Climate Smart Agriculture in Malawi

Supplementary material

Annex 1

Selection of agricultural production systems key for food security in Lesotho (methodology)

Different agricultural commodities have varying importance in different countries/regions depending on the culture, perceptions, socio-economic orientations and the political economy. Based on these factors, having varying opinions on the most important agricultural commodity in a region or country is commonplace. In developing the profile, we use a number of criteria (standard that can allow comparability across countries) to identify and prioritize nationally important agricultural (crops and livestock) commodities for further analysis. We consider relevance of the commodity to population's food security, its contribution to national economy and the extensiveness of the production (productivity dimension). We consider the nutritional value of the crop/livestock product in determining the relevance of the value chain to food security, the commodity's contribution to the National Gross Domestic Product (GDP) and the Net Present Value (NPV) in assessing the commodity's economic importance, and the area under production and the coefficient of variation in production in assessing the production dimension. For all the aforementioned indicators, we use global datasets; FAOSTAT for the Economic and production dimensions, and the United States Department of Agriculture (USDA) for the nutrition data. We take a five-year average (for instance 2009-2013) of the most recent available data to come up with the statistics as a way of ensuring consistency. Below is a detailed discussion of the above-mentioned indicators.

Economic dimension

Net Production Value (US$ Constant 2004-2006): Reflects the importance of the commodity in currency value to the economy, which we arrive at as shown in equation 1.

*Net Production Value (NPV) = (Production (tons)*Unit price (US$/ton) ……………………………… (1)*

Commodity's contribution to national Gross Domestic Product (US$ Constant 2004-2006): Is a benchmark (for the agriculture sector) relative with the rest of the sectors of the economy. See equation 2.

*Contribution to GDP = (Gross production value of commodity) / (total national GDP) *100…. (2)*

Nutrition quality dimension

In assessing the nutritional value of the commodity, we consider:

- *Food supply (or dietary energy supply)* (Kcal/day): indicator of food security (nutrition quality. Calories is a standard measure for food quantity).
- *Protein supply quantity* (g/capita/day): indicator of food security (nutrition quality). Assessing protein supply captures the quality of the food, and is an indicator of hunger as well.
- *Iron content (mg of iron / 100 gr of product)*: indicator of food security (nutrition quality). Iron deficiency is an indicator of hidden hunger, but also a critical reflection of access to quality food. Iron deficiency represents a major global public health challenges in the world.

- *Zinc content (mg of zinc / 100 gr of product)*: indicator of food security (nutrition quality). Zinc deficiency is the number one deficiency in the world and represents a major global public health challenge.
- *Vitamin A content (IU Vitamin A / 100 gr of product)*: indicator of food security (nutrition quality). Deficiency of Vitamin A is an indicator of hidden hunger and represents a major global public health challenge in the world.

Production dimension

- *Harvested area (ha) / Pastureland (ha)* indicates the importance of the production system in terms of total harvested area.
- *Coefficient of variation in production (standard deviation)*: Shows how production has been varying in the past years preferably (5-10). Production systems with higher variation in the coefficient are considered more vulnerable to climate and non-climate conditions and therefore in greater need to be prioritized. Formula: (Variation in production) = (Standard deviation) / Average for 5 years in production)

Steps for prioritizing the agricultural commodities

1. First, a long list of key agricultural production systems (15-20) is compiled based on existing literature and knowledge of the country context[1].
2. An analysis of the selected commodities´ contribution to food security and economic-production indicators (mentioned previously) is then done to identify those production systems (eight to ten) that are most relevant to food security and productivity objectives.
3. The scores of each production system in each indicator are then normalized to adjust values measured on different scales to a common 0-1 scale, prior to averaging. This allows for comparison of indicator values within the same production system and across selected production systems.
4. A total score for each production system is then calculated using a weighted average of the values of the economic, productivity, and food security indicators (from stage 3). Each category (economic, productivity, and food security) was given an equal weight (0.33).
   For example, *the total weighted score for a production system = Average [(Economic indicators values x 0.33) + (Productivity indicators values x 0.33) + (Food security indicators values x 0.33)], where:*

The *Economic indicators values = (Value of Economic indicator 1, Value of Economic indicator 2) / 2*

5. Based on the final scores, the production systems are then ranked and the list reduced to maximum 10 for further analysis.
6. The short list is eventually validated by in-country experts, who give suggestions; regrouping systems (where necessary), or removing those that are not considered relevant for the scope of the study (for instance, not very relevant to small-scale / family farming) or if there is no data to allow further analysis.

[1] For the purposes of this profile, we frequently use the word production system to be analogous with agricultural commodity, or value chain.

Below we present the analysis of the production systems for Malawi.

Table 1: Assessment of the selected value chains for Malawi

Production system	Economic indicators			Nutrition quality indicators					Productivity indicators		
	NPV (Constant 2004-2006 1000 I$)	*GPV (Constant 2004-2006 1000 I$)*	PS Contribution to national GDP (%)	Dietary energy supply (Kcal/capita/day)	Protein supply (gr of protein/capita/day)	Iron content (mg of iron / 100 gr of product)	Zinc content (mg of zinc / 100 gr of product)	Vitamin A content (IU Vitamin A / 100 gr of product)	Harvested area (ha)	Production (t)	Coefficient of variation in production
Maize	428,608	508,850	7.9	1,134	29.88	0.52	0.45	1.00	1,661,480	3,591,925	0.029
Groundnut	136,362	148,585	2.33	69	2.92	2.00	0	0	317,258	329,352	0.137
Tobacco	242,548	242,548	3.71	0	0	0	0	0	140,553	152,281	0.341
Sugar	87,346	87,346	1.37	102	0	0	0	0	24,800	2,660,000	0.068
Pigeon Peas	88,336	119,921	1.89	2	0.12	2.08	0.27	1,087	196,638	224,474	0.184
Cassava	451,059	451,059	7.05	151	1.58	0.27	1.39	13	200,530	4,317,885	0.099
Sweet potato	571,145	654,963	10.3	225	4.61	2.29	0	0	233267.6	3880550.2	0.117
Beans	76,073	104,676	1.6	46.6	3.01	8.20	2.79	0	292,293	174056.4	0.085
Rice	32,463	33,436	0.5	48.8	0.94	0.80	1.10	0	62006.2	119989.4	0.090
Soy bean	11,695	24833	0.4	19	2.11	15.70	4.89	22	90871.4	90537.6	0.196
Tea	51,068	51068	0.8	0	0.07	0	0	0	19063.8	48020	0.085
Cotton	42,390	42390	0.7	0	0	0	0	0	111000	29660	0.798
Coffee	5,389	5389	0.1	0	0.05	0	0	0	3254.8	5016.8	0.169

Annex 2

Methodology for assessing climate-smartness of ongoing practices

CSA technologies and practices present opportunities for addressing climate change challenges, economic growth and development of the agriculture sector. For this profile, practices are considered CSA if they enhance food security, and at least one of the other pillars of CSA (adaptation and/or mitigation).

The analysis of CSA practices and technologies is shaped around the landscape / agro-ecozones perspective, which recognizes that a CSA practice is not universally applied and that its application depends on a broader set of social, cultural, institutional, policy, economic and agro-environmental variables. One practice may have different impacts (positive/negative) when applied to different production systems and different agro-ecological zones. Therefore, the practices selected for further assessment in this study relate to (though not very exclusively) specific commodities and regions (AEZ) focusing on: (i) the one most vulnerable to climate change impacts, and (ii) the one where the production system under analysis prevails (in terms of harvested area).

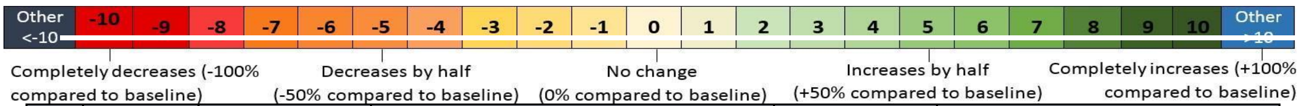
Below is a detailed description of the stages we follow in the selection and evaluation process:

Step 1: Identification of an initial list of practices in the country through a desk review. In-country experts (mostly agronomists with experience in the selected agricultural commodities) then confirmed the list of the practices.
Step 2: Presentation of the validated list of practices to another group of experts in a workshop/focus group discussion for further assessment. Through a semi-structured questionnaire, the experts characterize the practices, highlighting the adoption rates, the majority of farmers (whether smallholder, medium or large scale) that have adopted the practice, and then qualitatively evaluate the climate smartness (considering a number of sub-indicators related to the CSA pillars) for each of the selected practice. The sub-indicators we used (though not exhaustive; we consider them minimum requirement for CSA) are:

- Productivity: yield smart (yields, post-harvest loss [only for crops]), and income smart (income).
- Adaptation: water smart (water availability, water use efficiency), soils smart (soil disturbance), risk/information smart (climate risks management and prevention, diversification of income sources), and gender smart.
- Mitigation: energy smart (energy use [fossil fuels],) carbon smart (Biomass [aboveground], biomass [belowground], soil carbon stock, methane emissions), nutrient smart (nutrient use efficiency).

A number of questions guided the qualitative assessment. We asked the experts to give a score,

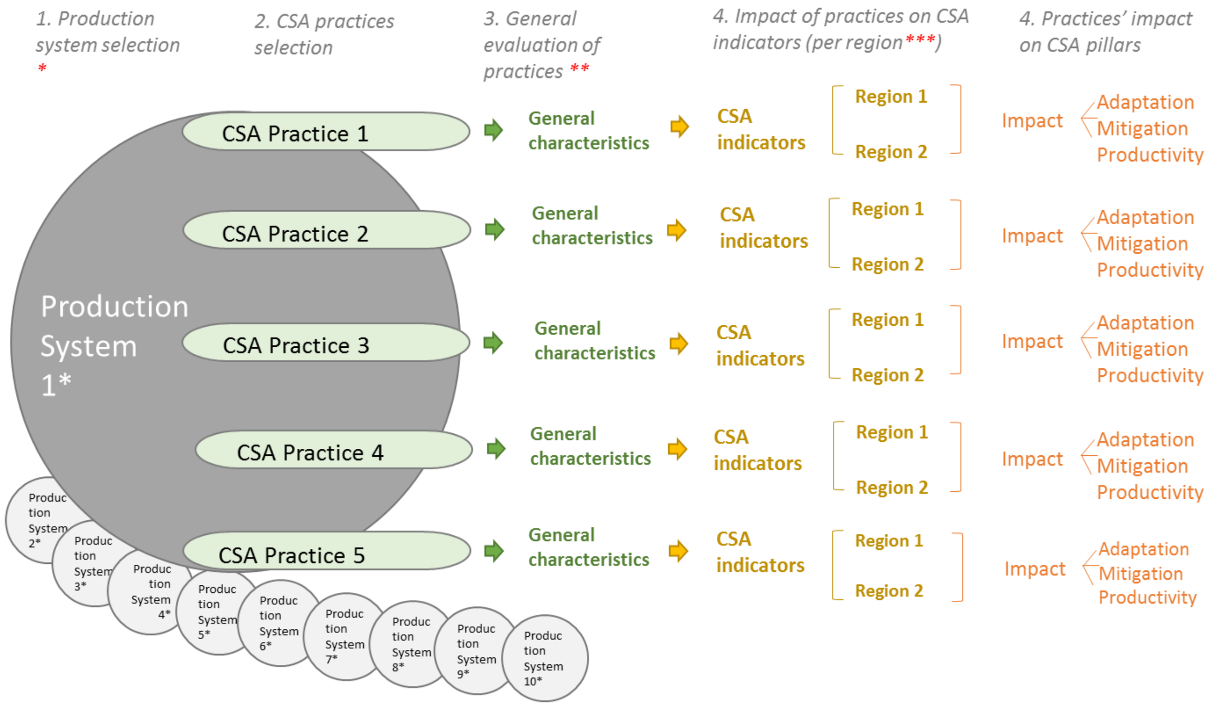
from -10 to 10 (-100% to 100%), where the negative shows that a particular practice does not lead to an improvement in a certain indicator but rather worsens it. See description of the scale, indicators and sub-indicators against which the assessment was done.



Pilar	Smartness category	Indicator	Expected change	Metric	Qualitative scale explained
PRODUCTIVITY	YIELD SMART	**YIELD**	By implementing the CSA practice, what are the expected changes in crop/livestock yields per season on 1 hectare?	Ordinal (-10 to 10, or Other-if outside the range [>-100% or >+100%])	-10=completely decreases (-100% compared to baseline); -5=decreases by half (-50% compared to baseline); 0=no change or N/A; 5=increases by half (50% compared to baseline); 10=completely increases (+100% compared to baseline).
		POST-HARVEST LOSS	By implementing the CSA practice, what are the expected reductions in (pre and post-harvest) losses of crops and livestock? every season on 1 hectare?	Ordinal (-10 to 10, or Other-if outside the range [>-100% or >+100%])	-10=completely decreases (-100% compared to baseline); -5=decreases by half (-50% compared to baseline); 0=no change or N/A; 5=increases by half (50% compared to baseline); 10=completely increases (+100% compared to baseline).
	INCOME SMART	**INCOME**	By implementing the CSA practice, what are the expected changes in income and/or profits per unit of area?	Ordinal (-10 to 10, or Other-if outside the range [>-100% or >+100%])	-10=completely decreases (-100% compared to baseline); -5=decreases by half (-50% compared to baseline); 0=no change or N/A; 5=increases by half (50% compared to baseline); 10=completely increases (+100% compared to baseline).
ADAPTATION	WATER SMART – Impacts on water use and management	**WATER AVAILABILITY**	By implementing the practice what are the expected changes in the availability of water for crops and livestock (both surface water, aquifers and in the soil) Per season?	Ordinal (-10 to 10, or Other-if outside the range [>-100% or >+100%])	-10=completely decreases (-100% compared to baseline); -5=decreases by half (-50% compared to baseline); 0=no change or N/A; 5=increases by half (50% compared to baseline); 10=completely increases (+100% compared to baseline).
		WATER USE EFFICIENCY	By implementing the practice, what are the expected changes in the efficiency with which water is used? Scale: -10 = less efficiency; 0 = No improvement or reduction in efficiency; +10 = greater efficiency (Refers to water used for crop irrigation and/or livestock production).	Ordinal (-10 to 10, or Other-if outside the range [>-100% or >+100%])	Scale: -10 = less efficiency; 0 = No improvement or reduction in efficiency; +10 = greater efficiency
	SOIL SMART	**SOIL DISTURBANCE**	By implementing the practice what are the expected changes in the health of soils (organic matter content, soil structure, nutrient content, soil depth, water-holding capacity)? Scale: -10 = highly disturbed, 0 = not change, to 10 = not disturbance or zero-till)	Ordinal (-10 to 10, or Other-if outside the range [>-100% or >+100%])	Scale: -10 = highly disturbed, 0 = not change, to 10 = not disturbance or zero-till)
	RISK/INFORMATION SMART	**CLIMATE RISKS MANAGEMENT & PREVENTION**	By implementing the CSA practice, what are the expected changes in farmers' capacity to manage, avoid and/or withstand climate risks and hazards (e.g. drought, floods, and dry spells) related to the production system?	Ordinal (-10 to 10, or Other-if outside the range [>-100% or >+100%])	-10=completely decreases (-100% compared to baseline); -5=decreases by half (-50% compared to baseline); 0=no change or N/A; 5=increases by half (50% compared to baseline); 10=completely increases (+100% compared to baseline).
		DIVERSIFICATION OF INCOME SOURCES	By implementing the CSA practice, what are the expected changes in the level of diversification of farmers' agricultural activities on a crop/livestock farm?	Ordinal (-10 to 10, or Other-if outside the range [>-100% or >+100%])	-10=completely decreases (-100% compared to baseline); -5=decreases by half (-50% compared to baseline); 0=no change or N/A; 5=increases by half (50% compared to baseline); 10=completely increases (+100% compared to baseline).

	GENDER SMART	**GENDER**	By implementing the CSA practice what is the expected reduction in labour, time spent in the field and distance travelled by women for agriculture related activities. Scale: 10= huge reduction in labour; 0= no reduction; -10 = huge increase in labour	Ordinal (-10 to 10, or Other-if outside the range [>-100% or >+100%])	Scale: 10= huge reduction in labour; 0= no reduction; -10 = huge increase in labour
MITIGATION	ENERGY SMART	**ENERGY USE (FOSSIL FUELS)**	By implementing the CSA practice, what are the expected changes in the efficiency of use of fossil fuel energy in the production system every season? Scale: +10= increased efficiency to -10= reduced efficiency	Ordinal (-10 to 10, or Other-if outside the range [>-100% or >+100%])	Scale: +10= increased efficiency to -10= reduced efficiency
	CARBON SMART	**BIOMASS (ABOVE-GROUND)**	By implementing the CSA practice, what are the expected changes in the availability of aboveground biomass (trees, shrubs, grasses and other vegetation) within the production system? Every season on 1 hectare? Aboveground biomass (AGB): All living biomass above the soil such as trees, crops, grasses, trees litter, seeds etc. E.g., Forest can accumulate more AGB than a desert.	Ordinal (-10 to 10, or Other-if outside the range [>-100% or >+100%])	-10=completely decreases (-100% compared to baseline); -5=decreases by half (-50% compared to baseline); 0=no change or N/A; 5=increases by half (50% compared to baseline); 10=completely increases (+100% compared to baseline).
		BIOMASS (BELOW-GROUND)	By implementing the CSA practice, what are the expected changes in the availability of belowground biomass and soil organic matter in the PS every season on 1 hectare? Belowground biomass (BGB): All living biomass of live roots. Fine roots <2mm diameter are often excluded. E.g., Forest can accumulate more BGB than savannah or desert. (Ton/ha)	Ordinal (-10 to 10, or Other-if outside the range [>-100% or >+100%])	-10=completely decreases (-100% compared to baseline); -5=decreases by half (-50% compared to baseline); 0=no change or N/A; 5=increases by half (50% compared to baseline); 10=completely increases (+100% compared to baseline).
		SOIL CARBON STOCK	By implementing the CSA practice, what are the expected changes in the quantity of organic matter accumulated in soil in areas under crop/livestock?	Ordinal (-10 to 10, or Other-if outside the range [>-100% or >+100%])	-10=completely decreases (-100% compared to baseline); -5=decreases by half (-50% compared to baseline); 0=no change or N/A; 5=increases by half (50% compared to baseline); 10=completely increases (+100% compared to baseline).
		METHANE EMISSIONS	1. In the case livestock: By implementing the CSA practice, what are the expected changes in the quality of animal diet (including diet diversification, forage quality, digestibility) per season, on a livestock system? 2. In the case of Rice: By implementing the CSA practice, what are the expected changes in the amount of methane released into atmosphere per season, on a Rice system? Metric: N/A	Ordinal (-10 to 10, or Other-if outside the range [>-100% or >+100%])	-10=completely decreases (-100% compared to baseline); -5=decreases by half (-50% compared to baseline); 0=no change or N/A; 5=increases by half (50% compared to baseline); 10=completely increases (+100% compared to baseline).
	NUTRIENT SMART	**NUTRIENT USE EFFICIENCY**	By implementing the CSA practice, what are the expected changes of the nutrients (NPK) available for plants in the soil?	Ordinal (-10 to 10, or Other-if outside the range [>-100% or >+100%])	-10=completely decreases (-100% compared to baseline); -5=decreases by half (-50% compared to baseline); 0=no change or N/A; 5=increases by half (50% compared to baseline); 10=completely increases (+100% compared to baseline).

We recognize that there are many considerations to make when assessing the smartness of a practice, and that our list of categories and indicators is not exhaustive. However, we consider them as important entry points for adaptation and mitigation of climate change in the agricultural sector. We argue that a combination of efficient use and management of water, soils, energy, carbon and nitrogen, combined with efforts to reduce climate risks and to promote the utilization of local knowledge increases the practice’s likelihood to improve adaptation and productivity sustainably. The following diagram summarizes the selection and evaluation process of CSA practices:



* The exercise repeats for ALL production systems selected as key for food security in the country

** **General characteristics** refer to: challenges that the practice addresses, adoption rate, predominant farmers, barriers and opportunities for adoption, practices' impacts on CSA pillars

*** Region 1: most vulnerable to climate change; Region 2: where production system predominates (harvested area)

Figure 1: Summary of the assessment stages

Table 2: Climate-smartness of selected CSA practices in Malawi

Commodity	Practice name	Region1 AEZ (Most vulnerable area)	Region2 AEZ (Most harvested/ cultivated area)	Smartness Average								
				Yield	Income	Water	Soil	Risk/info	Energy	Carbon	Nitrogen	Total average
Maize	Inorganic fertilizer (NPK)	Lower Shire (Chikwawa, Nsanje)		2	2	ND	-2	2	-8	3.5	6	0.8
Maize	Inorganic fertilizer (NPK)		Central Region (Lilongwe, Dowa, Ntchinsi, Kasungu, Dedza, Nkhotakota, Salima, Ntcheu)	2	-6	ND	-2	3	-8	5.5	8	0.4
Maize	Conservation agriculture (Minimum tillage, mulching and use of herbicides)	Lower Shire (Chikwawa, Nsanje)		1	1	2.5	8	1	0	3.7	1	2.3
Maize	Conservation agriculture (Minimum tillage, mulching and use of herbicides)		Central Region (Lilongwe, Dowa, Ntchinsi, Kasungu, Dedza, Nkhotakota, Salima, Ntcheu)	2	2	3	8	3	0	5.0	1	3.0
Maize	Intercropping with legumes	Lower Shire (Chikwawa, Nsanje)		2	3	1	0	5.5	5	3.7	2	2.8
Maize	Intercropping with legumes		Central Region (Lilongwe, Dowa, Ntchinsi, Kasungu, Dedza, Nkhotakota, Salima, Ntcheu)	3	5	6	0	5.5	5	5.0	3	4.1

Commodity	Practice name	Region1 AEZ (Most vulnerable area)	Region2 AEZ (Most harvested/ cultivated area)	Smartness Average								
				Yield	Income	Water	Soil	Risk/info	Energy	Carbon	Nitrogen	Total average
Rice	Rice intensification (Timely watering, hand weeding)	lake Shore (mangochi, Salima, Karonga) Lower Shire (Nsanje)		4	2	3.5	-6	1	0	0.0	1	0.7
Rice	Rice intensification (Timely watering, hand weeding)		Lake shore (Zomba, Phalombe, Salima, Karonga)	6	6	6	-6	4	0	1.0	2	2.4
Rice	Alternate wetting and drying (timely application of water)	lake Shore (mangochi, Salima, Karonga) Lower Shire (Nsanje)		1	1	1	-6	1	0	ND	0	-0.3
Rice	Alternate wetting and drying (timely application of water)		Lake shore (Zomba, Phalombe, Salima, Karonga)	2	2	5	-6	7	ND	ND	0	1.7
Rice	inorganic fertiliser	lake Shore (mangochi, Salima, Karonga) Lower Shire (Nsanje)		4	4	2	0	0	-8	3.0	4	1.1
Rice	inorganic fertiliser		Lake shore (Zomba, Phalombe, Salima, Karonga)	4	4	3	0	0	-8	4.0	6	1.6
Meat	Disease resistant breeds and productivity	Lower Shire and along Lakeshore (Chikwawa, Nsanje, Salima, Nkhotakota, Mangochi, Balaka)		2	3	ND	-1	4	7	0.3	1	2.3
Meat	Disease resistant breeds and productivity		Central and northen region (Thyolo, Blantyre and Mulanje)	5	6	ND	-1	5	8	1.3	1	3.6
Meat	Hybridisation	Lower Shire and along Lakeshore (Chikwawa, Nsanje, Salima, Nkhotakota, Mangochi, Balaka)		3	7	1	-1	4	7	0.5	1	2.8
Meat	Hybridisation		Central and northen region (Thyolo, Blantyre and Mulanje)	6	8	1	-1	6.5	8	1.5	1	3.9
Meat	Manure produciton	Lower Shire and along Lakeshore (Chikwawa, Nsanje, Salima, Nkhotakota, Mangochi, Balaka)		4	5	3.5	8	4.5	6	5.3	3	4.9
Meat	Manure produciton		Central and northen region (Thyolo, Blantyre and Mulanje)	6	8	6.5	10	6	8	5.3	5	6.8
Meat	Fodder Shrubs (planting legume shrubs to produce fodder for goats)	Dedza, Mulanje, Blantyre, Mzimba		1	2	2.5	2	1.5	7	3.3	2	2.7
Meat	Fodder Shrubs (planting legume shrubs to produce fodder for goats)		Chikwawa and Nsanje	5	7	4	6	2.5	8	5.0	4	5.2
Meat	Disease resistant breeds and productivity	Dedza, Mulanje, Blantyre, Mzimba		1.5	2	-1	-1	3.5	8	1.5	0	1.8
Meat	Disease resistant breeds and productivity		Chikwawa and Nsanje	1	8	-2	-4	4.5	10	2.8	0	2.5
Meat	manure collection	Dedza, Mulanje, Blantyre, Mzimba		1	2	2	5	2	5	6.3	2	3.2
Meat	manure collection		Chikwawa and Nsanje	5	7	4	10	5	7	8.0	3	6.1
Tuber	Seed multiplication during dry season	Lower Shire (Chikwawa, Nsanje, Neno)		5	5	0	0	7	0	2.3	5	3.0
Tuber	Seed multiplication during dry season		Nationawise (Dedza, Ntcheu)	8	5	0	0	5	0	3.3	5	3.3
Tuber	Early, timely planting	Lower Shire (Chikwawa, Nsanje, Neno)		5	5	4.5	1	3.5	0	4.3	3	3.3
Tuber	Early, timely planting		Nationawise (Dedza, Ntcheu)	8	8	5.5	2	5.5	0	5.7	5	5.0
Tuber	Integrated pest management	Lower Shire (Chikwawa, Nsanje, Neno)		5	5	5	3	5	0	3.0	5	3.9
Tuber	Integrated pest management		Nationawise (Dedza, Ntcheu)	6.5	8	8	4	8	0	4.0	5	5.4
Tuber	Rapid Seed Multiplication	Lake shore (Balaka)		5	5	0	0	3	0	3.0	0	2.0
Tuber	Rapid Seed Multiplication		Lake shore (nkhotakota, Nkhatabay)	8	8	0	0	3.5	0	4.3	0	3.0
Tuber	Timely Planting and Spacing	Lake shore (Balaka)		5	5	1	7	1.5	0	5.7	4	3.6
Tuber	Timely Planting and Spacing		Lake shore (nkhotakota, Nkhatabay)	8	8	1.5	8	2	0	6.7	5	4.9
Tuber	Integrated pest management	Lake shore (Balaka)		3.5	5	5	3	5	4	3.7	5	4.3
Tuber	Integrated pest management		Lake shore (nkhotakota, Nkhatabay)	5	8	8	4	8	4	4.0	5	5.8

Commodity	Practice name	Region1 AEZ (Most vulnerable area)	Region2 AEZ (Most harvested/ cultivated area)	Smartness Average								
				Yield	Income	Water	Soil	Risk/info	Energy	Carbon	Nitrogen	Total average
Oilseed	Intercropping	Southern region (Chikwawa, Nsanje, Blantyre, Mwanza, Balaka)		-5	4	5	6	7	0	5.7	7	3.7
Oilseed	Intercropping		Central region (Dowa, Lilongwe, Kasungu, Ntchisi, Mchinji, Ntcheu, Dedza)	-5	-5	4	6	7	0	5.7	7	2.5
Oilseed	Recommended spacing	Southern region (Chikwawa, Nsanje, Blantyre, Mwanza, Balaka)		4.5	6	6.5	4	2	ND	3.7	7	4.8
Oilseed	Recommended spacing		Central region (Dowa, Lilongwe, Kasungu, Ntchisi, Mchinji, Ntcheu, Dedza)	4.5	6	5.5	4	1	ND	3.7	7	4.5
Oilseed	Recommended spacing	Southern region (Chikwawa, Nsanje, Blantyre along the shire, Mwanza, Balaka)		3.5	6	6.5	4	2	0	3.7	7	4.1
Oilseed	Recommended spacing		Central region (Dowa, Lilongwe, Kasungu, Ntchisi, Mchinji, Ntcheu, Dedza)	3.5	6	5.5	4	1	0	3.7	7	3.8
Oilseed	improved drying techniques to avoid mould and decay	Southern region (Chikwawa, Nsanje, Blantyre along the shire, Mwanza, Balaka)		9	8	0	0	0	0	0.0	0	2.1
Oilseed	improved drying techniques to avoid mould and decay		Central region (Dowa, Lilongwe, Kasungu, Ntchisi, Mchinji, Ntcheu, Dedza)	9	8	0	0	0	0	0.0	0	2.1
Tobacco	integrated soil fertility management	Lakeshore areas, Shire valley (Karonga, Salima, Nkhotakota, Machinga)		0.5	6	5.5	-10	2.5	6	7.7	9	3.4
Tobacco	integrated soil fertility management		Kasungu, Lilongwe, Mchinji, Dowa, Mzimba, Rumphi, Chitipa, Mangochi, Zomba, Chiradzulu, Thyolo	2	8	7	-10	2.5	8	8.7	10	4.5
Tobacco	Box ridges	Lakeshore areas, Shire valley (Karonga, Salima, Nkhotakota, Machinga)		2	6	7	-10	3	7	4.7	5	3.1
Tobacco	Box ridges		Kasungu, Lilongwe, Mchinji, Dowa, Mzimba, Rumphi, Chitipa, Mangochi, Zomba, Chiradzulu, Thyolo	-2.5	8	5	-10	1.5	7	5.3	6	2.5
Tobacco	Recommended varieties	Lakeshore areas, Shire valley (Karonga, Salima, Nkhotakota, Machinga)		2	8	7	10	5.5	6	1.7	0	5.0
Tobacco	Recommended varieties		Kasungu, Lilongwe, Mchinji, Dowa, Mzimba, Rumphi, Chitipa, Mangochi, Zomba, Chiradzulu, Thyolo	4.5	10	8	10	4	8	2.3	0	5.9
Pulses	Integrated soil fertility management	Lilongwe, Kasungu, Mzimba, Rumphi, Zomba, Phalombe, Thyolo		1.5	5	6	-10	3	5	6.7	8	3.1
Pulses	Integrated soil fertility management		Mchinji, Dedza, Ntcheu, Dowa, Ntchisi, Highlands (Jenda, Mzuzu, Nyika, Misuku hills, Chiradzulu, Thyolo, Mulanje, Livingstone mountains)	2	7	7.5	-10	2	6	7.7	10	4.0
Pulses	Recommended varieties	Lilongwe, Kasungu, Mzimba, Rumphi, Zomba, Phalombe, Thyolo		2.5	6	6	10	4.5	7	2.3	3	5.2
Pulses	Recommended varieties		Mchinji, Dedza, Ntcheu, Dowa, Ntchisi, Highlands (Jenda, Mzuzu, Nyika, Misuku hills, Chiradzulu, Thyolo, Mulanje, Livingstone mountains)	3.5	10	7	10	3.5	8	3.0	4	6.1
Pulses	Plant population	Lilongwe, Kasungu, Mzimba, Rumphi, Zomba, Phalombe, Thyolo		2.5	6	3.5	10	4.5	6	5.7	5	5.4
Pulses	Plant population		Mchinji, Dedza, Ntcheu, Dowa, Ntchisi, Highlands (Jenda, Mzuzu, Nyika, Misuku hills, Chiradzulu, Thyolo, Mulanje, Livingstone mountains)	3.5	8	4.5	10	3	6	6.3	7	6.0

Annex 3

Institutions for CSA in Malawi

Institutions in this context are understood as formal organizations deliberately and intentionally created by individuals in order to organize the society. The institutions are key in shaping agriculture decision making as they affect resource use and the associated outcome. The policies are, in this sense, products of these institutions (organizations) that help guide individuals' and/or group's actions.

Successful implementation and scaling out of CSA practices relies heavily (but not exclusively) on the existence and functioning of an array of government, civil society and private institutions which operate at national and sub-national level; their roles, responsibilities, and activities have the capacity to promote/potentially facilitate the adoption of CSA practices. This section on "Institutions and Policies for CSA" aims to provide baseline information on the principal institutions relevant to the agricultural sector, and assesses their readiness/capacity to build resilience to climate change/variation. It provides information on their current roles in supporting CSA activities and analyzes the extent to which these respond to the (current and future) needs of actors engaged in CSA activities; the target beneficiary being the smallholder farmer.

Cognizant of the above, a stakeholder mapping (of the organizations, and the partners and collaborators) was conducted to identify the main actors (both public and private) working on agriculture, climate change, forestry, environment, natural resource management and rural/sustainable management, or intervening in CSA-related activities such as:

- Production of knowledge and information related to CSA (research)
- Provision of financial and non-financial incentives for CSA promotion and/ or scale-out (financing)
- Development and promotion of CSA technologies and practices (technological development)
- Development of policies and strategies that enable on-field CSA implementation and/or scale out (policy and institutional support)

We present this information in the Venn diagram to give a general, pictorial representation of the primary focus of the institution (either productivity, adaptation, and/or mitigation topics). Noteworthy is that the approach is not scientifically rigorous, and hence representation in the Venn diagram does not reflect any mathematical relation between the variables. The classification of the institutions according to the three CSA pillars is also not straightforward. One institution can fall into various intersection points of the Venn circles, depending on author's or the interviewee's interpretation. At the same time, an institution can have an explicit mandate on productivity increase, but an implicit mandate to work on increasing farmers' resilience.

Annex 4

Policies for CSA in Malawi

Policies are tools used by the institutions to effect and/or shape actions. Given the multi-dimensionality of CSA, and scarce resources, coordination and definition of the action paths of the different actors is pertinent, hence the need for policies. In this work, we extend the meaning of policy to include any action plan, strategy and/or national programme that relates to at least one of the CSA pillars (Productivity, Adaptation and Mitigation), that is either in formulation (meaning that the policy is in the design/ consultation process), is already legally formalized and enacted or is already being actively implemented. Therefore, the study targeted policies such as among others:

- National Action Plan for Adaptation (NAPAs)
- Nationally Appropriate Mitigation Actions (NAMAs)
- National agricultural development and food security plans
- National development plans
- Poverty reduction strategies papers natural resource management plans (with reference to the agricultural sector).

National Communications to the UNFCCC have been considered as key in enabling CSA, since they demonstrate country's compliance with global commitments to climate change action (in this case, the Kyoto Protocol, Paris Declaration). These Communications provide valuable information on emissions and removals of greenhouse gases (GHGs) and details of the activities the country has undertaken to implement the Convention (reducing emissions, increasing resilience to climate change).

The assessment is essential since it highlights the level of awareness of the policies, available capacity in enforcing the policies, financial resources available for training and creating public awareness, monitory and evaluation measures to help identify gaps and the best ways to include CSA in the development narratives. However, the integration of certain policies and strategies into different CSA pillars is also subject to the author's and reviewer's interpretation; the focus of some policies on the three CSA pillars can often times be implicitly expressed in the policy's description.

Annex 5

Assessing finances for CSA in Malawi

Finances form a pivotal component in CSA. Reforms such as inclusion of climate considerations in the agriculture sector requires restructuring of agriculture investments (both public and private). CSA finance plays a crucial role in this restructuring; it can act as a catalyst for the broader adoption of CSA, facilitate climate change mainstreaming into national policy and legal frameworks, and promote creation and diffusion of skills, knowledge and technologies.

The goal of the CSA finance analysis is to identify the funds currently accessed for CSA adoption in the country and highlight potential new funding sources. The analysis begins with development of a list of important international funds from a mix of sources; the CSA finance section in FAO (2013), the 21 selected funds in Clarvis (2014), and from a rigorous internet search[2]. Once the list was developed, we classified the funds based on the purpose (for instance for CSA, and which pillar of CSA, and public or private). Stakeholders identified as most relevant in the country in handling the funds (channels) validated the list through individual interviews, focus group discussions and a workshop. The information sought after in these engagements included:

- The name of the particular project being funded and by who
- The sector targeted (agriculture, fishery etc.)
- Whether the project (fund) intervened in other non-agricultural sectors such as energy.

A fund the country had applied for but has not yet accessed (or was never awarded due to some reasons) was considered a potential fund; a tentative source of financial incentives for CSA adoption, whether for national, state and local level governments or for farmers.

National funds, (which include monies sourced within the boundaries of the country through taxes, fees levied on services/facilities, and devoted to at least one of the pillars of CSA by a national entity) were also considered.

An important assumption in this methodology is that increasing the number of funders can potentially increase CSA scale up. Current funders could also increase their financial support to meet the CSA needs. Notwithstanding, accessing additional funders may not necessarily guarantee CSA scale up since this is pegged on already discussed issues such as governance. A key limitation of the approach we use is that access of a certain fund once is not surety for continued access hence the methodology does not fully capture all the dynamics of future access. The information given is also largely dependent on the extensiveness of the knowledge of the participants.

[2] An example of the source include OECD available at:
https://qdd.oecd.org/subject.aspx?subject=climatefundinventory

Annex 6

Agro-ecological zones for Malawi

The country is divided into 3, sometimes 4 agro-ecological zones based on biophysical characteristics such as rainfall regime, temperature and the quantity and variability of average rainfall, as well as soil quality and vegetation:

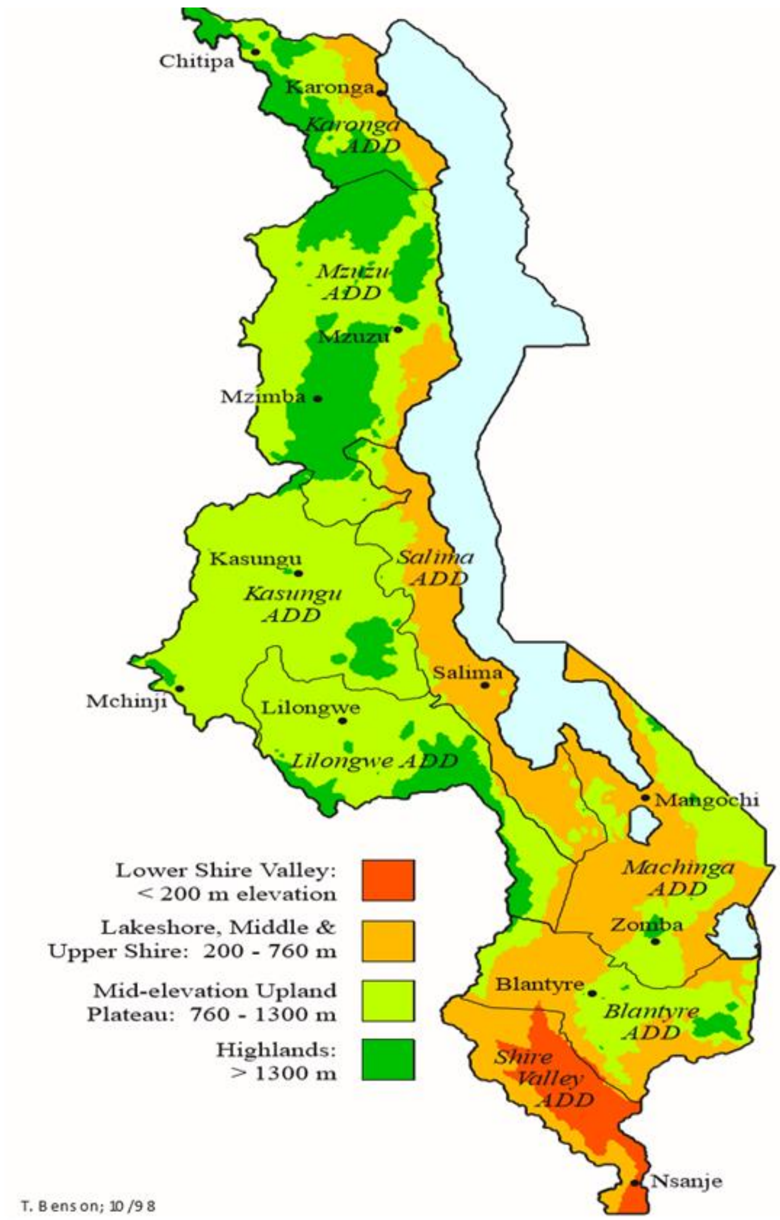


Figure 3: Map showing agro-ecological zones in Malawi