretariat, will administer such rights on behalf of the contracting states (Article 4.2). Effectively, the Protocol hands over to the ARIPO Secretariat full authority to take decisions on matters that should be the prerogative of the government of Zimbabwe.

Secondly, the ARIPO Protocol is in conflict with Zimbabwe's existing PBR Act (Table 14). Zimbabwe's PBR Act is based on UPOV 1978 and as such contains at least some provisions that balance the rights of breeders and farmers, as well as the public interest. For example, s17.3 of the Act allows use of a protected variety for further breeding with minimal restrictions and some level of reuse, sale and exchange of farm saved seeds/propagating material. The Act also allows the Registrar to refuse PBRs if it is contrary to public order or morality (s10.1.d). Additional breeder's rights in s17 are limited to propagating material and do not extend to harvested material and products made from harvested material. Breeders must also disclose the origins of the plant (s7.3). By contrast, the Protocol protects breeders' rights to the detriment of farmers' rights, national and public interests. In these aspects the Protocol is inconsistent with the Zimbabwean PVP Act and the ITPGRFA. The Protocol does not recognise the right of farmers to freely save, exchange and sell protected varieties, even in small quantities.

Table 14: Key contradictions between the Zimbabwean PBR Act and the ARIPO PVP Protocol

	Zimbabwe's Plant Breeder's Rights Act	ARIPO Protocol
Scope of Act	PBRs to be granted only to "variety of a prescribed kind" (s3.1)	Applied to all plant genera and species (Art 3)
Scope of Breeders' Rights	Scope of Breeders' rights limited to propagating material. Does not extend to harvested material and products made from harvested material (s17)	Extensive Breeders' Rights. Extends to propagating material, harvested material and products made from harvested material. (Art 21)
Exceptions to Breeders' Rights	Some level of saving, exchanging, donation and sale of farm-saved seed/ propagating material allowed (s17.3.b, c and d).	Seed saving for propagating purpose on own holdings is limited to very specific crops and farmers may have to pay royalties to the breeder. Exchange and sale of seed/propagating material is not allowed. Requires farmers to provide information on use of seed to breeders (Art 22.2. 3).
Exceptions to Breeders' Rights	Protected variety may be used as initial source of variation for creating any other new variety, provided the protected variety is not repeatedly used for reproduction or multiplication (s17.3.a). Further breeding not restricted by essentially derived varieties (EDVs).	Further breeding allowed but with restrictions. If the newly bred variety is an EDV, that variety cannot be commercialised without the authorisation of the right holder (Art 22.1.c).
Refusal of Application	Registrar can refuse application if the growing of the plant concerned, or the grant of the PBRs, would be contrary to public order or morality (s10.1.d).	No corresponding provision. This means that refusals on public and national interest grounds is not allowed.
Publication	No provision allowing applicant to hide behind 'confidentiality' and refuse to disclose information.	Allows applicant to keep key information (e.g. concerning pedigree of the variety, origin, etc.) away from public scrutiny (Art 15.2).
PBR Holder to Maintain reproductive material	Specific provision requiring the right holder to maintain reproductive material that is capable of producing the variety, failing which PBRs can be cancelled (s16).	No specific provision requiring applicant to maintain and make available the propagating material.
Application for PBRs	Requires disclosure of 'origins of the plant concerned' (s7.3). Requires complete description of the variety; samples of reproductive material necessary for the reproduction of the plant concerned; specifies procedure for the maintenance and reproduction of the plant concerned (s8).	Art 12 concerning filing of applications lacks these elements.
Compulsory License	An important ground mention for the issuance of CL is that the reasonable requirements of the public with respect to the variety concerned have not or will not be satisfied. (s19.1)	CL may be granted by ARIPO Office but only for reasons of "public interest". What is public interest is not defined (Art 24).

Seed certification and multiplication

Seed certification is a quality control process which aims to guarantee the purity and germination of seed sold to farmers. In Zimbabwe it is governed by the Seeds Act 11 of 2001 (Republic of Zimbabwe, 2001a), which was originally passed in 1965 and revised at various points over the years. A set of regulations accompany the Act, including the Seed Certification Scheme, 2000. The Act governs testing and certification, sale and import and export of seed. An unregistered person or entity may not test or sell seed (s8.1), but any farmer who grows and sells seed for use as seed is exempt from this (s8.2). The Act sets up a Seed Certification or Approval Scheme (s12). Such schemes establish the framework for registration, production, testing, etc. of certified seed of prescribed varieties. Contraventions of the Act may lead to a fine or imprisonment and seed may be forfeited (s24).

Seed Services within the DR&SS is responsible for administration of the legislation. Zimbabwe has an official seed testing laboratory accredited to the International Seed Testing Association (ISTA). Seed Services is currently centralised in Harare and discussions are being held regarding decentralisation, to be closer to production areas (Mujaju, 2010:16). Seed certification is mandatory for the eight crops of commercial importance, viz., maize, soya beans, tobacco, cotton, wheat, barley, oats and potatoes (Mujaju, 2010:7).

Seed companies may multiply only the crops they are licenced to produce. Companies are obligated to notify Seed Services of who the growers are, where they are located, how much they are producing, which varieties, etc. Inspections and seed testing are carried out by registered inspectors and agents, who may be from private companies. In 2010 the public sector had 12 seed inspectors, compared with 55 registered inspectors in seed companies (Mujaju, 2010:10). In 2013 there were six licenced private seed labs, owned by SeedCo, Pannar, Prime Seeds, the Forestry Commission, the Tobacco Control Board (TCB) and Quton (Mujaju and Jonga, 2014:5). Seed inspectors are considered to be of high quality (Mujaju and Jonga, 2014:2).

In the early days, legally binding agreements required the government to release breeders' seed for bulking up and multiplication to the government-owned SeedCo, only. SeedCo was the first commercial seed company in Zimbabwe, established in the 1940s (Table 15). This created the monopoly by SeedCo over hybrid seed production, together with its close alliance with large-scale farmers with whom it had contracts. The government partially liberalised seed production from the 1980s, and Cargill, Pioneer and Pannar began seed production alongside SeedCo. More seed companies emerged as a result of liberalisation during the ESAP, although SeedCo maintained a 90–95% market share of wheat seed and an 80–85% share of maize, in spite of the competition (Havazvidi and Tattersfield, 2006). US-owned multinational corporations—Pioneer, Cargill and Monsanto—together with the South African company, Pannar (now under Pioneer), and two Zimbabwean-owned seed companies, National Tested Seeds and the Africa Centre for Fertiliser Development, shared the remaining 10–20%. Government officially consented to the release of certified OPVs only in 1985. A number of emerging seed companies were banned from producing and distributing the OPV Kalahari Early Pearl maize variety, as it was considered a threat to the seed industry (Utete, 2003).

Before 2000, certified seed programmes focused mostly on hybrid maize although production proceeded also for commercial crops like soya beans and sunflowers, and for a short time for such crops as cowpeas, pearl millet, sorghum and finger millet. While most seed companies contracted outgrowers in the large-scale commercial sector during this period, some also operated their own farms for seed production and a very few worked with smallholder farmers. For example, SeedCo in collaboration with national and international research institutes contracted smallholder farmer groups to produce certified seed of small grains and cowpeas.

SeedCo was privatised during the era of structural adjustment and today the production and marketing of seed is almost entirely generated by the private sector. Two parastatals, ARDA Seeds and Zimbabwe Technological Solutions (ZTS) produce and distribute minor quantities of seed (Mujaju and Jonga, 2014:4). Hybrid maize seed remains at the centre of the commercial seed industry and is the only key food crop for which smallholder farmers rely on the commercial sector. Although hybrid maize is dominant, several other maize varieties (some suited to dry land conditions) are also available. Hybrid seeds of other crops are sold, but not to the same extent as maize. Commercial crops, such as barley, cotton, soya beans, sunflowers and wheat are also sold, as are improved varieties of cowpeas, groundnuts, pearl millet and sorghum.

In 2013 there were 38 seed companies registered in Zimbabwe. Table 15 indicates a selected list, designated crops and the date of registration. Fifteen companies were involved in maize seed production, 11 were involved in sorghum seed production, 7 produced soya bean seed and 3 produced cotton seed (Mujaju and Jonga, 2014:3). Agri Seeds, NTS, Pannar and SeedCo produce OPV maize seed, mainly for export to regional markets, especially Angola and Mozambique.

Since 2000, Zimbabwe has been a net importer of certified seed, with maize coming mainly from South Africa, Zambia and Malawi, and vegetable seed imported mostly from the Netherlands and South Africa (Mujaju, 2010:29). The commercial seed sector in Zimbabwe almost shut down from 2005 to 2008, as a result of the unfavourable policy/regulatory environment, hyper-inflation, price controls and foreign currency shortages. After the removal of large-scale commercial producers following land reform, new contract seed growers had to be established. In addition, almost all retail channels for certified seed closed. Certified seed production dropped sharply from 47 000 tons in 2001/02 to 18 500 tons in 2007/08. Most of the larger seed companies reduced their seed production activities within Zimbabwe, preferring to import from their operations in neighbouring countries. Uncertainties with seed prices, the possibility that government at any time could requisition seed for large-scale seed distribution programmes, and the high cost of contracting many small-scale farmers after the disappearance of the large-scale farmers have all contributed to seed companies producing less than the national requirement during the period up to 2009.

The introduction of a multi-currency system—US dollars and South African rands (US$/ZAR)—and the liberalisation of the economy in early 2009 triggered the renewed expansion of seed companies, their grower networks, the re-opening of retail outlets and the rebound of certified seed production to 48 000 tons (Mujaju, 2010:13). Zimbabwe has been able to meet all its hybrid maize seed requirements since then. Although there are opportunities to produce certified OPV maize seed and some of the self-pollinating pulses and cereals such as sorghum, millets, cowpeas and others, many seed companies in Zimbabwe are not particularly keen to pursue these prospects. As a result, supplies of certified seed for these crops will probably remain limited.

In recent times and on a global scale there has been much merger and acquisition activity, which has implications for Zimbabwe's commercial seed sector.[9] Prime Seed was taken over by SeedCo in June 2015;[10] French MNC Limagrain now holds a 30% share in SeedCo; Agriseed is now 80% owned by South African MNC, Klein Karoo/Zaad;[11] the process of merging Pannar and Pioneer under global giant Du Pont was approved in Zimbabwe in October 2015;[12] and Mahyco of India (which has been engaged in a joint venture with Monsanto since 2002) acquired a 49% share of Quton in 2014.[13] A recent assessment of the formal seed sector found extremely high levels of concentration in the cotton, soya bean and sorghum seed markets, and a moderately high level of concentration in the commercial maize seed market (Mujaju and Jonga, 2014:2). Cotton is so highly concentrated because historically

9. Thanks to Gareth Jones at ACB for these updates.
10. http://www.herald.co.zw/seed-co-takes-over-prime-seeds/.
11. http://allafrica.com/stories/201506100334.html?aa_source=nwsltr-agribusines.
12. http://www.bh24.co.zw/pioneer-hi-bred-zimbabwe-pannar-seed-complete-merger/.
13. http://www.theindependent.co.zw/2014/08/22/seedco-sells-us10m-quton-stake-partner/.

Table 15: Private seed companies in Zimbabwe, year registered and designated crops

Company	Reg. year	Designated crops
SeedCo	1940	Maize, millets, sorghum, groundnuts, sugar beans, soya beans, cowpeas, wheat, barley, oats
National Tested Seeds	1979	Maize, wheat, sorghum, field beans, velvet beans, soya beans, groundnuts, cowpeas, vegetables
Agri Seeds	1983	Maize, millets, sorghum, groundnuts, field beans, sunflower, cowpeas, sunhemp, vegetables, paprika, bambara nuts
Pannar Seed	1984	Maize, wheat, sunflower, vegetables
Pioneer Seed	1988	Maize
Quton Seed Co	1994	Cotton
Chemco Seed Crops	1997	Maize, wheat, soya beans, groundnuts, sunflower, cowpeas
Prime Seeds	1997	Maize, sorghum, millets, beans
Tocek Investments (formerly Monsanto)	1998	Maize
ARDA (Agricultural Seed Associations)	2002	Maize, sorghum, millets, wheat, groundnuts, soya beans, cowpeas
Progene Seeds	2004	Maize, sorghum, millets, wheat, groundnuts, sunflowers, cowpeas, potatoes, bambara nuts, beans
FSI Agricom Holdings	2005	Maize, sorghum, millets, wheat, groundnuts, sunflowers, cowpeas, potatoes, bambara nuts, sugar beans
Klein Karoo (Pristine Seeds)	2005	Maize, sorghum, millets, groundnuts, cowpeas, sugar beans
Seeds for Development	2006	Maize, sorghum, cowpeas
ACFD/Sandbrite	2007	Maize, soya beans, sorghum
Highlands Seed Company (Savannah)	2011	Maize, sorghum, millets, wheat, groundnuts, soya beans, cowpeas, sugar beans and other dried beans
Cargill Cotton	2012	Cotton
Alliance Ginneries	2012	Cotton
Zaka Super Seeds	2012	Maize, sorghum, cowpeas, sugar beans, rice
ZTS	2012	Maize
Syngenta		Maize

Source: Seed Services.

Quton had an exclusive right from the Cotton Research Institute (CRI) to market seed. In 2012 Quton's monopoly ended and Cargill and Alliance Ginnerie joined the market. One company (not named in the report) controls about 47% of the maize seed market and 67% of the soya bean seed market. The top four companies control 86% of the maize seed market. The two largest companies in the sorghum market control 74% of the market between them (Mujaju and Jonga, 2014:3).

Seed aid and seed subsidy programmes

The 'relief seed system' is a fairly new term, created to distinguish seed supply systems that aim to maintain recurring emergency seed distributions (Bramel et al., 2004). This system deserves special mention, given that it is thriving in most of southern Africa and was particularly prevalent in Zimbabwe in the years before 2009. The relief system follows a clear sequence of declaring a crisis, disaster or an emergency, assuming that seed is needed, and putting in motion a well-established chain of suppliers. The financial solvency of systems such as these are completely dependent on and prefer perennial emergencies. The relief seed system was in full operation in Zimbabwe during most of the years from 1980 and for every year from 2002 to 2008. The system continued after 2009 and until 2013 but used market-based modalities to deliver subsidised seed.

Free distribution of seed is very profitable for suppliers as it facilitates the marketing of large quantities of a small number of crops by means of only a few transactions. Yet repeated free distributions have produced negative impacts in most of sub-Saharan Africa (Sperling et al., 2008). Frequent free seed distribution robs seed/grain traders of markets (Rohrbach et al., 2004), and because of its recurrent nature, people start expecting it; this creates perverse incentives and undermines seed acquisition strategies at the local level.

In direct seed aid approaches implementers usually procure, transport and distribute the seed. These approaches sometimes include food aid which is given to protect seed stocks. Frequently referred to as 'seeds and tools', because a hand hoe often comes together with the seed package, direct seed distribution is premised on the assumption that farming households do not have seed after a disaster. Since the approach often introduces seed from outside the locality, the implicit assumptions are that the quality of local seed is poor and that the varieties being brought in are appropriate to the agro-ecological and social context. Typically, direct seed distribution entails the use of certified hybrid seed because such suppliers meet donor requirements (Remington *et al*., 2002). As a result, direct seed distribution has been confined mainly to a narrow range of varieties and crops, especially those produced by the commercial sector which are extensively adapted (Sperling, 2001). Direct seed aid therefore also functions as a conduit for commercial seed and serves a market-building purpose. A large part of such relief in Zimbabwe is maize based and frequently includes hybrids (Rohrbach et al., 2005). Some direct seed distribution operations that have been implemented in Zimbabwe have used imported vegetable seeds. Many donors and NGOs seem to prefer direct seed distributions as these help them to spend money easily, follow the delivery process better, and produce 'concrete results' since the actual distribution of seed is almost certain.

In response to mounting pressure from some donors and NGOs for the seed of crops other than maize, direct seed distributions in Zimbabwe have also procured locally-appropriate crops and varieties, especially for small grains. The fact that seed is procured from the same area in which it will be distributed implies that seed is normally available in these situations and that access to seed is more likely the limitation faced by farmers (Remington, 2004).

When considering the distribution of seeds only, direct seed distribution is a simple approach that is usually conducted successfully. However, there are a number of operational challenges to implementing this type of aid. In the short term, seed often arrives late because it is procured in larger quantities, and the crop or variety choice may be incorrect (Overseas Development Institute (ODI), 1996). In the longer term, questions about the overall effectiveness of the approach in contributing to long term recovery become important, suggesting that direct seed aid is not always needed (Longley and Sperling, 2002).

Direct seed distributions have been implemented on a chronic and often near-continuous basis in Zimbabwe (Bramel et al., 2004). An emergency is declared almost year after year and, as the routine agricultural response, seed aid is provided. Frequently, in addition to not addressing the correct problem, the chronic delivery of seed aid has resulted in several negative consequences. There is growing evidence that frequent distributions alter the strategies that farmers use to procure seed (Phiri et al., 2004). For example, farmers interviewed for this study in the Mutoko, Murewa, Zvishavane, Zaka and Chiredzi districts, mentioned relief seed as one of their ways of acquiring seed. As expected, recurring seed aid has led to the rise of the relief seed system as a parallel delivery system in Zimbabwe (Bramel et al., 2004). The entrepreneur who specialises in the quick delivery of a small range of crops could benefit from the frequent delivery of seed aid. Most farmers interviewed during this study requested a halt to free seed distributions as they were making people lazy—farmers were not applying themselves to acquire seed, or to save it. In addition, most key informants supported the termination of constant free seed distribution because it has been used as a political rather than an agricultural tool, especially during election years in Zimbabwe.

In 2009 the macroeconomic situation in Zimbabwe began to show signs of recovery. In 2010 there was a rethink by the donor and NGO community regarding the implementation of agricultural input (seed and fertiliser) subsidies, and the delivery of seed aid has become more market-friendly, most notably through voucher based systems. Since 2010 the broad aim of these programmes has been to re-establish the commercial supply chain for seeds with agro-dealers at the heart of the seed business. The FAO case implemented during the 2012/13 agricultural season has been discussed in the section on subsidy programmes (see Overview of Green Revolution in Zimbabwe).

Starting in 2001 a number of organisations had piloted market-based interventions. CARE International implemented a seed assistance voucher programme that supported agro-dealers in Masvingo Province (Musinamwana, 2009). In 2002 the CRS piloted a seed vouchers and fairs (SVF) programme in emergency situations (Mazvimavi et al., 2008). SVFs were common in Zimbabwe during the years 2002 to 2009, to encourage the on-farm conservation of plant genetic resources. The use of vouchers alone has become important in programmes implemented after 2009.

Seed fairs have their origins in safeguarding cultural heritage and biodiversity and are structured to help farmers preserve their seed diversity and increase awareness of its value (Jarvis et al., 2000). In biodiversity-focused fairs, although very small quantities of seed change hands, the exchange of many varieties takes place. The fairs do not aim to supply seed as such, but rather to transfer genetic material with its attendant cultural heritage and knowledge, as well as to bring seed sellers together in the same place, minimise the misuse of vouchers and simplify logistics. Seed fairs are usually organised for one or two days in multiple locations locally. CRS and Plan International have organised seed fairs to which agro-companies and farmers brought seed and other inputs, to sell, at a dedicated place where potential seed sellers and voucher holders are present. In the case of Care International, farmers received vouchers to buy seed and other inputs from agro-dealers (Mazvimavi *et al*., 2008).

The SVF approach facilitates timely access by farmers to the seed of the crops and varieties they want. In Zimbabwe, NGOs have used cash and vouchers to connect farmers to formal seed sector shops (Rohrbach et al., 2004). New varieties frequently circulate through local vendors, allaying fears that farmers are limited to using only local varieties if using this approach (Otysula et al., 2004). SVF tactics support both the seed voucher recipients, who are the buyers, as well as the sellers of seed. This includes other farmers and many small traders who sell seed to obtain direct income for use in augmenting other economic activities. The approach allows poor households, including women, to sell seed and offers economic support to local seed systems. Between 65% and 85% of aid resources revert to the local economy during a fair (Walsh et al., 2004). Seed fairs also offer opportunities for knowledge exchange among farmers, and between farmers and traders, on a wide range of topics including crop varieties and seed quality (Makokha *et al*., 2004).

There are a number of disadvantages associated with the use of SVFs during emergencies. The first concerns the quality of the seed. Some implementing partners feel responsible for the seed they distribute and may not support the use of farmer-produced seed acquired directly from producers, on local markets or through traders (West and Bengtsson, 2005). The promoters of seed fairs have responded by setting up on-site committees to screen farmer-produced seed and by sponsoring independent testing, using formal parameters. CRS proposes a form of social sanction—which they call 'social certification'—whereby farmers will not patronise a seller who has cheated at one fair, at subsequent fairs. With more refinement this may become one of the most powerful forms of control.

Several activities focus on seed and varietal quality. The introduction of new varieties (and crops sometimes) during relief operations has become more acceptable to both implementing partners and farmers. Such efforts are sometimes referred to as 'developmental relief', since they link emergency aid to the circulation of improved varieties. Parallel interventions in the recovery and development phase also promote the introduction of new improved varieties into local systems through activities such as PPB and PVS.

Another challenge for the SVF approach centres on scale, logistics and staff capacity. One critique is that because SVFs are locally organised they reach a limited audience—an average of 500 participants per fair, but mostly from within the locality. This could become costly; in order to cover a range of agro-ecological zones and communities, numerous fairs will have to be organised. In turn, this will require the availability of sufficient expertise to work in geographically extended areas (Bramel et al., 2004). There are other concerns about the approach: fairs could drive the price of seed up; fairs do not always provide the range and quantity of varieties required; fairs may favour large over small traders (Van der Steeg *et al*., 2004). All these issues need further investigation.

In principle the concept of seed fairs is a powerful one and it may be possible to work with existing processes to widen the scope of seed fairs beyond their localities. For example, it may be possible to facilitate farmer exchanges between the fairs where farmers can exchange diverse genetic materials and learn from one another. This could start quite simply by matching farmers in similar agro-ecological zones that are quite far from one another geographically. This will enhance diversity among local seed supplies.

Farmer involvement in certified seed production and quality declared seed

Although large-scale commercial farmers continued to be significant maize seed producers, maize production from this sector decreased from the 1980s and during the 1990s, as these farmers diversified into higher value products, such as horticulture and flowers (Moyo, 2000; Utete, 2003). Increasingly, government targeted the smallholder sector as producers (Jayne *et al*., 2005). Smallholder farmers working with seed companies, international agricultural research centres, AGRITEX and NGOs produced most of the non-maize food crop seed that was sold for relief seed in the early 2000s (Bramel *et al*., 2004).

Where local level seed production for community-based seed multiplication groups was supported technically and organisationally, for example at the FFS in Murewa district, there was an abundance of seed from small grains, groundnuts and cowpeas. FFSs, as well as individual farmers who still held stocks of small grains produced a long time ago, cited the marketing of produced seed as a major constraint. It is easy to sell seed locally during the first few seasons but the markets are soon saturated, as every farmer begins to sell her/his own seed. There is a need to link commercial seed production efforts with a marketing plan even before seed multiplication; this should include an assessment of demand, local needs and the presence of other distribution outlets.

In the 1996/97 season, FFSs started in Zimbabwe with a programme on Integrated Pest Management (IPM). In the 2003/04 season, FAO supported some FFSs with integrated soil nutrient and water management. The farmers were also trained in the multiplication of cowpeas, ground nuts, pearl millet and sorghum seed. The FFSs multiplied seed as individuals and also as a group. In Tsholotsho, the number of FFSs that were multiplying seed grew from 6 to 46 between 2003/04 and 2008/09. The amount of seed multiplied by these FFSs also improved immensely. For example, in the 2003/04 season the FFSs produced 14.5 tons of pearl millet seed, which increased to 84 tons in the 2008/09 season. Groundnut seed production rose from 10.2 tons to 28 tons in the same time. SeedCo contracted the same FFSs for four seasons to multiply sorghum and pearl millet seed; and the GMB contracted the same farmers to multiply the same crops. Agriseeds purchased 30 tons of cowpea seed from just one of the communities in 2009 (Sperling *et al*., 2009).

NGOs like CTDT, Plan International and others have worked with farmers to establish community-based seed production schemes, which have produced mainly small grains. NGOs help the farmers get seed from a public breeding programme or a seed company, procure other inputs and sometimes pay for quality control services from Seed Services. Then the NGO trains the famers in seed production, the choice of variety and crops, seed sources, quality control, cleaning, packaging, the marketing of seed and issues of sustainability. The producers then approach Seed Services for seed quality inspection. Seed Services inspects at least 10% of the seed crops and at least 10% of the seed that is offered for sale. Organisations such as CTDT and Plan International have adopted the FFS concept for seed multiplication. Plan International managed a seed multiplication project in the Chiredzi and Chipinge districts, using planting materials for sorghum (macia, SV1 and SV4), millet (PMV1, PMV4 and Okatshana) and cowpeas (CBC1, 2 and 3),from research institutions such as CBI and ICRISAT. Plan has also been promoting the production of sesame seed, known locally as runinga. CTDT operates in ten districts to support seed multiplication of both farmer-saved and improved seed, mainly bulking up pearl millet, and working with SeedCo, ICRISAT and Agriseeds on improved seed. For these activities farmers have a total of 1 582 accessions in community seed banks; cowpea and sorghum are the main crops but the banks include indigenous vegetables, groundnuts, millet and maize (CTDT, 2014).

In Zimbabwe, several types of interventions have addressed seed quality. Some, for example Plan's activities in Chipinge district, emphasised improvements in the sanitary, physical and physiological quality attributes of 'below-average' planting material. These efforts could be very important for vegetatively-propagated crops. Other interventions, for example the FFS in Tsholotsho, are regarded as profit-making enterprises and specialise in building business skills. Most seed quality-related work, except occasional new variety injections, aims to strengthen seed systems in case of any transitory disasters. Further investigation could be done to see what lessons can be learned for seed quality control in farmer-managed systems.

In Zimbabwe QDS is termed standard grade seed (Mujaju, 2010:12); this is not officially recognised but is tolerated. According to FAO (2006a), QDS is seed which meets the minimum standards set for the concerned crop species and which has undergone stipulated germination, analytical purity and varietal purity quality control measures. The QDS system intends to offer less demanding quality control during seed production, and yet control that is sufficient to produce good quality seed for both in-country use and cross-border trade. QDS can arise from varieties developed through breeding, landraces or from alternative plant breeding approaches, like PPB. Minimum standards may be different from those for varieties developed through formal plant breeding programmes and, for technical reasons, the national controlling authority may enforce a limitation on the number of generations produced.

Standard grade seed allows farmers to grow seed without meeting stringent certification requirements. It is defined as a class of seed that meets the minimum germination and purity requirements only, as stipulated in the seed regulations. There is a list of crops eligible for production as standard grade seed. Most of the listed crops include the seed of self-pollinating crops like rice, sunflowers and others; the seed of crops with high seed rates but low multiplication rates like groundnuts, cowpeas, sugar beans, bambara nuts and others; and OPV maize, sorghum, and pearl and finger millets. Crops on this list are also called 'non-compulsory'; this refers to the fact that it is not mandatory to apply the DUS system for variety identification. It is illegal to sell standard grade seed of crops on the compulsory list that require DUS testing (see above), although there are exemptions for farmers producing seed on their own land that is not for a formal system, as indicated above.

Standard grade seed is labelled for sale. As a minimum, every label shows the following: the crop species, variety name, the words 'standard grade seed', a reference number of the seed lot, the name of the seed producer, physical purity percentage, germination percentage, net weight, details of any chemical treatment and the name of the responsible authority. Labels are attached in a way that makes their reuse impossible.

Farmer assessments of the impact of the commercial seed sector in Zimbabwe

Most of the farmers we interviewed, especially those allied to organisations that practice organic farming, such as ZIMSOFF, Tsuro Trust, PELUM, Chikukwa Ecological Land Use Management Trust (CELUCT) and other CA and agro-ecology organisations, considered the impacts of hybrid seed technologies in a broader historical context. A number of impact areas were identified: loss of agricultural biodiversity; deforestation; changes in the production of crops grown, areas planted to maize and other crops, varieties grown, yields obtained over time and the associated costs of production; marketing and income issues in terms of policy support for different crops; input and output prices and markets; and consumption issues in terms of dietary diversity and the processing of various foods.

Mono-cropping of maize has been blamed for monotonous maize diets which have made people weak and susceptible to all sorts of disease, due to low immunity and disease resistance. Diets used to be varied and exciting, as recollected by the Zvishavane group. There were several ways of preparing sorghum, including mixing it with milk to make *mavhuvegwa*, (a sort of bread), *matsevengwani* (a variety of cookies), and *mutongoza* and *mbwire mbwire* (a kind of roasted grain, salted and ground, eaten in powder form). Respondents added that there were also numerous creative ways of making relish, to be eaten fresh, or dried and cooked in peanut butter, sesame butter, or oil from *shomhwe* nuts, with fruit from the marula (*Sclerocarya birrea*) or mobola plum (*Parinari curatellifolia*) trees. A wide range of vegetables could be picked from the forest, dambos and arable fields, as well as many types of mushroom, but these can no longer be found. According to Mr Jacob Mvuto, Councillor of Murowa Ward, Zvishavane district:

> *People of old were strong and very fit yet there were no hospitals, doctors and tablets unlike these days where we are living on tablets ... These days you get people just collapsing and dying or getting paralysed. That never used to happen ... You see* vaMusinami *(referring to the chief) he is way older than all of us here but he can stand for hours on end, he can dance and his sight is still good, he can read without glasses which I can't do. He belongs to old school where they used to eat natural herbs ... But now that culture has been eroded, people are now living in and exercising their 'rights'.*

Respondents in Shashe village in Masvingo observed that both yields and production have been declining over the years, as they cannot afford the fertilisers that go together with hybrid seed. Another impact of hybrid seed is a change in labour patterns that was observed across all the sites. Respondents said it was possible to grow large areas of small grains in the past because households would team up together for critical operations like ploughing, weeding, harvesting and threshing. Beer brewing was a routine endeavour which accompanied all these activities. Households would brew beer for ploughing (*doro remagejo*), beer for weeding (*doro rekusakura*), beer for harvesting (*doro rekucheka*) and beer for threshing (*doro rekupura*). These activities were given different names in different places, like *humwe, jakwara* or *nhimbe*. Men did the heavier aspects of this work, like ploughing, while some women and girls cooked, while others helped with broadcasting the seed, weeding, harvesting and winnowing. This was done in turn, according to the needs of different households. But the advent of hybrids has changed all this—according to Mr Makuvire, the District Agricultural Extension Officer of Murewa district, people have become more and more selfish in the pursuit of profit.

SOIL FERTILITY

Overview

Zimbabwe's agrarian structure historically is dualistic, with large-scale commercial farming on the one hand and small-scale subsistence production on the other. Seventy per cent of Zimbabwe's soils are sandy and inherently infertile, low in organic matter and prone to leaching. Nitrogen (N) and phosphorous (P) are the most limiting factors, with multiple micro-nutrient deficiencies in degraded areas. Soils are largely low in pH (acidic) which reduces the effectiveness of nutrient inputs. Three quarters of small-scale farmers are located on sandy soils in semi-arid areas (Dhliwayo, et al., 2009:1). NR I, the agro-ecological zone with the highest rainfall and the best conditions for production, has mostly acidic soils that are highly leached.

As was the case elsewhere in the region, a differentiated support system accompanied the dualistic agrarian structure. Development of a synthetic fertiliser sector for large-scale commercial farmers was initiated as early as the 1930s. Large-scale producers were the focus of support all the way into the 1990s, although a new channel was opened to small-scale farmers from the 1980s. In the period prior to the 1980s, small-scale farmers were left mainly to their own devices for subsistence production. These farmers relied on traditional methods of production, many of which are agro-ecological techniques. This section of the report first looks at the continuation of some of these agro-ecological techniques; it then considers the development of the synthetic fertiliser industry in Zimbabwe, its expansion into small-scale agriculture from the 1980s up to the current situation; and then focuses attention on more recent interventions around ISFM and CA.

Review of agro-ecological practices for soil fertility

Smallholder farmers in Zimbabwe historically have used a number of methods for soil fertility management. The most important of these encompass the addition of SOM from a variety of sources, including soil from ant heaps, animal manure, especially from cattle, and humus from rotting leaves; nitrogen fixing including through rotations with grain legumes like groundnuts, tree legumes like *faidherbia albida*; and intercropping of cereals with grain legumes such as cowpeas and bambara nuts. These soil fertility practices are combined with other land management practices such as fallow cropping. These practices were confirmed by all respondents in the research. One of the respondents, Nelson Mudzingwa, the ZIMSOFF National Coordinator and member of the Central Cluster in Masvingo district said:

> *This idea of feeding crops came with hybrids, long ago people used to feed the soil using such techniques as mixed cropping, humus, termeteria, manure, resting the fields through fallows, having fields around homesteads where rubbish from the kitchen would be allowed to rot then spread in the fields ... Later on after Alvord, rotations were introduced but these have since been done away with as people are now mono-cropping ... then the soil would feed your crops. The soil would be rich, alive and healthy but now our soil is dead.*

Animal manure is a main source of soil nutrients for smallholder farmers on communal lands in Zimbabwe. There is a common pattern to all communal lands regarding the production and management of animal manure. Animals (goats, sheep, cattle) are herded in grazing areas during the day throughout the cropping season and penned at night in kraals (enclosures) located at the homestead. During the non-cropping season animals are not necessarily herded during the day, but they are penned at night for manure and protection from wild animals and thieves. Kraal manure is removed towards the end of the dry season. It is allowed to cure for up to three months and then spread on the fields in September/October, in time for land preparation for the next cropping season.

Cattle manure is used most often because there are generally higher volumes and most people own cattle, compared with sheep and goats. If penned for a whole day, Kraal manure left to cure and ready for use, Shashe village, Masvingo.

one livestock unit (1 LU = 500 kg live mass) subject to feeding, can produce up to 1.5 tons of recoverable manure per year (Rodel et al., 1980). Cattle drop a large amount of manure on common grazing lands where it remains uncollected.

Mr Mavedzenge, a former researcher with the Farming Systems Research Unit of the DR&SS, who is also part of the ZIMSOFF Central Cluster in Masvingo, says he believes in soil fertility management informed by research. While organics (livestock manure and biomass) are good, he said the percentage of N is very low (1%) if used directly. There may be a large weed burden and benefits may be derived only in seasons after application, as organic matter needs to decompose. To address this farmers resort to the pit storage of manure: they dig a 2m deep pit, place the manure in it and cover it, which allows anaerobic respiration to take place. This generates the high temperatures needed to concentrate nitrogen, kill weeds and produce well-cured manure. The result is very good manure with improved N of around 3%, which does not burn or scorch crops and in which weed seeds have been incinerated. This can be considered as a fertiliser to be put in rows, rather than spread everywhere. Mr Mavedzenge said that composting in the traditional way, by mixing manure with crop stover and allowing it to mature for months on-site and in heaps can work. However, farmers tend to prefer curing manure in pits as there are greater benefits.

Smallholder farmers in Zimbabwe also use composts for enhancing soil fertility, especially in gardens but increasingly in fields as well. Composts are heaps of organic matter, green matter, manure, etc. above or below the ground, made in such a way that the heaps are no wider than 1.5 m, to allow for air movement and decomposition. The various layers are sprinkled with water to enhance decaying. Composts used to be turned when they became very hot but organisations like CADS have been promoting what they call 'thermal composts', which are allowed to generate a lot of heat to kill all the weed seeds and hasten decomposition.

Zimbabwe has a long history of promoting green manure trials through the Soil Fertility Network, funded by the Rockefeller Foundation, and through the University of Zimbabwe/SADC/ICRAF programme, funded by the EU, among others. The trials involved both food crops (soya beans and cowpeas) and forage legumes (sun hemp and velvet beans), rotated or intercropped with maize to lessen striga (witch weed) infestation, enhance soil fertility, and improve maize yield. Although substantial benefits in cereal yields have been realised following only one season of a green manure crop, this has not provided sufficient incentive for uptake by smallholder farmers. One approach that has proved to be attractive to farmers in much of southern Malawi and parts of Zimbabwe with low livestock populations is inter-cropping maize with legumes such as pigeon pea or cow pea (Sanginga, et al., 2001). Although the work generally demonstrated that green manures improve soil fertility and maize yields (Mapfumo and Giller, 2001; Muza, 2003), it has not gone beyond the experimental level. The use of green manures to improve soil condition and fertility has declined to insignificant levels because of increased synthetic fertiliser use, management challenges and economic changes (FAO, 2003).

When pigeon pea is planted between maize planting stations, the maize plant population

Composts in Domboshawa and Chikwaka communal areas, Goromonzi district.

and yield can be maintained, while at the same time obtaining the yield advantages from harvesting the pigeon pea (Sakala, 1998). The slow initial growth of pigeon pea offers minimal competition with the cereal for water or light, and its continual growth during the dry season after maize harvesting makes it an ideal inter-crop legume. The leaves that fall from pigeon pea before cereal harvest produce a mulch capable of adding up to 90 kg N/ha to the soil. This mineralises fairly gradually throughout the following season, availing N for the next maize crop (Adu-Gyamfi et al., 2007; Sakala et al., 2000). Although not offering the best soil cover, pigeon pea offers a significant rotational benefit for the following crop.

Evaluations of a range of soil fertility improving technologies, including green manures, grain legumes and fodder legumes, have indicated that smallholder farmers consistently prefer grain legumes owing to their role in direct food provision (Chikowo et al., 2004; Adjei-Nsiah et al., 2007; Kerr et al., 2007; Ojiem et al., 2006). Although agroforestry legumes and green

Maize-cowpea-mucuna intercrop, Goodhope FFS, Murewa.

manures are a lot better at providing N and mulch for ensuing crops (Giller and Cadisch, 1995), they do not offer farmers the other direct benefits they seek.

Fertiliser trees are categorised under agroforestry, a land management system blending tree growing activities with conventional livestock and crop husbandry. Agroforestry as a science developed in response to widespread environmental degradation caused by increased deforestation; the increased deforestation resulted from growing pressure on woodlands and forests from livestock and human populations, which produced overgrazing and over-cropping. The use of trees in agriculture had been a consistent feature of production in traditional agricultural systems in Zimbabwe—until the advent of the Green Revolution. It was common practice for fruit trees like marula (Sclerocarya birrea), mobola plum (Parinari curatellifolia) and monkey orange (Strychnos cocculoides), to be left in place. It remains common to grow crops under certain trees which have a beneficial impact on the crops. This is a common practice in Gokwe and Binga districts in Zimbabwe, where the apple ring tree, also called winter thorn (Faidherbia albida), grows naturally. All focus group respondents confirmed the traditional land management system that not all trees—especially fruit trees like fig tree species or marula—would be cut down in arable lands. Big trees would merely be trimmed to reduce shade.

This changed with magobo (destumping), which was advocated with the coming of the Green Revolution. Yet roots play a very important role in binding the soil. Chirimisi, the extension system, undermined the practice of leaving trees in arable fields. This fuelled

Grain legumes in Murewa district.

deforestation by encouraging all people who had enrolled for extension teaching to construct three kraals, even if they did not have cattle. Zimbabwe has a long history of research in agroforestry for soil fertility management.[14] While some aspects have worked very well with smallholder farmers, other agroforestry aspects have hardly gone beyond the research station.

The *chitemene* system represents the best form of natural fallows. Farmers would clear land, plant on it for several seasons and when it was no longer productive they would move on to new land, when the cycle would start again. This type of bush fallow has not been possible in recent years in Zimbabwe, given increased population pressure and land shortage. While this practice has stopped, communal farmers retain fallow systems (known locally as *maradzaminda*) on their arable lands—at any point in time a family will have one or more fields that are not being planted. This may be for fertility regeneration, the result of labour issues, or constraints related to draught power.

Improved fallows (*maradzaminda anehungwaru*) make use of land lying fallow by planting fast growing nitrogen-fixing trees to improve fertility. The trees are removed after two or three years, and the land is cropped for three or four years. Improved tree fallows shorten the time required for soils to recover fertility, compared with 8–10 years under bush fallow. Tree fallows have a low labour demand and substantial amounts of organic matter are added to the soil. Tree species for improved fallow are selected for their ease of establishment, fast growth and the production of lots of leafy biomass and nitrogen-fixing ability. Suitable species that have been used are *Sesbania sesban, Tephrosia candida, Cajanus cajan, Gliricidia sepium* and *Calliandra calothyrsus*. While improved fallows shorten the fallow period and generate a lot of organic matter, they are not being used extensively by smallholder farmers who prefer grain legumes because they are a direct source of food (Chikowo *et al*., 2004).

Nitrogen trees used for improved fallow and livestock fodder, ICRAF farm, Domboshawa.

Mixed cropping is an agroforestry system which uses crops integrated with fertiliser trees. The same tree species as for biomass transfer can be used but have to be managed by cutting. In Zimbabwe mixed cropping was practiced as part of the Protracted Relief Programmes in seven districts, including Mutoko, Zaka, Mazowe, Makonde, Kariba, Chimanimani and Mutasa. During fieldwork for the current study researchers found evidence of farmers still practicing these techniques.

14. Interview with L. Matarirano, ICRAF focal person in Zimbabwe.

Table 16: Land and soil fertility management over time in Ward 9, Mutoko District

Aspect	1970s	1980s	1990s	2000s
Chitemene	XXXXXX	XXXX	X	
Mixed cropping	XXXX	XX	X	X
Intercropping	XXXXXXX	XXXX	XX	XX
Termeteria (anthills)	XXXX	XX	X	X
Humus	X	X	X	XXXX
Manure	XXXX	XX	XX	XXX
Fertiliser		XXXXX	XXX	XXX
Compost			XX	XXXX

Source: Fieldwork

For example, a number of farmers were still practicing mixed farming with trees in Ward 9 in Mutoko, and in Zaka and Chimanimani districts (Table 16) although they faced some challenges with keeping animals out of the fields. These practices remain widespread in Zimbabwe and help farmers in periods of economic crisis, when externally-sourced forms of nutrients including synthetic fertilisers cannot be relied upon.

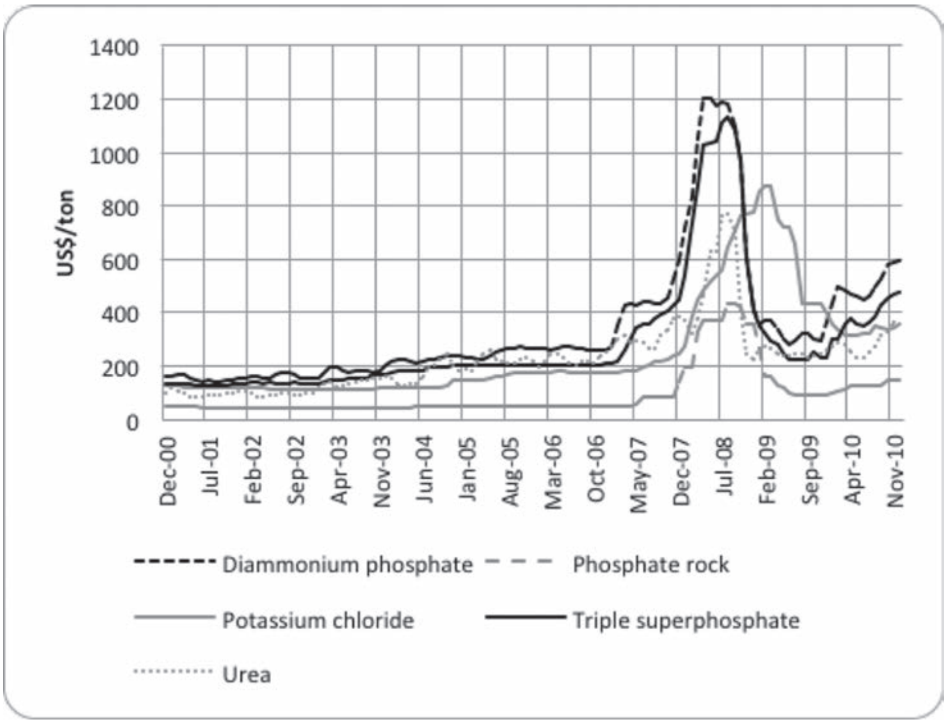
Synthetic fertiliser use in Zimbabwe

At the outset we define synthetic fertiliser as any fertiliser that goes through an industrial process of ingredient manufacture. All fertiliser, whether synthetic or organic, is composed of chemicals and their bonds. Synthetic fertilisers tend to focus on increasing yields as a key target. They are most effective with seed that has been tailored to realise maximum growth with specified doses of synthetic fertiliser inputs. Crop hardiness outside this context is not given as much attention, even though this is the condition faced by the majority of small-scale farmers.

Synthetic fertiliser use has a long history in Zimbabwe, starting in the 1930s. The Fertiliser, Farms and Feeds Act was passed in 1952 and regulated the commercial industry. From the outset until well into the 1990s the focus of synthetic fertiliser use was the large-scale commercial farming sector. However, from the 1980s investments were made to extend synthetic fertiliser use amongst small-scale farmers, including through agricultural loans. During the entire period, until the ESAP in the early 1990s, the government maintained direct control of fertiliser trading. The ESAP liberalised markets by removing price controls and deregulating foreign exchange, although government regulation still existed for imports and the approval of fertiliser composition (Minde *et al*., 2010:2). The 2000 fast track land reform severely disrupted these markets as commercial production was interrupted and restructured and the demand for synthetic fertiliser dropped.

Zimbabwe is one of the biggest fertiliser producers in sub-Saharan Africa. In 2009 Zimbabwe produced 100% of sub-Saharan AN, 28% of NPK, 18% of ammonia and 5.5% of phosphoric acid (ACB, 2014:18), while its companies also export into the region. Historically the country has relied on domestic production to meet domestic demand. The country produced around 560 000 tons of commercial fertiliser products a year in 2000, but this dropped to just 150 000 tons in 2009, with a three quarters drop in nitrogen, phosphorous, potassium blends (NPK) and AN production (Kachere, 2010:10). Capacity utilisation was under 30% in 2008 although it started recovering in 2009 (Kachere, 2010:11). Figures show that consumption was already dropping from the mid-1990s at least, and that there was not a particularly significant shock decline after 2000 but rather the continuation of a longer downward trend in consumption (Kachere, 2010:12). This suggests land reform was not the only factor resulting in declining fertiliser use. Zimbabwe also faced a series of droughts during the 2000s. In addition, global prices skyrocketed during the speculative commodities boom that fed into the 2008 crash. Fertiliser prices rose almost vertically

Figure 4: Global prices of key fertiliser ingredients, 2000–2010



Source: http://www.indexmundi.com/commodities/.

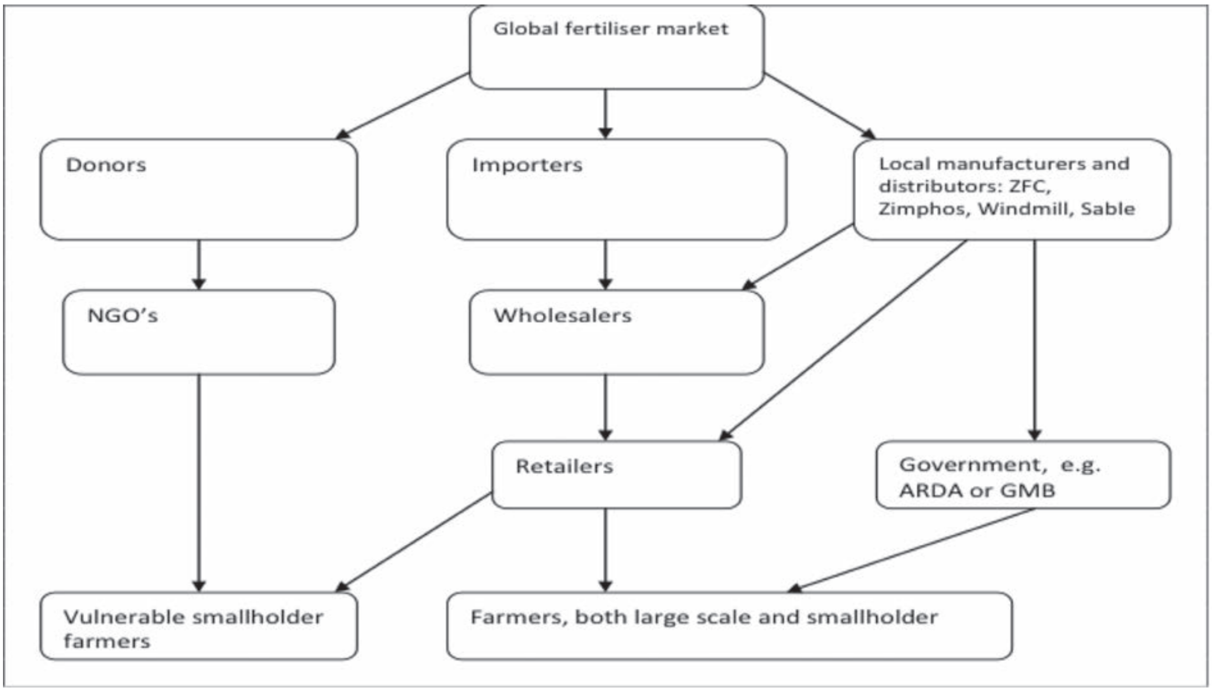
from May 2007 to July 2008 before the market collapsed (Figure 4). Consumption declined thereafter, with significantly volatile external and internal developments preventing the smooth organisation of markets.

Prior to 2000 about half the fertiliser used was allocated to maize, followed by tobacco (12%), wheat (11%), cotton (6%), sugar (4%) and horticulture and soya beans (3% each) (FAO, 2006:33). Small-scale farmers utilised 90% of all fertiliser on maize, while for the commercial sector this figure was around one third (FAO, 2006:35). About one fifth of small-scale farmers were using fertiliser prior to 2000. Small-scale farmers who were interviewed for this research confirmed that most of the fertiliser they use now is applied on hybrid maize, while very little or none at all is applied on other crops. The main types of fertilisers used are straight fertilisers, including AN, ammonium sulphate, calcium nitrate, single, double and triple phosphates, potassium chloride, potassium sulphate, sodium nitrate and urea; compound fertilisers, e.g. compound A and D; and fertiliser blends, e.g. specialised maize and tobacco blends. These fertilisers come bagged and in granular form.

In conversation with farmers we found that those in the higher rainfall districts of Mutoko, Murewa, Goromonzi, upper Chimanimani and Chipinge, routinely use fertilisers. Farmers in lower Chipinge, with black clay soils, who never used to apply synthetic fertilisers are now utilising it, though sparingly and on an irregular basis. Farmers cited the high cost of fertilisers as being the major constraint to improving soil fertility. We should investigate further to see whether the situation is similar to that in neighbouring countries, where farmer dependency on synthetic fertiliser, from season-to-season to produce a harvest, is a concern. In such circumstances, farmers are caught on a treadmill with few options but to keep paying to produce a crop.

The supply of fertiliser in Zimbabwe arises from a combination of domestic production and commercial and aid imports (Figure 5). In recent years, about 32% of fertiliser and chemicals were produced domestically and the rest were imported (MIC, 2011:24). Domestic products tend to be cheaper than imports

Figure 5: Structure of the fertiliser industry in Zimbabwe



Source: Adapted from Minde et al., 2010.

(Kachere, 2010:7). In the 1980s government controlled the fertiliser sector and allocated foreign exchange to companies to purchase production inputs. With liberalisation in the early 1990s, MNC fertiliser companies entered Zimbabwe as agents to sell fertiliser (Minde et al., 2010:4). Nevertheless, between them, local companies Zimbabwe Phosphate Industries (Zimphos) owned by Chemplex Corporation; Zimbabwe Fertiliser Company (ZFC); Sable Chemical Industries and Windmill dominate the market. These companies have a cross-linked ownership structure (MIC, 2011:24). Sable imports ammonia for production into ammonia nitrate which it sells to Windmill and ZFC. Zimphos uses domestic sources of phosphate rock and pyrites, imports sulphur and manufactures and sells superphosphates to Windmill and ZFC. The latter two combine the products from Sable and Zimphos together with imported potash to produce NPK compounds and AN top dressing (Kachere, 2010:4).

Other smaller companies operate in niche markets for speciality chemicals or processes. For example, Nico-Org produces organic fertilisers including slow-release urea. Other players in the industry are traders who do not produce their own fertilisers from scratch, but buy them locally or import them in bulk, and then repackage or blend and sell. Such traders include Omnia from South Africa, Farmers' World of Malawi, and Nutrichem, a Zimbabwean company importing products in bulk from South Africa.

Significant investments in input subsidy programmes, as shown above, indicate government orientation towards increasing synthetic fertiliser use. The fertiliser and chemical industry is identified by government as one of four priority pillars in the industrial development plan for 2012–2016 (MIC, 2011). In an effort to support domestic fertiliser production, government has proposed a zero tariff for raw material imports for fertiliser production, while tariffs will be imposed on finished products (MIC, 2011:24). Trade and tariff structures, business financing and land tenure are some of the key policy issues that have been identified, and a call has been made to develop a clear fertiliser policy (Kachere, 2010:19). These mirror the wider Green

Revolution agenda that can be seen clearly in the G8's NAFSN, even if this programme does not operate directly in Zimbabwe.

Integrated Soil Fertility Management (ISFM) and Conservation Agriculture (CA)

Ziimbabwe has seen extensive research spanning many decades on soil fertility enhancement and management, based on organic and synthetic fertilisers (e.g. Grant, 1967; Mashiringwani, 1983; Mugwira and Murwira, 1997). Research has involved fertiliser types, rates and the timing of applications for the different soil types, cropping and farming systems and rainfall regimes in all the agro-ecological regions. The Agronomy Institute and the CSRI within the DR&SS spearheaded this research, especially during the early period after independence when they received funding. Though the Institutes carry out soil improvement research involving synthetic fertiliser and organic and bio-fertilisers, such as legumes, due to funding constraints they are currently running only one experiment offsite. The aim of the experiment is to establish how to rehabilitate degraded arable lands, abandoned by farmers in favour of fields around their homesteads, through different soil management activities such as rotations, fertilisation and liming.

ISFM is essentially about blending appropriate external inputs, based on scientific recommendations, with practices that increase SOM. In practice, proponents tend to emphasise the availability of synthetic fertiliser as the priority. CA is a broad term for categorising a number of farming practices intended to enhance the sustainability of fibre and food production through water, soil and energy conservation. Conceptually, CA has evolved from an initial concern with the decrease or rejection of inversion tillage, as shown in earlier terminology such as "stubble-mulch tillage, zero tillage and reduced tillage", to a broad concept made of a package of three fundamental principles. These principles include the preservation of soil cover with crop residues or cover crops, the utilisation of crop rotations or inter-cropping, and the reduction or elimination of soil disturbance by adopting reduced or zero tillage techniques. GAP, which is based on improved management including thoroughness, precision and timeliness, could be added to these techniques.

Since the 1980s, a number of CA techniques were actively promoted and assessed in Zimbabwe: mulch ripping; clean ripping; no-till tied ridging; no-till strip cropping; hand-hoeing or zero till; and open plough furrow planting followed by mid-season tied ridging and tied furrows for semi-arid regions. These techniques have often been used together with mechanical structures, for example: dead level contour ridges with cross-ties, mainly for semi-arid regions; graded contour ridges; *fanya juus* for water retention in semi-arid regions; infiltration pits dug at intervals along contour ridge channels; broad-based contour ridges used mainly on commercial farms, and vetiver strips. Both ISFM and CA are areas for possible further investigation in Zimbabwe. They are important because they recognise in principle the importance of SOM for soil health and fertility, are recognised by government and have some resource backing.

We still need a fuller picture of these practices in Zimbabwe and their links to agro-ecology. Zimbabwe is the home of Allan Savory's path-breaking work on holistic management (Savory and Butterfield, 1998), which integrates farm livestock into the ecosystem. This has significant soil fertility implications and further research could look at ways in which to integrate the lessons from these practices with other agro-ecological techniques. It may be fruitful to pursue intersections with ISFM/CA approaches on issues such as:

- detailed soil testing;
- localisation of soil testing technologies to bring them closer to farmers' control;
- R&D/extension/farmer interactions and role of farmers in R&D;
- analysis of missing nutrients; and
- a deeper understanding of the science of prescription micro-dosing and synthetic fertiliser blends targeted to specific areas.

These could go hand in hand with practical work with farmer associations to systematise and share local knowledge that identifies what nutrients the soils and plants require, and to identify and assess possible local sources of inputs.

Dead level contours in Murowa Ward, Zvishavane district.

Ecological impacts of excess and imbalanced nutrient supply

As is the case with the Green Revolution across the continent, standard NPK is the main synthetic fertiliser input, though this may be changing as more companies realise the importance of greater precision and tailoring to local conditions. In this section we look at some of the consequences of excesses in some nutrients and deficiency in others. We should note that a 'pure' soil is undefinable. The presence of a compound because of human activity is not in itself sufficient to prove impaired soil functioning. The concentration of a compound in the soil is the most important consideration (Bolt and Bruggenwert, 1978:194–196). This does not apply only to synthetic fertilisers; it applies to any chemical input, including organic inputs. For example, manure generally releases N slowly, and excess application may lead to nitrate leaching out of season (Bolt and Bruggenwert, 1978:198).

Chemistry is the basis of interactions in a complex micro-system. The relationship between a plant and the soil boils down to the capacity for inter-exchange of chemical compounds. The soil is a living entity that also uses nutrients to survive—nutruents are not just for the plant. Standard recommendations (e.g. FAO, 2006) tend to talk about optimal use in terms of plant requirements, which obviously includes certain assumptions about yield targets and production conditions. Soil tests measure pH, the capacity of soils to transfer ions, and other factors that may constrain the plant from receiving its ideal nutrient requirements to meet its genetic potential. The soil itself also needs to have a certain dynamism within it, to perform the function of a carrier of nutrients for a plant. There can be an excess of supply from any nutrient source but organic systems tend to be self-balancing, whereas concentrated doses of a few chemical components can quickly cause imbalances.

What does oversupply do? Because of the slow impact reverberation into the soil system, possible impairments must be predicted before they happen. In order to do this scientifically, we will benefit from knowledge of the composition of the influx (what is being added to the soil), knowledge of the fate of the compounds, and the transport and accumulation processes of potentially hazardous compounds. Deeper understanding will benefit from knowledge of positive adsorption (electrostatic attraction), electrostatic repulsion, chemisorption and chemical bonding, precipitation and dissolution reactions, and decomposition and turnover reactions, including (photo)-chemical and microbial degradation (Bolt and Bruggenwert, 1978:194–195).

The malfunctioning of soil for agricultural plants has seldom been a problem for N. In other words, excess N does not damage the plant. Plants merely absorb what they need and the rest is left behind. Although excess N does not have any impact on the plant itself in the immediate sense, it has a number of other longer-term negative ecological side effects that will undermine the production system over time. The use of synthetic fertilisers leads to an increase in reactive nitrogen (N_r) in the ecosystem, because N_r is inefficiently used by plants and animals. Soils reach a nitrogen saturation point and the excess either leaches into water as nitrate or oxidises to become nitrous oxide (N_2O) (Schwartz, 2013:49). Although excess N does not necessarily lead to instantaneous leaching, this will occur in the longer term (Bolt and Bruggenwert, 1978:200). About 50% of nitrogen from synthetic fertilisers is transported downstream or downwind. Reactive nitrogen has become widely dispersed in the water and air, and is accumulating in the environment because creation rates are greater than removal rates (Galloway, *et al*., 2003:342–3).

A major negative effect of excess N is in runoff in drainage water, producing nitrates (NO3) which are a health hazard for humans and livestock. Seepage of reactive nitrogen into water ecosystems leads to eutrophication (too much plant growth and decay), hypoxia (loss of oxygen in the water), the loss of biodiversity, and an increase in acid levels and habitat degradation (Galloway, *et al*., 2003:343). A second significant negative ecological impact is on the production of N_2O, a greenhouse gas. Greenhouse gases in the atmosphere trap heat. Molecular nitrogen (N_2) found in the atmosphere is neither a greenhouse gas nor an air polluter. However, reactive nitrogen, especially in the form of N_2O, is a very strong greenhouse gas, with 298 times the warming effect of carbon dioxide (CO_2) over 100 years. Thus, despite its low concentrations in the atmosphere, it is the third largest contributor to greenhouse gases after CO_2 and methane (CH_4).[15] Human activity is thought to produce about 30% of all nitrous oxide released into the atmosphere, with livestock producing about 65% of human-related nitrous oxide.[16] Elsewhere the US Environmental Protection Agency (EPA) says most human-generated N_2O released into the atmosphere is caused by the application of nitrogen-based fertilisers.[17]

Apart from these effects, excess nitrogen can also destabilise the soil ecosystem itself. Malfunctioning of the soil as a filter of contaminants is not uncommon for N, because of its high mobility in soil (Bolt and Bruggenwert, 1978:197). Too much reactive nitrogen in the soil removes soil carbon. It speeds up the growth of micro-organisms that feed on nitrogen, at the expense of other soil dwellers, and these microbes consume the humus (Schwartz, 2013:49–50). Humus is the nutrient-rich layer of the soil which plants require to survive. Too much nitrogen also decreases biodiversity in many natural habitats (Galloway, et al., 2003:343). Excess N is quite simply remedied by reducing the supply (Bolt and Bruggenwert, 1978:194–196). This means paying more attention to the nutrient requirements of the soil and plants before applying N and other chemicals.

P has a similar story to N. Phosphates are found in the soil primarily as soil phase compounds with low solubility. This precludes inhibition of the growth of living organisms which means plants and even micro-organisms in the soil will not be affected by excess P in the soil. However, as with N, malfunctioning is mainly related to undesirable P concentrations in drainage water which also contribute to eutrophication (Bolt and Bruggenwert, 1978:210).

A key measure of soil health and fertility must be soil life, both macro and micro flora and fauna, ranging from beetles and earthworms down to bacteria and fungi. However, evaluation of the biotic soil fraction (living matter) is challenging because it is ongoing and dynamic (Bolt and Bruggenwert, 1978:194). Generally there is a tendency in soil testing to focus on soil chemistry to the exclusion of soil life, except where microbial activity plays a dominant role in the fate of the compound.

Other ecological impacts can be attributed to the shift to Green Revolution mono-crop agriculture. In Zimbabwe, deforestation is a concern. A number of factors contribute towards deforestation, including agricultural practices and poor forest management, unsustainable ways of collecting fuel wood, excessive timber extraction, and the underlying policy and market failures of forest resource pricing, land and tree tenure, as well as trade policies. This takes us well beyond simple chemical reactions and into the vast field of social and historical relations. Deforestation results in the loss of organic matter and nutrients held in forest ecosystems, and biodiversity loss. Green Revolution technologies have encouraged the expansion of maize production, in particular on lands otherwise unsuited to the crop.

15. https://en.wikipedia.org/wiki/Nitrous_oxide.
16. https://en.wikipedia.org/wiki/Nitrous_oxide.
17. http://epa.gov/climatechange/ghgemissions/gases/n2o.html

Table 17: Trend in forested areas, forest products and controls over time in Zvishavane district

	1940s	1960s	1980s	2000s
Forest area				
Forest products	Animals, birds, fuel wood, timber, fruits, mushrooms, vegetables, aesthetic beauty, humus, honey, insects, termites	Animals, birds, timber, fruits, mushrooms, vegetables,	Timber, some fruits and vegetables	Very little timber, some vegetables
Controls	Cultural norms and traditions upheld to prevent over deforestation	Cultural norms and traditions upheld to prevent over deforestation	Cultural norms and traditions to prevent over deforestation have broken down	There are no controls but equally no trees

Source: Murowa Ward FGD, Zvishavane district.

FGDs and key informant interviews conducted during this study in the densely populated communal areas of Mashonaland East, Masvingo and Manicaland, confirmed that deforestation has worsened in recent years (Table 17). Respondents indicated that forests play a very important role in local diets, especially during the years of droughts, through the provision of termites, caterpillars, honey, fruits, small wildlife species, mushrooms, etc. Forest services mentioned by respondents included construction poles and fuel wood. There was general agreement across all sites that there has been a serious decline in all these services, as very few forests remain after most have been converted to arable land or residential areas.

Respondents indicated the multipurpose functions of woodland resources in their local language, "*musango ndimo munobva zvese*", which means, 'you get everything from the forest'. Forests are a source of building materials, fuel wood, traditional medicines as well as organic manure for soil fertility management and browsing for livestock. To curb deforestation farmers affiliated to ZIMSOFF have resorted to building dry stone walls in Zvishavane and Masvingo districts.

CONCLUSIONS AND FURTHER WORK

Zimbabwe is in a unique situation regionally because of the fast track land reform programme and the resultant changes in the agrarian structure, but also because of the disruption caused by the unfolding of Green Revolution processes since the late 1990s. As with Cuba, following the collapse of the Soviet Union at the end of the 1980s, a profound crisis could also present an opportunity for renewal along agro-ecological lines. However, the Zimbabwean government has chosen to stick to the path of Green Revolution input subsidies rather than diverting resources to more decentralised and context specific support systems for the country's farmers.

Zimbabwe has a long history of Green Revolution interventions, including to small-scale farmers dating back to the 1980s. As in the rest of the region, these interventions were based on hybrid maize and synthetic fertiliser. Input subsidies and seed aid programmes have played a crucial in sustaining commercial input markets throughout the crisis and government and farmers are now locked into a Green Revolution input subsidy regime. This is very difficult to crack politically, and is entrenched in the relationship between the state and the society, even beyond individual governments. The context remains very fluid and is difficult to analyse because many variables have changed very rapidly. It is evident, however, that the smooth unfolding of the Green Revolution was disrupted.

Zimbabwe also has a history of many agro-ecological practices and perhaps some extension capacity in this regard. Challenges to developing and supporting these practices are the lack of public sector resources and the decay of the public sector. These are also challenges for Green Revolution interventions because this environment makes it difficult to build PPPs which are the preferred method of operation.

Zimbabwe has an existing network of organisations working with farmers to preserve and maintain seed at the local level. All seed used is farmer managed except for maize hybrid and a small amount of a few other crops. Farmers generally do not have an ideological opposition to using hybrid seed, but they do note the negative long-term effects on the socio-ecology. Zimbabwe's PBR law is one of the more progressive in the region, based as it is on UPOV 1978. The current law says farmers on 10 ha or less, or who earn at least 80% of annual income from agriculture on communal or resettlement land, are exempt from PVP. However, this will be under threat if Zimbabwe ratifies the Arusha PVP Protocol. Currently discussions are underway in regard to reviewing domestic PBR legislation, with a view to aligning it with UPOV 1991 (Mujaju, 2010). This will impose new restrictions on farmers' rights to recycle, maintain and exchange at will the seed produced on their own farms. This is in contradiction to Zimbabwe's membership of the ITPGRFA. The Arusha PVP Protocol must still go through a process of national consultation before it can be passed.

Seed certification and production systems in Zimbabwe have standard features seen throughout the region, including quality-controlled seed testing and regulations on the production and sale of seed. The system appears to be functioning well. There is a fairly strong private sector presence although the market has declined, especially since 2000, and a number of private sector entities have relocated their breeding and production activities to neighbouring countries. The private sector is focused on hybrid maize but is likely to start moving into legumes as a complementary crop for maize. Zimbabwe operates a QDS system and small-scale farmers appear to be involved both in their own seed production and in production for commercial or intermediate markets. This suggests a strong base of practice that could be a good lever for regional farmer exchanges.

As with seed, synthetic fertiliser has a long history of use in Zimbabwe, alongside which there are many indigenous agro-ecological practices. Generally, the Green Revolution resulted in the expansion of hybrid maize production into marginal areas based on subsidised inputs. This has produced negative ecological effects including deforestation. Zimbabwe is a major continental producer of synthetic fertiliser and the domestic industry is dominated by four main companies. Synthetic fertiliser production and use has dropped substantially since 2000, following the disruption of the Green Revolution. Recent approaches emphasise ISFM and CA as intermediates. This is a positive development in that there is explicit recognition of the importance of organic content in the soil. Further work can be done to investigate these practices in more detail.

This scoping report offers an initial sketch of the situation in Zimbabwe. There are many areas for further investigation. At the broad level, more work can be done on updating current Green Revolution interventions, especially looking at interventions by USAID, the EU and the UK, exploring how Zimbabwe fits into the regional agricultural corridors approach, and identifying PPPs. Further work can be done to map the various public programmes related to agro-ecological support, and to start identifying possible points of intersection. Where seed is concerned, civil society and farmer organisation responses to the domestication of the Arusha PVP Protocol will be required. Further study may be required on the workings of the PBRs and the seed laws, including who benefits, how they impact on the seed sector, how they facilitate corporate expansion, and other aspects.

A more thorough scoping of farmer involvement in seed production could be of value, including farmers' own seasonal seed saving and storage practices for own use and support needs, participation in PVS, PPB and QDS, and fully certified seed production. This could include a more detailed mapping of specific instances—how are the programmes working, have they benefited farmers and how, which crops are successful, what are the constraints, should it be supported, etc. Explicitly, this could take the form of identifying and working with specific farmer associations to identify support needs to build their precise breeding, seed enhancement, production and storage requirements, and to scan the public sector for existing programmes and possible channels of support. It would be interesting to look in more detail at the seed fairs approach as a potential mechanism for the farmer-to-farmer exchange of germplasm and knowledge.

Similar work could be done on agro-ecological practices in soil fertility. A focus still needs to be determined for this work, but ISFM/CA programmes may warrant deeper investigation, both to develop a critique and to learn from the approach. It will be valuable to connect the research to specific farmer associations, to embed the research and to identify key priorities for further work.

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