Smallholder Risk Management Solutions (SRMS) in Malawi and Ethiopia

Risk Management Scoping Study

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Abstract

This report synthesises information on pigeonpea (*Cajanus cajan*) in Malawi and teff (*Eragrostis tef*) in Ethiopia to justify their selection as entry points for action research on smallholder risk management. Our choice of these crops was based on five criteria: (1) their potential for scaling-out at national level; (2) their potential to reduce risk; (3) their market potential; (4) their potential to increase both household food security and cash income; and (5) their relevance for poorer smallholders and women. We selected Mulanje district in southern Malawi and Wollo South zone in the Amhara region as project areas. Our choice of these areas was based on their relevance for the crops in question, accessibility, and synergy with ongoing, complementary projects.

We developed a conceptual framework that identified four systemic risks along smallholder value chains: natural shocks; prices; economic coordination; and opportunism. We used this framework to identify the risks and risk management strategies (RMS) along the value chains for pigeonpea and teff. Both risks and RMS were identified based on a literature review and interviews with stakeholders, including smallholders, seed companies, processors, farmer organisations and policy-makers. Pigeonpea and teff are themselves RMS because they are adapted to semi-arid environments with a high drought risk; other potential RMS are shown below. The final choice of RMS will be made after the studies of the pigeonpea and teff value chains that will follow the current scoping study.

	Potential RMS	
Value chain	**Pigeonpea**	**Teff**
Systemic investment risks:		
Natural shocks	Varieties with range of field durations Improved varieties resistant to pests and diseases 'Nyongo' ('power') packs for pest control	Improved varieties resistant to pests and diseases
Price risks	Improved varieties with desired market traits for export market for *toor dhal*	Improved varieties with desired market traits for urban high-income consumers Improved profitability with TIRR technology package Grain storage for sale at peak price
Economic coordination risks	Increased seed supply of improved varieties using Small Seed Packs Increased awareness of improved varieties Collective marketing	Increased seed supply of improved varieties using Small Seed Packs Increased awareness of improved varieties Collective marketing
Opportunism risks	Forward contracting with local exporter	
Policy issues:		
Trade bans	No	Yes
Incentives for export	Yes	Limited
Research and Development	Limited	Limited
Delivery system for certified seed	Agro-dealers, Farm Input Subsidy Programme (FISP)	Farmer cooperatives, farmer seed producer groups

Relevant policy issues included trade bans, incentives for exports, and market-led agricultural research and development. The trade ban on teff was not relevant for smallholders since there is strong domestic demand and the export market is served by licensed, commercial growers farmers. The main policy issues for both crops is the limited investment in research and development, which has resulted in low productivity and the lack of an effective system for the delivery of certified seed, leading to the low adoption of improved varieties. Contrasts between the two value chains will enable the project to learn lessons about how risk management can promote the commercialisation of smallholder agriculture. These contrasts include: production for export (pigeonpea) and domestic (teff) markets; high price levels for teff, and lower price levels and high price variability for pigeonpea; private delivery systems for certified seed for pigeonpea, and public delivery system for teff; an efficient marketing system with few intermediaries for teff, compared with more layers of traders for pigeonpea; limited benefits from collective marketing for teff, but higher benefits for pigeonpea; and different gender roles in crop production and marketing, with women playing a major role for pigeonpea, whereas for teff women play a major role in crop production but a minor role in crop marketing.

We identified potential partners to help the project influence policy-makers. In Malawi, the primary channel for communicating project results and lessons will be the Legume Development Trust, which brings together the main actors in the pigeonpea value chain, including our project partners, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and Lilongwe University of Agriculture and Natural Resources. In Ethiopia, this role will be played by two organisations. At the regional level, we will communicate research results and lessons through the Bureau of Agriculture in Amhara, while at the national level we will communicate through the platform operated by the Africa Rising project, which has good links with apex organisations such as the Agricultural Transformation Agency (ATA).

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List of abbreviations

ATA	Agricultural Transformation Agency
AHCX	Auction Holdings Commodity Exchange
ARARI	Amhara Agricultural Research Institute
CISANET	Civil Society Agriculture Network
DFID	Department for International Development
EIAR	Ethiopian Institute of Agricultural Research
EPA	Extension Planning Area
FGD	Focus Group Discussion
FISP	Farm Input Subsidy Programme
FUM	Farmers Union of Malawi
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IFPRI	International Food Policy Research Institute
IPC	Innovation and Productivity Centre
LDT	Legume Development Trust
NASFAM	National Smallholder Farmers Association of Malawi
OPM	Oxford Policy Management
RDP	Rural Development Project
RMS	Risk Management Strategy
SAIRLA	Sustainable Agricultural Intensification Research and Learning in Africa
SNNPR	Southern Regions and Nationalities Peoples Regional State
SRMS	Smallholder Risk Management Solutions
TIRR	Teff, Improved Seed, Reduced Seed Rate, Row-planting
USAID	United States Agency for International Development

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1 Introduction

Smallholder Risk Management Solutions (SRMS) will test innovative RMS for selected value chains in order to increase participation by poorer smallholders. The project will focus on Ethiopia and Malawi. We selected these two countries for comparative purposes because they differ widely in terms of political economy, market institutions, livelihood systems and gender norms (OPM, 2016). We believe that these differences have important implications for how smallholders manage risk.

As the entry point for research on smallholder risk management, we selected one value chain for each of our two target countries. Our choice of value chains was based on four criteria:

1) Potential for scaling-out;
2) Potential for market growth;
3) Potential to both benefit household food security and provide a cash income; and
4) Potential for social inclusion of poorer smallholders and women.

To increase the relevance of these value chains for poorer smallholders, we targeted staple food crops. Value chains for staple food crops have low barriers to entry and are therefore more broad-based than higher-value commodities such as horticulture serving global supermarkets with stringent quality standards. In addition, they combine both household food security and income objectives. Market-led intensification may fail because farmers do not adopt innovations with higher risks for household food security. Intensification to increase household food security may fail because farmers are reluctant to adopt innovations that do not offer immediate cash returns. Combining food security and income objectives is therefore an important RMS for smallholders.

This report presents the findings from a scoping study to identify specific value chains. The general objective of the report is to justify our choice of value chains for the project. The four specific objectives are to:

1) Describe the target regions and crops;
2) Analyse the systemic risks associated with each value chain;
3) Identify RMS to overcome these risks; and
4) Identify relevant policy issues and partners to influence policies.

The results from this scoping study will provide the context for two other research outputs planned for 2017, namely a diagnostic study of the selected value chains, and of seed supply systems.

Information for the scoping study was collected through a review of literature and databases and through interviews with value chain actors, including smallholder farmers, extension agents, processors, and service providers. A full list of interviews held is presented in Annex A. In Malawi, we conducted two Focus Group Discussions (FGDs) with smallholders in Mulanje district, but this was not possible in Ethiopia because of the political situation at the time of our field visit.

This report is organised into four sections. Sections 2 and 3 review the available and relevant information for Malawi and Ethiopia. Both sections follow the same structure, justifying our choice of the crop sub-sector, the specific crop within the sub-sector, and our choice of project area, then

reviewing risks, RMS, the policy process, and potential partners for influencing policy. Section 4 provides a summary comparison of the two selected value chains.

2 Malawi

2.1 Why legumes?

We selected grain legumes for six reasons:

1) Legumes are critical for nutrition. They provide the main source of protein for poor households. Hence, they are an important component of the farming system.

2) Legumes are an avenue for intensification. Since they are usually intercropped with maize, the staple food crop, the area planted to legumes can be expanded without threatening household food security.

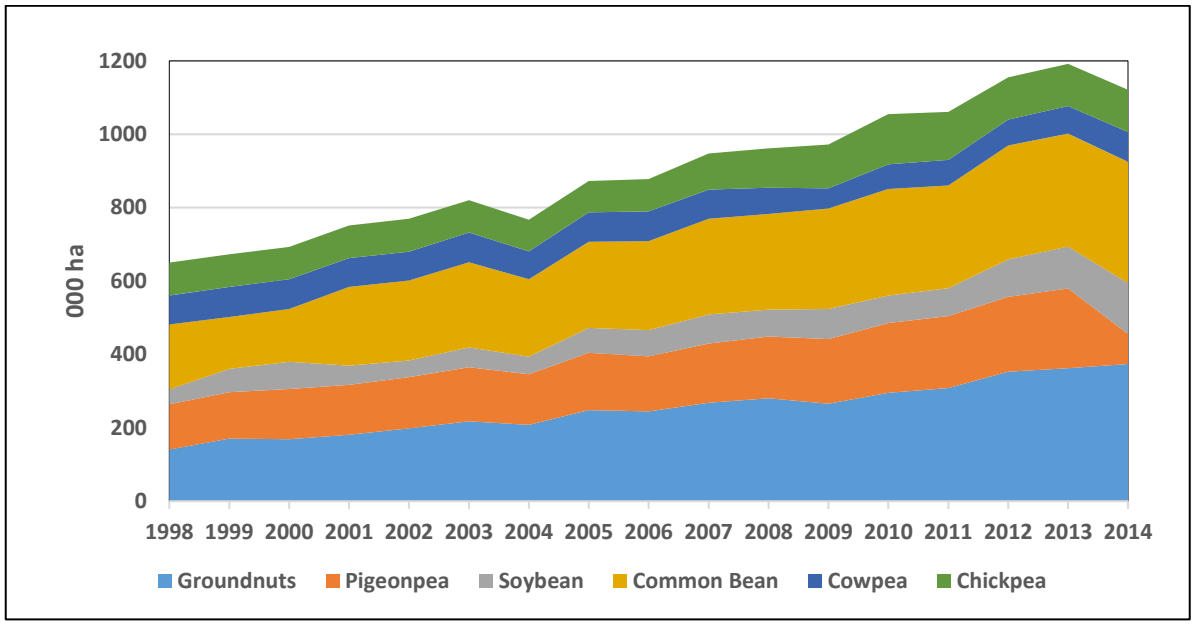
3) Legumes have potential for commercialisation. In Malawi, pigeonpea and groundnuts are widely sold in domestic and regional markets. Poorer farmers prioritise food security in their choice of legumes (Kamanga *et al.*, 2014). In northern Malawi, feeding children is a major reason for growing legumes, and legumes are grown primarily for food, not to provide a cash income (Bezner-Kerr *et al.*, 2007).

4) Legumes contribute to agricultural sustainability, because they fix atmospheric nitrogen, which improves soil fertility. Research in Malawi has shown that farmers will not adopt legumes based solely on their benefits for soil fertility. Rather, they want to see immediate benefits in terms of nutrition or a cash income (Snapp *et al.*, 2002). Farmers chose edible legume intercrops such as pigeonpea and groundnuts over green manure crops like mucuna (Bezner-Kerr *et al.*, 2007).

5) Legumes are managed by women (Pircher *et al.*, 2013). Women prefer grain legumes that improve food security and do not choose green manures or tree legumes that are associated with male responsibilities and tenure (Bezner-Kerr *et al.*, 2007). Since the management of soil fertility is seen as a male responsibility, women have no incentive to adopt legumes that do not contribute to food security (Pircher *et al.*, 2013). This makes these crops relevant for understanding the relationships between gender, intensification and commercialisation.

6) The area planted to legumes has grown steadily over the last decade (Figure 1). The trend is similar for all legumes. The increase in the area planted reflects a growing demand for legumes for sale as well as for home consumption.

Figure 1: Area planted with legumes in Malawi, 1998–2014 (000 ha)



Source: Famine Early Warning System, Malawi

In contrast, other value chains were considered less appropriate:

1) Maize – the staple food crop – has been intensively studied but offers less scope for original research. Besides, the scope for commercialisation is limited since most smallholders in southern Malawi are net maize buyers, not sellers.

2) Horticulture is common, and in 2005 28% of households in southern Malawi cultivated *dimba* crops, which included cabbage and tomatoes (RoM, 2005: 100). However, without access to modern irrigation the scope for scaling-out is limited.

3) Livestock – particularly milk – is profitable, but only 4% of households in the southern region own cattle (RoM, 2005: 108). This reflects the high cost of dairy cows and the shortage of grazing land.

4) Tobacco (*Nicotiana tabacum*) is not widely grown in southern Malawi. The Second Integrated Household Survey in 2005–06 reported that only 9.3% of households in the southern region grew tobacco. The proportion in Mulanje district was 4.7% (RoM, 2005: 106). The value chain for burley tobacco has not produced the expected benefits for smallholders. Unlike legumes, tobacco reduces household food security because it cannot be intercropped with maize. Tobacco is dominated by men, who control the income from this crop (Pircher *et al.*, 2013). Smallholders face a high risk of large losses in poor seasons, as in 2004–05 (Takane, 2006).

5) For soybean (*Glycine max*), analysis of adoption shows that farmers prefer Magoye soybean to other grain legumes like pigeonpea because of its good yield, multiple uses in diet fortification, and because it is promiscuous with no need for seed to be inoculated with *Rhizobium* (Kamanga *et al.*, 2014). In Malawi, there is no domestic oil industry that is competitive with others in the region, so oil is imported. There is scope for import substitution because 70% of oils consumed are made from imported oilseeds. Demand for soybean

products other than oil is limited because it is not traditionally part of the diet in Malawi and so soybean products (porridge, tofu, soy milk, oil) require extensive of promotion and marketing.

In sum, non-legume value chains are already the subject of ongoing research (maize), face problems with markets (burley tobacco, soybean), or have limited potential for scaling-up or social inclusion (horticulture, dairy).

2.2 Why pigeonpea?

Groundnuts are a widely-grown legume crop but are already the focus of agricultural projects by the McKnight Foundation (Lilongwe University of Agriculture and Natural Resources), international NGOs (Compatible Technology International, working with ICRISAT on post-harvest mechanisation), and the Innovation Lab, managed by the University of Georgia. Groundnuts in Malawi therefore represents a crowded field and the SRMS project would not make a major contribution to our knowledge.

Pigeonpea is the most widely-grown grain legume in the southern region. This fact alone would dictate our choice. However, pigeonpea has several other advantages:

1) Food security: pigeonpea contains high levels of protein (20–32%) and the important amino acids methionine, lysine and tryptopan. Intercropping does not reduce household food security since intercropping maize with pigeonpea produces at least as much total grain as growing maize in pure stand (Snapp *et al.*, 2002). Long-duration pigeonpea is harvested late and provides a food source when most other legume options have been exhausted (Bezner-Kerr *et al.*, 2007).

2) Cash income: the value chain in Malawi is well developed. About 35% of the pigeonpea crop is sold, and Malawi exports both whole and processed pigeonpea grain to the world market.

3) Sustainability: pigeonpea intercropped with maize can improve soil nitrogen through biological nitrogen fixation. Leaf fall if incorporated provides up to 40kg N/ha. Most legumes showed only small benefits to soil fertility over the evaluation period (1998–2007) (Kamanga *et al.*, 2014). Pigeonpea stems provide fuelwood for rural households, reducing pressure on forest resources.

4) Drought tolerance: pigeonpea's vertical tap-roots reach depths of 1–2m and enable it to make better use of residual soil moisture than many other legumes, as well as to recycle nutrients from deep in the soil profile. This gives pigeonpea 'a unique role in meeting food security needs for subsistence farmers in climatically risky regions' like southern Malawi (Snapp *et al.*, 2003).

5) Labour-saving: farmers typically coppice pigeonpea (cut the plant back to the main stem after harvesting, which encourages regrowth and a higher yield in the second year), intercropping the two-year old plant with maize the following year, and thereby growing grain legumes two years in a row, or 'doubled-up grain legumes'. Saving labour is important in hoe agriculture where ridging, planting, and weeding must all be done by hand within a short period.

6) Gender: in Malawi, pigeonpea is regarded as a women's crop (Me-Nsope and Larkins, 2016). Intercropping pigeonpea and maize is 'the option of choice' for female farmers because it economises on both labour and seed (Bezner-Kerr *et al.*, 2007). Women make 75% of

pigeonpea sales to vendors (BIF, 2014). This makes pigeonpea an ideal crop to explore the impact of commercialisation on gender relations.

2.3 Why southern Malawi?

Several factors make smallholder agriculture in the southern region particularly vulnerable to risk. Table 1 summarises some relevant risk indicators. The south has Malawi's highest concentration of rural poverty (63%), and 47% of the poor population in the country. Average farm size is low (0.5 ha). Smallholder agriculture is primarily rainfed, with a high risk of crop failure from drought, which affects six in 10 rural households. Since there is only one growing season – November to March – the risk to household food security is high. Since households are not self-sufficient in maize, grain purchases account for one-third of household expenditure. Half of rural households experience low or very low food security. The farming system is based on maize with numerous intercrops, chiefly pigeonpea and groundnuts. Finally, three in 10 households are headed by women, reflecting a matrilineal system of inheritance, with half the land owned exclusively by women (RoM, 2012: 134).

Table 1: Malawi's rural south: facts and figures

Indicator	Rural south	Rural centre	Rural north	Rural Malawi
Household size (no.)	4.3	4.8	4.7	4.6
Female-headed households (%)	28.7	22.0	20.8	25.0
Area planted (ha)	1.6	1.5	0.8	1.4
Plots intercropped (%)	58.7	17.3	27.9	37.8
Plots planted with pigeonpea (%)	41.2	0.5	0.5	16.4
Plots planted with groundnuts (%)	10.7	20.4	13.9	15.6
Households experiencing drought/erratic rains (%)	58.3	17.3	27.9	37.8
Consumption per head (MK/year)	29,658	37,978	31,421	33,103
Share of total expenditure on cereals (%)	34.1	29.9	27.8	31.3
Households with low/very low food security (%)	48.7	35.4	41.7	42.0
Months experiencing food shortage (no/year)	3.6	2.7	2.8	3.2
Households below poverty line (%)	63.3	48.7	59.9	56.6
Share of poor households (%)	46.9	34.6	13.2	94.8

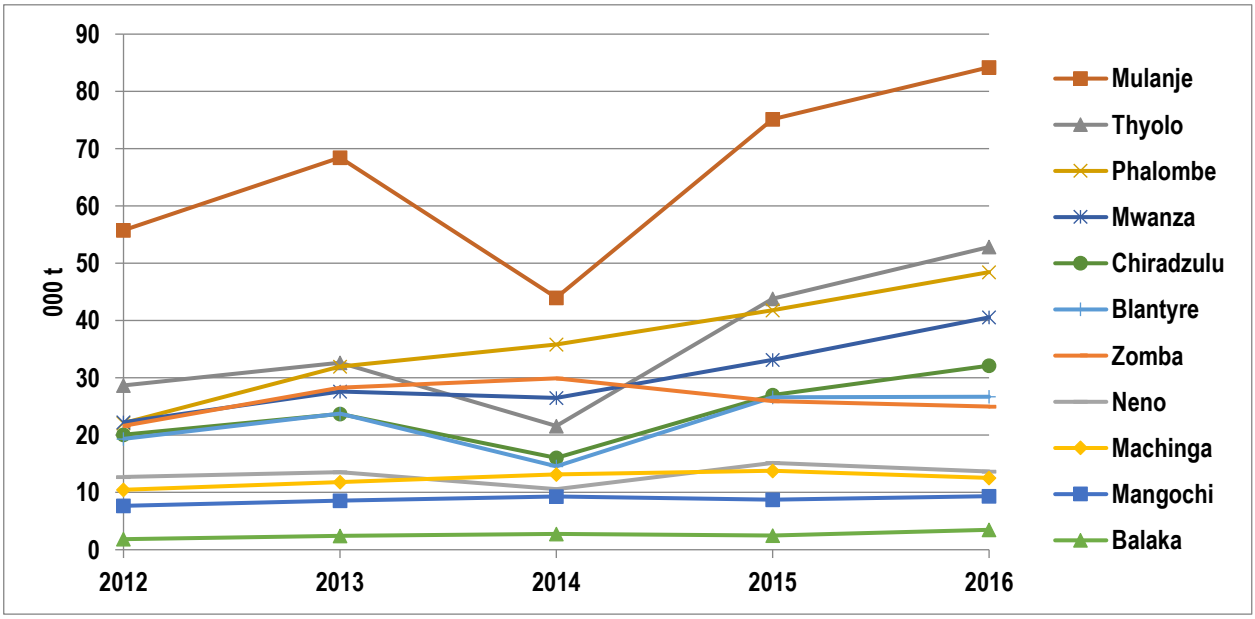
Source: RoM (2012). Integrated Household Survey 2010–2011.

2.4 Why Mulanje district?

Mulanje district has the highest production of pigeonpea in southern Malawi, estimated at 84,000 tonnes in 2016 (Figure 2). Socio-economic indicators for Mulanje district reveal high vulnerability to risk. Food security and poverty indicators are close to those for the southern region as a whole but population density (261 persons per km^2) is well above average (Table 2). The high population density poses a challenge for agricultural sustainability since it puts pressure on natural resources.

According to extension agents at Mulanje Rural Development Project (RDP), of the five extension planning areas (EPAs) in Mulanje district, the EPA with the highest concentration of pigeonpea is Msikawanjala, followed by Milonde. Conditions in these EPAs are most favourable for pigeonpea. Based on this information, we selected Msikawanjala EPA for FGDs with pigeonpea growers. However, the exact location for project activities will be decided after the value chain workshop.

Figure 2: Production of pigeonpea in southern Malawi, by district, 2011–2016



Source: Ministry of Agriculture, Irrigation, and Food Security.

Table 2: Mulanje district, facts and figures, 2010–2011

Indicator	Mulanje district	Rural south
Population (2010)	536,846	5,361,665
Area (km^2)	2,056	31,753
Population density (persons/km^2)	261	168.9
Share of households with low/very low food security (%)	51.2	48.7
Households reporting food shortage due to drought/erratic rains (%)	49.6	58.3
Months of food shortage (no.)	3.7	3.6
Consumption (MK/capita/year)	29,475	29,658
Expenditure on cereals as share of total consumption (%)	38.6	34.1
Households below poverty line (%)	65.3	63.3
Households below ultra-poverty line (%)	33.6	34.2

Source: RoM (2012). Integrated Household Survey 2010–2011.

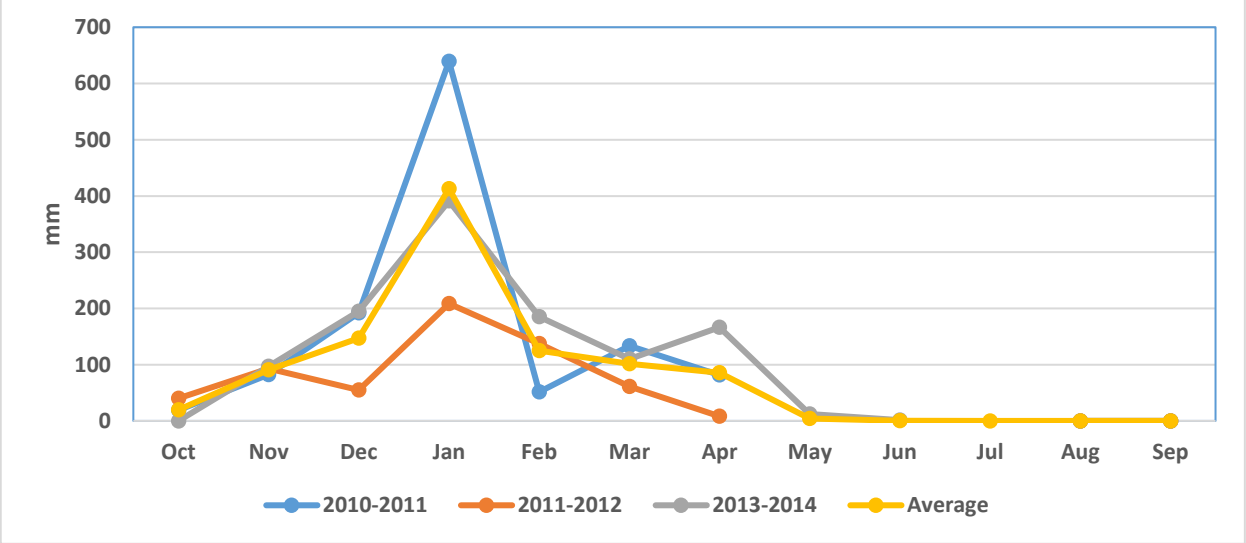
2.5 Risks in the value chain

This section analyses the systemic risks that hamper development of the value chain for pigeonpea. These risks include: (1) natural shocks; (2) price risks; (3) economic coordination risks; and (3) opportunism risks.

2.5.1 Natural shocks

Drought is a major risk facing pigeonpea growers in Mulanje district. Rainfall usually lasts from November to April (Figure 3). However, there is significant variation. In 2010–11, rainfall in January reached 600mm, whereas in the 2011–12 season, rainfall in January averaged just 200mm and ended in March. Notice that the traditional *chiperoni* rains in the southern region between June and July seem to have failed in all three years.

Figure 3: Mean monthly rainfall, Msikawanjala EPA, 2010–2014



Source: Msikawanjala EPA, Mulanje

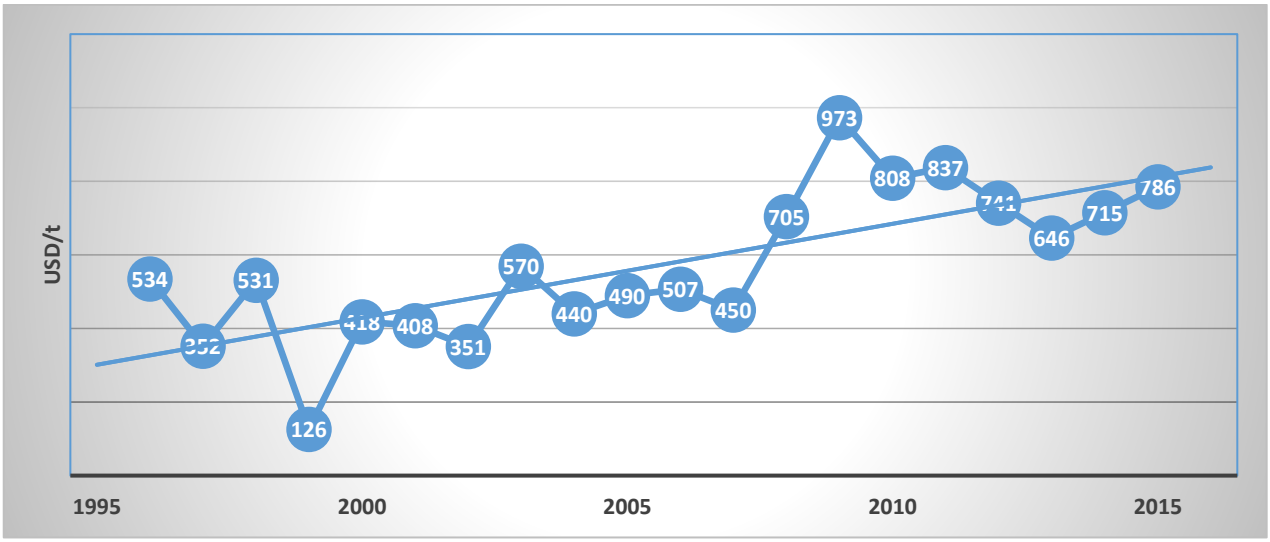
Another risk is yield losses from pests and diseases. The major pests of pigeonpea are podborers (*Helicoverpa armigera*) and pod sucking bugs (*Nizara viradula*). In Chisepo, central Malawi, farmers have abandoned pigeonpea due to damage from these pests (Kamanga *et al.*, 2014). The two major diseases of pigeonpea in eastern Africa are Fusarium wilt and Cercospora leaf spot (ICRISAT, 1998). Yield losses from Fusarium wilt average 16% (ICRISAT, 1998). Long-duration varieties are particularly susceptible to Fusarium wilt disease – yield losses can be as high as 85% in a bad year (ICRISAT, 1998). The improved variety Mwaiwathualimi (ICEAP 00557) is susceptible to podborers and requires chemical sprays (Table 4).

Pigeonpea can be damaged by livestock if they are allowed to graze freely after the harvest of maize (Bezner-Kerr *et al.*, 2007). Farmers reported that long-duration pigeonpea was often damaged by livestock (Kamanga *et al.*, 2014). This has prevented the expansion of pigeonpea in central and northern Malawi. However, in southern Malawi local bye-laws control free grazing after the harvest of maize.

2.5.2 Price risks

About 35% of pigeonpea in Malawi is sold, with most sales going to the export market (Lo Monaco, 2003). Pigeonpea is exported either as whole grain or as processed grain, i.e. split, decorticated grain, known in Hindi as *toor dhal.* Whole grain is exported to India, whereas *toor dhal* is exported to the Indian diaspora in Europe (mainly the UK) and the USA. About 10% of *toor dhal* stays in Malawi for domestic consumption (Makoka, 2009). India imports about 35% of its requirements for pigeonpea. Myanmar is the biggest source of imports, followed by Tanzania, Mozambique and Malawi. Pigeonpea prices in India peak in November–December. Pigeonpea in Malawi is harvested mainly between July and September, so exports coincide with a period of relative shortage and high prices in India (Lo Monaco, 2003).

Figure 4: Producer price of pigeonpea, Malawi, 1996–2015



Source: FAOSTAT.

Producer prices for pigeonpea in Malawi show a positive trend, but with high annual variations (Figure 4). A poor harvest in India increases the demand for imports, resulting in high prices. In turn, high prices encourage growers to increase production, which results in low prices the following year. In 2015, India experienced a major drought and this pushed up prices in Malawi to USD786/t. This was followed by a price crash in 2016. In Blantyre, producer prices fell from 1,000MK/kg in 2015 to 400MK/kg in 2016. Thus, producer prices for pigeonpea follow the classic cobweb cycle. In addition, prices may also fluctuate within the season, either falling after harvest or (as in 2015) rising sharply as processors respond to rising prices in India. This is an additional source of uncertainty for smallholders.

The competitiveness of pigeonpea in Malawi depends not just on the variability of prices in India, but also on the level of prices. Malawi's competitiveness in the export market is limited by its landlocked position, which results in high transport costs. Freight charges from Malawi are USD130/t, compared to USD50 for Mozambique, which has a coastline. According to processors, 'that directly hits the farmers only' and results in lower farmgate prices for growers. Malawi has longer shipment times (four to five weeks) than Kenya and Tanzania due to operations for border clearance and railage through Mozambique. Delays can result in importers defaulting on orders or re-negotiating the price (Lo Monaco, 2003).

How then does Malawi manage to compete on the world market? We identified three reasons. First, the government subsidises exports by giving a 25% rebate on freight charges from taxable profits. Second, Malawi still has a comparative advantage because its pigeonpea is good quality and the brand is known. Third, exporters can earn a price premium for white pigeonpea grain. Red/speckled grain reduces the price by 5–10%, which makes a difference for Malawi exports, which have high transport costs. This results in a loss of USD30–40/t on exports of pigeonpea grain. There is a price difference of USD150 per ton between the price of Myanmar 'lemon' *toor dhal* and Malawi white pigeonpea. The price for Malawi white is USD650–700, while that for Myanmar is USD750/t.

However, the problem is that because of high transport costs a fall in the price of pigeonpea would hurt Malawi more than its competitors. The value chain study conducted by the project must establish the risks posed by these costs and prices to the profitability of pigeonpea for smallholders. At what price level in India does pigeonpea in Malawi become uncompetitive, and what are the risks of this price level?

Price premiums are determined by the following criteria:

1) Colour: Indian consumers will pay a price premium for *toor dhal* that is light yellow in colour, which means that the whole grain must be an off-cream colour. Myanmar *toor dhal* has a pale yellow colour and is known in India as 'lemon toor' and gets a premium price. Second is 'Arusha', from Tanzania, which has off-cream colour seed. Third in importance is 'Malawi *toor dhal*'.

2) White varieties are preferred for *toor dhal* because they are easier to dehull, while the husk of red varieties is hard. This results in a longer processing time, and reduces the yield by 0.5%. 'Malawi red pigeonpea is the lowest priced pigeonpea in the world.' Also, white varieties produce a slightly shiny *toor dhal*, while red does not. Red or speckled grain from Nthawajuni is too bold and does not split well, and when split the colour of *toor dhal* is dark yellow. Red/speckled grain reduces the price by 5–10%, which makes a difference for Malawi exports, which have high transport costs.

3) Bold grains: this is preferred for *toor dhal* by Indian consumers in the UK.

4) They will reject loads with a high proportion of unfilled grains. This is a problem with white varieties, which mature earlier.

2.5.3 Economic coordination risks

ICRISAT's analysis of the pigeonpea sub-sector in Kenya, Mozambique and Tanzania revealed the importance of transaction costs in preventing the commercialisation of pigeonpea (Freeman and Jones, 2001). Their findings have been confirmed by a more recent study (BIF, 2014). These transaction costs included the following factors:

1) Value chain actors lacked information about price, market outlets, quality standards and market requirements;

2) Rural assemblers had high opportunity costs, collecting small volumes of pigeonpea from large numbers of producers scattered across rural areas;

3) Many smallholders sold to particular traders even when dissatisfied with their services because they could not find alternative buyers or because the cost of finding and/or negotiating an alternative buyer was too high;

4) Sellers deliberately mixed pigeonpea with stones or sold mixed varieties because there was no price premium for quality, even though prices at final markets recognised quality differences;

5) Traders relied on their own funds, not credit, for trade finance, reflecting the widespread failure of credit markets in rural areas; and

6) Traders preferred a quick cash turnover even though they could hold stock and get better prices. This reflected uncertainty about demand, product quality and market conditions.

On the supply side, economic coordination risks reduce the incentive for the supply of pigeonpea seed by private firms (Jones *et al.*, 2001). Pigeonpea is self-pollinated, so seeds can be recycled for up to three years without significant loss of yield. Pigeonpea also has a relatively high seed multiplication rate, and farmers have little difficulty in storing the crop – both factors that are likely to reduce the demand for purchased seed. The farmers' practice of coppicing pigeonpea – allowing the crop to grow for two seasons – reduces demand for seed still further.

Moreover, transaction costs in seed markets can be high for both buyers and sellers. Farmers face costs in acquiring reliable information about improved varieties, and the risk of buying inappropriate or poor quality seed. Suppliers find it expensive to discover farmers' preferences and their costs are increased by the inventory, storage, and wastage costs of having to stock multiple varieties of seed in small amounts at the right time, and by carrying stocks sufficient to meet uncertain and fluctuating demand. This makes commercial seed production and distribution unprofitable and risky for private firms.

Consequently, most growers recycle saved seed or buy seed from other farmers or local markets. A survey by ICRISAT revealed that in 2006–07 80% of pigeonpea growers used their own saved seed (Simtowe *et al.*, 2010). Lack of seed or cash to buy seed is the most important single factor hampering the adoption of improved legume seed (Snapp *et al.*, 2002). A recent study of the pigeonpea value chain funded by the UK's Department for International Development (DFID) identified improving the supply of certified seed to smallholders as the top priority (BIF, 2014).

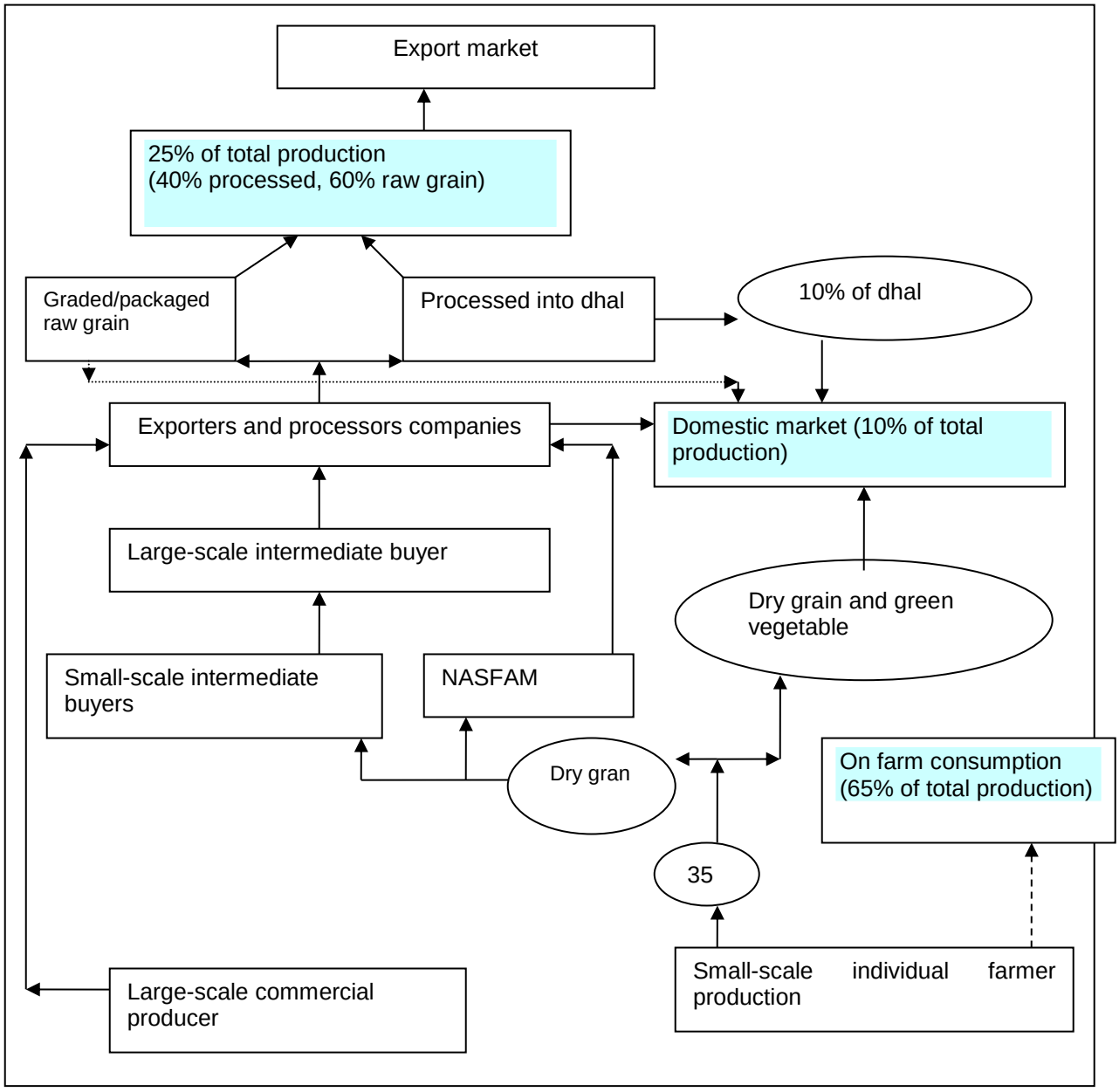
On the demand side, economic coordination risks mean that sellers and buyers rely on spot markets. There is no forward contracting, or vertical integration with buyers supplying seeds or agreeing a purchase price. Buyers fall into two main categories. Rural traders purchase small quantities of pigeonpea at the farmgate or in local markets, which are then aggregated, transported and sold to exporters and processors in Limbe. Besides intermediate buyers, there are more than 14 companies in Malawi that buy grain legumes and have the capacity to process, package, locally distribute and export different types of grain legume products (Simtowe *et al.*, 2011).

There are more than 12 pigeonpea millers in Malawi with a total milling capacity of 20,000 metric tons of *toor dhal* per annum (Simtowe *et al.*, 2011). These include three companies – Rab Processors, Export Trading, and HMS Foods and Grains Limited – interviewed for this scoping study. The biggest single buyer is Export Trading, which reported exporting 23,000 tons in 2015 and 32,000 tons in 2016. Smaller companies (Rab Processors, Transglobe) buy about 10,000 tons each. Other buyers also come from India during the season to buy about 3,000 tons, but have no permanent base in Malawi.

Rab Processors has its own network of dealers and warehouses (Kulima Gold Network) where it buys pigeonpea in quantities of 20 kg up to 30 tons.

The National Smallholder Farmers Association of Malawi (NASFAM) undertakes the collective marketing of smallholder crops, buying from smallholder clubs for sale to exporters. However, NASFAM discontinued trading pigeonpea in 2010, after a marketing study found that pigeonpea trade was unprofitable (Simtowe *et al.*, 2011).

Figure 5: Pigeonpea value chain in Malawi



Source: Simtowe *et al.* (2011).

2.5.4 Opportunism risks

Opportunism risks discourage exporters from buying directly from farmers. As one processor explained:

> *No forward contracting, because of the uncertainty over the Indian harvest and therefore the market price they can offer. Also, there is the risk of farmers side-selling if they get a better offer. 'Where is the guarantee that we will get it?' 'Everybody wants to play safe.' Also, 'whom should we approach?' 'Forward contracting works only with cooperatives' that can aggregate the crop. 'We need at least 200 tons to make forward contracting viable.' However, one Indian company (name unknown) did make some forward contracting this year. So, in this highly unstable market, forward contracting is too big a risk for buyers.* (HMS Foods and Grains Limited)

2.6 RMS

In this section, we identify current and potential strategies used to reduce systemic risks in the pigeonpea value chain. These provide possible entry points for project interventions to reduce risks along the value chain.

2.6.1 RMS for natural shocks

We identified two main RMS to manage the risk from natural shocks: (1) spreading the risk by planting several different varieties; and (2) reducing the risk by planting varieties that are tolerant to pests and diseases.

RMS # 1: Planting varieties with a range of field durations

Farmers in Mulanje district usually plant three or four different varieties (Table 3). This is a well-established strategy for spreading the risk from drought and from pests and diseases. The improved variety *Mwaiwathualimi* (ICEAP 00557) is reported to be less resistant to pests and diseases.

> Mwaiwathualimi *is not resistant to field pests: if you don't spray, then few pods will remain. 'Zero resistance'. 'In some places where water stays, you can still get a yield.' 'Only three out of 10 who grow will harvest if they don't spray.'* (Tiyese Farmers' Club)

> *Farmers sprayed* Mwaiwathualimi *in the field operated collectively by the club, but none sprayed in their own fields, because they were short of cash.* (Nyungwe Farmers' Club)

> *Farmers grow both* Namanjo *and* Mwaiwathualimi *in order to spread risk. They 'check which one will do better, and matures earlier, and which will give money quicker'.* (Nyungee Farmers' Club)

On the other hand, the overall risk of crop failure is lowest with medium-duration varieties because they avoid late-season drought:

> Mwaiwathualimi *matures fast, so is less risk. 'It's not affected by drought.' 'If the rains are good,* Nthawajuni *does well, and its more resistant to pests than* Mwaiwathualimi*.'* Namanjo *has 'the*

least risk, because its early maturing'. With late-maturing local varieties, 'if there's a drought, you can't harvest anything.' (Nyungwe Farmers' Club)

Risk is lower with Nthawajuni *because of lower pest attack.* Wa makolo *varieties are 'never attacked by pests'. The single best thing about* Nthawajuni *is its early maturity and its resistance to pests. Nobody grows only* Mwaiwathualimi *in order to minimise risk from drought, in which you get only half the yield.* (Tiyese Farmers' Club)

Table 3: Farmer's scoring of pigeonpea variety traits, Msikawanjala EPA, Mulanje district

(Score 1–10, with 10=highest)

Trait	Tiyese Farmers' Club, Khajavo Cooperative			Mpando village, Nyungwe Farmers' Club			
	Mwai-wathualimi (00557)	*Nthawajuni*	*Wa makolo* (late maturing)	*Mwai-wathualimi (00557)*	*Nthawajuni*	*Namanjo*	*Wa makolo* (late-maturing)
Seed availability	10	10	10	5	10	10	0
Resistance to insect pests	3	10	10	5	8	10	8
Yield (50 kg bags per 1/2 acre)	7–8	5	3	4	2	10	0.5
Firewood	7	4	10	10	5	5	10
Early maturity	10	10	5	10	8	6	3
Market price	10	5	9	10	5	7	7
Taste (cooked grain and green pods)	10	4	10	10	5	5	10
Cooking time	10	5	7	10	5	5	10
Risk of crop failure	6	7	4	5	7	10	3

Source: FGD, village (12 women, two men).

Farmers therefore face a trade-off between yield losses from drought and from pests and diseases. Short-duration varieties (100–120 days) and medium-duration varieties (150–200 days) will escape late-season drought. On the other hand, short-duration varieties are more vulnerable to yield losses from pests, because the reproductive – and most vulnerable – stage of plant growth coincides with the seasonal peak in the insect population (ICRISAT, 1998). In contrast, long-duration varieties (220> days) are vulnerable to late-season or terminal drought (Jones *et al.*, 2002). On the other hand, long-

duration varieties produce multiple flushes of flowers and pods, thereby avoiding the risk of pest damage associated with a single flowering period. Cultivars that mature during the dry season have low damage levels. This is an avoidance strategy, as reproduction occurs when pest levels are low (Snapp *et al.*, 2003). Based on this evidence, seed distribution by the SRMS project should not focus on a single variety.

RMS # 2: 'Nyonga' packs for crop protection

The improved variety Mwaiwathualimi is susceptible to damage from podborers and requires chemical sprays. Accessibility and affordability limit the adoption of chemical pests control by smallholders. Innovative products are required to overcome these restraints. Farmers Organisation Ltd is the leading supplier of pest and disease control inputs in Malawi and has a network of 4,000 agro-dealers. It is developing a Nyonga ('Power') pack of chemical control for pigeonpea for small areas of land (e.g., 0.25 ha) (BIF, 2014). This is the chemical equivalent to a 'Small Seed Pack'. The project should investigate demand for these packs by farmers growing Mwaiwathualimi. A recent study of the pigeonpea value chain identified this as the second-top priority with a 'good' chance of success (BIF, 2014).

RMS # 3: Improved varieties

Seven improved varieties of pigeonpea have been officially released in Malawi (Table 4). They combine advantages and disadvantages. ICP 9145 is resistant to Fusarium wilt, but its hard seed coat is difficult to remove, which makes it unpopular with processors for *toor dhal*. ICEAP 00040 has a softer seed coat, Mwaiwathualimi (00557) has the market traits required by Indian consumers (large, cream-coloured seeds) but requires chemical pest control, which few smallholders can afford.

Based on the evidence in Table 3 and Table 4, distribution of certified seed by the SRMS project should focus on the varieties Mwaiwathualimi (00557) and Nthawajuni. To reduce the risks from natural shocks, smallholders may prefer to plant both varieties.

Table 4: Improved varieties of pigeonpea released in Malawi

Name	Year released	Field duration (days)	Advantage	Disadvantage
ICP9145 (Sauma)	1987	Long (220–270)	Resistant to Fusarium wilt and leaf spots *Cercospora* spp.	Seed coat is hard to remove
ICEAP 00040 (Kachangu)	2000	Long (190–240)	Seed coat is easy to remove	
ICEAP 00053	2003	Long	Large, cream-coloured seeds	
ICPL 87105	n/a	Short	Susceptible to Fusarium wilt and leaf spots *Cercospora* spp., to podborers and pod-suckers	Requires chemical pest control
ICPL93026	n/a	Short	Susceptible to Fusarium wilt and leaf spots *Cercospora* spp., to podborers and pod-suckers	Requires chemical pest control
ICEAP 00557 (Mwaiwathualimi)	2009	Medium	Large, cream-coloured seeds	Requires chemical pest control
ICEAP 01514/15	2011	Medium	High pod load	

Source: Kananji *et al.* (2009); Rao *et al.* (2012); Koaneka *et al.* (2016).

2.6.2 RMS for economic coordination

We identified three strategies for reducing economic coordination risks:

RMS # 4: Increase seed supply of improved varieties

An ICRISAT survey revealed that the main reason for non-adoption was the lack of seed or the cash to buy seed (Simtowe *et al.*, 2010). Increasing awareness of improved pigeonpea varieties would increase adoption from the current level of 14% to 41% (Simtowe *et al.*, 2016). This suggests that 'improved seed delivery strategies may be a prerequisite to any legume intensification strategy' (Snapp *et al.*, 2002).

Three strategies have been used to expand the supply of improved pigeonpea seed to smallholders:

1) Sell small seed packs through commercial agro-dealers. Experience with this strategy in Malawi suggests it may not be commercially viable for agro-dealers (Jones *et al.*, 2000). However, the Agricultural Trading Company in Limbe sells 2kg packs of pigeonpea seed. These are supplied by Peacock Suppliers Limited and Funwe Limited (Mangochi). These packs are produced under the FISP for distribution to retailers.

2) Sell seed through NGOs. The international NGO Africare distributed the improved variety *Mwaiwathualimi* to 2,200 households in 41 villages in Mulanje district for three seasons (2012–2014). Seed was distributed free in Year 1 to farmer groups (0.5 kg per household). In Year 2, households had to pay for seed, and were repaid in seed. Farmers liked Mwaiwathualimi because: (1) it was good for marketing; (2) had a high yield; and (3) required only a one-hour cooking time.

3) Develop seed producer groups that market certified seed to neighbouring farmers. ICRISAT's experience with these groups in southern Malawi has been mixed (Jere *et al.*, 2013). Most pigeonpea seed was sold as grain since the seed market is not well developed, and seed groups were not able to establish links with commercial agro-dealers. Groups also required intensive training and supervision over an extended period.

4) Sell seed through processors and exporters. This was tried in 1998/99, when ICRISAT and the Department of Agricultural Research and Technical Services provided 20 tons of foundation seed of ICEAP 00040 to the Grain and Legume Millers Association Limited, which then contracted farmers to multiply this seed (Jones *et al.*, 2000). This experiment does not seem to have been repeated. Processors that we interviewed for the scoping study were reluctant to become involved in seed supply. However, Export Trading Limited reported that it supplied seeds to growers in Phalombe – no further information was available.

The RDPs operate a legume upscaling project that promotes the adoption of improved pigeonpea seed. In 2015, Blantyre RDP received 1 ton of *Mwaiwathualimi* seed which was distributed in 10 kg lots, with farmers repaying 20 kg for each 10 kg. Farmers had to have a minimum farm size of 1 ha or be a group that could plant 1 ha of pigeonpea. This programme targets medium-scale farmers, probably because it is designed as a demonstration programme. Farmers were advised about spraying, but not provided with sprays. Improved seed is also available through agro-dealers but farmers need to travel there to acquire it.

RMS # 5: Improve flow of information about improved varieties

Makoka's (2009) survey of 200 growers in 2003 found that farmers were unaware of any improved varieties, except for ICP 9145. An ICRISAT survey revealed that, 20 years after the release of the improved variety ICP 9145, only 8% of pigeonpea growers knew about it, while the share that knew about ICEAP 00040 was 20%, seven years after its release. Increasing awareness of improved pigeonpea varieties would increase adoption from its current level of 14% to 41% (Simtowe *et al.*, 2016). As well as access to quality seed, therefore, smallholders also need more information about improved varieties.

RMS # 6: Collective marketing

We identified three possible strategies for the collective marketing of pigeonpea:

1. Farmer groups in Mulanje district, associated with the NGO Africare

Ex-Africare farmer groups have previous experience with the collective marketing of pigeonpea. These include the two farmer groups with which we held FGDs. Africare was able to link these farmer groups with Export Trading Limited, which paid them a premium for *Mwaiwathualimi* grain. Our interview with HMS Food and Grain Trading Limited showed that they would pay a small price

premium for high-quality pigeonpea grain. This would require quality control by farmer groups to ensure that pigeonpea is not mixed with foreign matter and that varieties are sold separately and not as a mixture.

> *HMS checks the quality of pigeonpea at the factory gate. They just pay attention to colour, nothing else. White pigeonpea gets a 6–7% price premium, not more. Sometimes they will grade using other criteria, but this is an additional cost. They might pay a premium for bold grains, since this is preferred for* toor dhal *by Indian consumers in the UK. They will reject loads with lots of unfilled grains. This is a problem with white varieties, which mature earlier. Because farmers want to get peak prices, they harvest too early, so there are many unfilled grains. Some traders will buy loads with a lot of unfilled grains, hold them, and then mix them with white varieties that have filled grains when these become available. Farmers also sell grains with high moisture content – 24% rather than 15% – because they are in a hurry to sell and get a higher price.*
>
> *Mixed white and red varieties are a problem, because they have to be sorted since the husk comes off at different times during processing, adding to wastage. If a mixed load is delivered, they pay the price for red varieties. White varieties are strongly preferred because they are easier to dehull, while the husk of red varieties is hard. This results in a longer processing time, and the yield goes down by 0.5%. 'Malawi red pigeonpea is the lowest priced pigeonpea in the world.' Also, white varieties produce a slightly shiny toor dhal, while red does not.*

2. Auction Holdings Commodity Exchange (AHCX)

AHCX is a subsidiary of Agricultural Holdings Limited. It buys a minimum quantity of 1 ton (20 bags of 50kg). The Agricultural Commodity Exchange for Africa buys all crops, paying cash on the spot. AHCX also operates a warehouse receipt system where farmers store crops after harvest in an AHCX warehouse and sell later when prices are higher. (While this is profitable for maize, however, where the price rises continuously after harvest, it may not be profitable for pigeonpea, where the price usually falls continuously after harvest.) Farmers have to bulk the crop themselves before delivery. According to agricultural extension staff at Mulanje RDP, in 2015 AHCX bought pigeonpea at 800MK/kg but farmers did not have information about this, so they sold to middlemen for a lower price. Now farmers are aware of price differences and will deliver to this buyer. In addition, Mulanje RDP is constructing four storage warehouses that will aggregate crops (mostly pigeonpea) and sell to Auction Holdings. These warehouses will be managed by farmer cooperatives.

3. NASFAM

NASFAM mainly buys groundnuts and other high value crops, such as tea, from farmers. NASFAM has six Innovation and Productivity Centres (IPCs), which cover several districts. One IPC is in Mulanje. The IPCs aggregate crops and distribute inputs, including seed. Demand for seed comes from club members who pay 400MK/year. NASFAM injects fresh seed (basic or certified), and each member pays back 2kg to the community through the community seed bank scheme. In normal years, the default rate is 20–25%, while it was about 60% in 2016. NASFAM acts as a broker between farmers and buyers, cutting out middlemen 'who exploit farmers'. NASFAM does not agree a buying price with farmers in advance but at the end of the season. It negotiates with buyers based on the prevailing market prices and the state of the market. The quantity they can buy depends on how much finance they can get from banks, at a 40% interest rate. NASFAM bears the risk of losses if the market price is too low to repay the bank loan. Members are not forced to sell to NASFAM but can play the

market, but they get a 4MK/kg loyalty bonus if they sell to NASFAM. Although NASFAM discontinued buying pigeonpea in 2011, this model may still be relevant.

2.6.3 RMS for opportunism

RMS # 7: Forward contracting

buyers. However, the NGO Africare had Africare-supported farmer groups selling pigeonpea. Five clubs (of 20–25 members) were amalgamated into clusters for collective marketing to Export Trading Limited, for the purchase of *Mwaiwathualimi*. According to group members, the problems experienced were:

1) Long distance to market (Export Trading is located in Luchemza and Limbe); and

2) Government restrictions on movement of commodities (with a consequent need to bribe police).

The advantages were that Export Trading paid a price premium for *Mwaiwathualimi* and that their weighing scales were accurate (farmers believe that vendors who buy at the farmgate tamper with the scales).

Opportunism risks seem to be low because processors are willing to pay a price premium for *Mwaiwathualimi* while vendors who buy at the farmgate are not.

2.7 Influencing policy-makers

This section summarises the available information about how the project might influence policy-level decision-making about pigeonpea.

2.7.1 Policy issues

In our interviews, the key stakeholders identified several policy issues relevant for pigeonpea. These included:

1) The government of Malawi periodically imposes export bans on agricultural commodities. The Minister of Agriculture can impose such bans without parliamentary authority. The Control of Goods Act is going through parliament now and once this is passed, export bans will require parliamentary authority. Maize has been subject to an export ban for the last four years. Controls on exports lead to a high level of lobbying. Export bans are suddenly imposed and then reversed in a matter of two weeks. A stable, transparent policy is needed. The unpredictability of policy deters private investors. The International Food Policy Research Institute (IFPRI) Malawi office sees this as a key policy issue.

2) Trade bans do not affect pigeonpea directly, since there has never been a trade ban on the export of pigeonpea. A ban would make no sense, since domestic consumption is low and India is the only export market. Conversely, the government of India would never impose an import ban on pigeonpea grain because it wants the price of *toor dhal* in India to stay low. *Dhal*

in India is like maize in Malawi, a barometer of wellbeing for the population, and of the government's legitimacy.

3) Trade bans affect pigeonpea indirectly, by discouraging trade finance and foreign investment. Rab Processors blamed a generalised fear of trade bans as the reason why they could not get trade finance from overseas banks. Rab has many joint ventures, but cannot get trade finance from offshore banks to help it buy grain, because banks know that if an export ban is imposed then they will lose their investment. This is too big a risk for foreign banks. Buyers have to finance purchases using local banks, which charge higher rates of interest. Import bans also discourage forward contracting with producers, at a fixed price, since buyers may not be able to export. Buyers know this so they will not take the risk. Export bans are also hurting investment in groundnuts; this explains the lack of investment by foreign companies in processing and value addition, because companies know they will not be secure for the next 10 years.

4) The government of India protects the domestic processing of *toor dhal.* Consequently, exports of *toor dhal* go to the Indian diaspora in the UK and the USA, not to India (Lo Monoco, 2003). Exports of pigeonpea to India therefore consist of whole grain.

5) The government of India also intervenes to protect consumers when prices rise. In 2015 the rise in price of *toor dhal* in India was exacerbated by hoarding and speculation, as traders withheld stocks to make prices rise further. The government then prohibited the holding of stocks beyond a certain period and some traders had their stocks seized and released onto the market. The government also released its strategic reserve to bring down prices. There is no price control in India, but the government can influence prices by forcing traders to offload stocks and by off-loading its own reserves. Following the sudden price rise in 2015, a relatively small amount of *toor dhal* was put on the ration card in India for the very first time.

6) The government of India encourages export of pigeonpea grain from eastern Africa. One result of the sharp rise in price of *toor dhal* in India in 2015 was that Prime Minister Modi visited eastern Africa and signed memorandums of understanding with governments (including Malawi) that committed the government to buy whatever pigeonpea they produced (without specifying the price). Malawi signed a memorandums of understanding with the MMPC, which is the trading arm of the government of India. The private sector in east Africa was not involved in this deal. The government of India wants to guarantee a market for African exporters in order to discourage Indian companies from speculating in stocks and to protect the Indian consumer.

7) The government of Malawi under-invests in research and development for legumes. Legumes get only 2% of the agricultural budget. This makes seed availability a problem, and the quality of certified seed is low. Formerly, ICRISAT used to supply certified seed but now it supplies only foundation seed; certified seed is provided by seed companies, which have limited commercial incentive to produce legume seed. The main desired policy changes are: (1) government should subsidise white pigeonpea to increase supply – 'This won't take long'; and (2) 'Give the Indian consumer what he wants'. Malawi should ask the government of India to bring over Indian experts who can provide the type of grain the market in India needs (small, white grains). Malawi need to use Indian varieties. 'This has to be government supported or it will not happen.'

8) Production and distribution of legume seed (including pigeonpea for southern Malawi) has been cut back by the new minister from 1.2 million to 900,000 households. However, legumes are still included in the subsidy programme.

2.7.2 The policy-making process

Policy decisions for agriculture are made by:

1) The Parliamentary Committee on Agriculture, a cross-party committee which determines the allocation of the agricultural budget which is set by the Treasury. This Committee also approves the size of the agricultural budget set by the Treasury and the Government; and

2) The Minister of Agriculture, Irrigation and Water Development, who can delay or accelerate policy changes recommended by the Committee. The current minister is Dr George Chaponda, who has been suspended from executing duties following the 'maizegate' scandal in January 2017. The Permanent Secretary is also influential and as a career civil servant is known to our project partners ICRISAT and the Lilongwe University of Agriculture and Natural Resources, who may facilitate access.

According to IFPRI, the policy-making process in Malawi depends on a combination of factors. The recent reduction in the budget for FISP is one example. For 10 years, there was no change in policy and the size of subsidy; then a new minister arrives and it changes in two weeks. This suggests that there first has to be a body of evidence that builds up over time, then might suddenly be used to justify a change, but the change might actually owe little to the evidence. Rent-seeking by politicians might explain the timing of the policy change. If donor pressure blocks one avenue for rent-seeking, a change in policy is made to open up an alternative avenue. One theory is that the FISP was cut because it was not as easy for rent-seekers as donors pressured for competition. However, savings will go to irrigation, which will be channelled through Office of President and Cabinet, so opportunities for graft are still there. USAID and World Bank are concerned about this, and have commissioned studies on the political economy of agriculture in Malawi. The SRMS project should obtain these reports through IFPRI once they are completed.

IFPRI suggested that Sustainable Agricultural Intensification Research and Learning in Africa (SAIRLA) might influence policy by identifying success stories of individuals (smallholders, traders, processors) who have succeeded with pigeonpea despite the odds and derive policy implications from this.

2.7.3 Partners for influencing policy

Farmers Union of Malawi (FUM)

FUM is an umbrella organisation that represents all farmers (smallholders, medium, and large commercial farmers). Smallholders join FUM as a group, medium and large farmers as individuals. FUM is 100% donor funded, but membership fees are a tiny part of income. FUM is essentially an advocacy/pressure group, but also provides services like linking farmers to buyers (contract farming), capacity building and training. The Director of Policy and Partnerships is Dr Candida Nakhumwa, who completed PhD on the groundnut sector in Malawi supervised by the National Resources Institute and sponsored by the McKnight Foundation.

FUM influences policy in three ways:

1) By commissioning consultants to provide evidence on desired policy changes. This results in reports and policy briefs, but for cultural reasons one-to-one meetings with key decision-makers are most effective;

2) By holding an annual policy conference, which is usually attended by the Minister of Agriculture; and

3) By conducting pre-budget consultations at district level, asking people what they would like to see in the budget. FUM analyses the budget and presents results back to the districts. Revisions to the budget may follow.

Examples of FUM policy influence: (1) pressure to reduce the scale of FISP, which consumed 60% of the agriculture budget; and (2) mechanisation, changing the current policy from collective ownership of machinery to government provision of machines for hire at district level. FUM claims to take credit for the recent reduction in government subsidy. **FUM would be a useful channel for publicising research findings, but they represent commercial farmers rather than poorer smallholders.**

Civil Society Agriculture Network (CISANET)

CISANET is a policy advocacy organisation working on agriculture and food security policy issues affecting not only the smallholder farmers but also generally poor people and their livelihoods.

CISANET's work mostly centres on two key policy areas. First, policy advocacy is the central part of CISANET's work. Under policy advocacy, CISANET works on Livestock and Dairy Development, Marketing and International Trade, Climate Smart Agriculture, the Budget Accountability programme, and Nutrition and Social Protection issues as its central foci. However, CISANET also focuses on general food security issues supporting policy.

Secondly, under the networking objective, CISANET works with its members at both national and district level to share information on food security issues as well as undertake policy advocacy initiatives which affect the poor. CISANET publishes a quarterly newsletter and holds an annual conference attended by top policy-makers. CISANET is currently lobbying to establish an ATA modelled on Ethiopia's, which will provide government with technical advice. **CISANET would be a useful channel for publicising research findings, but they have a reputation for making doubtful recommendations, like the ATA.**

National Association of Smallholder Farmers in Malawi (NASFAM)

NASFAM formerly focused on smallholder tobacco but their new agricultural strategy is to commercialise legumes for export earnings. Legumes are seen as important for soil fertility. NASFAM promotes groundnuts, beans and soya, but discontinued buying pigeonpea in 2011. Because of the shift from tobacco to legumes, the majority of NASFAM members are women. **Because of its geographical reach and work on the ground with smallholders, NASFAM has credibility with government, and would make a valuable partner.**

Aid donors/investors

There is a donor troika – EU, DFID and USAID – in the Donor Committee on Agriculture and Food Security. Bilateral projects are well-coordinated and work closely with the World Food Programme, funding the Malawi Vulnerability Assessment Committee, which allocates food aid. According to FUM, donors have limited direct influence. USAID funded the Malawi Agricultural Policy Support project funding commissioned research, but did not dictate the policy issues to be studied. USAID no longer funds research on agricultural policy in Malawi.

DFID has funded research on the pigeonpea sub-sector through its private sector development portfolio. The report by Imani Consultants made several recommendations for improving the pigeonpea value chain. The top three recommendations (improved supply of quality seed, Nyongo packs for pest and disease resistance, and use of the LGT to improve economic coordination) are echoed by this scoping study. However, it is unclear whether the recommendations in this report have been followed up. **The SRMS project should follow up with IMANI Consultants to learn the status of these recommendations.**

Legume Development Trust

The African Institute of Corporate Citizenship chairs a Legume Development Trust (LDT) that brings together all actors in legume value chains in Malawi, including pigeonpea. The LDT has technical working groups on production, policy, marketing, and processing and value addition. However, the CEO of Rab Processors (who sits on the LDT board) claimed that the LDT was not functional, and that the Grain and Legume Development Association Limited established in 1999 (which replaced the Dhal Millers Association Limited) was also defunct. A recent study of the pigeonpea value chain identified the LGT as the most suitable platform to improve coordination of the value chain (BIF, 2014). However, ICRISAT attends LGT meetings and views it as the most appropriate forum for communicating project findings. **Making contact with and determining the effectiveness of LDT represents an avenue for research findings**.

3 Ethiopia

3.1 Why cereals?

We selected cereals for three main reasons:

1) Planting more than one cereal crop is an important RMS for smallholders. Ethiopia has five widely-grown cereal crops. In order of highest production, these are: maize, sorghum, teff, wheat, and barley. Cereals occupy 71% of the total area under cultivation and are grown by 13 million smallholder farmers (Gierend *et al.*, 2014).

2) Cereals are widely sold. About three million tons of cereals are traded each year, equivalent to 28% of total cereal production. About one-third of smallholders belong to cooperatives and 28% of cooperative members sell cereals through cooperatives (Rashid and Negassa, 2012).

3) Cereals show strong potential for intensification. Since 2000, the area planted with cereals and the volume of cereals produced has grown rapidly. During this period – for the first time – growth in yield has outpaced growth in area. This reflects the adoption of improved cereal varieties and inorganic fertilisers (Taffesse *et al.*, 2012).

Value chains for non-cereal crops were judged less appropriate for risk management. Below we summarise information on four alternative value chains:

1) Chickpea (*Cicer arietinum*) is an important ingredient in the Ethiopian diet and has become an important cash crop. Ethiopia is the largest exporter of chickpea in Africa, with both the volume and value of exports growing since 2008, earning USD21 million in foreign exchange (ICRISAT, 2011). About one million households grow chickpea (ICRISAT, 2013). The main objection to chickpea as an entry point for SRMS is that it is already the subject of the ongoing Tropical Legumes project, funded by the Bill and Melinda Gates Foundation since 2009. ICRISAT and its Ethiopian partners have conducted intensive research into the chickpea value chain.

2) Coffee (*Coffea arabica*) is the main export crop, accounting for about 60% of foreign exchange. Almost 20% of the population depends either directly or indirectly on coffee production, processing, marketing, or transporting. Most coffee is produced by about four million smallholder farmers. The value chain is highly regulated with all coffee traded through the Ethiopian Commodity Exchange (Worako *et al.*, 2014). The main objection to coffee is that the crop involves a relatively small number of smallholders, does not contribute directly to household food security, and as a primary export crop is well-researched, so that the SRMS project would add little to knowledge.

3) The dairy sector accounts for 40% of total livestock production, but consumption of milk products is low compared to African averages (Gebremedhin *et al.*, 2014). Marketing of dairy products is dominated by butter while sale of fluid milk is limited to areas near urban centres. Butter is highly commercialised, and is produced and sold by women. However, the dairy value chain is already the subject of ongoing research by the Livestock and Irrigated Value Chains project, led by the International Livestock Research Institute based in Addis Ababa.

4) Sorghum (*Sorghum bicolor*) is the most widely planted cereal crop after teff, and is adapted to drought-prone, semi-arid environments. Sorghum has strong market potential. Consumer demand for sorghum in Ethiopia rises with income. Nationally, about 20% of sorghum is traded (Gierend *et al.*, 2014). Value chains are under-developed. The large brewing industry uses barley, while consumers distrust pre-packaged flour, and even urban households prefer to buy and process grain themselves. However, sorghum is already the subject of ongoing research by the Harnessing Opportunities for Productivity Enhancement project (2009–2019), funded by the Bill and Melinda Gates Foundation. ICRISAT and its partners have conducted studies on the sorghum value chain.

In sum, alternative value chains are either the subject of ongoing research by large research projects managed by international agricultural research centres (chickpea, sorghum, dairy), or traditional export crops that do not contribute directly to household food security (coffee).

3.2 Why teff?

We selected the teff value chain for four reasons:

1) *Teff is widely grown by smallholders.* Teff (*Eragrostis tef*) is the single most important crop in terms of area. It is grown by 6.5 million smallholders and planted on 23% of cultivated land (CSA, 2016a).

2) *It offers food and nutrition security.* Teff is the primary ingredient of *injera*, the bread that accompanies every Ethiopian meal. Teff is high in protein, essential amino acids, vitamin B1, vitamin C, calcium and iron, and low in sodium and saturated fat. Teff is gluten free, which makes it an appropriate cereal for those with celiac disease (Baye, 2014).

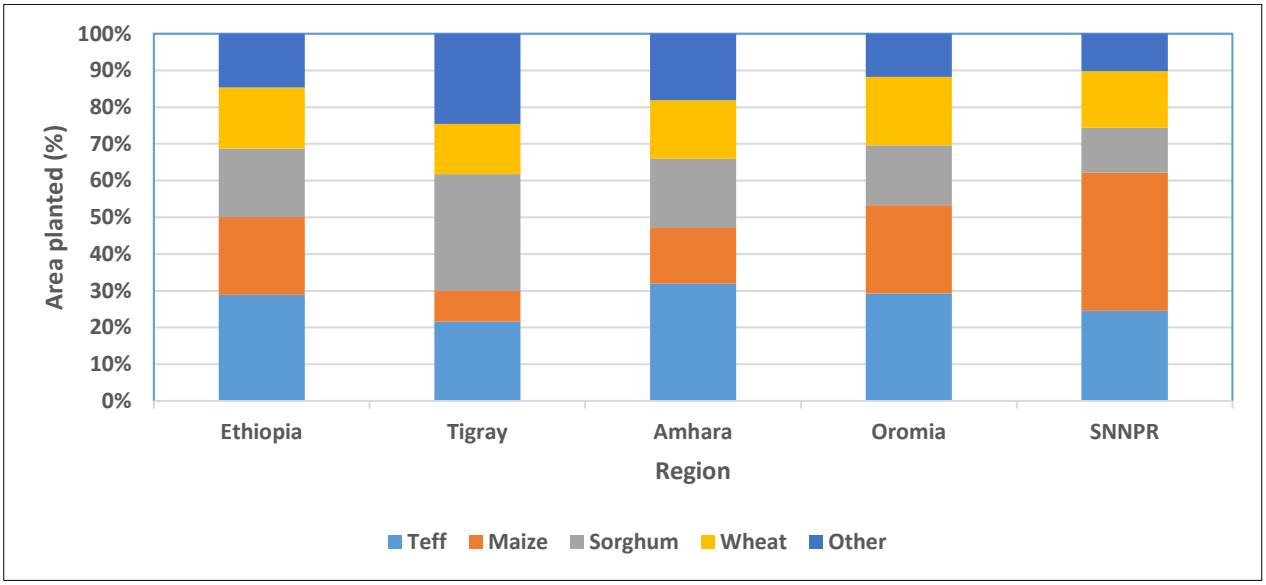
3) *It provides a cash income.* Teff is widely traded. A higher share of teff is sold (28%) than wheat (21%), maize (13%) or sorghum (11%) (CSA, 2016). Teff is mostly sold to urban markets. Consumption is three times higher in urban than in rural areas (602 compared to 197 calories per head per day (Berhane *et al.*, 2012). Prices for teff are higher than for other cereal crops. Teff's gluten-free qualities make it an attractive export crop with potential markets in developed countries.

4) *Teff is an orphan crop*. Teff has received little attention from agricultural research and development. Maize has been prioritised because of its higher productivity. Unlike maize, the application of inorganic fertiliser to teff results in lodging because of its weaker stems.

One disadvantage of teff, from a project standpoint, is that (unlike pigeonpea) teff is not regarded as a 'women's crop'. Gender norms in Ethiopia see farming as a male domain in which women play the role of 'helpers'. The gender gap in agricultural productivity is one of the highest in Africa, with productivity on fields managed by women 23% lower than on fields managed by men (World Bank, 2014). About 40% of this gap reflects a lower level of available resources, while the remaining 60% reflects lower returns on these resources. The gender productivity gap for 'cash crops' is even higher, at 83% (World Bank, 2014). Women are under-represented in cooperatives – only 20% of cooperative members are women (Woldu *et al.*, 2013). Cash crops, like maize and wheat, are regarded as 'men's crops' (Woldu *et al.*, 2013). Consequently, the share of female-headed households growing teff is small – about 5% of teff-growing households are headed by women (Minten *et al.*, 2013b). However, RMS to improve

productivity (reduced seed rate, row-planting, herbicides) would benefit women directly by reducing drudgery, since women share responsibility for planting and do most of the weeding.

Figure 6: Area planted with cereal crops in Ethiopia, by region (000 ha)



Source: CSA (2016a).

3.3 Why the Ethiopian Highlands?

The Rift Valley divides the Ethiopian Highlands into the north-western Highlands, which contains the Tigray and Amhara Regions, and the south-eastern Highlands, which contains the Oromia region. Table 5 summarises some relevant indicators.

Together, the three Highland regions (Tigray, Amhara and Oromia) make up 49% of the total land area of the country and contain 65% of the population. Population density in the north-western Highlands (Amhara and Oromia) is relatively high (over 110 persons/km^2). The mean farm size is 2 ha or above. Nine in 10 households are farmers and in the north-western Highlands most farmers combine crop farming with keeping livestock. Teff and sorghum are concentrated in the Highlands. Food insecurity is common, with one-fifth of households in Amhara and one-third in Oromia reporting at least one month of food shortage per year. Poverty is high, with one-third of the population below the poverty line, but this is the average for Ethiopia: 63% of Ethiopia's poor live in the Highlands.

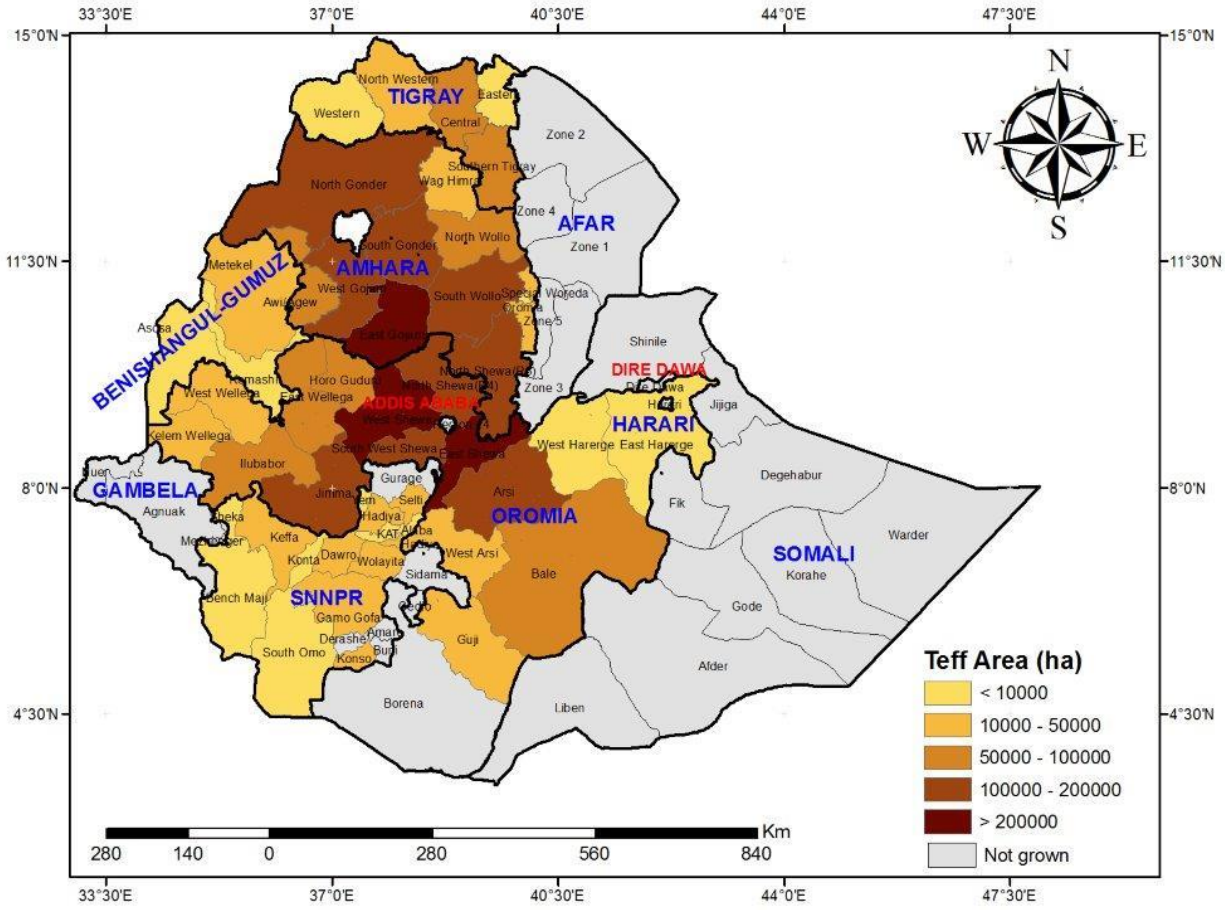
Table 5: Ethiopian Highlands: facts and figures, 2011

	Highlands			Lowlands		Total
Region	**Tigray**	**Amhara**	**Oromia**	**SNNP**	**Other**	**Ethiopia**
Household size (no.)	4.8	4.6	5.5	5.3	4.8	5.1
Land area (km^2)	84,722	154,709	284,538	105,476	434,207	1,063,652
Land area (%)	8	15	27	10	41	100
Population (000) (2013)	5,062	19,212	32,220	17,887	12,233	86,614
Population (%)	6	22	37	21	14	100
Population density (persons/km^2)	60	124	113	170	28	81
Average land (ha.)	1.08	2.53	1.98	0.88	2.59	1.77
Households farming (%)	89	87	87	96	89	90
Households with both farming and livestock (%)	55	81	84	83	84	82
Households growing teff (000)	468	2,521	2,541	960	47	6,537
Households growing teff (%)	7	39	39	15	1	100
Teff production (%)	6	38	49	7	1	100
Households growing maize (000)	610	2,672	3,770	1,326	308	8,686
Households growing wheat (000)	367	1,672	1,931	623	20	4,614
Households growing sorghum (000)	507	1,429	2,085	723	250	4,993
Households growing chickpea (000)	37	633	358	49	4	1,082
Households growing chat (000)	0	258	24	1,084	1,700	3,067
Reporting food shortage (%)	14.9	21.1	36.4	47.5	21.5	32.7
Poverty headcount (%)	31.8	30.5	28.7	29.6	n/a	30.4
Share of poor population (%)	6	22	35	20	16	100
Female-headed households (%)						

Sources: CSA (2016), World Bank (2015).

Our primary reason for choosing the Ethiopian Highlands, therefore, is not based on socio-economic indicators like poverty, small average farm size, or household food insecurity. In terms of these indicators, the Highlands are close to the national average. Rather, the choice is based on the fact that 85% of smallholders that grow teff live in the Highlands. Figure 7 shows the distribution of the area planted with teff in Ethiopia. The optimal growing conditions for teff are between 1,800 and 2,100 metres above sea level (Chamberlin and Schmidt, 2012). Our choice of the Highlands is therefore dictated by the optimal conditions required to grow the crop.

Figure 7: Distribution of teff in Ethiopia



Source: Yumba *et al.* (2014).

3.4 Why Amhara?

We selected Amhara region for three reasons:

1) Amhara is one of the two regions in the Ethiopian Highlands that grow teff. Over 2.5 million smallholders in Amhara plant teff and the region accounts for 38% of national teff production. In terms of area planted, teff is the most important crop in Amhara with 1 million ha, followed by sorghum (600,000 ha), wheat (500,000 ha) and maize (400,000 ha).

2) Amhara is less accessible than Oromia, where most agricultural research has been concentrated. For example, plant breeding for maize, sorghum and teff is centred at Melkassa Agricultural Research Centre, which is located 100km from Addis Ababa. The agricultural research centres in Amhara conduct on-station and on-farm trials with teff, but most of the plant breeding is done at Melkassa. Focusing research for the SRMS project on Amhara will build research capacity in a region that has limited experience with partnerships with advanced research institutes and international agricultural research centres.

3) The Amhara region is a key location for the Harnessing Opportunities for Productivity Enhancement project funded by the Bill and Melinda Gates Foundation and managed by ICRISAT. Teff and sorghum are closely integrated in the Ethiopian farming system. In particular, teff is an important insurance crop for household food security when drought reduces the production of sorghum. This offers the potential for synergies between the SRMS and Harnessing Opportunities for Productivity Enhancement projects, since they will focus on different components of the same farming system.

3.5 Risks in the value chain

3.5.1 Natural shocks

Teff is indigenous to Ethiopia and is therefore well-adapted to pests and diseases that affect other cereal crops. It is resistant to a wide range of field pests, except for shoot fly, and can be stored for 10 years without damage. Short-duration teff varieties can be harvested within three months, providing households with a food supply in drought years when longer-duration crops like sorghum and maize fail.

Drought is the most important threat to smallholder agriculture. In the drought of 1997/98, cereal production dropped by 25%. Ethiopia experienced a major drought in 2015, triggered by El Niño, when delayed rainfall prevented the planting of sorghum. Fields that we visited in Amhara were still unplanted in late July. Cereal production fell by an estimated 14% (Bachewe *et al.*, 2016).

Teff plays a critical role in managing drought. If the rains arrive on time in April, farmers plant long-duration sorghum, which will be harvested in October. If the rains arrive later, in June or July, farmers will plant shorter-duration sorghum, which is also harvested in October. Teff is usually planted in its own fields in June/July, and has a field duration of three to five months depending on altitude and the variety. If sorghum fails, income from the sale of teff is used to buy sorghum in the market. 'No crop can compete with teff in terms of risk management.'

A field visit was made to the Haik watershed in Tehuledere district, South Wollo, to confirm the importance of teff in the farming system (Figure 8). Cereal cropping varied by altitude zone: (1) barley, legumes, wheat; (2) short-duration sorghum (planted in April, eight months in the field), short-duration teff (three months, June–August), wheat, maize, chickpea; and (3): short-duration sorghum, short-duration teff (five months, June–November), chickpea on residual moisture, or river irrigation used for vegetables.

Figure 8: Crop calendar, Haik watershed, Amhara

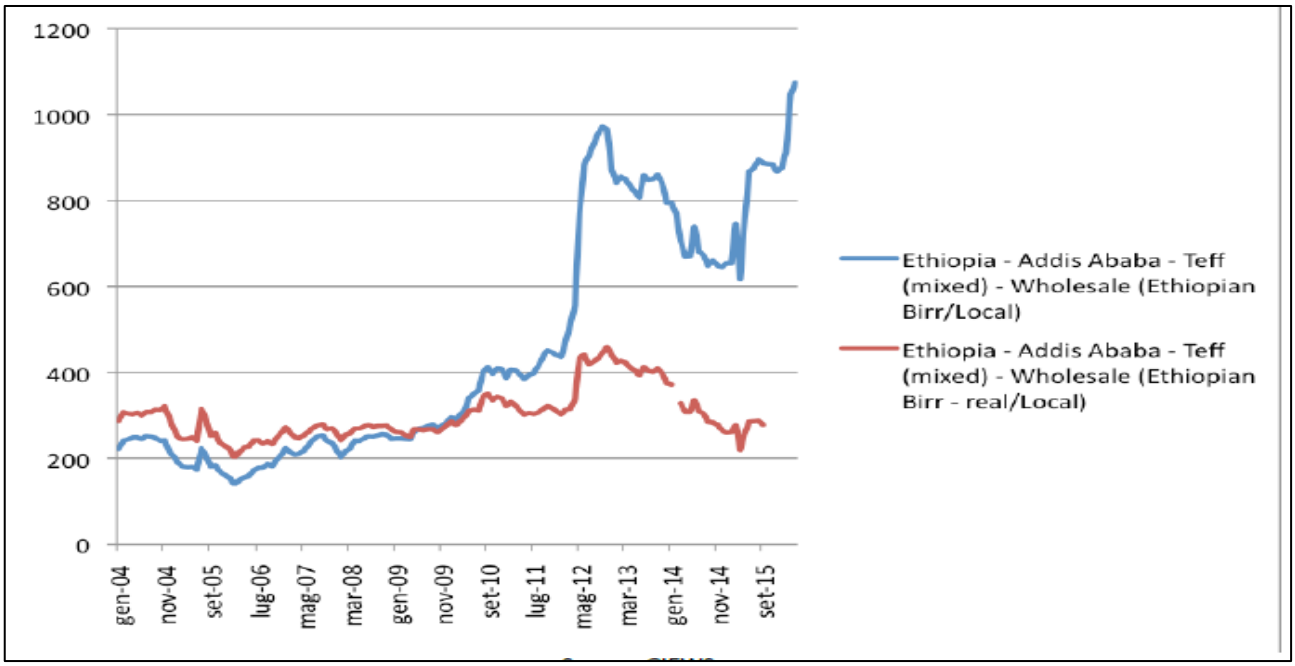
Rainfall	Crop				X	X		X	X	X			
Zone 1 High altitude	Barley/wheat												
Zone 2 Mid-altitude	Short-duration sorghum/maize												
	Short-duration teff												
	Legumes (faba beans, peas)												
Zone 3 Valley bottom	Short-duration sorghum												
	Long-duration sorghum												
	Long-duration teff												
	Chickpea												
	Month	J	F	M	A	M	J	J	A	S	O	N	D

Source: Field visit.

3.5.2 Prices

The real price of teff has risen since 2004, reaching over 400 Birr/kg in 2013, then falling to 300 Birr/kg in 2015 (Figure 9). During this period teff prices rose faster than for other cereals and the price gap between teff and cheaper cereals like wheat and maize widened (Demeke and Marcantonia, 2013).

Figure 9: Nominal and real price of teff, Addis Ababa, 2004–2012 (Birr/kg)



Source: Demeke and Marcantonia (2013).

Contrary to expectations, drought in 2015 did not result in higher cereal prices. In fact, prices actually fell. This is attributed to better market integration, reflecting investment in roads that allow cereals to flow quickly to food-deficit regions, and the expectation that imports will compensate for the fall in domestic production (Bachewe *et al.*, 2016). Although teff is not imported, there was no rise in the price of teff. This may reflect its ability to withstand drought better than other cereal crops.

Teff prices are seasonal, with a difference of 40% between the producer price at harvest and at the end of the season in August–October (Minten *et al.*, 2013a). Producer prices also make up a lower share (71%) of the retail price just after harvest. 'Distress' sales of teff, where farmers sell immediately after harvest to meet pressing cash needs, seem to be low: about 20% of teff sale transactions were classified as 'distress' in the sense that farmers would still have sold if the price had been 10% lower. We were unable to find a breakdown of teff production by farm size or by poverty status, but our presumption is that while teff is grown by all categories of smallholder farmer, the poorest make the majority of distress sales. Together, these findings suggest that there is scope to improve farmers' margins by storing teff after harvest and selling when prices are higher.

Price premiums vary according to the type of teff. In descending order of price, these are:

1) *Magna*, which makes the whitest *injera*. This is the top brand. The best tef which fetches the highest price is grown near Debre Zeit, at mid-altitude, on vertisols.

2) White, a medium type with a pale-coloured grain, between white and red, widely used by restaurants. This is called *Sirigegna*. Two-thirds of teff sold is white. The shift from red and mixed teff is a major change in the last 10 years (Minten *et al.*, 2013b).

3) Mixed. *Injera* made from mixed white and red varieties has a different texture and is less good. Traders buy white and red teff varieties from different regions and mix them to get a higher price.

4) Red, used mainly for home consumption.

Higher prices for magna and white varieties reflect consumer preference for white *injera*, their higher milling ratio, and the longer shelf life of *injera* made from white varieties (Minten *et al.*, 2013b). Magna and white teff varieties make up 70% of the teff which is marketed, up from 49% just 10 years ago (Minten *et al.*, 2013b).

3.5.3 Economic coordination

Figure 10 shows the teff value chain. A major study of the value chain conducted in 2012 concluded that the structure is efficient. This is attributed to the high market price of teff, which encourages competition among buyers (Minten *et al.*, 2013a).

Typically, there are only four stages in the supply chain (Figure 10):

1) Smallholders sell teff to rural assemblers at local weekly markets or traders with fixed shops at urban regional markets;

2) Rural traders sell teff to urban brokers or wholesalers in the Addis Ababa market;

3) Brokers and wholesalers in the Addis Ababa market sell to urban millers; and

4) Urban millers package and sell teff flour or ready-made *injera* to urban consumers. Increasingly, mills have become one-stop shops, offering grain cleaning, milling and transport.

The average sales transaction is 300kg or USD200. The efficiency of the teff value chain is signalled by the fact that smallholders receive between 78% and 86% of the final retail price, depending on quality. Most of the difference represents the margin between rural and urban wholesale markets. Addis Ababa is the primary market for teff.

Cooperatives play a minor role, accounting for only 2% of teff sales. During the Derg regime, cooperatives followed the Chinese model: farmers were forced to become members and to sell their produce to the cooperatives at low prices. Prices were centrally controlled by the Grain Marketing Corporation. Farmers now want to control their own marketing and sell as individuals. Cooperative marketing of teff is found in other regions (Orimiya, Gojam), where cooperatives will store teff then sell when prices rise. But because the supply of teff is lower in Amhara, everything sells immediately after harvest.

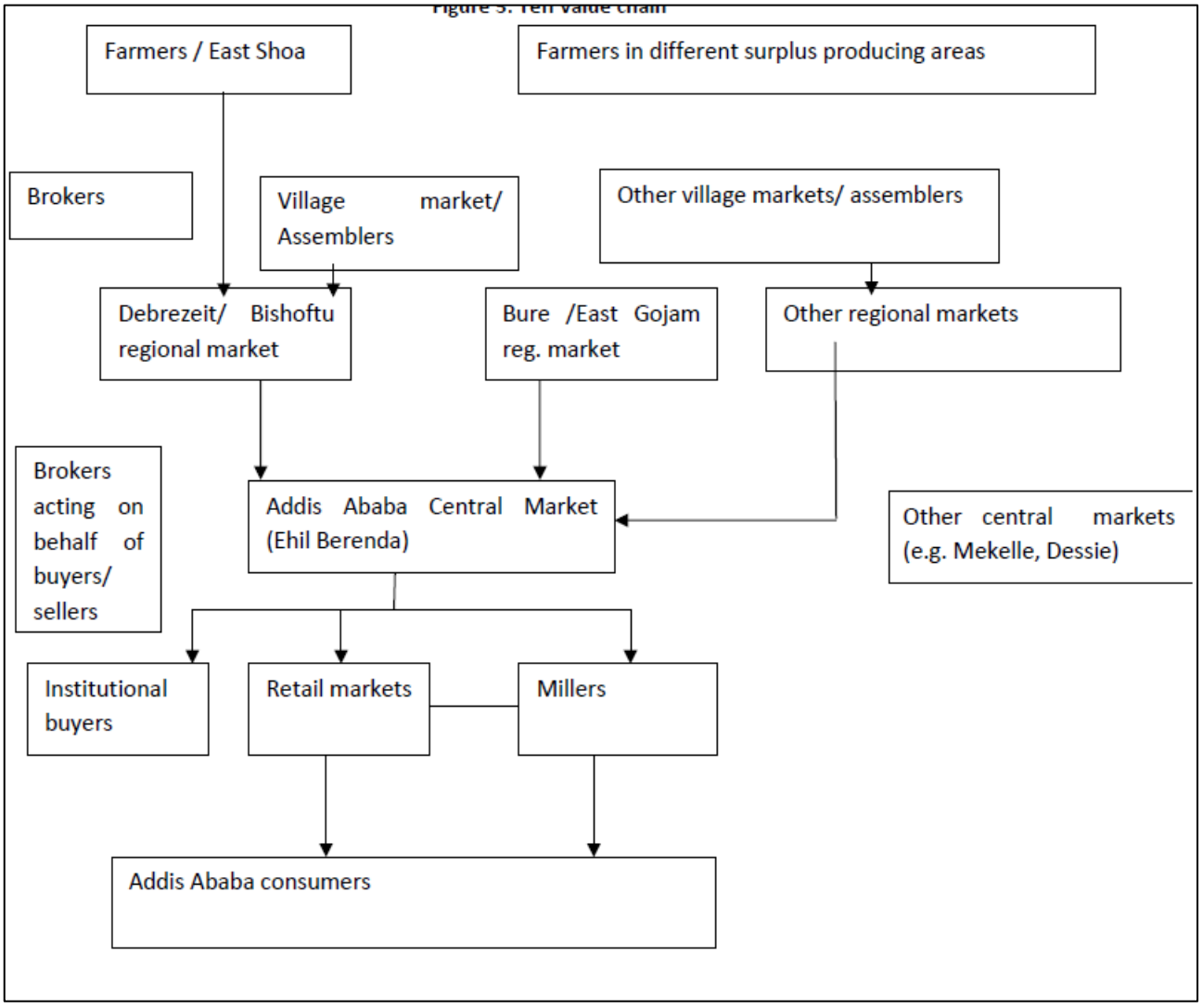
Credit is important for traders, but credit is generated from within the value chain rather than from external sources. Rural assemblers and traders mostly operate without advances from buyers.

However, 60% of urban wholesalers and 45% of urban retailers pay their suppliers on credit, but only for short periods (up to 21 days).

There are no large-scale teff mills. This is for cultural reasons: Ethiopians prefer to buy the grain at the market themselves and take it to mills to be ground into flour. This way consumers can be sure of the quality of the grain, whereas if consumers buy ready-made flour then the grain can be mixed with other lower-standard cereals. The high price of teff encourages farmers and traders and processors to mix teff with cheaper cereals. International buyers prefer to buy red teff varieties because white varieties can be mixed with rice.

The only real value addition is with *injera*. ET Teff, a large flour mill, was established in Addis in 2008 to produce teff flour for export. However, with the trade ban on teff grain it now exports ready-made *injera*.

Figure 10: Teff value chain in Ethiopia



Source: Demeke and Di Mercantonio (2013).

3.5.4 Opportunism

Traders weigh and make quality checks at each stage of the chain. Urban buyers work with a small number of suppliers and procure most of the teff they buy from their home area. These tight family networks reduce the risk of opportunistic behaviour. Less than 10% of rural traders buy on credit, which reduces the risk of side-selling (Minten *et al.*, 2013a).

3.6 RMS

In this section, we identify current and potential strategies used to reduce systemic risks in the teff value chain. These provide possible entry points for project interventions to reduce risks along the value chain.

3.6.1 RMS for natural shocks

RMS # 1: Planting varieties with different maturity dates

Because teff is indigenous to Ethiopia, farmers have a wide range of varieties to choose from. The choice of varieties is determined by altitude, with shorter-duration teff planted at mid-altitude and longer-duration teff at low altitude (Figure 8). This biodiversity reduces the risk of loss from drought and increases sustainability.

RMS # 2: Planting improved varieties

According to teff breeders at Debre Zeit Agricultural Research Centre, the main problem with teff is lodging. This has not yet been solved. Because teff is indigenous to Ethiopia, the available gene pool is limited, and there is not enough variability to identify varieties resistant to lodging. Lodging affects both the quantity and quality of yield. It also interferes with harvesting (whether manual or mechanical). Other problems include abiotic stresses, especially drought, cold/frost in the Highlands, and acidity.

About 20 improved varieties of teff have been officially released (Minten *et al.*, 2013b). Table 6 provides information about important teff varieties in the Amhara region. The most popular improved varieties are Quncho (mid-altitude), Cross (Lowlands) and Dega (Highlands). An analysis of the teff value chain in 2012 found that 76% of growers had adopted Quncho (Minten *et al.*, 2013b). Quncho was released for mid-altitude areas. In Gojam (western Amhara) all farmers grow Quncho, but they will combine it with local teff varieties. Quncho is regarded as unsuitable for regions like Oromia (below 1,600 metres above sea level) and is not widely grown there.

Farmers like Quncho because it is high yielding and its seed colour is pure white (Assefa *et al.*, 2011). Quncho is a cross between a high-yielding variety and a variety with a pure white seed. By contrast, earlier improved varieties like Dukem had a pale white seed and were less popular. Quncho is relatively tall. Teff straw mixed with mud is used for plastering houses, and the amount of teff straw required to plaster one house costs 400–500 Birr.

According to teff breeders, the 30% adoption rate from official statistics is misleading, because improved varieties from the breeding programme in the 1970s have been indigenised, and farmers now regard them as local or traditional varieties. The recommended variety depends on the agro-

ecology. Since the release of Quncho in 2006, the breeding programme has focused on pure white varieties. However, international buyers prefer brown or red varieties, and Debre Zeit is in the final stages of testing one for this market.

Table 6: Improved varieties of teff released in Ethiopia

Variety	Identification	Altitude	Days to maturity	Seed colour	Year of release	Developed by
Kora	DZ-Cr-438	1,700–2,400	110–117	Very white	2014	Debre Zeit/EIAR
Worekiyu	214746A	1,450–2,220	94	White	2014	Sirinka/ARAI
Quncho	DZ-Cr-387	1,800–2,500	86–121	Very white	2006	Debre Zeit/EIAR
Gimbichu		2,000–2,500	118–137	White	2005	Debre Zeit/EIAR
Zobel	DZ-01-1821	1,450–1,850	78–85	White	2005	Sirinka/ARARI
Lakech	RIL 273	1,450–1,850	90	Very white	2009	Sirinka/ARARI
Dega	DZ-01-2675	1,880–2,500	112–123	White	2005	Debre Zeit/EIAR
Magna		n/a	97	Very white	1970	n/a

Source: Ministry of Agriculture, various years; Assefa *et al.* (2011).

RMS # 3: Improve profitability

Teff is widely regarded as more labour-intensive than other cereals. However, this is true only for some regions. Farming systems research in Bahir Dar has shown labour requirements of 85 days/ha for teff compared to 136 days/ha for millet and 129 days/ha for maize. By contrast, in the Ada and Adet farming systems the labour requirement for teff was higher than for other cereals, at 59 and 137 days/ha, respectively (Yadeta *et al.*, 2001). Because the seeds are so small, teff requires a fine seed-bed with an average of four ploughings and two weedings (Minten *et al.*, 2013b).

The Teff, Improved Seed, Reduced Seed Rate, Row-planting (TIRR) technology package promoted by ATA has three components to reduce unit costs and raise profitability:

1) Plant improved seed with higher yield potential and desired market traits (i.e. white seed colour);

2) Reduce the seed rate from 30 kg/ha at present to about 5 kg/ha. A lower seed rate increases competition from weeds so teff requires more weeding. Sow seeds 2–3cm under the soil, not on the soil surface, to avoid lodging when fertiliser is added; and

3) Row-planting (20 cm apart) reduces the seed rate and also allows smallholders to replace manual weeding with herbicides to cut labour costs (most weeding is done by women).

According to teff breeders at Debre Zeit, row-planting by itself does not improve yields. However, row-planting allows more accurate placement of fertiliser and the use of herbicides instead of manual weeding, and also makes harvesting easier (teff is harvested with a sickle, close to the ground, because the straw is also valuable). The problem with row-planting, however, is that there is no

mechanical planter available, and the extra labour required for manual row-planting makes it unpopular. However, on-farm research has demonstrated that row-planting is profitable provided that yields increase by 7% (Vandercasteleen *et al.*, 2013).

RMS # 4: Improve flow of information about new technology

Although the majority of teff growers receive visits from extension workers, many do not know how to use new technology most efficiently. Only 50% of teff growers know the recommended fertiliser rate for teff, while only 10% are aware of zero tillage for teff (Minten *et al.*, 2013b).

3.6.2 RMS for economic coordination

We identified only two possible strategies for reducing economic coordination risks:

RMS # 5: Improve seed supply of improved varieties

Although improved varieties of teff exist, they are not readily available. One-third of teff growers reported they were unable to find seed of improved teff varieties, and 17% reported they did not know how best to use them (Minten *et al.*, 2013b). Teff has a high seed rate – farmers may use up to 50 kg/ha ((Minten *et al.*, 2013b). This worsens the problem of seed supply.

Debre Zeit Agricultural Research Centre produces breeder seed (used by breeders themselves, about one ton per variety) and pre-basic seed (seed they give to Seed Enterprise Board and private companies for production of certified seed, about 50 tons per year). Amhara Seed Enterprise, which serves the whole Amhara region, sells certified teff seed in 10kg bags. However, these state enterprises produce only enough certified seed to cover 1.5% of the area planted with teff each year in Ethiopia. The formal seed system mostly produces only two teff varieties – Magna and Quoncho (Alemu *et al.*, 2013).

Wollo University has sponsored seed production groups. We visited one group in Hitcha kebele, where the teff variety Koncho was being grown for certified seed by farmer seed producers on 2.5 ha of land. This will produce 25 quintals per ha, or 60 quintals of seed, which is enough to plant 100 ha of teff. The seed is sold by a local NGO or farmer cooperative.

In western Amhara, private seed companies produce and sell hybrid maize. However, private companies are not involved with the production and distribution of teff seed, because teff is self-pollinated and there are no hybrids. Farmers can recycle seed for up to three years. Private companies also want to market varieties that are widely adapted, but wide adaptation is difficult in this agro-ecosystem, which has many diverse niches, for which farmer-selected, local varieties are well-adapted.

Wollo University has sponsored seed production groups. The university provides farmers with the basic seed. We visited one group in Hitcha kebele, where the teff variety Quncho was being grown for certified seed by farmer seed producers on 2.5 ha of land. This will produce 25 quintals per ha, or 60 quintals of seed, which is enough to plant 100 ha of teff. The seed is sold by a local NGO or farmer cooperative. The Quncho variety has 72 tillers/plant and certified seed sells for 30 Birr/kg on the local market.

RMS # 6: Collective marketing

Farmers in Ethiopia who sell staple food crops through cooperatives receive 7% higher prices than if they sold them individually (Bernard *et al.*, 2010). However, teff growers already receive 80% of the final retail price. This has led to doubts about whether the collective marketing of teff would result in additional benefits for growers (Minten *et al.*, 2013a). Further research is required with farmers in Amhara, therefore, to determine their views on the value of this strategy. Would it reduce transaction costs, increase prices, or reduce their costs, and by how much?

RMS # 7: Crop storage

Teff prices are seasonal, and rise by 40% between one harvest and the next (Minten *et al.*, 2013a). The value chain study conducted by ATA also showed high seasonal price differences of between 26 and 43% (Fufa *et al.*, 2001). This study concluded, 'Farmers' immediate sale of tef grain is one of the immediate causes of reduced potential income at farm-level' (Fufa *et al.*, 2001: 314). This suggests that there would be high returns to on-farm storage. Teff can be stored for long periods without chemical treatment or damage from pests. However, most farmers sell teff immediately after harvesting in order to meet pressing cash needs, including informal loans and school fees. The project should explore with farmers the reasons for this and the scope for teff storage using existing or improved methods.

3.7 Influencing policy-makers

This section summarises available information about how the project might influence policy-level decision-making about teff.

3.7.1 Policy issues

Trade bans. In 2006 the Ethiopian government banned teff exports, fearing that exports would push up the domestic price of the local staple, as was the case with quinoa. The trade ban was imposed by the government, but the ban was supported by the Ministry of Agriculture and implemented by the Ministry of Trade. The trade ban is still in force.

ATA's Teff International Market Access project works with commercial farmers (not smallholders) in order to safeguard the supply of teff (which is a staple food crop) for the domestic market. The target is to get 25% of the total export market by 2025. The project has four main activities:

1) Circumventing the trade ban by working with 47 commercial farmers (10 ha and above) in four regions (Ahmara, Oromia, SNNPR, and Tigray) who are licensed to export teff grain. The trade ban remains in force but they are granted special licences to export teff. By 2025 they expect to work with 80 farmers. The first shipment of six containers of 19mt each was made in December 2016. Currently only 1% of teff is exported. International buyers prefer to buy red teff varieties because white varieties can be mixed with rice.

2) Training to raise teff yields. Commercial farmers are trained in an input package including varieties, row-planting, low seed rate, weeding and post-harvest practices. Mechanisation using a row-planting machine, but the price (5 million Birr or USD25,000) is too much even for commercial farmers.

3) Value addition of teff grain. At present the only value addition is through *injera* and some bread products. By the end of the project in 2025 the aim is to have a range of teff products available for exports.

4) Promotion of teff through trade fairs, contacts with international buyers, etc.

ATA regards the relevance of the trade ban for smallholders as limited. Smallholders produce teff for the domestic market, and to ensure national food security. By contrast, the world market is seen as appropriate for commercial farmers who can meet the stringent quality standards required to compete with producers in, for example, the Netherlands, Spain and South Africa.

3.7.2 The policy-making process

Policy decisions for agriculture are made by:

1) The Ethiopian ATA, which has direct access to the PM, who chairs the Agricultural Transformation Council. The ATA is the secretary of the Council. The Council discusses technology, including seed systems. The Council is now pushing for input insurance, where farmers are compensated not for yield losses but for losses of seed and fertiliser. ATA has tested this and is now pushing for wider implementation.

2) The Bureau of Agriculture sets plans for a five-year period. This specifies targets for: (1) food crops; (2) export crops (chickpea, sesame, common bean); and (3) industrial crops (bread wheat, durum wheat, malt barley). The regional bureaux then make plans based on this and implement them based on national targets. The five-year plan or Master Plan is broken down into annual plans or targets. The regional plan is disaggregated into zones and districts, then adapted for local conditions. The division into clusters is part of the annual plan. Previously annual plans were focused on commodities; now they focus on clusters, with two to three crops per cluster. The agriculture budget is set by the regional government, with some subsidy from the central government. The Bureau of Agriculture reports to the regional government. The regional bureau is led by a head, not by a minister, who leads the federal Ministry of Agriculture.

Regional plans are criticised for: (1) being too ambitious; (2) being too centralised – zones and woredas need more power; and (3) ignoring the micro-diversity of the Lowlands. Farmers' organisations are not directly represented in the planning process, only indirectly through the Department of Cooperatives. Although the ATA does not recognise teff as a priority crop in the Amhara region, the ratio of teff to sorghum in eastern Amhara is about 50:50. The federal government's Minister of Agriculture and the Regional President of Amhara both wish to focus on eastern Amhara, which includes the south Wollo zone.

According to the Amhara Agricultural Research Institute (ARARI), there is scope to influence agricultural policy by working directly with regional government. They give the example of Girana 1, an improved sorghum variety that survived the 2015 drought. The regional head of the Bureau of Agriculture saw this variety on a field visit, and was impressed by its resistance to drought. He then aggressively promoted it. Although the federal government in Addis Ababa has 'money power', the regional governments have political power and an army of extension agents. The system is

hierarchical, and lower levels have little leverage and influence. The lesson from our partners is: 'Work with the top echelons of government.'

This suggests that the SRMS project might have 'Policy-maker Field Days' at which top representatives from the Bureau of Agriculture in Bahir Dar can visit the field and witness our work, which can be filmed for wider publicity. This may be more effective than making videos or policy briefs for policy-makers.

3.7.3 Partners for influencing policy

The ATA

The ATA was established in 2011 and is mandated to transform subsistence agriculture in Ethiopia, making it commercial. Transformation will be managed in four phases, with Phase 2 (2016–2020) coinciding with the SAIRLA programme. Teff is a major focus of ATA's agenda. ATA promotes teff through: (1) the Teff International Marketing Access, established in 2010, which targets international markets and commercial farmers; and (2) the TIRR technology package. The TIRR package was scaled up to reach 2.2 million farmers by 2014/15, or 33% of teff growers and 36% of the land planted to teff in Ethiopia (ATA, 2015). This helps explain the 21% growth in teff yields between 2010/11 and 2014/2015. Extension service Subject Matter Specialists have also been trained in each agricultural zone.

ATA has also identified 'commercialisation clusters' across the country where each cluster has designated priority crops. **Since the ATA conducts policy research on teff and has close links to political decision-makers, research results and lessons should be communicated through this agency. The Africa Rising project has a platform with close links to policy-making bodies at national level, including ATA. The SRMS project should communicate with ATA through this platform.**

Farmer cooperatives

There is a Federal Cooperative Promotion Agency. At regional level, there are regional agencies for promotion of cooperatives, which are unions of cooperatives found at kebele level. At this level, cooperatives are owned by farmers and employ managers. The Federal Agency provides training and audits, and forms the regional unions. There is one cooperative in every kebele. **The SRMS project should work with local cooperatives in Amhara to improve access to certified teff seed.**

Bureau of Agriculture

The extension service is run by the Bureau of Agriculture. The extension service in Amhara region has 26,000 employees, about seven in each kebele, which is the lowest administrative unit, and which might comprise several villages. **At regional level, the SRMS project should channel research results and lessons through meetings of the Amhara Bureau of Agriculture, which are attended by the ARARI.**

The ARARI

The ARARI is a public agricultural research organisation established in 2000 by the Amhara National Regional State. It is mandated conduct agricultural research for the Amhara region. ARARI is primarily

financed by the Amhara Regional State and is under the Bureau of Agriculture and reports to it. ARARI influences the policy process by participating in regional Bureau of Agriculture meetings in Bahir Dar.

The main centre for crop improvement for teff is located at Debre Zeit Agricultural Research Centre, about 1.5 hours from Addis. There are two senior teff breeders (including the Centre Director) and two MSc level breeders. Other disciplines – entomology, pathology and economics – are shared with the centre's other mandate crops. The Debre Zeit region produces the teff variety Ada, which fetches a premium price. The breeding programme at Debre Zeit makes the crosses but these are tested at other regional centres (including Sirinka Agricultural research Centre in Amhara region), which can also release its own varieties. The breeding programme aims at wide adaptation, creating varieties suitable for many different regions.

4 Synthesis: comparing the two value chains

This concluding section synthesises the information from the previous section to compare the two value chains.

Figure 11 presents a visual overview of the risks and suggested RMS for the two value chains. Below we summarise the results:

Risks

1) The systemic investment risks in these value chains can be divided into four types: natural shocks, prices, economic coordination, and opportunism.

2) All four types of risk are present in both value chains, although not all risks are equally severe. The risk from natural shocks is relatively low because both pigeonpea and teff are resistant to drought.

3) The severity of these different types of risk differs between value chains. Pigeonpea has a higher price and is exposed to more economic coordination risks than teff. This reflects differences in market conditions.

RMS

1) The four types of systemic investment risk require different RMS.

2) Risks from natural shocks can be reduced by improved varieties with pest and disease resistance; this is particularly important with pigeonpea (Fusarium wilt, podborers), but less so with teff (shoot fly). However, one improved pigeonpea variety Mwaiwathualimi (ICEAP 00557) requires chemical sprays, which will require small packs affordable by smallholders.

3) Price risks can be reduced by growing improved varieties with the market traits that will earn growers a price premium, new technology that reduces unit costs and increases profitability, storing grain to sell when prices are higher and by forward contracting where buyers fix the price at planting time. At present, grain storage and forward contracting are not used.

4) Economic coordination risks can be reduced by collective marketing, smaller seed packs, and changes in trade policy. There is some collective marketing for pigeonpea but none for teff. The supply of high-quality seed is a problem in both value chains. Smaller seed packs would increase availability and reduce the risk for farmers using new varieties for the first time.

5) There are opportunism risks in both the supply of inputs and in output markets. The risks of buying poor quality inputs can be reduced by improving delivery systems (e.g., accredited agro-dealers). Side-selling (where sellers renege on contracts) can be reduced through forward contracting.

Figure 11: Risk mapping of smallholder value chains for pigeonpea and teff: a generic model

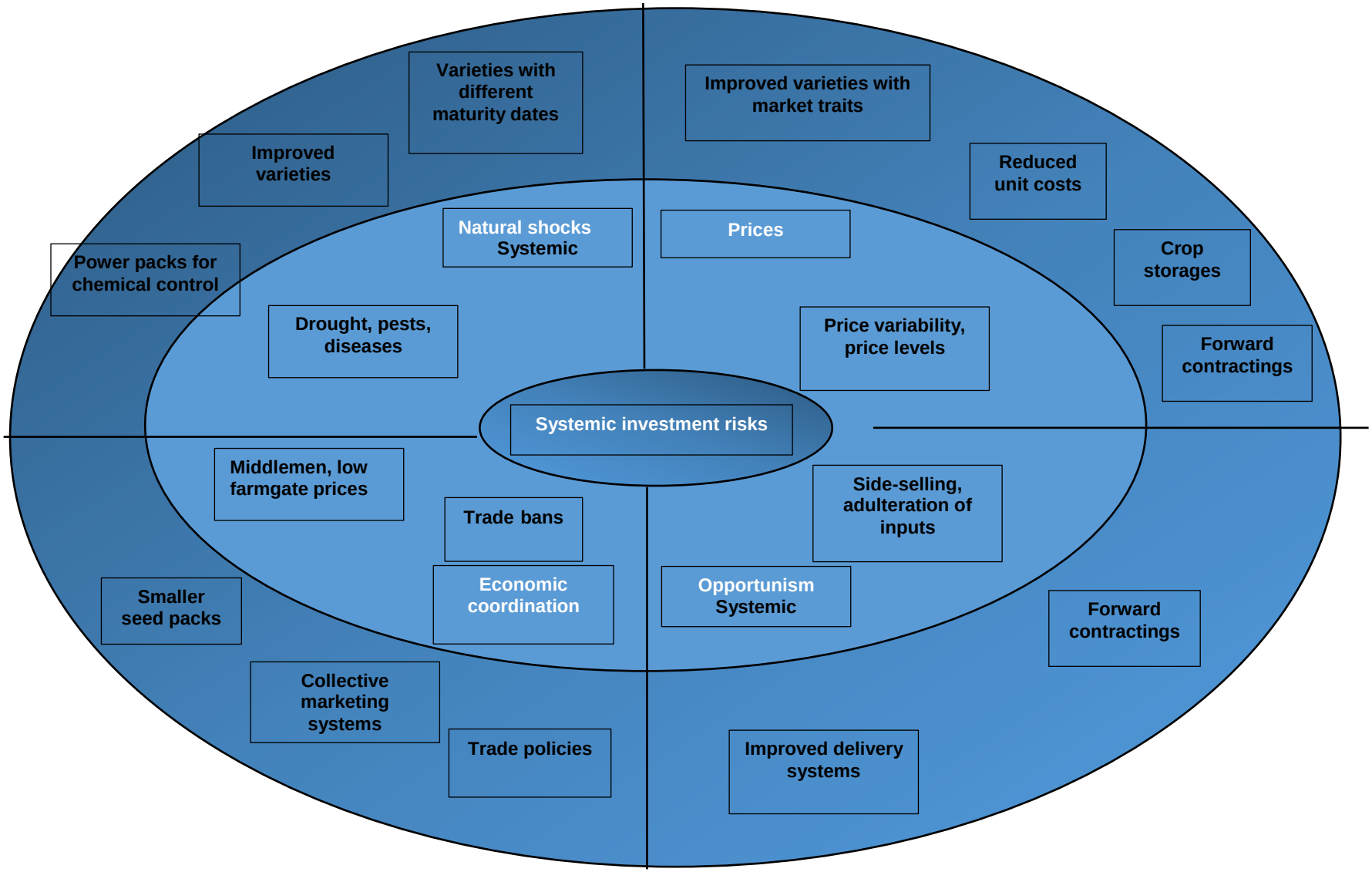


Table 7 compares key variables for the two value chains. Below we summarise the main similarities and differences.

Similarities

1) Inclusion of poorer smallholders;
2) Growing consumer demand;
3) Low risk from natural shocks (for pigeonpea, depending on variety);
4) Output markets dominated by private trade; and
5) Limited investment in research and development.

These results show that the two value chains compare closely in terms of social inclusion, market potential, and resilience to risk from natural shocks. For both commodities, the main buyers are private traders. Both crops have received relatively little attention from research and development.

Differences

1) The inclusion of women is lower for teff;
2) Systemic investment risks are higher for pigeonpea, with higher price, economic coordination and opportunism risks;
3) Higher risks for pigeonpea reflect reliance on global not domestic markets;
4) Input supply systems in Malawi rely on agro-dealers compared to cooperatives in Ethiopia;
5) Trade policy is restrictive for teff with trade bans and export controls; and
6) Rising prices for teff between harvests offer scope for increasing profitability through on-farm storage.

These contrasts show that the project may generate several lessons about the commercialisation of smallholder value chains:

1) Gender norms and the impact of commercialisation on women;
2) RMS where smallholders compete in world markets; and
3) The effectiveness of private and public seed delivery systems.

Table 7: Comparison of pigeonpea and teff value chains

Indicator	Description	Pigeonpea	Teff
Social inclusion	Poorer smallholders	High	High
	Women	High	Low
Markets	Competition from neighbouring countries	High	Low
	Consumer demand	High/growing	High/growing
	Market	Foreign	Domestic
Risks	Natural shocks	High/Low	Low
	Price	High	Low
	Economic coordination	High	Low
	Opportunism	High	Low
Institutions	Input supply	Agro-dealers	Cooperatives/ seed producer groups
	Buyers	Private traders	Private traders
	Processors	Large companies	Small/medium enterprises
Policies	Trade bans	No	Yes
	Regulations on exports	No	Yes
	Investment in research and development	Limited	Limited

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