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Innovation for Sustainable Agricultural Growth in Malawi

PARI

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About this study

In 12 African countries and India Green Innovation Centers (GICs) have been established under the ‘‘One World, No Hunger’’ Initiative (SEWOH) of the German government and other investors. The aim of the GICs is to promote agricultural innovation, improve food and nutrition security and build sustainable value chains in the agri-food sector of these countries. The Program of Accompanying Research for Agricultural Innovation (PARI) has been providing independent research to the SEWOH since 2015. PARI is led by the Center for Development Research (ZEF) at the University of Bonn in close collaboration with the Forum for Agricultural Research in Africa (FARA) and its network of national and regional partners in Africa, the African Growth and Development Policy Modeling Consortium (AGRODEP) facilitated by the International Food Policy Research Institute (IFPRI, Africa Office) and other partners in Germany and India. This country dossier offers a situation analysis of the current state of the agri-food sector, related policies and existing agricultural innovations. It thereby provides basic background knowledge necessary to make fruitful investments in line with the country‘s policies and its potentials, and to find promising partners for development cooperation.

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Acronyms/Abbreviations

ADD	Agricultural Development Divisions
AEDC	Agricultural Extension Development Coordinator
AEDO	Agricultural Extension Development Officer
ASSMAG	Association of Smallholder Seed Multiplication Action Group
ASWAp	Agricultural Sector-wide Approach
BMZ	German Federal Ministry of Economic Cooperation and Development
CAADP	Comprehensive African Agriculture Development Programme
CARE	Cooperative for Assistance and Relief Everywhere
CGIAR	Consultative Group on International Agricultural Research
CISANET	Civil Society Agriculture Network
COMESA	Common Market for Eastern and Southern Africa
DADO	District Agriculture Development Officer
DAES	Department of Agricultural Extension Services
DARS	Department of Agricultural Research Services
DFID	United Kingdom Department for International Development
DHS	Demographic and Health Survey
EPAs	Extension Planning Areas
FANR	Food, Agriculture and Natural Resources
FAO	Food and Agriculture Organization
FARA	Forum for Agricultural Research in Africa
FISP	Farm Input Subsidy Programme
FTF	Feed the Future
FUM	Farmers Union of Malawi
GDP	Gross Domestic Product
GHI	Global Hunger Index
GIC	Green Innovation Center
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit / German Agency for International Cooperation
GNI	Gross National Income
GoM	Government of Malawi
HIV/AIDS	Human Immunodeficiency Virus/ Acquired Immune Deficiency Syndrome
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IFPRI	International Food Policy Research Institute
IITA	International Institute of Tropical Agriculture
IP	Innovation Platform
MAPAC	Malawi Programme for Aflatoxin Control
MAPP	SADC Multi-Country Agricultural Productivity Programme
MGDS	Malawi Growth and Development Strategy
NASFAM	National Smallholder Farmers' Association of Malawi
NGO	Non-governmental Organization
NSO	National Statistics Office
PARI	Program of Accompanying Research for Agricultural Innovation
PPP	Purchasing Power Parity
R&D	Research and Development
RCA	Revealed Comparative Advantage
RUTFs	Ready-to-use therapeutic foods
SADC	Southern African Development Community
SEWOH	"One World, No Hunger" Initiative
TFP	Total Factor Productivity
TIP	Targeted Input Programme

UNICEF	United Nations International Children's Emergency Fund
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
WHO	World Health Organization
WTO	World Trade Organization
ZEF	Zentrum für Entwicklungsforschung / Center for Development Research

1 General background information of the agricultural and food sectors

Agriculture remains the largest sector of the Malawian economy. It accounts for 37% of Gross Domestic Product (GDP) and 85% of export revenues (Mucavele, 2013). Two main subsectors characterize Malawian agriculture: the small-scale farmers and the large scale farmers (estates). There are an estimated 2 million highly subsistence smallholder farming households, each cultivating an average 0.3 to 1 ha (National Statistics Office (NSO), 2010; Rapsomanikis, 2014). These smallholder farmers produce about 80% of Malawi's food (mainly maize) and 20% of its agricultural exports (Thomas, 2003). On the other hand, the estate subsector is the main foreign exchange earner – providing more than 80% of agricultural exports, mainly from tobacco, sugar, and tea. Tobacco is the dominant cash crop, accounting for approximately 63% of the country's total export earnings, while tea and sugar account for about 8% and 7% of export earnings, respectively (World Trade Organization (WTO), 2002).

In twelve African countries, including Malawi, Green Innovation Centers (GICs) have been established in selected regions under the ''One World, No Hunger'' Initiative (SEWOH) of the German government and other investors. The aim of the GICs is to promote agricultural innovation, improve food and nutrition security and build sustainable value chains in the agri-food sector. The selected value chains in Malawi are sunflower, soya, groundnut and cassava. These value chains were selected because they are relevant for food security, aligned with Malawi's development goals, they have market potential, they create local value, and they can contribute to economic empowerment of women.

1.1 Pan-African policies and strategies

Malawi is a member of regional economic blocks including the Common Market for Eastern and Southern Africa (COMESA) and Southern African Development Community (SADC), each of which has set some development targets.

a. Comprehensive African Agriculture Development Programme

Malawi signed the Comprehensive African Agriculture Development Programme (CAADP) Compact on April 19, 2010. The goals of CAADP include achieving a 6% agricultural growth and allocating at least 10% of budgetary resources to the agricultural sector (NEPAD, 2010). CAADP comprises four mutually reinforcing pillars, namely (i) sustainable land and water management, (ii) improved market access and integration, (iii) increased food supplies and reduced hunger, and (iv) research, technology generation, dissemination and adoption, which is a cross-cutting pillar supporting and reinforcing the other three pillars.

b. SADC Action on Food Security

Being a member of SADC, Malawi also follows the Food Security Program and the Regional Indicative Strategic Development Plan, which is implemented by the Food, Agriculture and Natural Resources (FANR) Directorate of SADC (FANR, 2008). FANR operates through the following units:

- Agricultural Information Management System;
- Crop Development Unit;
- Livestock Sector Unit.

c. The SADC Multi-Country Agricultural Productivity Programme[1]

The Multi-Country Agricultural Productivity Program (MAPP) is a 15-year program, being implemented in three five-year phases (FANR, 2008). MAPP is derived from the CAADP and focuses on its fourth pillar, agricultural research, and seeks to strengthen technology development, technology dissemination, and linkages among agricultural institutions in the SADC region (Johnson *et al.,* 2014). MAPP aims at ensuring sustainable access to safe, nutritional and adequate food at all times.

[1] www.sadc.int/themes/agriculture-food-security/food-security

1.2 National (and regional) policies and strategies

The Government of Malawi has developed various national development strategies, agricultural strategies and agricultural-related legislation and policies to ensure the promotion of the economy. These include the 2010-2016 National Agricultural Policy, the National Irrigation Policy and Development Strategy (2010), National Nutrition Policy and Strategic Plan (2007-2012), the Cooperative Development Policy, National Nutrition Policy and Strategic Plan, the Agricultural Sector-wide Approach (ASWAp), the Malawi Growth and Development Strategy (MGDS) I and II, which provide the national policy context. The ASWAp is based on the priority agricultural elements of the defunct MDGs (and now the Sustainable Development Goals) and is consistent with the CAADP under the umbrella of the New Partnership for Africa's Development. The CAADP provides the regional context of achieving sustainable agricultural growth and development when translated into actions at the national level. The Development Assistance Strategy provides a global framework for Aid Harmonization (Kamangira *et al.*, 2016).

1.3 Data on food and nutrition security in Malawi and GIC-region

The following section includes information about important socio-economic and agricultural indicators and data on diet quantity, diet quality and nutrition status.

1.3.1 Socio-economic and agricultural data

Table 1: Selected national economic and health-related data

Indicator	Value	Year
Population, total	16,829,144	2014
Population growth (annual %)	2.8	2014
Rural population (% of total population)	84	2014
GDP per capita, PPP (constant 2011 international $)	778	2014
GNI per capita, PPP (constant 2011 international $)	753.3	2014
Poverty headcount ratio at $2 a day (PPP) (% of population)	88	2010
Poverty headcount ratio at $1.25 a day (PPP) (% of population)	72	2010
Poverty headcount ratio at national poverty lines (% of population)	51	2010
Rural poverty headcount ratio at national poverty lines (% of rural population)	57	2010
Agricultural land (% of land area)	61	2012
Agricultural irrigated land (% of total agricultural land)	0.5	2008
Agriculture value added per worker (constant 2005 US$)	253	2014
Agriculture, value added (% of GDP)	33	2014
Access to electricity, rural (% of rural population)	2	2012
Employees, agriculture, female (% of female employment)	no data	
Employees, agriculture, male (% of male employment)	no data	
Employment in agriculture (% of total employment)	no data	
Literacy rate, adult total (% of people ages 15 and above)	61	2010
Ratio of female to male secondary enrolment (%)	91	2013
Mortality rate, under-5 (per 1,000 live births)	68	2013
Maternal mortality ratio (modeled estimate, per 100,000 live births)	510	2010

Source: World Bank, data.worldbank.org/country
Note: GDP refers to Gross Domestic Product; GNI refers to Gross National Income; PPP refers to Purchasing Power Parity

1.3.2 Consumption and nutrition status

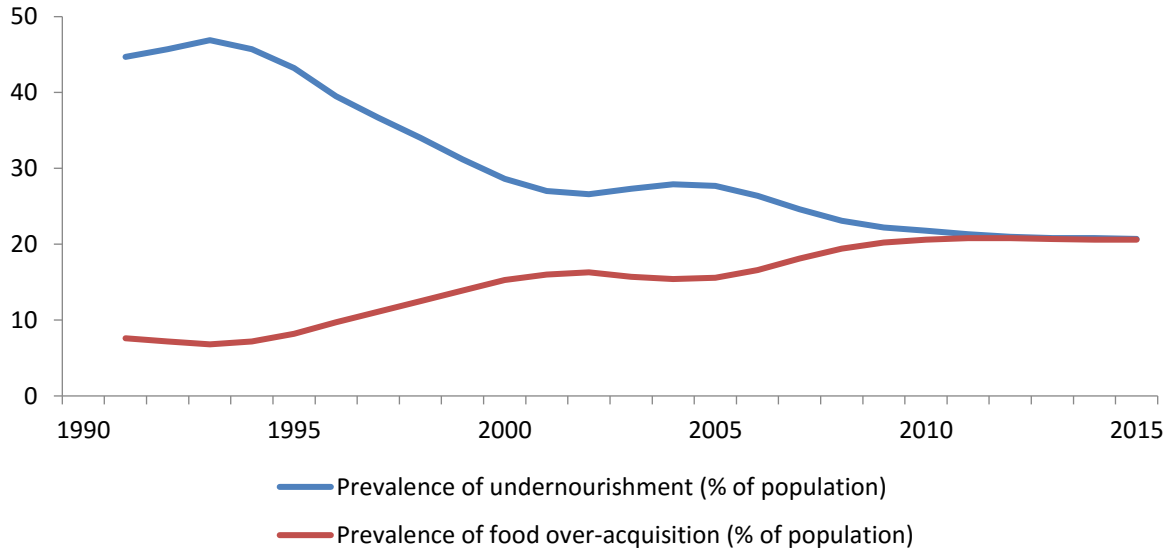
Data on diet quantity, diet quality and nutrition status are relevant for assessing food and nutrition security. Overall, dietary energy supply per capita – a measure of diet quantity – is sufficient in Malawi, since it exceeds the average dietary energy requirement of the population (Table 2). However, about one fifth of the population is unable to meet their minimum dietary energy requirements and suffers from chronic undernourishment. Malawi has made good progress in reducing undernourishment since 1990-92, cutting the initial 45% rate by more than half (Figure 1). The prevalence of food over-acquisition has risen at the same time, but the increase of 13 percentage points was smaller than the concurrent decrease in undernourishment. The Food and Agriculture Organization (FAO), estimates that about one fifth of Malawi's population regularly acquire food in excess of their dietary energy needs (Table 2).

Table 2: Food and nutrition security indicators

Indicator	Value	Year
Diet quantity		
Dietary energy supply (kcal/caput/day)	2364	2014-16
Average dietary energy supply adequacy (% of average requirement)	111	2014-16
Prevalence of undernourishment (% of population)	21	2014-16
Prevalence of food over-acquisition (% of population)	21	2014-16
Diet quality		
Dietary energy supply from cereals, roots and tubers (% of total dietary energy supply)	71	2009-11
Dietary energy supply from carbohydrate (% of total dietary energy supply)	74	2009-11
Dietary energy supply from protein (% of total dietary energy supply)	11	2009-11
Dietary energy supply from fat (% of total dietary energy supply)	15	2009-11
Average protein supply (g/caput/day)	62	2009-11
Average fat supply (g/caput/day)	39	2009-11
Child feeding practices		
Minimum dietary diversity: consumption of 4+ food groups (% of children 6-23 months)	29	2010
Consumption of foods rich in vitamin A (% of children 6-23 months)	77	2010
Consumption of foods rich in iron (% of children 6-23 months)	45	2010
Nutrition status		
Child wasting (% of children under five)	4	2013-14
Child stunting (% of children under five)	42	2013-14
Child overweight (% of children under five)	5	2013-14
Adult overweight and obesity (% of adults 18+ years)	22	2014
Adult obesity (% of adults 18+ years)	5	2014
Vitamin A deficiency (% of children 6-59 months)	47	2013
Anemia in children (% of children 6-59 months)	55	2014
Anemia in women (% of women 15-49 years)	29	2010

Source: FAO (2016), and authors' calculations based on FAO (2016); National Malaria Control Programme (NMCP) and ICF International (2015); NSO (2015); NSO and ICF Macro (2011); Stevens *et al.* (2015), quoted in International Food Policy Research Institute (IFPRI) (2015); World Health Organization (WHO) (2015a)
Note: See Annex A for definitions of the indicators.

Figure 1: Prevalence of undernourishment and food over-acquisition (1990-92 to 2014-16)



Source: Authors' presentation based on data from FAO (2016)

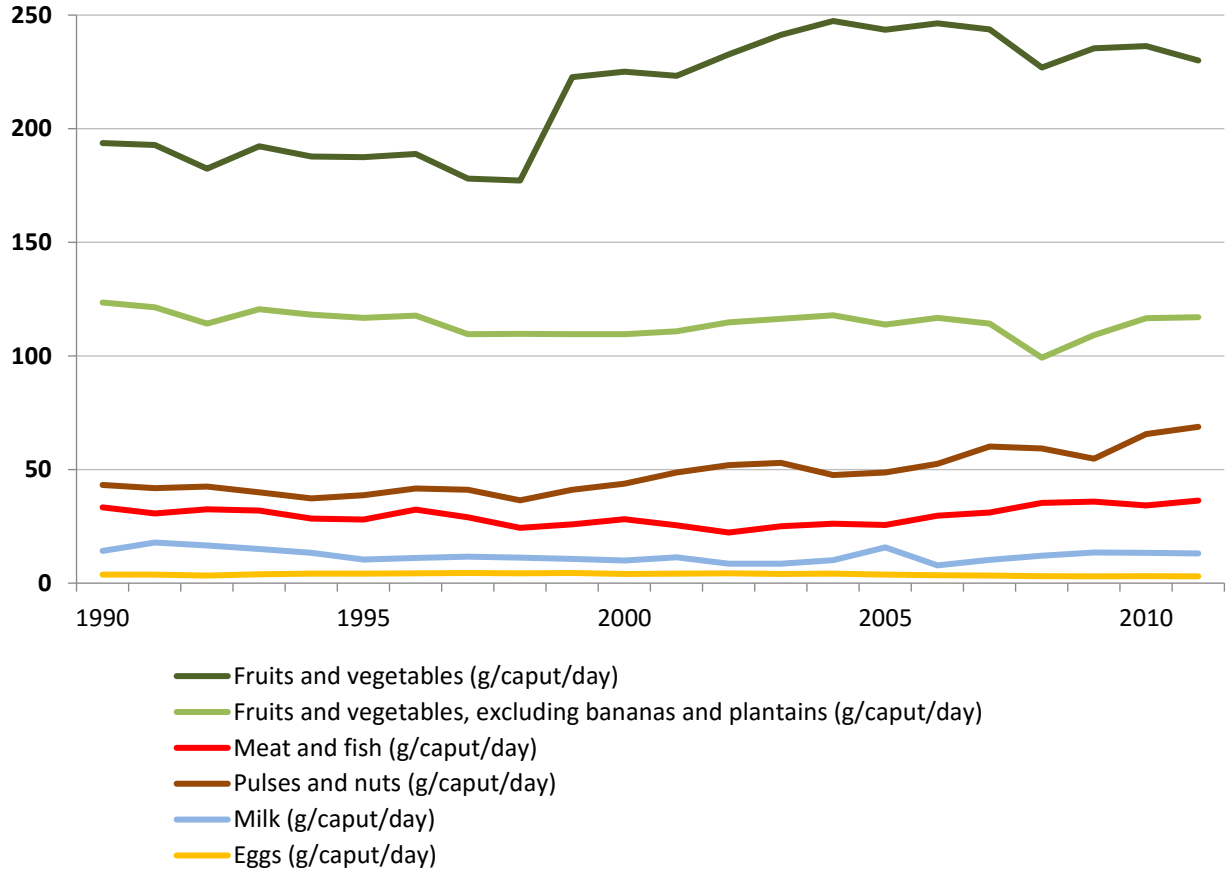
The diet in Malawi is heavily based on starchy staples (predominantly maize, and, to a lesser extent, potatoes and cassava) that provide about 70% of dietary energy supply (Table 2). The share of dietary energy supply from carbohydrates is at the higher end of the recommended range of 55-75%, whereas the shares of protein and fat are at the lower end of the recommended ranges of 10-15%, and 15-30%, respectively (WHO, 2003). Since these are average values, the diet of poorer sections of the population is likely to be unbalanced in terms of its macronutrient composition, with carbohydrates making up a larger share of dietary energy supply than recommended, and protein and fat supply making up smaller shares. Yet, on average, protein supply is sufficient (Table 2; see Annex A for further explanation).

The consumption of sufficient quantities of non-staple foods such as fruits and vegetables and animal-source foods is essential for a diet that provides adequate micronutrients. Meat and fish supply amounts to less than 40 g/caput/day in Malawi and has barely increased since 1990 (Figure 2). Milk supply is even lower and has slightly declined overall, and the supply of eggs is minimal. Pulses and nuts are supplied in increasingly larger quantities; they provide close to one fourth of protein supply.[2] At 230 g/caput/day, the supply of fruits and vegetables is considerably below the recommended intake of 400 g of fruits and vegetables per day (WHO, 2003). Bananas and plantains constitute about half of the fruit and vegetable supply, which increased markedly after 1998 due to a rise in banana supply. The supply of fruits and vegetables other than bananas and plantains has remained virtually unchanged since 1990.[3]

[2] Source: Food balance sheet for Malawi, 2011, from FAOSTAT, accessed 18 Nov, 2016.

[3] Bananas and plantains are rich in carbohydrate and B-vitamins, and plantains are also a good source of vitamins A and C, but these fruits have lower concentrations of micronutrients than dark green leafy vegetables, for example (United States Department of Agriculture [USDA] 2016).

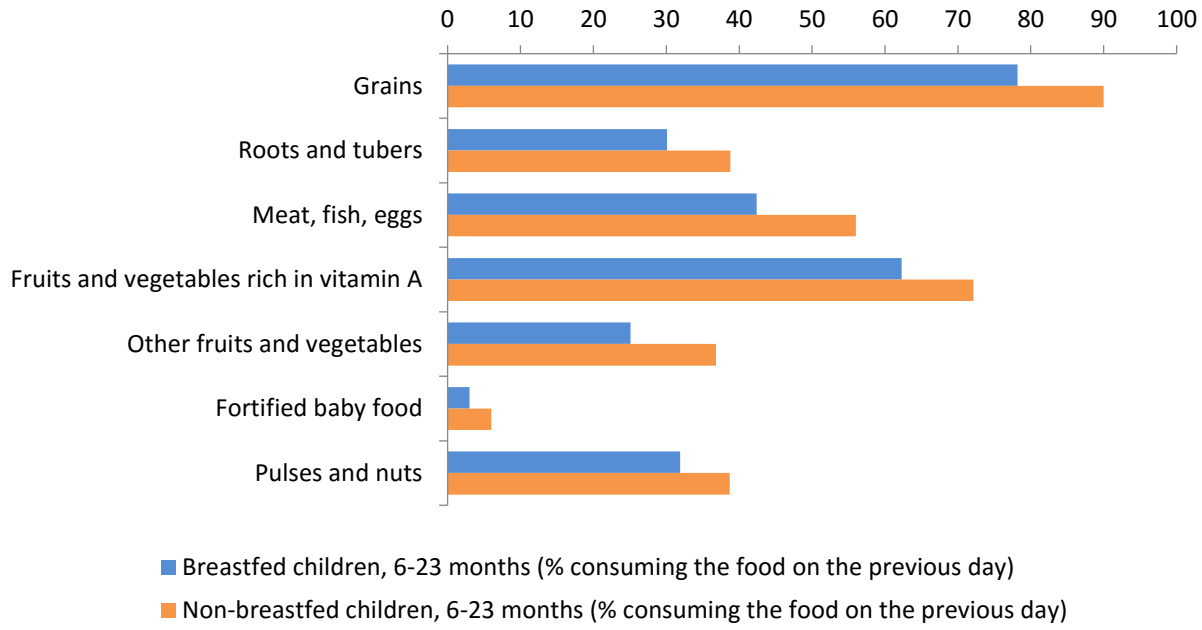
Figure 2: Supply of non-staple foods (1990-2011)



Source: Authors' presentation based on data from FAOSTAT, accessed 07 Oct 2016
Note: Based on their nutrient profiles, pulses and nuts include groundnuts and soybeans, although these foods are classified by FAO as oil-crops. Coconuts are not included among pulses and nuts because they have low protein content.

Infant and young child feeding practices are crucial for children's nutrition and health status and long-term development. Children aged 6-23 months should consume at least 4 out of 7 food groups (minimum dietary diversity) and receive iron-rich foods and foods rich in vitamin A daily. In Malawi, infants' and young children's diets fall short of these goals: less than one third achieved minimum dietary diversity, 77% consumed foods rich in Vitamin A, and less than half consumed foods rich in vitamin A on the previous day (Table 2). Both breastfed and non-breastfed children aged 6-23 months were most frequently fed foods made from grains; other, more micronutrient-rich foods such as meat, fish and eggs, fruits and vegetables rich in vitamin A, and pulses and nuts, were fed more rarely (Figure 3). Fortified baby foods, which can compensate for a lack of micronutrients in the diet, were consumed by less than 5% of breastfed and by less than 10% of non-breastfed children.

Figure 3: Percentage of infants and young children consuming foods from selected food groups (2010)



Source: Authors' presentation based on data from NSO and ICF Macro (2011)

Stunting and wasting are indicators of chronic and acute child undernutrition, respectively. Stunting has severe public health significance in Malawi, as more than 40% of children are stunted (Table 2). Although stunting prevalence has been reduced by about one quarter since the early 1990s, it continues to be unacceptably high. By contrast, wasting has remained below the threshold of mild public health significance of 5% for about ten years (UNICEF/WHO/World Bank 2016)[4]. According to the latest available data, overweight in children can be considered a moderate public health concern (Table 2).

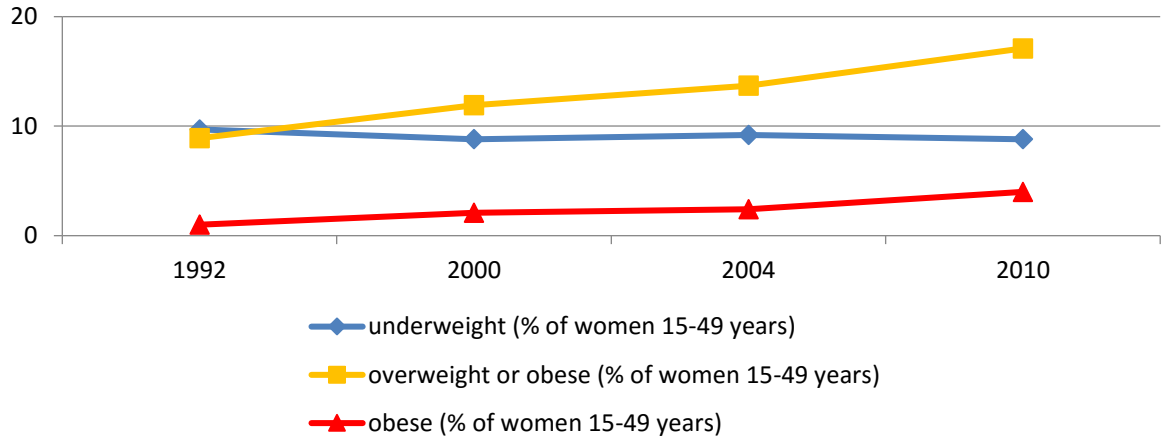
Overweight and obesity are risk factors for chronic diseases such as diabetes (Must and McKeown 2012). About one fifth of adults in Malawi are overweight or obese (Table 2). Since the early 1990s, the combined prevalence of overweight and obesity has almost doubled among women of reproductive age, while the prevalence of obesity has quadrupled during the same period (Figure 4). The prevalence of underweight among women is below 10%, but has barely declined since 1992.[5]

Vitamin A deficiency is a risk factor for blindness and for mortality from measles and diarrhoea in children aged 6–59 months (Imdad *et al.,* 2010; Imdad *et al.,* 2011). In Malawi, almost half of all children in this age group are estimated to be vitamin A deficient (Table 2). More than half of children aged 6-59 months and almost 30% of all women of reproductive age suffer from anemia (Table 2). About half of the global burden of anaemia can be attributed to iron deficiency (WHO, 2015b). Anemia is also caused by malaria, a disease that has high transmission rates in Malawi all year round. Malaria accounts for a significant proportion of anemia among preschool children in Malawi (NMCP and ICF International, 2015).

[4] UNICEF = United Nations International Children's Emergency Fund

[5] See Annex A for definitions of overweight, obesity, and underweight.

Figure 4: Underweight, overweight and obesity among women of reproductive age (1992-2010)



Source: Authors' presentation based on data from ICF International (2015), The Demographic and Health Survey (DHS) Program STATcompiler, funded by the United States Agency for International Development (USAID), accessed 12 Sept 2016

Regionally disaggregated data are available for indicators of nutrition status and child feeding. The diversity of infants' and young children's diets hardly differs across Malawi's three major regions (Table 3). The proportions of children consuming foods rich in iron and vitamin A are a bit lower in the Central region than in the Northern region, but the differences are not very pronounced. Anemia in children is lowest in the Northern region and highest in the Southern region, although the disparity between the two regions is not very large (Table 4). The Northern region does slightly better on stunting than the other regions. The Northern region has the highest rate of overweight in children.

Regarding overweight and obesity in women, the differences across regions are also negligible (Table 5). The rate of underweight among women is lowest in the Northern region, which also has the lowest anemia rate.

Of all the indicators of children's nutrition status that are available at the regional level, anemia is the most important in terms of prevalence rates, followed by stunting (Table 4). Under the assumption that half of all anemia is due to iron deficiency, iron deficiency anemia in children is of moderate public health significance in all three regions.[6] Stunting has moderate public health significance in the Northern region, and severe significance in the Central and Southern regions. Wasting is below the threshold for mild public health significance in all regions. Overweight in children has mild public health significance in the Southern region, and is a moderate concern in the other two regions.

Of all the indicators of women's nutrition status that are available at the regional level, anemia has the highest prevalence in all three regions, followed by the combination of overweight and obesity (Table 5). Underweight rates are low all over the country.

[6] About half of the global burden of anemia is attributable to iron deficiency (WHO, 2015b). Since the prevalence of anemia in children in Malawi is in the range of 48.7-60.9% at the regional level, the prevalence of iron deficiency anemia can be estimated to be 24.4-30.5%, falling within the range of 20-39% that has been defined for moderate public health significance (see Annex A). However, it is possible that less than half of all anemia in Malawi is caused by iron deficiency since malaria is widespread in the country.

Table 3: Child feeding practices by region, 2010

Share of children 6-23 months consuming:					
4+ food groups		Foods rich in vitamin A		Foods rich in iron	
Region	(%)	Region	(%)	Region	(%)
Northern	31	Northern	77	Northern	48
Central	30	Southern	76	Southern	46
Southern	28	Central	73	Central	43

Source: NSO and ICF Macro (2011)
Notes: GIC regions are highlighted in red. See Annex A for definitions of the indicators.

Table 4: Child nutrition status by region, 2013-14/2014

Prevalence among children under five:						Prevalence among children 6-59 months:	
Stunting		Wasting		Overweight		Anemia	
Region	(%)	Region	(%)	Region	(%)	Region	(%)
Northern	39	Northern	3	Southern	4	Northern	49
Southern	42	Central	4	Central	6	Central	52
Central	44	Southern	4	Northern	7	Southern	61

Source: NMCP and ICF International (2015); NSO (2015)
Notes: GIC regions are highlighted in red. Data on wasting, stunting and overweight were collected in 2013-14 and data on anemia in 2014. See Annex A for definitions of the indicators.

Table 5: Women's nutrition status by region, 2010

Prevalence among women of reproductive age (15-49 years):							
Underweight		Overweight + obesity		Obesity		Anemia	
Region	(%)	Region	(%)	Region	(%)	Region	(%)
Northern	6	Southern	16	Northern	3	Northern	26
Central	9	Northern	18	Southern	4	Central	29
Southern	10	Central	18	Central	4	Southern	30

Source: NSO and ICF Macro (2011)
Notes: GIC regions are highlighted in red. See Annex A for definitions of the indicators.

In summary, Malawi faces problems of both over- and undernutrition; stunting in children is a great concern and micronutrient deficiencies need to be addressed. Dietary energy supply should be increased for disadvantaged population groups, ideally without triggering increases in overweight and obesity. The availability of starchy staples, especially maize, is quite high, but dietary diversity and the supply of micronutrient-rich foods need to be increased. This could be achieved by developing value chains for fruits and vegetables, such as cassava leaves, and for animal-source foods in particular, since the supply of meat, fish, milk, and eggs is very low. It is also worthwhile to invest in value chains for pulses and nuts, because these foods figure prominently in the Malawian diet and are good sources of micronutrients, protein, and dietary energy. The fortification of staple foods and the production of fortified baby foods could be addressed at the processing stage of the value chain. Promoting biofortified staple foods, such as iron-rich beans and vitamin A-rich yellow cassava and orange maize developed by HarvestPlus, could also improve micronutrient intakes in Malawi.[7]

[7] See www.harvestplus.org/what-we-do/crops

In addition, reducing the aflatoxin contamination of foods is crucial in order to improve food safety in Malawi. Aflatoxins are highly toxic substances that are produced by certain types of fungi and can cause acute poisoning, liver cancer, and stunted growth in children (Bhat and Vasanthi, 2003; Gong *et al.*, 2004). In Malawi, three crops that are susceptible to aflatoxin contamination – maize, cassava and groundnuts – account for 60% of dietary energy supply (Malawi Programme for Aflatoxin Control [MAPAC], 2013). A study of maize samples from Malawi's three regions found that maize from the Southern region was highly contaminated, and that about 20% of all samples exceeded the tolerable upper limit for aflatoxins; contamination with fumonisins (another type of mycotoxins) was also common (Mwalwayo and Thole, 2016). An analysis of maize-based, traditional home-made beer demonstrated that its consumption can significantly enhance aflatoxin and fumonisin exposure in beer consumers (Matumba *et al.*, 2014b).

Aflatoxin concentrations that are above safe levels were also found in groundnuts, groundnut-based therapeutic foods, locally processed peanut butters and maize-based baby foods (Monyo *et al.*, 2012; Matumba *et al.*, 2014a). Aflatoxin contamination of groundnuts has long been recognized as a major challenge for expanding Malawi's groundnut exports. More recently, the lack of locally produced groundnuts containing aflatoxin levels below defined standards has hampered efforts to develop local production of ready-to-use therapeutic foods (RUTFs) to meet the demand of nutritional programs (MAPAC, 2013).[8]

Regionally disaggregated data for children's diets and women's and children's nutrition status reveal that, by and large, the disparities across regions are minor. Most indicators point to slightly better outcomes in the Northern region than in the other two regions, but the differences are too small to justify prioritizing the central and southern regions for interventions and agricultural innovations.

Malawi is a member of the Scaling Up Nutrition network, a global movement led by 57 countries that aims to end malnutrition in all its forms. See scalingupnutrition.org/ for more information.

1.4 Data on most relevant crops and value chains

The main farming systems in Malawi are subsistence-based rain-fed agriculture and large-scale cash crop production using improved technologies and inputs. The main crops grown by smallholder farmers are tobacco, maize, Irish potatoes, groundnuts, pulses, sweet potatoes, cassava, sorghum, rice, sunflower, wheat, vegetables, fruits, coffee, macadamia, cashew and spices. Maize, the main staple food, is the most important crop for the Malawian population. Smallholder farmers also keep some livestock, the main ones being cattle, sheep, poultry, goats, rabbits and pigs. The estate sub-sector comprises 14,700 estates occupying about 850,000 hectares of privately owned land under leasehold title. The commercial farm type primarily produces cash crops: burley and flue cured tobacco, sugar, coffee, tea and tree nuts. (Kamangira *et al.*, 2016).

Tobacco and tea are the most valuable export crops. For the period of 1994 to 2013, cassava production increased by 692.3%, while maize production increased by 41.6%, and potatoes by more than 86% (FAOstat[9]). The vast majority of legumes are grown by smallholder farmers in the country, and the National Export Strategy recommends value addition to these crops (legumes) and to sugar and sugar products and their promotion as potential agricultural exports in view of the world's campaign against tobacco production and utilization. Production and consumption data are provided below.

[8] RUTFs are energy-dense, fortified processed foods that were developed for treating severe acute undernutrition.

[9] Last accessed on December 2016

1.4.1 Production

Table 6: Top 10 crops produced by area, volume and value

Area harvested (ha)		Production volume (tons)		Production value*	
Top 10	**Share of Total (%)**	**Top 10**	**Share of Total (%)**	**Top 10**	**Share of Total (%)**
Maize	41.4	Cassava	27.4	Cassava	24.7
Groundnuts	9.0	Maize	18.9	Potatoes	17.5
Beans, dry	7.8	Potatoes	18.4	Maize	16.2
Cassava	5.3	Sugar cane	16.2	Groundnuts	4.2
Potatoes	4.6	Bananas	2.3	Beans, dry	3.5
Seed cotton	4.6	Plantains	2.1	Tobacco, unmanufactured	3.1
Pigeon peas	4.2	Groundnuts	2.0	Pigeon peas	3.0
Soybeans	2.9	Pigeon peas	1.6	Meat indigenous, pig	2.6
Chick peas	2.9	Fruit, fresh nes	1.3	Meat, pig	2.6
Tobacco, unmanuf.	2.6	Vegetables, fresh nes	1.2	Bananas	2.2
Rank 22: Sunflower seed	0.4	Rank 16: Soybeans	0.6	Rank 18: Soybeans	1.3
		Rank 28: Sunflower seed	0.1	Rank 31: Sunflower seed	0.1

Data: average 2012-2014, FAOSTAT, accessed 18 January, 2017
* Gross Production Value (constant 2004-2006 million US$), data: average 2011-2013, FAOSTAT, accessed 18 January, 2017
Note: GIC value chains marked in red; nes refers to Not elsewhere specified

Table 7: Yield of major commodities

Year	Commodity Yield (Kg/ha)			
	Maize	**Cassava**	**G/nuts**	**Soya**
1993	1,532.7	2,878.1	901.7	862.3
1994	920.9	3,466.0	321.6	443.6
1995	1,351.7	3,466.9	355.0	645.0
1996	1,443.3	4,587.5	563.3	790.4
1997	1,095.9	5,724.9	707.5	722.9
1998	1,371.1	5,493.9	720.3	702.0
1999	1,810.9	5,456.3	771.4	621.1
2000	1,742.8	15,460.5	723.2	639.4
2001	1,184.5	16,941.6	855.8	658.1
2002	1,046.0	14,963.5	767.4	649.4
2003	1,225.9	15,745.3	826.6	759.3
2004	1,046.0	16,164.4	703.6	644.7
2005	809.3	14,299.5	568.2	579.7
2006	1,481.4	17,311.6	830.3	763.9
2007	2,654.7	18,772.2	1,014.3	897.2
2008	1,649.8	19,076.0	913.9	872.2
2009	2,226.5	20,291.2	1,030.8	980.4
2010	2,015.6	20,431.1	1,007.6	975.7
2011	2,207.9	21,540.8	1,055.6	997.7
2012	2,193.2	22,388.3	1,042.2	1,043.3
2013	2,170.8	22,804.1	1,049.5	979.1
2014	2,333.9	23,579.4	1,057.2	1,084.3
2015	1,656.3	22,504.0	792.9	870.1

Source: FAOSTAT (2016) (In most cases, yield data are not directly recorded but are instead obtained by dividing the production data by the data on area harvested).

Table 8: Overall agricultural growth

Year	National GDP (billion U.S. dollars)	Agricultural GDP (billion U.S. dollars)	Contribution of Agriculture to GDP (%)
1994	1.18	0.296	25.1
1995	1.40	0.426	30.4
1996	2.28	0.791	34.7
1997	2.66	0.867	32.6
1998	1.75	0.623	35.6
1999	1.78	0.674	37.8
2000	1.74	0.688	39.5
2001	1.72	0.667	38.8
2002	2.67	0.981	36.7
2003	2.42	0.852	35.2
2004	2.63	0.919	34.9
2005	2.75	0.911	33.1
2006	3.12	0.985	31.6
2007	3.65	1.153	31.6
2008	4.28	1.272	29.7
2009	5.03	1.569	31.2
2010	5.40	1.599	29.61
2011	5.63	1.750	31.1
2012	4.24	1.293	30.5
2013	3.71	1.232	33.2
2014	4.26	1.419	33.3

Source: The World Bank; theGlobalEconoy.com[10]

Table 9: Agricultural Total Factor Productivity (TFP)

	TFP Annual Growth Rate
1994	0.154
1995	-0.018
1996	0.052
1997	0.086
1998	0.032
1999	0.061
2000	0.020
2001	0.049
2002	-0.046
2003	-0.027
2004	0.013
2005	0.037
2006	0.032
2007	0.093
2008	-0.009
2009	0.041
2010	-0.011
2011	0.022

Source: United States Department of Agriculture (USDA) Economic Research Service[11]
Note: TFP growth (output growth minus input growth) takes into account all of the land, labor, capital, and material resources employed in farm production and compares them with the total amount of crop and livestock output. If total output is growing faster than total inputs, we call this an improvement in total factor productivity.

[10] data.worldbank.org/indicator/NV.AGR.TOTL.ZS; www.theGlobalEconomy.com
[11] www.ers.usda.gov/data-products/international-agricultural-productivity.aspx

The increase in crop yields (in particular for maize) is due to the government Farm Input Subsidy Programme (FISP) implemented since the 2005/2006 cropping season, coupled with a relatively favourable rainfall pattern. As of 1998, the government implemented a similar programme, the Starter Pack, which was proceeded by the Targeted Input Programme (TIP) 2000/01 for poor smallholder farmers in the country.

While agricultural subsidies have enabled Malawi produce surplus food, they have also been shown to exert huge pressure on the meagre government resources. There are also heightened concerns regarding the sustainability of the program; the majority of smallholder farmers are yet to become self-reliant (Kamangira *et al.*, 2016).

In the financial year following the implementation of the TIP, the budget allocation for agriculture rose from 4.7% to 10.9%. The budget allocation for agriculture then declined once again before rising to above 10% in 2004/5. Over the years, the government limited the subsidy program to the poorest of the poor and focused only on food crops in order to enhance food security. In 2003, African governments (including Malawi) committed to achieving agricultural growth of at least 6% through the CAADP framework and, to this purpose, signed the African Union's Maputo Declaration in which they agreed to increase national budgetary resources to the agricultural sector to at least 10% of their respective national budget. Malawi has performed well, particularly between the 2005/06 and 2015/16 financial years, with budgetary allocations to agriculture ranging from 11.3% in the 2010/11 financial year, to 18.8% in the 2014/15 growing season (Table 10).

Table 10: CAADP Performance

Financial Year	Government Budget ('000,000 MK)	Budget Allocated for Agriculture ('000,000 MK)	Agriculture Budgetary Allocation (%)
1994/95	2,045	90	4.4
1995/96	5,446	162	2.97
1996/97	6,797	389	5.7
1997/98	12,524	590	4.7
1998/99	16,685	1,818	10.9
1999/2000	23,042	1,495	6.5
2000/01	32,825	1,675	5.1
2001/02	40,912	2,542	6.2
2002/03	45,263	2,526	5.6
2003/04	58,081	2,588	4.5
2004/05	89,888	7,027	7.8
2005/06	119,499	15,171	12.7
2006/07	139,896	18,537	13.3
2007/08	172,839	20,970	12.1
2008/09	229,524	30,803	13.4
2009/10	256,769	32,127	12.5
2010/11	297,084	33,537	11.3
2011/12	303,714	37,715	12.4
2012/13	408,390	65,021	15.9
2013/14	638,151	118,674	18.6
2014/15	748,129	140,665	18.8
2015/16	901,594	133,687	14.8

Source: All data were compiled by The Budget Section of the Ministry of Finance, Economic Planning & Development (September 2015). MK = Malawi Kwacha

1.4.2 Trade

Tobacco, sugar, maize and tea are the main commodities in terms of export volume and value. Groundnut, a GIC-selected value chain is also an important good for the country's trade. The other GIC chains, however, only account for small shares, namely soy, sunflower and cassava.

Table 11: Malawi's Imports

Import volume (tons)		Import value (US$)	
Top 10	**Share of Total (%)**	**Top 10**	**Share of Total (%)**
Wheat	55.0	Wheat	32.2
Maize	7.3	Tobacco, unmanufactured	22.0
Tobacco, unmanufactured	7.0	Oil, soybean	8.3
Cottonseed	5.3	Food prep nes	4.1
Oil, soybean	5.1	Fatty acids	3.2
Fatty acids	3.0	Maize	2.6
Cake, soybeans	2.2	Milk, whole dried	2.1
Malt	1.7	Sugar confectionery	1.8
Food prep nes	1.4	Cottonseed	1.8
Oil, palm	0.8	Cake, soybeans	1.6
Rank 12: Oil, sunflower	0.7	Rank 14: Oil, sunflower	1.1
Rank 20: Groundnut, shelled	0.3	Rank 44: Soybeans	0.1
Rank 29: Soybeans	0.2	Rank 27: Groundnut, shelled	0.1

Data: average 2011-2013, FAOSTAT, accessed 18 January, 2017
Note: GIC value chains marked in red; nes refers to Not elsewhere specified

Table 12: Malawi's exports

Export volume (tons)		Export value (US$)	
Top 10	**Share of Total (%)**	**Top 10**	**Share of Total (%)**
Sugar Raw Centrifugal	25.6	Tobacco, unmanufactured	56.2
Tobacco, unmanufactured	20.3	Sugar Raw Centrifugal	13.1
Maize	17.4	Tea	8.0
Groundnuts, shelled	7.9	Groundnuts, shelled	5.0
Tea	5.8	Maize	3.2
Peas, dry	4.5	Cotton lint	3.1
Bran, wheat	2.3	Peas, dry	1.6
Cake, cottonseed	2.2	Nuts, nes	1.4
Cotton lint	2.1	Rubber natural dry	1.0
Sugar refined	1.6	Sugar refined	1.0
Rank 13: Soybeans	1.0	Rank 15: Soybeans	0.4
Rank 26: Sunflower Seed	0.2	Rank 32: Sunflower seed	0.1
Rank 41: Cake, sunflower	0.1	Rank 84: Starch, cassava	0.0
Rank 71: Starch, cassava	0.0		

Data: average 2011-2013, FAOSTAT, accessed 18 January, 2017
Note: GIC value chains marked in red; nes refers to Not elsewhere specified

1.5 National (and regional) innovation system

1.5.1 Research system and organizations

1.5.1.1 International

The international organizations actively conducting agricultural research and coordinating efforts to support agricultural growth in Malawi include:

- The United Nations Food and Agriculture Organization;
- The United Nations Development Program;
- Future Earth – a major international research platform providing the knowledge and support to accelerate transformations to a sustainable world;
- The Consultative Group on International Agricultural Research (CGIAR):
- International Center for Tropical Agriculture;
- International Potato Center;
- International Maize and Wheat Improvement Centre;
- International Livestock Research Institute;
- International Institute of Tropical Agriculture (IITA);
- International Crops Research Institute for the Semi-Arid Tropics (ICRISAT);
- World Agroforestry Centre.

Others include:

- United States Agency for International Development (USAID);
- United Kingdom Department for International Development (DFID);
- Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ);
- Alliance for a Green Revolution in Africa;
- Forum for Agricultural Research in Africa;
- Australian Centre for International Agricultural Research;
- CGIAR Research Program on Climate Change, Agriculture and Food Security;
- Food, Agriculture and Natural Resources Policy Analysis Network;
- Norwegian University of Life Sciences.

1.5.1.2 National

There is underinvestment in agricultural research and extension in Malawi. There is need for increased investments to revitalize the research and extension services, and to raise agricultural production. There is also need to integrate and diffuse international, regional, national and private technology to farmers. The National Agricultural research Services in Malawi is managed by the Agricultural Research Council, which was created in November 1985. The main objective of this council is to oversee research priorities in the public sector in Malawi. The Department of Agricultural Research Services (DARS) is the main organization of NARS. DARS alone constitutes more than half the total research potential in Malawi. DARS is within the organizational chart of the Ministry of Agriculture, Irrigation and Water Development. The DARS mandate covers crop and livestock production, natural resources, agro-forestry, farming systems and agricultural engineering.

Other organizations that make up NARS in Malawi include:

- Department of Animal Health and Industry;
- Forestry Research Institute of Malawi;
- Tobacco Research Institute of Malawi;
- Universities working with DARS;
- The Tea Research Foundation of Central Africa;
- Sugar Research Foundation.

1.5.2 Innovation platforms

A list of some of the innovation platforms (IP) operating in Malawi is presented below:

Table 13: Innovation platforms

Name of Platform	Years active	Location of Platform	Commodities of the platform
School of Agriculture for Family Independence	2007 to today	Mponela, Dowa district	Crop and livestock production, vegetable, fisheries
Mwandama Millennium Village Project	2006 to present	Mwandama Village, TA Mulumbe, Thondwe, Zomba South	Maize and legumes intercropping; Orange Flesh Sweet Potato promotion against vitamin A deficiency;
Mponela AIDS Information and Counselling Centre	1992 to present	Dowa West	HIV/AIDS Prevention, Conservation Agriculture, and Food security
International Crops Research Institute for the Semi-Arid Tropics	1982 to present	Chitedze (Lilongwe)	Improved seed for groundnuts, pigeon peas and rice
Indigenous Vegetables IP	2008 to present	Thyolo District, five research villages in four Extension Planning Areas (EPAs)	Improved vegetable seed, improved vegetable production, improved producer-buyer linkages, diversity in vegetables, improved access to inputs and loans
Zomba Vegetable IP	N/A	Zomba District, five research villages	Improved vegetable seed, improved vegetable production, improved producer-buyer linkages, diversity in vegetables, improved access to good quality inputs
Conservation Agriculture IP	N/A	Balaka District	Maize, tomatoes, pigeon pea
Machinga	N/A	Machinga District	Staple maize, legumes, cassava and vegetables

Source: Kamangira *et al.* (2016)
Note: HIV/AIDS refers to Human Immunodeficiency Virus/ Acquired Immune Deficiency Syndrome; N/A refers to Not Available

1.5.3 Extension system and organizations

For a long time, agricultural extension services in Malawi were the government's responsibility through its Ministry of Agriculture and the Department of Agricultural Extension Services (DAES). Political changes in 1990s, leading to a subsequent adoption of democratic principles, necessitated a paradigm shift in the provision of agricultural extension and advisory services (Chowa, 2010; Chowa *et al.,* 2013). Decentralization and the presence of other agricultural extension service providers in the field dictated a review of the agricultural extension delivery system. This review was followed by a decree in 2000 to launch a policy, summarized in the policy document entitled "Agricultural Extension in the New Millennium: Pluralistic and Demand-driven Services" (Masangano and Mthinda, 2011). Besides

government ministries, players in the pluralistic extension policy include non-governmental organizations (NGOs) (which are a majority), farmer-based organizations, multilateral organizations, private sector organizations and, to some extent, semi-autonomous organizations.

Major Institutions Providing Extension/Advisory Services in Malawi[12]

Public Sector

The public sector is represented by the Ministry of Agriculture and Food Security and its various departments, including DAES, the University of Malawi and other education and research institutions around the country. These institutions provide extension services through various departments and institutes e.g.:

Public Extension Institutions:

- Ministry of Agriculture, Irrigation and Water Development;
- Department of Agricultural Extension;
- Agricultural Research & Extension Trust

Public Research Institution:

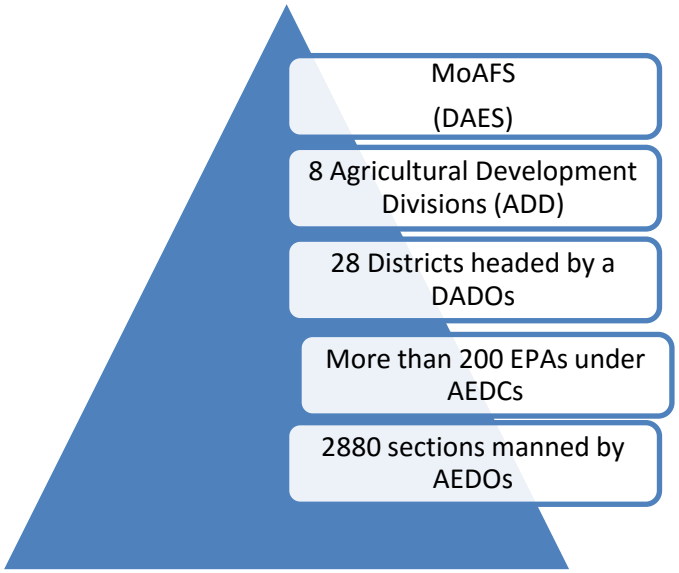
- Department of Agricultural Research Services (DARS).

Higher Education Institutions:

- Lilongwe University of Agriculture and Natural Resources;
- Mzuzu University;
- Chancellor College, University of Malawi.

In Malawi, the delivery of agriculture messages to farmers follows a comprehensive structure composed of the following: 8 Agricultural Development Divisions (ADD) demarcated according to agro-ecological characteristics; 28 Districts are each headed by a District Agriculture Development Officer (DADO) and more than 200 EPAs are each managed by an Agricultural Extension Development Coordinator (AEDC). There are 2880 sections, each manned by an Agricultural Extension Development Officer (AEDO) who is the frontline extension officer and the one to translate agriculture messages to the farmer (Kamangira *et al.*, 2016).

Figure 5: Malawi's agricultural extension structure



Source: Author's presentation based on Kamangira *et al.* (2016)

[12] More information available at: www.worldwide-extension.org/africa/malawi/-malawi

Farmer-Based Organizations and Cooperatives

In Malawi, groups of farmers in specific geographic areas have organized themselves into local level membership-based associations, unions, and/or cooperatives. These farmer-based organizations focus on promoting production and marketing of a particular crop or livestock product and represent the interests of its members. Some other organizations such as the National Smallholder Farmers' Association of Malawi (NASFAM) operate with groups and associations from across the country at the national level.

Farmers' associations:

- NASFAM;
- Malawi Organic Growers Association;
- Mpoto Dairy Farming Association;
- Shire Highlands Milk Producers Association.

Unions:

- Mzuzu Coffee Planters Cooperative Union Ltd.;
- Farmers Union of Malawi (FUM).

1.5.4 Private research and development activities

Private Sector Firms

Private sector organizations in Malawi play an important role in promoting development and marketing of particular commodities. Private firms collaborate with government extension officers in their work and conduct tasks such as identifying producers, administering contracts, monitoring the adherence of production to set standards. Some of the private organizations that provide support in the form of inputs and technical advice to farmers in Malawi are:

- Alliance One International;
- Malawi Bio Energy Resources LTD;
- Land O'Lake.

The Monsanto-sponsored Donald Danforth Plant Science Center is researching genetically modified cassava varieties (Arndt *et al.*, 2015).

Non-Governmental Organizations and other donors

In Malawi, the NGOs are the largest grouping in the extension system, with a substantial number of extension service providers involved in various agricultural activities. Some of the NGOs are associated with a particular commodity or are affiliated with a particular church or religion, which provides them with funds. Some of the NGOs operating in Malawi are the following:

- ActionAid in Malawi;
- Africare;
- Catholic Development Commission-Chikwawa;
- Cooperative for Assistance and Relief Everywhere (CARE);
- Church of Central African Presbyterian Development Department;
- Community Youth Development Activities;
- Eagles Relief and Development Program;
- Emmanuel International;
- Evangelical Association;
- Fair – a Joint Rural Livelihood Program;
- FAO;
- Good Samaritan;
- Heifer International;

- Japan Overseas Cooperative Association;
- Maranatha Ministries;
- NASFAM;
- Plan International;
- Small-Scale Livestock Production Program;
- Sustainable Rural Growth and Development;
- The Hunger Project;
- Total Land Care;
- World Alive Commission for Relief and Development.

1.6 Key challenges, emerging needs and potentials in the agricultural sector

There are several key constraints in the agricultural sector. These include:

- Low and stagnant yields;
- Over-dependence on rain-fed farming, which increases vulnerability to weather related shocks;
- Low level of irrigation development;
- Small land holding sizes, land fragmentation and land degradation;
- Low uptake of improved farm inputs, especially by poor farmers, due to ever-increasing costs of fertilisers and herbicides;
- Weak links to markets and high transport costs, and lack of market information;
- Low efficiency and effectiveness of agricultural input subsidies;
- Few farmer organizations;
- Poor quality control;
- Limited value addition;
- Adverse climatic conditions;
- Institutional and Capacity Challenges such as:
  - Weak and poor coordination among implementing institutions;
  - Weak implementation and management capacities;
  - Limited support (past and present) to institutional development and capacity building.
- Agriculture not being perceived as a business by smallholder farmers. This mindset needs to change in order for productivity to improve (Kamangira *et al.*, 2016).

1.7 Potential areas for investment in Malawi

Based on the general approach presented in chapter 4 of Husmann *et al.* (2015) and in pursuit of efficiency and effectiveness, investment by Germany into the agricultural and food sector are suggested in African countries that:

- Show actual progress in sustainably increasing agricultural productivity through related innovations, as indicated by comprehensive productivity measurement and innovation actions on the ground;
- Have a track record of political commitment to foster sustainable agricultural growth, as indicated by performance under CAADP; and
- Prioritize actions for hunger and malnutrition reduction and show progress, but where agricultural and rural development and nutrition interventions are likely to make a significant difference, as indicated by public policy and civil society actions.

Results of the assessment for Malawi[13]:

Expected agricultural growth performance:

- Malawi's agricultural sector has modestly increased; it achieved an annual growth rate above the 6% target defined by CAADP for five of the years between 2005 and 2014 (www.resakss.org);
- Total factor productivity in Malawi had improved by 47% between 2001 and 2008 (Fuglie and Rada, 2011), which may indicate that Malawi´s commitment to research and development (R&D) investment into the agricultural and food sector is significant. However, some reviews have shown that Malawi has neglected R&D, especially since the launch of the FISP (Chinsinga, 2012).

Government commitment:

- Malawi has a track record of strong political commitment to foster sustainable agricultural growth, as indicated by being active in the CAADP process and having completed seven of the eight steps in the CAADP process (www.resakss.org);
- The Malawi government has also shown a strong willingness to invest in the agricultural sector by surpassing the CAADP 10% agricultural expenditure target for nine years between 2005 and 2014 (www.resakss.org);
- However, Malawi spends only 0.8 % of its agricultural GDP on agricultural research, which is slightly lower than the African Union target value of 1% (www.asti.cgiar.org). This indicates that, even though Malawi´s commitment to R&D for the agricultural and food sector is not yet sufficient, though it is much better than all the other GIC countries.

The impact of these commitments ought to be considered; especially in terms of their outcomes and the quality of commitments. Any assessment of the success of these commitments should focus on the following questions: what has been the impact of completing seven of eight steps? What has been the impact of spending 10% of its budget on the agricultural sector? Have these investments been significantly transformative?

Food and nutrition security progress and need:

- Malawi seems to assign low priority to actions for hunger and malnutrition reduction and shows a less than 6% improvement in undernourishment between 2001 and 2011, which is lower than the threshold (FAO, 2014a);
- In addition, Malawi has a Global Hunger Index (GHI) score value of 13.6, reflecting a serious level of hunger (von Grebmer *et al.,* 2014)[14]. This justifies investments into the agricultural and food sector in Malawi in order to fight the high rates of food insecurity.

[13] Details on the data sources and methodology used in the assessment can be found in Husmann *et al.* (2015)

[14] GHI score values of less than 5.0 reflect low hunger, values from 5.0 to 9.9 reflect "moderate" hunger, values from 10.0 to 19.9 indicate a "serious" level of hunger, values from 20.0 to 29.9 are "alarming," and values of 30.0 or greater are "extremely alarming."(von Grebmer *et al.,* 2014)

Table 14: Malawi performance indicators

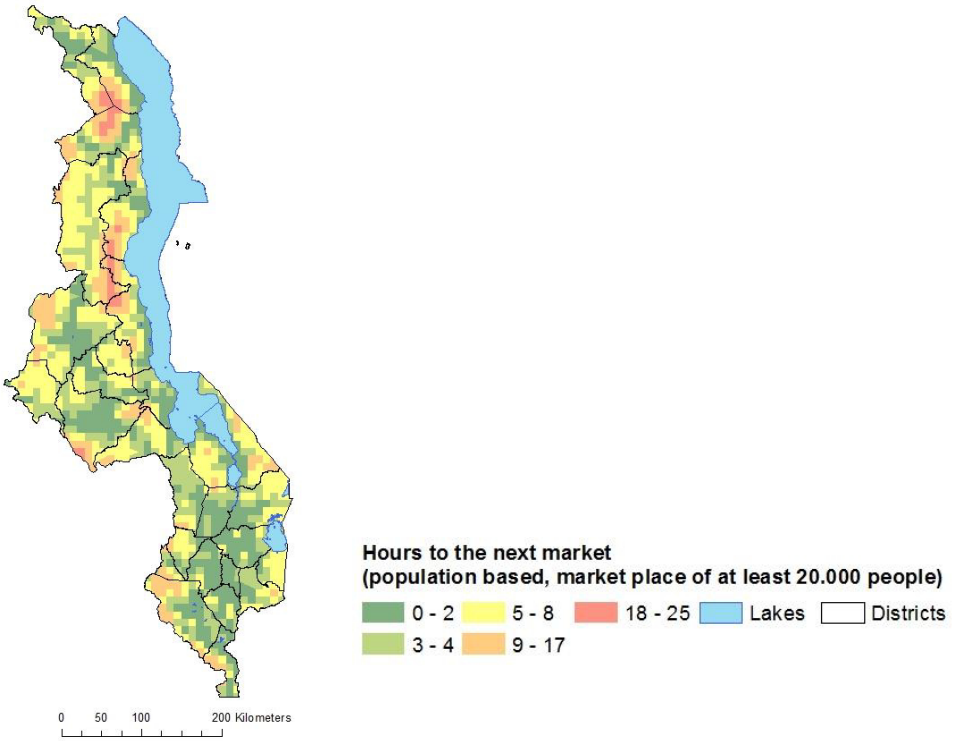
Indicators	Indicator score	Overall score
1. Number of Years with more than 6% agricultural growth (2005 to 2014)	5	50
2. Percentage point change in TFP index between 2001 and 2008	47	100
3. Number of years with more than 10% government expenditure (2005 to 2014)	9	90
4. Average share of agricultural GDP spent on R&D (2005 to 2011) in %	0.8	78
5. Steps in CAADP completed	7	88
6. Percentage point improvement in undernourishment between 2001 and 2011	5.7	30
7. Global hunger index (2014)	13.6	30
Total score (weighted)		63

Data source: Husmann *et al.* (2015)
Note: TFP refers to Total Factor Productivity

The economic, political, and social/nutrition framework in Malawi suggests increasing investments into the agricultural and food sector of the country.

The selection of which value chain to focus on is also determined by market access, i.e. transport intensive products should be promoted in areas that are well connected to markets, whereas remote areas should focus on low volume and livestock value chain segments. Figure 6 presents the average time (number of hours) it takes to reach the nearest marketplace of at least 20,000 people in Malawi.

Figure 6: Distance to markets



Data sources: Hours to next market - HarvestChoice, 2015;
Administrative areas: www.gadm.org, accessed 20.9.2015
Inland water bodies: www.diva-gis.org/gData (water bodies), accessed 20.9.2015

2 Most relevant value chains in Malawi

2.1 GIC-value chains

2.1.1 Groundnuts

Groundnut is one of the most important food and cash crops in Malawi; it is grown on 9% of the total harvested land area and is thereby the second most widely grown crop in Malawi after maize (see Table 6). It is also one of the major foreign exchange earners for the country; Malawi has ideal conditions for producing high yields of groundnuts, though concerns over aflatoxin contamination have resulted in the country losing much of its global market share. Currently, 60% of what is produced is consumed at the household level, 25% goes to the domestic market and 15% is exported (Arndt *et al.*, 2015). Groundnuts thereby account for 7.9% of total export volumes and are the 4th largest export crop (see Table 12). The crop is an important source of protein, edible oil, fats, energy, minerals, and vitamins (Chirwa, 2009; Longwe-Ngwira *et al.*, 2012). The national goal is to improve the yield and quality of both confectionary and oil nuts in order to meet the local and export demand and to provide raw materials to the domestic vegetable oil industry (African Development Bank, 2013). Groundnut yields have grown by an average rate of 10% annually over the period between 2005 and 2012 (see Table 7). As tobacco production is expected to decline, large areas suitable for groundnut cultivation will become available. To benefit from this opportunity, public and private sector actors are investing in capacity building for groundnut production and processing (Arndt *et al.*, 2015).

2.1.2 Soy (Soya)

Soybean is an important and valuable legume because of its multiple uses. It has a very high protein content (37%) and can be consumed by both humans and livestock (Government of Malawi [GoM], 2008). It is used in the production of high-protein, and regular livestock feeds. In Malawi, main actors on the demand side for soy are large local food manufacturers (Rab Ltd., Universal Ltd.) and the animal feed industry, notably in the aquaculture and chicken production sectors. Growing use of soy in the animal feed industry has led to an increase in demand of over 5% p.a. (Arndt *et al.*, 2015). In Malawi, Soybeans do not rank in the top food crops consumed. The crop is grown on 2.9% of the total harvested land area (see Table 6). Production has been growing steadily since 2003. Yields are too low (around 1 t/ha) for profitable cultivation, however Malawi could become a major soy producer for the regional market (Arndt, *et al.* 2015). On the one hand, soybean oil is a major import in the country and represents 8.3% of total import value (see Table 11). On the other hand, raw soybeans are exported on a small scale, and account for 0.4% of total export value (see Table 12). A beneficial effect of growing soy accruing to farmers is its capacity to fix nitrogen and improve soil fertility. The national goal is to encourage the growing and utilization of soybeans and increase yields in order to meet the high demand in both domestic and export markets (Tinsley, 2009).

Opportunities for soy:

- A blend of maize-soy is used to make breakfast porridge;
- Increasing demand for soybean for making infant and baby formula;
- Increasing demand for nutrition and relief programs, especially by NGOs in hospitals, orphanages, and refugee relief efforts;
- Demand for use as feed in animal industry (poultry and dairy productions).

However, there is currently limited value addition in the soybean value chain taking place in Malawi.

2.1.3 Cassava

Cassava is grown on over 5% of the total harvested land area in Malawi and accounts for the biggest share of total production volume (25%) and value (31%) (see Table 6). It is mainly grown in the lakeshore areas of Nkhota-Kota, Nkhata-Bay, Rumphi and Karonga. In some districts, such as Mzimba, Kasungu, Lilongwe, Dedza, Dowa, Machinga, and Mulanje, cassava is increasingly becoming a major cash crop. It is also grown in other parts of Malawi as a food security crop. The quantity of cassava supplied nationally in 2013 exceeded 1.2 million tons, and daily per capita consumption stood at 147 kcal (FAOSTAT, 2017). In Malawi cassava is not traded internationally; the supply of cassava is completely produced nationally. The main advantage of growing cassava are the following: its tolerance to drought, its high yields on marginal soils, its tolerance to pests and diseases, its minimal labour requirement, its low yield fluctuations compared to grains, and its leaves can be used as relish. Over the period of 2005 to 2012, cassava yields in Malawi increased by an average rate of 7% annually (see Table 7). Farmers now achieve average yields of 23 t/ha, which is moderately high but could be increased to 30 t/ha by adopting best practices (Arndt *et al.*, 2015). The national goal is to increase yield and production in all areas.

2.1.4 Sunflower

Sunflower production in Malawi is currently rather small. However, production has been growing since 2006. Domestic demand is strong, but farmers are largely unaware of this fact. Consequently, only 30% of demand is met by domestic production. The potential for expansion of production is high (Arndt *et al.*, 2015). Annual yield has been growing by an average rate of 17% over the 2005 and 2012 period (see Table 7), however the average yield of 0.8 t/ha is far below the achievable 1.5 - 3 t/ha yield (Arndt *et al.*, 2015).
According to the Malawi Oilseed Sector Transformation program, the Malawian sunflower market has potential, as well-established companies are interested in buying the product. Knowledge of this development can increase trust in the sunflower market of farmers who formerly had experienced let-downs by a company that had promised to buy their entire yield. Demand for sunflower for the purpose of oil production exceeds the national supply substantially. Companies are looking to buy the product nationally, because of foreign exchange shortages. Sunflower cultivation requires few input and little labour. Increasing national production could also replace imported cooking oil (Kapindu, 2013).

2.2 Other relevant value chains

The other relevant value chains besides those selected for the GICs are discussed in this subsection. The relevance in this case is based on, among other things, the extensive review of available literature on the crop, the importance of the crop in relation to share of area cultivated (harvested), production volume, and trade importance (import and export).

2.2.1 Maize

Maize cultivation takes up the biggest share (41.4%) of agricultural land area in Malawi. It is the second most valuable agricultural product after groundnuts (see Table 6). 97% of farming households grow maize. Nevertheless, productivity per hectare is low, and the majority of Malawian farmers operate below subsistence level. Almost all maize is grown without irrigation and is subject to losses due to rainfall variabilities. Fertilizer use is not common. Additionally, losses during storage are high. Due to these productivity constraints, only 20% of farmers produce surplus and sell their product. Most households have to purchase maize when their stocks are exhausted (Denning, 2009). Nonetheless, maize remains an important crop for export (see Table 12) and for food supply. Its production in 2013 exceeded 2 million tons, and daily per capita consumption was an estimated 1,125 kcal (FAOSTAT,

2017). Maize experienced the highest yield growth (annual average of 23%) compared to other crops (see Table 7). Maize is therefore a major crop in Malawi and investment in strengthening its value chain can prove highly beneficial.

2.3 Promising agricultural products and value chains

In addition to assessing the returns on investments into institutional innovations in Ghana, analyses are also undertaken in order to choose the most promising value chains in the country. This analysis is important because it provides an objective indicator for priority value chains that would have the highest returns on investments into technological and institutional innovations. The trio objectives of PARI (to promote and support the scaling of proven innovations in the agri-food sector; to support and enhance investments in the GICs through research; and to contribute to the development of the agri-food sector in Africa and India through the identification, assessment and up-scaling of innovations) guide the selection of indicators. The indicators should thus focus on improving the food and nutrition security, reducing poverty and improving the market participation of the small holder farmers. Taking into account the availability of data and the purpose of the study, four indicators that focus on poverty and market potential are used to select the five most promising agricultural products from the long list of agricultural products that the country produces and sells. These indicators are:

1. Trade potential (Revealed Comparative Advantage (RCA) index): computed to identify value chains over which the country has revealed, albeit may not necessarily potential, comparative advantage in the export market. The revealed comparative advantage is an index used in international economics for calculating the relative advantage or disadvantage of a certain country in the production and export of a certain class of goods or services as evidenced by trade flows. It is based on the Ricardian comparative advantage concept. We use Balassa's measure of RCA to determine the competitiveness of selected agricultural products in overseas export markets. In the present case, the RCA index compares the share of a given agricultural product in the country's export basket with that of the same product in total world exports
2. Yield gap: used to assess the expected return of the envisaged investment on the given country value chains. The yield gap of a crop grown in a certain location and cropping system is defined as the difference between the yield under optimum management and the average yield achieved by farmers. A standard protocol for assessing yield potential and yield gaps is applied for some crops based on best available data, robust crop simulation models. It is a powerful method to reveal and understand the biophysical opportunities to meet the projected increase in demand for agricultural products.
3. Average yield growth: used to examine the potential of the product for poverty reduction. The most widely used indicator of crop productivity is production per unit of land (also referred to as crop yield). Average yield growth may reduce poverty in the following ways: (1) higher yield implies higher surplus product that could be sold in the market and thereby increase farmers income, (2) higher surplus product mean large quantity of food supplied to urban and rural market at a relatively lower price which in turn reduces urban and rural food poverty, (3) higher agricultural productivity will stimulate growth in the non-agricultural sector through its strong backward and forward linkage. For example, it boosts growth in the industry sector by freeing agricultural labor and reducing urban wage pressure (Lewis, 1962), and (4) agriculture's fundamental role in stimulating and sustaining economic transition, as countries (and poor people's livelihoods) shift away from being primarily agricultural towards a broader base of manufacturing and services (DFID, 2004).
4. Total production of the crop as a share of total supply (production + imports) is also used to assess the relevance of investing on that crop .Because it signals whether the agro-ecological system is suitable for the production of that crop in meeting the global demand for that particular crop. The ratio of production to total supply also illuminates the degree of integration of the producers that

particular crop, small holder farmers in most African countries cases, into markets. The extent to which small holder farmers are able to participate in both input and output markets, and the functionality of those markets, are key determinants of their willingness and ability to increase marketable surpluses (Arias, 2013). Across the developing world, smallholders farm in diverse agro-climatic systems which together with their assets and skills, shape their economic lives. Markets and the extent to which they are functioning well, also play a determining role.

Note: The share of production of that particular crop over the total crop production is another key indicator considered in this study while assessing the relevance of investing on a particular crop in a country. This indicator is used as an eliminating criteria. If the share of a given crop out of total crop production is less than 0.5 %, we consider it as less relevant and exclude from the list of most promising value chains.

The summary of the five most promising value chains based on the RCA index, average yield growth and relevance of crop is reported in Table 15 below. The production share, RCA index, actual yield growth and relative yield gap for the GIC value chain(s) are also reported at the bottom of the table, when they are not included in the list of the first five most promising value chains.

Table 15: Selection of promising agricultural products /value chains

	Rank by RCA		**Rank by Yield progress****		**Rank by relevance of crop**	
Rank	**Name of agricultural Product**	**RCA index (2011)***	**Name of the Crop**	**Average annual Yield growth (2005 to 2012)**	**Name of agricultural Product**	**Production share of supply (2011)***
1	Tobacco, unmanufactured	36	Maize	23	Beverages, Alcoholic	125
2	Cotton, carded, combed	34	Pigeon peas	21	Sunflower seed	110
3	Coffee, substitutes containing coffee	15	Rice, paddy	17	Maize and products	109
4	Cotton linter	10	Seed cotton	12	Rice (Milled Equivalent)	100
5	Tea	9	Potatoes	11	Millet and products	100
	Groundnuts, shelled	9	Sunflower seed	17	Soya beans	100
	Sunflower seed	0.03	Groundnuts, with shell	10	Cassava and products	100
	Starch, Cassava	0.01	Soybeans	9	Groundnuts (Shelled Equivalent)	98
	soybean	0.04	Cassava	7	Sunflower seed Oil	50

Source: * Own computation based on FAO 2015 data.
Note: ** a minimum of 0.5% production (volume) share threshold is used as a screening (crop relevance) criteria.

Results of assessment (Table 15):

- The trade potential (RCA index) is very high for unmanufactured tobacco, carded cotton, coffee substitutes, cotton linter, tea and one of the GIC-selected value chains, groundnuts. This indicates that Malawi has a comparative advantage (in the export) of these commodities. The RCA value for the other GIC crops, namely sunflower, cassava and soy, is less than 1, indicating that Malawi has a comparative disadvantage (in the export) of these commodities;

- The yield performance indicating progress suggests that over the CAADP period (2005 to 2012), maize, pigeon peas, paddy rice, seed cotton and potatoes were the five most promising crops. The yield performance of the GIC-selected crops (groundnut, soybeans and cassava) also grow at a higher rate and are ranked as the 8th, 9th and 11th most promising crops. The other GIC product, sunflower, recorded a very high growth rate, but its production share is less than 0.5%;
- The leading value chains in terms of relevance (production share of supply) are alcoholic beverages, sunflower seed, maize and rice. The total production of the first three products exceeds the total supply. The total supply of the latter two products and three of the GIC-selected products (soybeans, cassava and groundnut) is domestically produced while only half of the sunflower seed oil supplied in the market is locally produced.

2.4 Summary on selection of agricultural products and value chains

This chapter (chapter 2) has presented different relevant and important value chains in Malawi based on different criteria, resulting in the selection different value chains. In summary, the three top value chains in each set – the GIC-selected value chains, other relevant value chains, and those identified by analysis of promising agricultural products and value chains – are presented in Table 16. The summary table shows that only the sunflower value chain, selected by the GIC is also identified as a promising relevant crop in the analysis of promising agricultural products and value chains. The maize value chain discussed in the literature review is identified as promising in terms of yield progress and relevance of crop.

Table 16: Summary of all value chains

GIC value chains	Other value chains	Promising agricultural products and value chains (top 3)		
		RCA	Yield progress	Relevance of crop
Groundnut	Maize	Tobacco, unmanufactured	Maize	Beverages, Alcoholic
Soy		Cotton, carded, combed	Pigeon peas	Sunflower seed
sunflower		Coffee, substitutes containing coffee	Rice, paddy	Maize and products
Cassava				

Source: Authors' compilation

3 Innovations in value chains in the past 20 years

3.1 Main limiting factors

3.1.1 Groundnut value chain

Constraints: The main constraints for groundnuts are limited access to improved seed varieties, poor husbandry practices, pest and disease control, and poor linkages to markets (Stepman, 2013).

A number of reasons are attributed to low groundnut production in the country including the following:

- Erratic rainfall and dry spells during critical periods of the plant growth;
- Reliance on small-scale traditional groundnut farming husbandry practices;
- Poor access to improved seed materials and low adoption of improved technologies outside of core production areas;
- Limited availability of basic seed for multiplication and especially low involvement by the private sector in improved groundnut seed multiplication;
- Low yields due to the use of traditional varieties and seed recycling, especially in most remote areas of the country;
- Poor crop husbandry practices and low nutrient application, resulting in declining soil fertility levels;
- Inadequate support services, such as extension services and credit facilities;
- A clash in labour demand and competition with other crops, notably maize, tobacco, soybeans etc;
- Pest and diseases (Kamangira *et al.*, 2016).

A number of constraints affecting post-harvest handling of groundnuts include the following:

- Continued use of traditional methods of harvesting;
- Limited knowledge of groundnut grading and value addition, and of proper groundnut handling during drying and shelling;
- Shelling methods render nuts susceptible to aflatoxin;
- Use of unimproved storage facilities that increase chances of post-harvest losses from pest and disease;
- Poor collective bargaining power due to individual sales by farmers;
- High transportation and storage costs and lack of commercial farming and aflatoxin management skills;
- Lack of viable markets, low prices;
- Poor road and market infrastructure and dishonest traders (tamper with weighing scale);
- Absence of price differentiation for quality;
- Little value addition by the processors;
- Weaker partnerships and linkages between the private sector and government in groundnuts compared with the tobacco industry;
- Lack of accredited laboratories for groundnut quality certification in the country (Stepman, 2013).

3.1.2 Cassava value chain

Cassava production is mainly constrained by limited use of improved varieties, poor husbandry practices, pest and disease incidence, lack of value-adding processing and poor linkages to markets for processed cassava products.

High soil acidity decreases yields and limits the effectiveness of fertilizer use. Where cassava is grown on slopes, soil erosion has been observed (Arndt *et al.*, 2015).

3.1.3 Soy bean value chain

The main constraints include limited access to improved seed varieties, poor use of *Rhizobium inoculum* to increase yield, poor husbandry practices, and poor linkages to markets.

Farmers might be held back from the cultivation of soy by factors like high input and production costs compared to other oilseeds. Selecting the right variety is difficult for farmers, and research about suitability of different varieties for certain areas and seasons still needs to be conducted (Arndt *et al.*, 2015).

Land parcels used for oilseed production are generally too small for the profitable acquisition of machinery, which limits the opportunities to increase (Arndt *et al.*, 2015).

3.1.4 Sunflower seed value chain

There is economic potential to expand the production of sunflower. However, the crop has a bad reputation with farmers, since previous attempts to cultivate the crop failed due to lack of a value chain. Yield potential is not met, and there is limited demand for seed due to a weak system of knowledge transfer. Access to extension services has to be improved in order to increase production.

3.2 Important value-chain related and cross-cutting innovations

In this section, we describe some of the key innovations that have been initiated in selected value chains in Malawi in the last 20 years. The innovations described are considered significant or beneficial because of their widespread adoption, proven positive impact on increasing productivity, adaptability to environmental challenges (such as drought), potential to increase incomes and create employment, etc. ,

3.2.1 GIC value chains

a. Groundnut value chain

There are a number of opportunities which could prove effective in improving the groundnut value chain in Malawi:

- Existence of various trading opportunities in the regional SADC and COMESA trading blocs;
- Persistent problems in tobacco value chain present opportunities for smallholder farmers to switch to groundnuts and other high-value legumes;
- The MGDS 2011-2016 seeks to diversify agricultural production of high value commodities for exports to promote food security, economic growth and wealth creation;
- The possibility to expand agro-processing and market development as prescribed in ASWAp);
- ICRISAT breeds groundnut seeds for higher productivity and resistance to pests, diseases and other stresses and is releasing improved varieties to make groundnut production more attractive for farmers.

The most effective control measures to improve disease resistance are husbandry practices, such as crop rotation and early sowing. Potential for resistance through breeding alone is limited. To improve yields, farmers found that residual soil fertility in restored soils with high organic matter is more effective than direct fertilisation. Farmers have to be encouraged to test intercropping with different crops and conservation agriculture to find effective ways to build up soil organic matter (Arndt *et al.*, 2015).

To lower aflatoxin levels, better drying practices and storing innovations need to be promoted. Farmers have developed raised drying racks that allow the nuts to dry more quickly and evenly. The FAO also provides a source of improved storage innovations, such as small metal silo bins. The use of Aflasafe –

developed by the IITA in collaboration with the University of Bonn – protects groundnuts against Aflatoxin contamination through the entire value chain and should be promoted to groundnut farmers. Innovative and sustainable business models allowing smallholders to mechanically shell their groundnuts with rented hand shellers are being developed by a consortium comprising Twin Trading, ExAgris and NASFAM. If gathered in large amounts, shell by-products can be turned into briquettes and sold to further offset groundnut production costs.

b. Soybean value chain

Entry points in the value chain include:

- Promote early field preparation and timely planting;
- Encourage farmers to follow recommended planting technology to achieve optimal plant population;
- To mechanize and intensify the production process; low cost machinery acquired by medium-size holdings could service small farms (Arndt *et al.*, 2015)
- Promote use of improved and high quality seed;
- Encourage seed inoculation and use of fertilizer (Inoculation and Fertilisers);
- Encourage farmers to control pests and promote Integrated Pest Management;
- Promote timely harvesting;
- Promote the use of good storage facilities;
- Link farmers to markets;
- Improve access to open pollinated varieties Soya Bean seed through community seed multiplication.

Innovations in soybean cultivation revolve around varieties, intercropping and seed inoculation. Groundnuts and soy complement each other well in intercropping systems. Conservation Agriculture innovations that combine maize-soybean crop rotation with *faidherbia albida trees* have also been developed.

The IITA has developed a number of non-genetically modified soybean varieties, a popular one being Tikolore, which smothers weeds and increases yields to over 2 t/ha, though at the cost of lower oil and protein content. Other good varieties developed are adapted to hot temperatures.

Inoculation of non-promiscuous varieties with the bacteria *Bradyrhizobium japonicum* leads to improved nitrogen fixation and can double production. Inoculants need to be supplied, and appropriate methods suitable for smallholders need to be developed.

Incorporating the soy plant material back into the soil has shown to avoid the depletion of potassium and phosphorous, a problem that often occurs in soy cultivation. (Arndt *et al.*, 2015)

c. Sunflower value chain

Pannar Seed and Monsanto are providing improved seeds for sunflower, and a few local agricultural research stations provide technical support to the farmers. Seeds can also be selected from previous crops. Recent investments in Malawi by BERL (Bio Energy Resources Limited) enable the processing of large volumes of sunflower oil. For farmers to benefit from these developments linkages along the value chain and trust have to be strengthened. To improve yields, different husbandry practices, such as intercropping with legumes, planting times, spacing and weed control have to be tested further (Arndt *et al.*, 2015).

d. Cassava value chain

Entry points in the value chain include:

- Promote early field preparation, timely planting and timely harvesting;
- Encourage farmers to follow recommended planting technology to achieve optimal plant population;
- Promote use of improved and high quality planting material;
- Encourage farmers to control pests and promote Integrated Pest Management;
- Encourage cassava processing and use of good storage facilities;
- Link farmers to markets for processed cassava;
- Increase access to improved cassava varieties;
- Raise community awareness, facilitating the formation of farmers groups, providing improved high quality, clean and disease-free planting material, etc.

The IITA has developed improved varieties and distributed stems for the establishment of nurseries. These contain low hydrogen cyanide levels, high carotene levels, are disease-resistant, pest-resistant, achieve high yields and have a low height of first branching in order to better suppress weeds. The development of genetically modified varieties is not perceived as necessary, as conventional breeding continues to yield crop varieties with the desired traits.

The application of the fungi *Trichoderma harzianum* to the soils has shown to decrease root rots.

Intercropping cassava with cowpeas, pigeon peas or crotalaria can help reduce pests and maintain nitrogen levels in the soil. Incorporating sown legumes as green manure can also improve soil chemically.

To mechanize the process of cassava production and reduce the required labor input, cassava planters, lifters and tractor pulled harvesters could be introduced more broadly to Malawian farmers.

Cassava starts decaying within few days once harvested. Arndt et al (2015) name a list of innovations in harvest practices and post-harvest management that have proven effective in prolonging the freshness of cassava roots.

According to Arndt et al, “the most important innovation in today’s cassava processing in Africa is the production of high quality cassava flour and the possibility of mobile processing inside the area of agricultural production.” Innovations from Nigeria can be used by several companies which are starting to produce high quality cassava flour in Malawi.

Through the Conservation Agriculture IPs, innovations in cassava husbandry practices have been promoted in Malawi, which include zero tillage, residue retention, fertilization and the use of herbicides (Kamangira *et al.*, 2016).

3.2.2 Other value chains and cross-cutting innovations

Many crosscutting innovations have been adopted under Malawi’s innovation platforms, the most successful ones being:

- Compost manure (Mwandama fertilizer)
- Conservation agriculture (minimum soil disturbance, crop rotation, mulching, zero tillage, residue retention, fertilization, use of herbicides)
- Plant breeding
- Crop management and storage to reduce post-harvest loses (Kamangira *et al.*, 2016).

The high acidity of soils is increasingly becoming a problem in Malawi, decreasing yields of crops (i.e. cassava, soy) by affecting the potassium and phosphorus content of the soil. Farmers could save money on fertilizer by using pH indicator strips as a rapid test and adjusting soil pH before applying fertilizer.

The soil acidity can be reduced by applying lime (Calcium carbonate), dolomite (Calcium-magnesium carbonate), wood ashes or compost.

Integrating nitrogen-fixing shrubs or *faidherbia* trees into the fields has proven to have various benefits. Beyond increasing yields, the trees serve as source for livestock fodder, medicine, construction material and fuel. This practice has rarely been introduced on family farms so far (Arndt *et al.*, 2015).

Mechanization of the agricultural process, which is rare in Malawi, is a crucial step towards increasing productivity. The International Centre for Tropical Agriculture encourages women farmers to develop tailor-made, labour saving agricultural hand tools, of which the project will make plastic prototypes with a 3D-printer. These can then be used by local artisans to replicate the real tool. Innovation in the mechanization of oilseed crop production is mainly around small tractors and seed drills. The use of small tractors greatly improves the incorporation of organic matter into the soil. However, innovative mechanisation practices are not adopted by Malawian farmers, possibly due to their small cultivation areas. Communal ownership models have varying degrees of success. Medium-sized farms could potentially acquire machinery and offer service to smallholders (Arndt *et al.*, 2015).

USAID/Malawi Integrating Nutrition in Value Chains: Feed the Future (FTF)[15] is a United States Government global initiative to sustainably reduce poverty and hunger. USAID/Malawi's flagship FTF activity, Integrating Nutrition in Value Chains, strengthens the competiveness of the soy and groundnut value chains, improves the nutritional status of women and children, and builds the capacity of Malawian agriculture and nutrition organizations" (FTF, 2011).

Key achievements

- More than 320,600 rural households have benefitted from FTF activities, which includes technical assistance on improved agronomic practices, access to improved seed varieties, linkages to market opportunities, including warehouse receipt commodity marketing and nutrition education aimed at increasing consumption of nutritious crops;
- Nearly 215,000 households improved their food security thanks to an integrated package of activities that included nutrition, health, hygiene and sanitation, conservation agriculture, irrigation, agribusiness and disaster risk management assistance;
- Through support for the New Alliance for Food Security and Nutrition, FTF helped the Government of Malawi develop an inter-ministry and country-owned policy agenda to drive the commercialization and growth of the agriculture sector;
- Private sector companies made investments amounting to US$ 23 million in Malawi's agriculture sector, which related to their original New Alliance commitments.

The treadle pump is an innovation that makes irrigation more practical and less labour intense, especially for small scale farmers. It allows many Malawian small scale farmers to increase their productivity and income. Wind-powered irrigation systems have also been developed by the Malawi Research and Technology Development Centre for irrigation of fields in Chikwawa.

4 Suggestions for collaboration

The tables below provide some suggestions for key partnerships in the groundnut and soybean value chains.

[15] www.feedthefuture.gov/country/malawi

Table 17: Key partners in the groundnut value chain and their roles

Partner	Role
Department of Agricultural Research Services; Ministry of Agriculture and Food Security	Undertake variety development, evaluation and release; produce breeder and foundation seed; develop integrated crop management technologies; provide Aflatoxin testing services
Seed Services Malawi	Seed systems support to help collaborating NGOs and Community Based Organizations with the monitoring of quality seed production
Department of Crop Production; Ministry of Agriculture and Food Security	Provide guidance in integrated groundnut production technologies and associated packages; facilitate groundnut value chain coordination
Department of Agricultural Extension Services; Ministry of Agric. and Food Security	Educate farmers and disseminate technology
Ministry of Industry and Trade	Identify opportunities in regional and international groundnut trade
Farmers	Use products and services
Farmers Union and Associations (FUM, NASFAM, ASSMAG, etc.)	Enable the formation of associations for collective production and marketing by farmers; facilitate linkages to other agro-industries
NGOs (CISANET, CARE Malawi, Plan Malawi)	Support farming communities by imparting knowledge and skills to increase production; facilitate farmer-friendly agricultural policies
ICRISAT; CGIAR	Provide improved germplasm; Build capacity through training; conduct research on effective methods of technology dissemination
Private sector (market intermediaries, seed enterprises, processors and agro-input dealers)	Facilitate processing and commercialization

Source: Monyo (2013).

Table 18: Key partners along the soybean value chain and their roles

Partner	Role
IITA-Malawi	Soybean breeding, variety development, technical backstopping and training
Ministry of Agriculture and Food Security	Agricultural policies
Department of Agricultural Research Services	Research on varietal development
Lilongwe Agriculture and Natural Resources	Research and training
National Smallholder Farmer's Association of Malawi (NASFAM)	Production of quality declared seeds and linking farmers to markets
Association of Smallholder Seed Multiplication Action Group (ASSMAG)	Farmer owned and controlled rural seed production and marketing organization
Department of Agricultural Extension Services (DAES)	Extension of technologies
Seed Co - Malawi (private seed company)	Production and marketing of seeds
Central Poultry Feeds and Rab Processors	Buy soybean grain from farmers, process soybeans into human food and animal feed
Soybean Association of Malawi	Address soybean trading and marketing issues as well as lobby financing institutions to support the soybean industry
Grain Legumes Development and Marketing	Enhance the production and marketing of legumes
Department of Crop Development	Provide guidance in crop production

Source: Monyo (2013).

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Annex A: Background Information on Nutrition

This annex provides background information on diet quantity and quality, child feeding practices and nutrition status (including micronutrient deficiencies) and definitions of the food and nutrition security indicators presented in Chapter 1.4.2.

Background on food and nutrition security

Diet quantity: Dietary energy supply per capita is an indicator of diet quantity that can be gauged against a population's average dietary energy requirement. The data are based on FAO's food balance sheets that estimate the quantity of each food item available for human consumption at the national level. It has to be emphasized that supply does not equal intake: Supply includes food that households feed to domestic animals or pets and food that they waste. Also, a sufficient average supply of dietary energy (or a nutrient such as protein) may leave those parts of the population deprived that have greater-than-average requirements or lower-than-average intakes. Indicators of undernourishment and food over-acquisition seek to consider the distribution of dietary energy consumption in the population and the minimum/maximum requirements of the average individual in a country (Cafiero, 2014).

Diet quality: Assessing diet quality requires a look at the composition of the diet. In the absence of national food consumption surveys for most countries, data from FAO's food balance sheets are used. The percentage of dietary energy supply from starchy staples (cereals, roots and tubers) is a rough indicator of diet quality: generally, the higher this percentage, the lower the micronutrient density of the diet; starchy staples are rich in carbohydrate and good sources of dietary energy, but they are usually not very micronutrient-rich. Non-staple foods are important for micronutrient and protein supply: Foods of animal origin are good sources of high-quality protein and vitamin A as well as highly bioavailable iron and zinc (meat, fish) and calcium (milk, small fish eaten whole with bones). Pulses and nuts are also good sources of protein and micronutrients. Fruits and vegetables provide a range of micronutrients while generally contributing little dietary energy (USDA, 2016).

The shares of dietary energy supply from carbohydrate, protein, and fat roughly indicate whether the diet is balanced in terms of its macronutrient composition. The recommended shares of dietary energy are 55-75% for carbohydrate, 10-15% for protein, and 15-30% for fat (WHO, 2003). It should be noted that these shares do not reveal whether dietary energy supply per capita and average protein supply are insufficient, sufficient, or excessive in absolute terms. A diet that meets the average dietary energy requirement for Africa as a whole (2200 kcal/day according to FAO, 2016) and provides 55-82.5 g protein per day and 36-73 g fat per day contains the recommended shares of 10-15% of dietary energy from protein and 15-30% of dietary energy from fat. For an adult weighing 60 kg, a protein intake of 50 g/day is considered sufficient, and 60 g/day for an adult weighing 75 kg. No safe upper limit of protein intake has been established, but it is unlikely that intakes of twice the recommended level pose any risk (WHO/FAO/UNU, 2007).

Child feeding practices: Feeding practices are determined by local food availability and household access to food, but also by maternal knowledge and care. Breastfed and non-breastfed children aged 6-23 months should eat foods rich in iron (meat, fish, or eggs) and fruits and vegetables rich in vitamin A daily, and consume at least 4 out of 7 food groups every day (PAHO/WHO, 2003; WHO, 2005; WHO, 2010).

Nutrition status: Household food security, the health environment, and mothers' caring capacity influence children's dietary intakes and the risk of infection, and thereby their nutrition and health status (UNICEF, 2013). Wasting, or acute undernutrition, is the result of recent rapid weight loss or the failure to gain weight that is caused by inadequate diets or infection. Stunting is the failure to grow adequately and results from chronic or recurrent undernutrition or infection (UNICEF/WHO/World Bank, 2016). Stunting in early childhood can have irreversible consequences, such as impaired motor and cognitive development, shorter adult height, lower attained schooling, and reduced adult income, whereas wasting carries a higher mortality risk (Victora et al. 2008; Black et al. 2013; Olofin et al. 2013). Overweight in children and overweight and obesity in adults occur when dietary energy intakes exceed

dietary energy requirements. Overweight and obesity increase the risk of noncommunicable diseases (UNICEF/WHO/World Bank, 2016).

Micronutrient deficiencies arise from insufficient intakes or absorption of essential vitamins and minerals. Major causes are poor diets, diseases, and increased requirements during life stages such as early childhood, pregnancy, and lactation. Micronutrient deficiencies are not limited to poor populations with inadequate dietary energy intakes, but may coexist with overweight and obesity in individuals and communities. Measuring micronutrient deficiencies poses challenges: There is often a need to resort to proxy indicators and large data gaps persist. Anemia, for example, is used as a proxy indicator for iron deficiency, although only about half of the global burden of anemia can be attributed to iron deficiency. Iron deficiency anemia impairs cognitive and motor development, causes fatigue and low productivity, and may result in low birth weight and increased maternal and perinatal mortality if pregnant women are affected (WHO 2015b). Whenever survey data on anemia prevalence are not available, modeled estimates from WHO (2015b) are used. Vitamin A deficiency increases the risk of vision problems, infectious diseases, and death among children (Imdad et al., 2010). Without exception, the data on vitamin A deficiency that are presented in this dossier are modeled estimates (Stevens et al., 2015, quoted in IFPRI, 2015).[16]

Table A1: Cutoffs to identify nutrition problems of public health significance in children

Category of public health significance	Stunting	Wasting	Overweight	Iron deficiency anemia
Severe	≥40	≥15	≥10	≥40
Moderate	30-39	10-14	5-9	20-39
Mild	20-29	5-9	3-4	5-19

Source: Adapted from World Bank (2006) and based on data from WHO (1995) and WHO (2000)

Notes: The cutoffs for public health significance were applied to prevalence rates of stunting, wasting, overweight and iron deficiency anemia (estimated from anemia prevalence) that were rounded to the first decimal. In the tables in Chapter 1.4.2, the data have been rounded to integers, which may lead to seeming contradictions: In a region where 29.8% of children under five were stunted (30% if rounded), stunting would be considered a mild public health problem, and in a region where 30.3% of children under five were stunted (also 30% if rounded), stunting would be considered a moderate public health problem.

Indicator definitions

Dietary energy supply: National average energy supply, expressed in kcal/caput/day (FAO, 2016).

Average dietary energy supply adequacy: Dietary energy supply expressed as a percentage of the average dietary energy requirement. Each country's average supply of calories for food consumption is divided by the average dietary energy requirement estimated for its population to provide an index of adequacy of the food supply in terms of calories (FAO, 2016).

Prevalence of undernourishment: Probability that a randomly selected individual from the population consumes an amount of calories that is insufficient to cover her/his energy requirement for an active and healthy life (FAO, 2016). This indicator seeks to estimate of the percentage of individuals in the population who are chronically undernourished because they fail to meet their minimum dietary energy requirements on a consistent basis.

Prevalence of food over-acquisition: Percentage of individuals in a population who tend, on a regular basis, to acquire food in excess of their maximum dietary energy requirements (FAO, 2016).

Dietary energy supply from cereals, roots and tubers: Percentage of dietary energy supply provided by cereals, roots and tubers (FAO, 2016). A higher share of dietary energy supply from cereals, roots and tubers is generally associated with a lower micronutrient density of the diet.

[16] Iodine deficiency disorders are an important public health problem in many countries. They are not discussed here because salt iodization, the main prevention and control strategy, is not related to agricultural value chains.

Dietary energy supply from carbohydrate: Percentage of dietary energy supply provided by carbohydrates, calculated by subtracting dietary energy supply from protein and dietary energy supply from fat from 100%.

Dietary energy supply from protein: Percentage of dietary energy supply provided by protein, calculated as average protein supply times 4 kcal/g divided by total dietary energy supply.

Dietary energy supply from fat: Percentage of dietary energy supply provided by fat, calculated as average fat supply times 9 kcal/g divided by total dietary energy supply.

Average protein/fat supply: National average protein/fat supply, expressed in g/caput/day (FAO, 2016).

Minimum dietary diversity: consumption of 4+ food groups: Percentage of children aged 6-23 months fed four or more food groups in the 24 hours preceding the survey. The food groups are 1) infant formula, milk other than breast milk, cheese or yogurt or other milk products; 2) foods made from grains, roots, and tubers, including porridge and fortified baby food from grains; 3) vitamin A-rich fruits and vegetables (and red palm oil); 4) other fruits and vegetables; 5) eggs; 6) meat, poultry, fish, and shellfish (and organ meats); 7) legumes and nuts (ICF International, 2015, The DHS Program STATcompiler).

Consumption of foods rich in vitamin A: Percentage of children aged 6-23 months who consumed foods rich in vitamin A in the 24 hours preceding the survey. Foods rich in vitamin A include meat (and organ meat), fish, poultry, eggs, pumpkin, red or yellow yams or squash, carrots, red sweet potatoes, dark green leafy vegetables (for example, cassava leaves, pumpkin leaves, kale or spinach), mango, papaya, and other locally grown fruits and vegetables that are rich in vitamin A (ICF International, 2015, The DHS Program STATcompiler).

Consumption of foods rich in iron: Percentage of children aged 6-23 months who consumed foods rich in iron in the 24 hours preceding the survey. Foods rich in iron include meat (and organ meat), fish, poultry, and eggs (ICF International, 2015, The DHS Program STATcompiler).

Child wasting: Percentage of children under five who are wasted, that is, have weight-for-height below minus 2 standard deviations of the median of the WHO Child Growth Standards. This means that they are too thin for their height (UNICEF/WHO/World Bank, 2016).

Child stunting: Percentage of children under five who are stunted, that is, have height-for-age below minus 2 standard deviations of the median of the WHO Child Growth Standards. This means that they are too short for their age (UNICEF/WHO/World Bank, 2016).

Child overweight: Percentage of children under five who are overweight, that is, have weight-for-height above 2 standard deviations of the median of the WHO Child Growth Standards. This means that they are too heavy for their height (UNICEF/WHO/World Bank, 2016).

Adult overweight and obesity/overweight and obesity among women of reproductive age: Percentage of adults aged 18 years or older/percentage of women of reproductive aged 15-49 years whose body mass index (BMI) is equal to or greater than 25 kg/m2 (WHO, 2015a; ICF International, 2015, The DHS Program STATcompiler). BMI is calculated by dividing body weight in kg by squared height in m.

Adult obesity/obesity among women of reproductive age: Percentage of adults aged 18 years or older/percentage of women aged 15-49 years whose body mass index (BMI) is equal to or greater than 30 kg/m^2 (WHO, 2015a; ICF International, 2015, The DHS Program STATcompiler).

Adult underweight/underweight among women of reproductive age: Percentage of adults aged 18 years or older/percentage of women aged 15-49 years whose body mass index (BMI) is below 18.5 kg/m^2 (ICF International, 2015, The DHS Program STATcompiler).

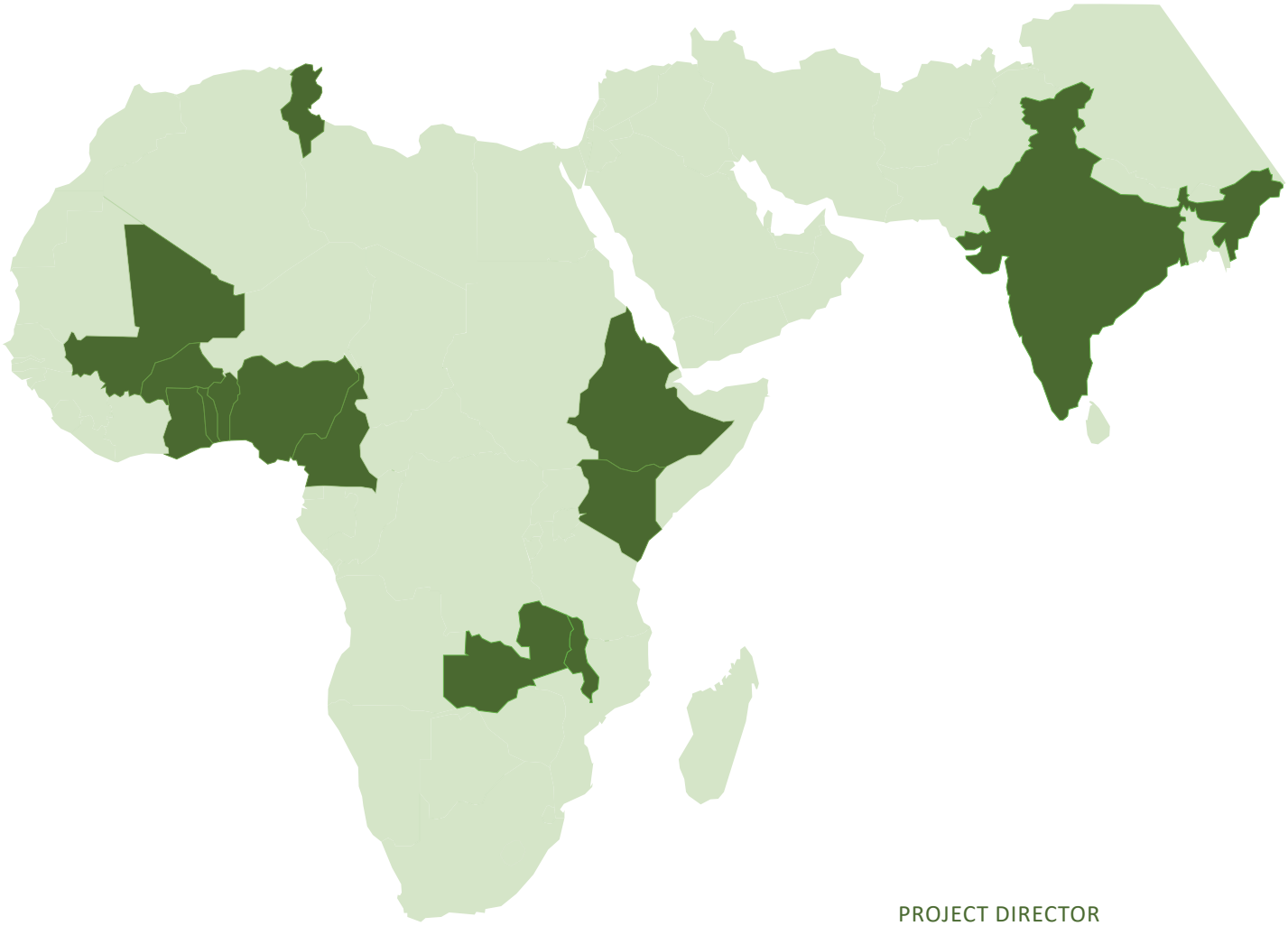
Vitamin A deficiency: Percentage of children aged 6-59 months with a serum retinol concentration below 0.7 µmol/l.

Anemia in children: Percentage of children aged 6-59 months with anemia, namely, a blood hemoglobin concentration below 11.0 g/dl.

Anemia in women: Percentage of women aged 15-49 years with anemia, namely, a blood hemoglobin concentration below 12.0 g/dl for non-pregnant women and below 11.0 g/dl for pregnant women.

ABOUT PARI

The Program of Accompanying Research for Agricultural Innovation (PARI) brings together partners from Africa, India and Germany to contribute to sustainable agricultural growth and food and nutrition security in Africa and India as part of the “One World, No Hunger” Initiative supported by the German government.



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