Detailed farm characterisations to explore the adoption potential of grain legumes in Malawi

Introduction

Legume technologies are often promoted to increase nutrition, livelihoods and soil fertility of sub-Saharan smallholder farmers. Differences between regions as agro-ecological potential, market access and off-farm income opportunities and differences between farmers in terms of resource endowment and livelihood strategy imply that blanket recommendations for legume technologies are unlikely to be effective. In this MSc research, legume technology niches were identified through detailed system characterization, with the use of a farm typology to deal with the large diversity in smallholder farms. The results of farm characterizations, covering diverse farm types in Mchinji and Salima district in central Malawi, were used to gain insights in the possibilities of legumes to improve nutrition, livelihoods and soil fertility.

Farm typology

A survey was conducted to identify different types of farmers with variation in resource endowment, production orientation and source of income. The stratification of farms based on wealth and production criteria resulted in a descriptive typology with five farm types. Most household belonged to farm type 2 or 3 (Table 1).

Farms of type 1 were low resource endowed (LRE), small-scale farms where one or more family members worked casually for other farmers to generate additional income and food, since they were too small to be self-sufficient. However, casual labour generated low wages and sometimes created a labour shortage within the own household. Farms of this type hardly owned assets like radios or bicycles and, except for some chickens and the occasional goat, usually did not own livestock. Farms of type 2 were in terms of resource endowment mainly similar to type 1. However, these farmers did not depend on casual labour but had some small temporary businesses and were sometimes able to sell a little farm produce. Also, they owned more livestock, but not necessarily more household and farming assets. The household head had received in general more years of education than the household heads of type 1 farms. Farms of type 3 were mainly medium resource endowed (MRE). Income was usually generated through a combination of farm surpluses and small enterprises that generated more income than those found in type 2. The high resource endowed (HRE) farms of type 4 had typically large landholdings and a wide range of assets including furniture and sometimes even a car. The farmers of this type usually owned some larger livestock (e.g. cows) and produced for markets. Most of the farms within this type relied on hired labour. Some farms also had other enterprises such as renting out houses, but still generated the largest part of their income on-farm. In farms of type 5, one of the household members worked outside the farm and earned a fixed monthly salary. The rest of the household members worked on the farm. The income generated off-farm was always larger than the income generated from farming. These farms sometimes owned some larger livestock since the animals can be used to store wealth. Household heads from the farms falling in type 4 or 5 had received on average more years of education than the household heads from the farms falling in type 1

Land allocation

Maize was grown across all farm types and the majority of the farmers allocated it the largest proportion of their cultivated area (Figure 1). Although farmers of the 1st, 2nd and 3rd type occasionally sold a small amount of maize within the village, only the larger-scale farmers of type 4 and sometimes 5 considered maize to be a cash crop as well. The typical cash crops tobacco and cotton were mostly grown by the market oriented farmers of type 4, who allocated large areas to these crops. Only small areas of cash crops were grown by the farmers of the other types. Groundnuts were grown across all farm types, especially in Salima. In some cases, groundnuts were considered as a prime cash crop, but most of the farmers cultivated groundnuts for both home consumption and income generation. Soyabean, cowpea and beans were cultivated very little compared to the other crops and fullfilled roles in both home consumption and generating cash.

In terms of adoption rate and allocated land, maize seemed to be the most important crop for all farm types, followed by the tobacco, cotton and groundnuts, whereas other legumes like soyabean, beans and cowpea only played a minor role and were hardly grown by the low resource endowed farmers of type 1 and 2.

Table 1. Characteristics of farm types in Mchinji and Salima district of Malawi

Farm Type	n	Education HH (years)	Family size	Farm size[b] (ha)	Cultivated area (ha)	Total value livestock[c] (US $)	Total value assets[d] (US $)	Source of income	Production orientation
Mchinji									
1	4	0.50 (0.50)	5.75 (0.48)	0.51 (0.12)	0.51 (0.12)	0 (0)	38 (21)	Off-farm	subsistence
2	20	5.15 (0.95)	4.70 (0.56)	1.30 (0.17)	1.24 (0.18)	130 (54)	89 (19)	Mixed	subsistence + low market
3	38	6.49 (0.53)	5.71 (0.34)	2.56 (0.52)	1.85 (0.18)	679 (317)	160 (16)	Mixed	subsistence + low market
4	2	6.00 (2.00)	9.00 (3.00)	7.00 (3.00)	3.84 (3.80)	22628 (21185)	20407 (20039)	On farm > off farm	market
5	6	8.33 (2.03)	7.17 (1.35)	4.43 (1.27)	3.30 (0.51)	3464 (1722)	1322 (999)	Off farm > on farm	subsistence + low market
Salima									
1	7	2.86 (1.39)	5.14 (1.18)	1.32 (0.33)	1.01 (0.19)	28 (17)	92 (45)	Off farm	subsistence
2	28	6.18 (0.62)	4.54 (0.38)	1.36 (0.17)	1.21 (0.10)	41 (12)	49 (9)	Mixed	subsistence + low market
3	27	5.59 (0.78)	5.70 (0.38)	2.74 (0.38)	1.94 (0.19)	255 (54)	133 (16)	Mixed	subsistence + low market
4	4	9.25 (1.70)	5.00 (1.08)	11.10 (3.32)	6.00 (0.82)	953 (344)	978 (524)	On farm > off farm	market
5	5	8.40 (2.20)	5.40 (0.75)	1.53 (0.31)	1.53 (0.31)	921 (713)	309 (181)	Off farm > on farm	subsistence + low market

[a] HH = household head.
[b] farm size and cultivated area are farmer estimates.
[c] including chickens, ducks, pigs, goats and cattle. Prices are 2010 sale prices.
[d] including farming tools, oxcart, wheelbarrow, radio, mobile phone, television, bicycle, car, excluding furniture

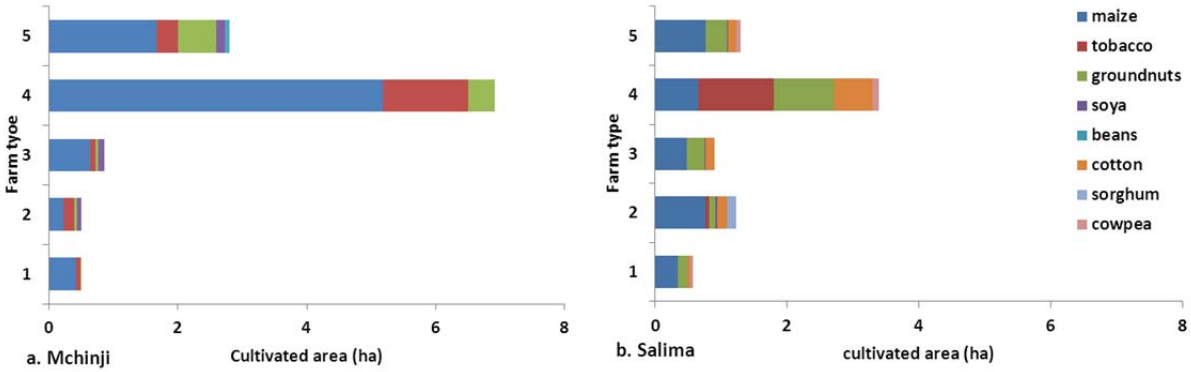

Figure 1. Land allocation to the different crops averaged per farm type for a. Mchinji and b. Salima.

Maize had a higher labour use efficiency (LUE) than groundnuts (Table 2). No significant correlation was found between labour inputs and yield of any of the crops. Energetic returns to land depended on the energetic value of a crop and the yield of the relevant crop. In Mchinji, maize gave the highest energetic returns to land. In Salima energetic returns of maize were much lower than in Mchinji due to lower yields of this crop. In Salima, energetic returns of groundnut to land and labour were comparable with those of maize.

Table 2. Average labour use efficiency and energetic returns of maize and groundnut to land and labour.

	maize	groundnuts

Mchinji		
Labour use efficiency (kg grain hour^{-1})	3.33	0.70
Energetic returns to land (kcal ha^{-1})	11 234 219	7 194 459
Energetic returns to labour (kcal hour^{-1})	8 577	3 699
Salima		
Labour use efficiency (kg grain hour^{-1})	1.55	0.96
Energetic returns to land (kcal ha^{-1})	8 402 952	8 806 500
Energetic returns to labour (kcal hour^{-1})	4 275	4 068

Partial budgeting analysis

Net benefits of maize were generally low or negative and worse than those of most other crops (Table 3). Although grain-prices for groundnuts varied strongly over the two years, in both locations net benefits were positive for the two years. With the good market prices of 2010, tobacco had the ability to generate the highest net benefits. However, because prices fluctuated heavily, average net returns became negative the following year. Even with the high 2010 market prices some farmers had negative returns to inputs due to low yields. Cotton generated relatively high net benefits with both price scenarios. However, market prices for cotton were considered high in both 2010 and 2011, relative to the preceding years. Soyabean in Mchinji generated only slightly positive or even negative net benefits, depending on the market price. Beans and cowpea always gave positive net benefits.

Table 3. Economic net-benefits per crop, based on average values on a per hectare basis. Sorghum is not included because no yield data were available. Soyabean is not included in Salima, since it was only cultivated in trials.

crop	costs				grain value	net benefits	grain value	net benefits
	purchased inputs	*hired labour*	*family labour*	*total costs*	*2010 grain prices*		*2011 grain prices*	
Mchinji								
maize	125	27	264	416	526	109	394	-22
tobacco	263	181	490	933	1796	863	1437	504
groundnuts	9	52	327	387	1377	990	455	404
soyabean	8	47	147	202	173	-29	215	125
beans	67	0	93	160	499	339	375	215
Salima								
maize	152	27	410	589	369	-220	295	-294
tobacco	459	144	1114	1717	4310	2593	1690	-27
groundnuts	24	30	451	505	1082	576	1406	901
cotton	61	0	297	358	1094	736	1844	1487
cowpea	31	0	144	175	1282	1108	648	473

Discussion

Farmers themselves defined the boundaries within which legumes can expand on their farm by food security and income. These were bordered and influenced by highly dynamic socio-economic, agronomic and biophysical factors. In Salima, groundnut could compete with maize in terms of energetic returns to land and labour, unlike other legumes (not given here) and groundnut in Mchinji. However, legumes were economically more profitable than maize. Since maize is perceived as the main food security crop, the majority of the farmers indicated that legumes can only be expanded when domestic maize production is sufficient to satisfy household demand. Low resource endowed households were generally less food secure than medium or high resource endowed households and mentioned lack of cash for seeds and lack of land and labour as the major production constraints to expanding legume production. The results indicated that targeting low resource endowed farmers who cannot be self-sufficient in maize production with legume technologies is only likely to be successful if legumes can compete with maize in terms of contributing to food security, which was only the case for groundnut in Salima. The high cultural value attached to maize in Malawi probably also impede an expansion of the area under legumes, although his was not formally assessed in this study.

Although legumes did not have the potential to generate as high net benefits as the typical cash crops tobacco and cotton, they were less risky in terms of possible negative net benefits and establishment costs. Therefore, cultivating legumes can be an option to generate some cash as well as to improve diets with good

quality protein for subsistence oriented farmers who are self-sufficient in maize production. Marketability of legumes other than groundnut was often a major constraint for market oriented farmers to expand their production. Farmers of all types were less interested in the potential soil fertility benefits of legumes than their direct benefit for food and sale. Current contributions of legumes to soil fertility are likely to vary among farms and fields due to (1) variations in biomass accumulation by legumes and associated biological nitrogen fixation, notably due to varying soil fertility within farms and the preferential allocation of legumes to less fertile fields and (2) differences in residue management affecting the carry-over of nutrients in residues over the dry season.

Greta van den Brand, Linus Franke