

# Innovation for Sustainable Agricultural Growth in Zambia



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## SUGGESTED CITATION

ZEF, FARA, ZARI (2017). *Country Dossier: Innovation for Sustainable Agricultural Growth in Zambia*. Program of Accompanying Research for Agricultural Innovation. Bonn, Accra and Lusaka: Center for Development Research, Forum for Agricultural Research in Africa and Zambia Agricultural Research Institute.

## ACKNOWLEDGEMENTS

The paper was developed within the project “Program of Accompanying Research for Agricultural Innovation” (PARI), which is funded by the German Federal Ministry of Economic Cooperation and Development (BMZ).



Federal Ministry  
for Economic Cooperation  
and Development

## **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**

AfDB	African Development Bank
CAADP	Comprehensive Africa Agriculture Development Programme
COMACO	Community Markets for Conservation
COMESA	Common Market for Eastern and Southern Africa
CSO	Central Statistical Office of Zambia
DHS	Demographic and Health Survey
EU	European Union
FAO	Food and Agriculture Organization
FARA	Forum for Agricultural Research in Africa
FFV	Fresh Fruits and Vegetables
FRA	Food Reserve Agency
GART	Golden Valley Agricultural Research Trust
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
GRZ	Government of the Republic of Zambia
HIV/AIDS	Human Immunodeficiency Virus/ Acquired Immune Deficiency Syndrome
IAPRI	Indaba Agricultural Policy Research Institute
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IITA	International Institute of Tropical Agriculture
IP	Innovation Platform
KSS	Key Support Services
MT	Metric Ton
NAIP	National Agriculture Investment Plan
NAP	National Agricultural Policy
NEPAD	New Partnership for Africa's Development
NGO	Non-Governmental Organization
NRDS	National Rice Development Strategy
PARI	Program of Accompanying Research for Agricultural Innovation
PPP	Purchasing Power Parity
R&D	Research and Development
RCA	Revealed Comparative Advantage
S3A	Science Agenda for Agriculture in Africa
SADC	Southern African Development Community
SARD-SC	Support to Agricultural Research for Development of Strategic Crops in Africa
SEWOH	"One World, No Hunger" initiative
SNDP	Sixth National Development Plan
SRI	System of Rice Intensification
TFP	Total Factor Productivity
UNICEF	United Nations International Children's Emergency Fund
UNZA	University of Zambia
USAID	United States Agency for International Development
VCA	Value Chain Approach
WHO	World Health Organization
ZARI	Zambia Agriculture Research Institute
ZEF	Zentrum für Entwicklungsforschung / Center for Development Research

# **1 General background information of the agricultural and food sectors**

The agricultural sector plays an important role in the Zambian economy. It generates between 16 and 20% of the Gross Domestic Product (GDP) and more than 70% of the country's population depends on agriculture for their livelihood, especially in rural areas. The sector also accounts for about 67% of the labor force and remains the main source of income and employment for rural women and men (Government of the Republic of Zambia-Food and Agriculture Organization (GRZ-FAO), 2009). The current Zambian government (and even past governments) has identified agriculture as the main sector driving the economy, complementing the mining sector which has been the largest contributor of foreign exchange earnings and national revenue.

The aspirations of the Zambian people – as captured in the Vision 2030 formulated in December 2006 – is among other things, “a diversified and balanced and strong industrial sector, a modern agricultural sector and an efficient and productive services sector (Vision 2030).” In the policy context, the Sixth National Development Plan: 2011-2015 (SNDP: 2011-2015) stipulated that the agricultural sector will continue to be a strategic area of focus in promoting economic growth, reducing poverty and creating employment. The major emphasis under the SNDP was on economic diversification, focusing on agriculture, tourism, manufacturing, mining and energy, as the growth sectors/areas.

This is in cognizance of the country's vast resource endowment in terms of land, water, labor and climate. This vast natural resource endowment reflects the enormous potential to expand and/or excel in agricultural development. Out of the 75 million ha total land area, 42 million ha (58%) is classified as having medium to high potential for agricultural production and being suitable for the production of a broad range of crops, livestock and fish, considering its annual rainfall ranging between 800 mm to 1500 mm. The potential irrigable land area is over 423,000 ha, of which about 100,000 ha is currently irrigated by large-scale, emergent and smallholder farmers. With the country's abundant surface and underground water resources, there is potential to drastically increase the area under irrigation (it is said that Zambia has about 40% of the water resources in the Southern African Development Community [SADC] region).

Agriculturally, Zambia is classified into three agro-ecological regions (Regions I, II and III) which are delineated on the basis of agro-climatic conditions, including rainfall patterns, temperature, farming systems and soil types.

Region I covers parts of Southern, Eastern and Western Provinces and constitutes 12% of the country's total land area. This region receives annual rainfall of less than 800 mm, and its soil type is loamy to clayey on the valley floor and coarse to fine loamy shallow soils on the escarpment. It is suitable for the production of crops such as cotton, sesame, sorghum, groundnuts, beans, sweet potatoes, cassava, rice and millet and has potential for the production of various irrigated crops including fruits and vegetables. This region is also suitable for extensive cattle production. However, the valley part of the region is not suitable for cattle rearing due to its hot and humid climate, its low altitude, and because of the tsetse flies.

Region II is sub-divided into Region IIa and IIb. It constitutes 42% of the country and receives annual rainfall of between 800 mm to 1,000 mm. Region IIa covers the Central, Lusaka, and parts of Southern and Eastern provinces. It has, for the most part, inherently fertile soils, and thus permanent settled systems of agriculture are practiced in this sub-region. A variety of crops are grown, including maize, cotton, tobacco, sunflower, soybeans, irrigated wheat, groundnuts and other arable crops. The area is also suitable for flowers, capsicum and vegetable production. The sub-region is also suitable for beef, dairy and poultry production. On the other hand, sub-Region IIb covers part of Western Province and consists of sandy soils. It is suitable for the production of cashew nut, rice, cassava, millet and vegetables; it is also suitable for beef, dairy and poultry production.

Region III: covers the Copperbelt, Luapula, Northern, Muchinga and North-Western Provinces. It constitutes 46% of the country's total land area and receives an annual rainfall of between 1,000 mm

and 1,500 mm. With the exception of the Copperbelt Province, the region is characterized by highly leached, acidic soils and thus the region's agricultural potential can be enhanced by the application of agricultural lime and organic matter. However, it has the inherent potential for the production of millet, cassava, sorghum, beans, groundnuts, coffee, sugarcane, rice and pineapples. Its perennial streams can be utilized for small-scale irrigation. Increased exploitation of the fisheries resources and introduction of fish farming offers good opportunities for development.

In nearly all the country's National Development Plans, agriculture has featured prominently. During the implementation of the National Agricultural Policy (NAP) 2004-2015, the agriculture sector registered some positive gains in a number of areas. The cited notable ones include:

- i) An increase in crop production. For instance, for selected crops, harvests from 2004 to 2013 increased as follows:
  - Maize: from 1,213,202 metric tons (MT) to 2,532,800 MT (by an average of 12.8 %);
  - Rice: from 11,699 MT to 44,747 MT (by an average of 18.3 %);
  - Wheat: from 82,585 MT to 273,584 MT (by an average of 18.8 %);
  - Cassava: from 911,673 MT to 1,114,583 MT (by an average of 6.4 %);
  - Groundnuts: from 69,696 MT to 106,792 MT (by an average of 13.9 %);
  - Mixed beans: from 18,161 MT to 56,411 MT (by an average of 16.8 %);
  - Soybeans: from 54,687 MT to 261,063 MT (by an average of 26.3 %); and
  - Sunflower: from 13,857 MT to 33,733 MT (by an average of 29.6 %).
- ii) An increase in capture fisheries and aquaculture fish production. Total annual capture fish production increased from 67,725 MT in 2004 to 76,214 MT in 2012 (by 12.5 %). Total inland aquaculture fish production, on the other hand, increased from 5,125 MT in 2004 to 12,988 MT in 2012 (by 153 %)
- iii) A general increase in the pig population from 286,726 in 2004 to 704,832 in 2008. However, the goat population decreased from 1,002,376 in 2004 to 746,143 in 2008 and the cattle population decreased from 2,341,970 in 2004 to 2,315,327 in 2008;
- iv) Additionally, the average maize yields of small scale farmers increased from 1.93 MT/ha in 2004 to 2.24 MT/ha in 2012, thereby marginally contributing to increased maize production, an increase that was previously attributed to increased area under maize production. However, it should be noted that these average yields dipped from 1.93 MT/ha in 2004 to 1.31 MT/ha in 2008 before reaching a maximum of 2.25 MT/ha in 2010 and again decreasing to 1.93 MT/ha in 2013. This indicates that no meaningful progress has been recorded in achieving increased productivity in maize production, despite huge investments made in providing input subsidies. Low productivity has been attributed to unfavorable rainfall conditions, weak extension services and poor research and technology transfer.

According to the Central Statistical Office's (CSO) Living Conditions Monitoring Surveys of 2006 and 2010, agriculture has marginally increased rural incomes and contributed marginally to poverty reduction and increased food and nutrition security (Mason *et al.*, 2013).

Additionally, the increases in agriculture production and/or gains recorded during the implementation of the NAP: 2004-2015 have not been significant enough to meet the growing domestic and foreign demand for Zambian agricultural commodities. This is also despite the skewed increase in government budgetary allocations (more than 60%) of the expenditure towards maize production and marketing.

In twelve African countries, including Zambia, 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 Zambia are legume value chains (particularly soybean and groundnut) in the Petauke and Katete districts in the Eastern Province and the milk value chain in the Choma district in the Southern Province.



## **1.1 Pan-African policies and strategies**

Zambia is part of or aligned with a number of strategies and frameworks existing at continental, regional and/or sub-regional levels for agricultural and rural development. These include those developed by the African Union, the SADC and the Common Market for Eastern and Southern Africa (COMESA). A few examples include:

- The Comprehensive Africa Agriculture Development Programme (CAADP) which was endorsed by African Heads of State and Governments in Maputo, Mozambique in 2003. The CAADP aims at achieving and sustaining a higher path of economic growth through agriculture-led development on the African continent. The preparation of the CAADP was facilitated by the Food and Agriculture Organization of the United Nations (FAO) in close collaboration with the New Partnership for Africa's Development (NEPAD) Secretariat. It was then implemented by the NEPAD. In Zambia, the CAADP process, which was launched in 2006, supports the implementation of National Development Plans. The program implementation has been participatory and inclusive of key stakeholder groups, including the farmer organizations, especially the Zambia National Farmers' Union, the private sector, agricultural research institutions, academia, civil society groups and development partners. The CAADP has been prepared to promote interventions that best respond to the widely recognized African agricultural crisis. In its commitment to the CAADP, Zambia also developed and signed the CAADP Compact on 18th January 2011 to support the implementation of the Vision 2030 and NAP. Under CAADP, African countries' governments agreed to commit at least 10% of their national budget to agriculture, projecting that it will lead to a 6% annual growth rate for the sector, with the specific aim of reducing poverty and hunger by 50% by 2015.
- CAADP is a strategic framework that has helped guide agricultural development in Zambia and is used as a framework to detail programs and projects that the various stakeholders in the agriculture sector can buy into and that address national priorities. Consequently, there has been increased investment in agriculture by the government, although the larger portion of investment comes from cooperating partners and donors, which raises the question of sustainability of agricultural investment initiatives (Chomba et. al., 2016). Going further under CAADP, Zambia has developed the National Agriculture Investment Plan (NAIP) 2014-2018, designed to make a difference in the manner in which the agricultural development agenda will be pursued in the country. The emphasis of NAIP is pro-poor agricultural-led economic development;
- The African Peer Review Mechanism in 2004, implemented one year after endorsement of the CAADP;
- The Abuja Declaration on Fertilizer for an African Green Revolution, under which the African Union Member States resolved to increase fertilizer use from 8.0 Kg to 50.0 Kg of nutrients per hectare by 2015;
- The Malabo Declaration of June 2014, intended to accelerate agricultural growth and transformation for shared prosperity and improved livelihoods by harnessing opportunities for inclusive growth and sustainable development;
- The Science Agenda for Agriculture in Africa (S3A) 2014, which was developed by a coalition of actors under the leadership of the Forum for Agricultural Research in Africa (FARA). The S3A is an African-owned and led process that articulates the science, technology, extension, innovations, policy and social learning that Africa needs to apply in order to meet its agricultural and overall development goals. The Science Agenda, in the medium- to long-term, aims at building systemic science capacity at national and regional levels, capable of resolving evolving needs for farmers, producers, entrepreneurs and consumers, e.g. effects of climate change;

- Southern Africa Development Community-Regional Agricultural Policy: Zambia has been active in the SADC's idea of coming up with a Regional Agricultural Policy aimed at harmonizing the growth and development of agriculture and the promotion of marketing and trade among SADC member States.

## **1.2 National (and regional) policies and strategies**

There are currently a number of national policy and strategy documents guiding the development of the Agricultural Sector in Zambia. Notable ones include:

- *National Agricultural Policy (NAP): 2004-2015*: currently being revised or updated. It is built on the following six guiding principles:
  1. The right to adequate and nutritious food;
  2. Equitable, inclusive and sustainable development;
  3. Profitability and competitiveness;
  4. Cognizance of current traditional and state land tenure systems;
  5. Stakeholder involvement; and
  6. Cognizance of international treaties, protocols and agreements.
- *Vision 2030*: Long-term development document that includes all other national socio-economic sectors besides agriculture.
- *Sixth National Development Plan (SNDP): 2011-2015*: a national medium-term development plan which also includes all other national socio-economic sectors besides agriculture.
- *National Agriculture Investment Plan (NAIP) 2014-2018*: formulated and developed under CAADP, outlining key interlinked and complementary areas of support for investment. The overall objective of NAIP is "to facilitate and support the development of a sustainable, dynamic, diversified and a competitive agricultural sector that assures food security at household and national levels and maximizes the sector's contribution to GDP" (NAIP 2013). In order to realize the objective, the following four inter-related programmes are planned, and two categories of key support services (KSS) are to be implemented under the NAIP:  
Programmes: (a) Sustainable Natural Resources Management; (b) Agricultural Production and Productivity Improvement; (c) Market Access and Services Development; and; (d) Food and Nutrition Security and Disaster Risk Management.  
KSS: (a) Knowledge Support Systems; and (b) Institutional Strengthening.

Other sub-sector policies and strategies include: (i) National Aquaculture Development Plan, (ii) National Rice Development Strategy (NRDS), (iii) Cassava Sector Development Strategy, (iv) National Irrigation Policy and (v) Cooperatives Development Policy.

It is important to underline that contemporary agrarian systems, processes and dynamics are shaped by the past political, economic, cultural and institutional arrangements. The historical context of the national and sub-regional policies and strategies for the development of agriculture in Zambia can be summarized in four broad but overlapping phases: (i) the Colonial period; (ii) Early Independence; (iii) 1980 to 2000; and (iv) 2000 to-date or beyond.

### **Other ongoing Agricultural Programs and Projects**

The following are some of the current agricultural projects in Zambia and those that will soon be launched:

- Agricultural Productivity Programme in Southern Africa: World Bank-funded;
- Enhanced Smallholder Livestock Investment Project: funded by the International Fund for Agricultural Development (IFAD);
- Irrigation Development Support Project: World Bank-funded;
- Smallholder Agribusiness Promotion Programme: IFAD-funded;

- Livestock Development and Animal Health Project: World Bank-funded;
- Livestock Infrastructure Support Project: African Development Bank (AfDB)-funded;
- Support to Productivity and Production Project (S3P): IFAD-funded;
- Pilot Project on Climate Resilience: World Bank-funded through the Zambia National Climate Change Secretariat;
- Farmer Input Support Programme: Government of the Republic of Zambia (GRZ)-funded;
- Support to the Agricultural Sector Performance Enhancement Programme-Phase II: European Union (EU)-funded;
- Conservation Agriculture Scaling-Up Project: EU-funded through the FAO;
- Agricultural Productivity and Market Enhancement Project (APMEP): AfDB-funded;
- Strengthening Rice Seed Production and Enhancing Extension Services to increase Rice Production in Zambia (FAO);
- Developing Value Chain Innovations and Value Chains to Improve Food Security in East & Southern Africa: Australian-agency-funded;
- Food Security Pack: GRZ-funded;
- Program of Accompanying Research for Agricultural Innovation (PARI): University of Bonn (German Government)-funded through FARA.

### 1.3 Data on food and nutrition security in Zambia and the 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

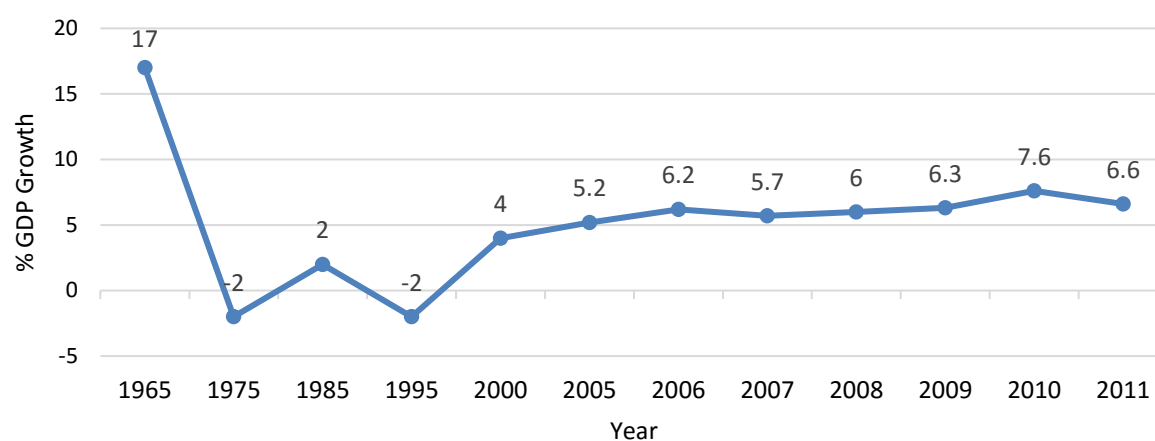
**Table 1: Selected national economic and health-related data**

Indicator	Value	Year
Population, total	1,5021,002	2014
Population growth (annual %)	2.5	2014
Rural population (% of total population)	60	2014
GDP per capita, PPP (constant 2011 international \$)	3898	2014
GNI per capita, PPP (constant 2011 international \$)	52,914,077,683	2013
Poverty headcount ratio at \$2 a day (PPP) (% of population)	87	2010
Poverty headcount ratio at \$1.25 a day (PPP) (% of population)	74	2010
Poverty headcount ratio at national poverty lines (% of population)	61	2010
Rural poverty headcount ratio at national poverty lines (% of rural population)	78	2010
Agricultural land (% of land area)	32	2012
Agriculture value added per worker (constant 2005 US\$)	353	2014
Agriculture, value added (% of GDP)	10	2013
Access to electricity, rural (% of rural population)	5.8	2012
Employees, agriculture, female (% of female employment)	79	2005
Employees, agriculture, male (% of male employment)	66	2005
Employment in agriculture (% of total employment)	72	2005
Literacy rate, adult total (% of people ages 15 and above)	61	2007
Ratio of female to male secondary enrollment (%)	59	1988
Mortality rate, under-5 (per 1,000 live births)	87	2013
Maternal mortality ratio (modeled estimate, per 100,000 live births)	280	2013

Source: World Bank, <http://data.worldbank.org/country>

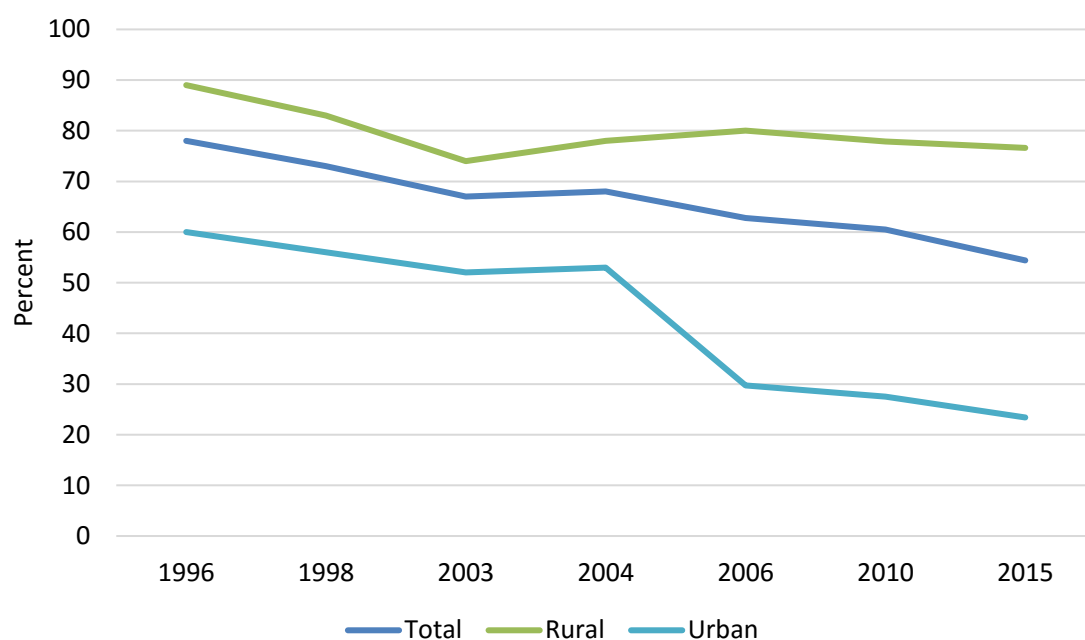
Note: GDP refers to Gross Domestic Product; GNI refers to Gross National Income; PPP refers to Purchasing Power Parity

**Figure 1: Annual GDP Growth (%) 1965 to 2011**



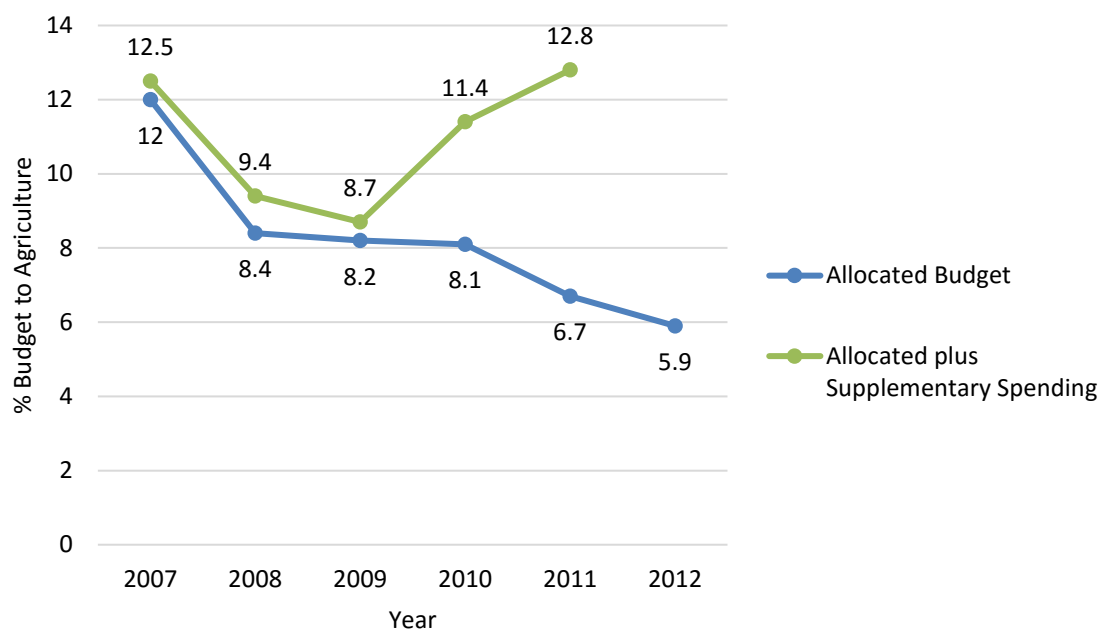
Source: Authors' presentation based on data from CSO (2014)

**Figure 2: Incidence of Poverty (1996 - 2015)**



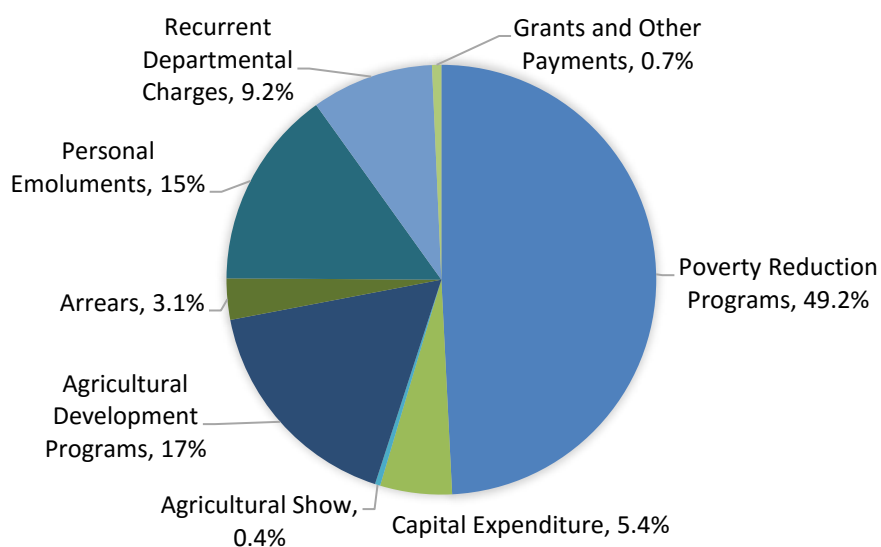
Source: Authors' presentation based on data from CSO (2014)

**Figure 3: Percentage of National Budget Spent on Agriculture 2007-2012: Allocated and Actual Spending**



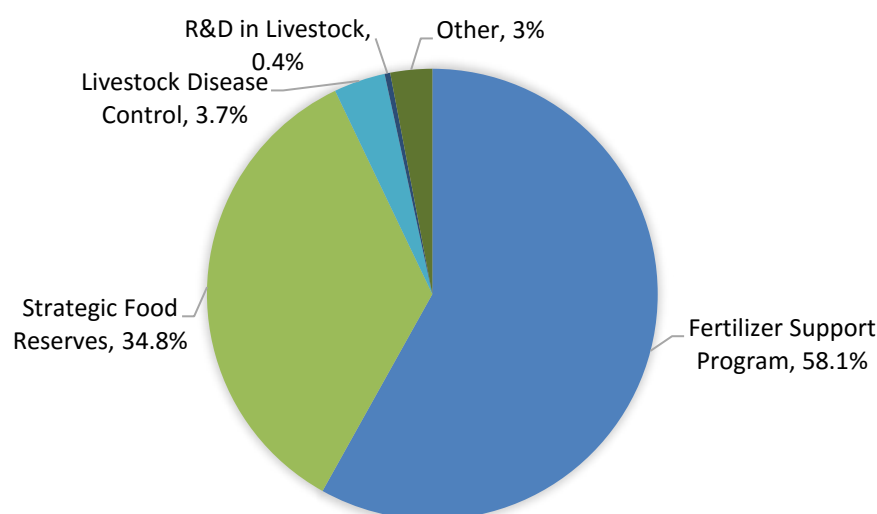
Source: Authors' presentation based on data from Kuteya (2012)

**Figure 4: 2013 Budget Allocations to Agriculture**



Source: Authors' presentation based on data from Kuteya (2012)

**Figure 5: Distribution of Poverty Reduction Programme Spending 2013**

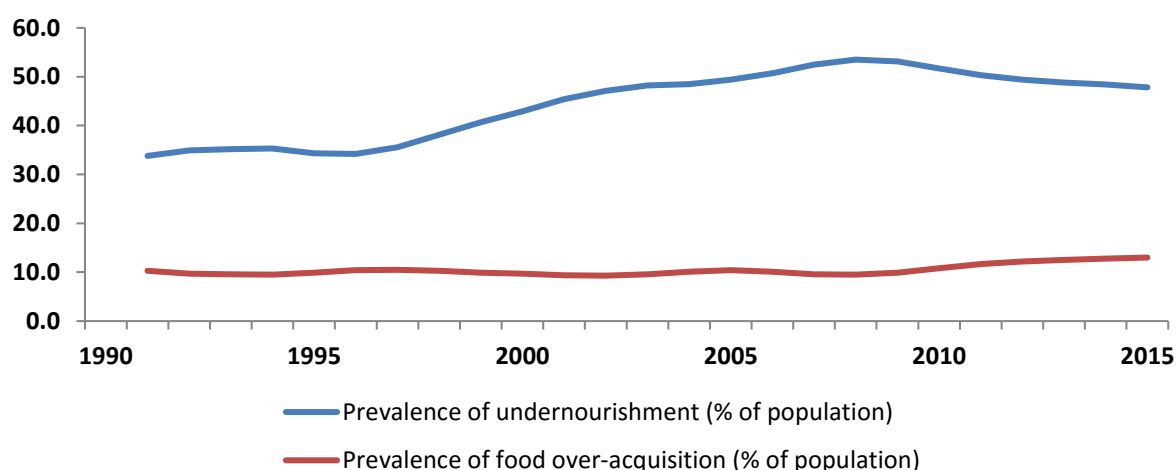


Source: Authors' presentation based on data from Kuteya (2012)

### **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 – has to be considered inadequate in Zambia because it falls short of the average dietary energy requirement of the population (Table 2). According to the FAO, almost half of the population is unable to meet minimum dietary energy requirements and suffers from chronic undernourishment.<sup>1</sup> The prevalence of undernourishment has risen by 14 percentage points since 1990-92, declining only slightly after a peak around 2008 (Figure 6). The prevalence of food over-acquisition stood at 10% in the early 1990s and has remained low, showing a minor increase only in recent years; the FAO estimates that 13% of the Zambian population now regularly acquires food in excess of dietary energy needs (Table 2).

**Figure 6: Prevalence of undernourishment and food over-acquisition (1990-92 to 2014-16)**



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

<sup>1</sup> FAO's undernourishment figure is at odds with data on women's nutritional status, which imply that dietary energy deficiency is less severe in Zambia than the FAO estimate would suggest.

Table 2: Food and nutrition security indicators

Indicator	Value	Year
<b><i>Diet quantity</i></b>		
Dietary energy supply (kcal/caput/day)	1954	2014-16
Average dietary energy supply adequacy (% of average requirement)	92	2014-16
Prevalence of undernourishment (% of population)	48	2014-16
Prevalence of food over-acquisition (% of population)	13	2014-16
<b><i>Diet quality</i></b>		
Dietary energy supply from cereals, roots and tubers (% of total dietary energy supply)	72	2009-11
Dietary energy supply from carbohydrate (% of total dietary energy supply)	70	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)	19	2009-11
Average protein supply (g/caput/day)	52	2009-11
Average fat supply (g/caput/day)	41	2009-11
<b><i>Child feeding practices</i></b>		
Minimum dietary diversity: consumption of 4+ food groups (% of children 6-23 months)	22	2013-14
Consumption of foods rich in vitamin A (% of children 6-23 months)	75	2013-14
Consumption of foods rich in iron (% of children 6-23 months)	49	2013-14
<b><i>Nutrition status</i></b>		
Child wasting (% of children under five)	6	2013-14
Child stunting (% of children under five)	40	2013-14
Child overweight (% of children under five)	6	2013-14
Adult overweight and obesity (% of adults 18+ years)	29	2014
Adult obesity (% of adults 18+ years)	9	2014
Vitamin A deficiency (% of children 6-59 months)	49	2013
Anemia in children (% of children 6-59 months)	59	2011
Anemia in women (% of women 15-49 years)	29	2011

Source: Central Statistical Office, Ministry of Health, and ICF International (2014); FAO (2016), and authors' calculations based on FAO (2016); Stevens et al. (2015), quoted in International Food Policy Research Institute (IFPRI) (2015); World Health Organization (WHO) (2015a); WHO (2015b)

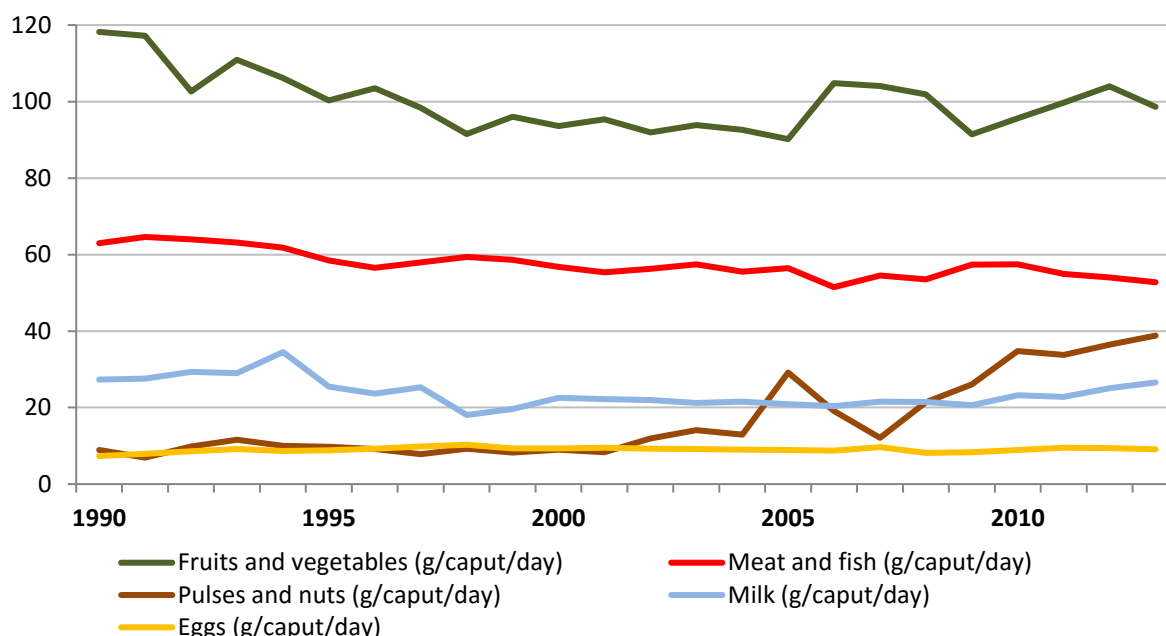
Note: See Annex A for definitions of the indicators.

The diet in Zambia is heavily based on starchy staples (mainly maize, cassava, and wheat) that provide more than 70% of dietary energy supply (Table 2). The shares of dietary energy supply from carbohydrates, protein, and fat are within the recommended ranges of 55-75%, 10-15%, and 15-30%, respectively (WHO, 2003). This means that the diet is balanced in terms of its macronutrient composition. However, since overall dietary energy supply is inadequate, the amounts of macronutrients available for human consumption are low; judged against protein requirements, average protein supply is borderline, which may put poorer segments of the population with below-average protein intakes at risk (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 amounts of micronutrients. In Zambia, meat and fish supply has declined quite steadily since the early 1990s and amounts to only about 50 g/caput/day (Figure 7). Milk supply has remained very low and stands at less than 30 g/caput/day, which is about the same level as in 1990. At roughly 10 g/caput/day, the supply of eggs in Zambia is

higher than in most other East African countries, but it is still low in absolute terms and has hardly grown in more than 20 years. Pulses and nuts have seen a considerable upswing in supply since 2001 and provide roughly one fifth of the protein supply in Zambia.<sup>2</sup> The supply of fruits and vegetables was already very low in 1990 and has followed a downward trend; amounting to only about 100 g/caput/day in recent years, it is far below the recommended intake of 400 g of fruits and vegetables per day (WHO, 2003).

**Figure 7: Supply of non-staple foods (1990-2013)**



Source: Authors' presentation based on data from FAOSTAT, accessed 07 Oct 2016

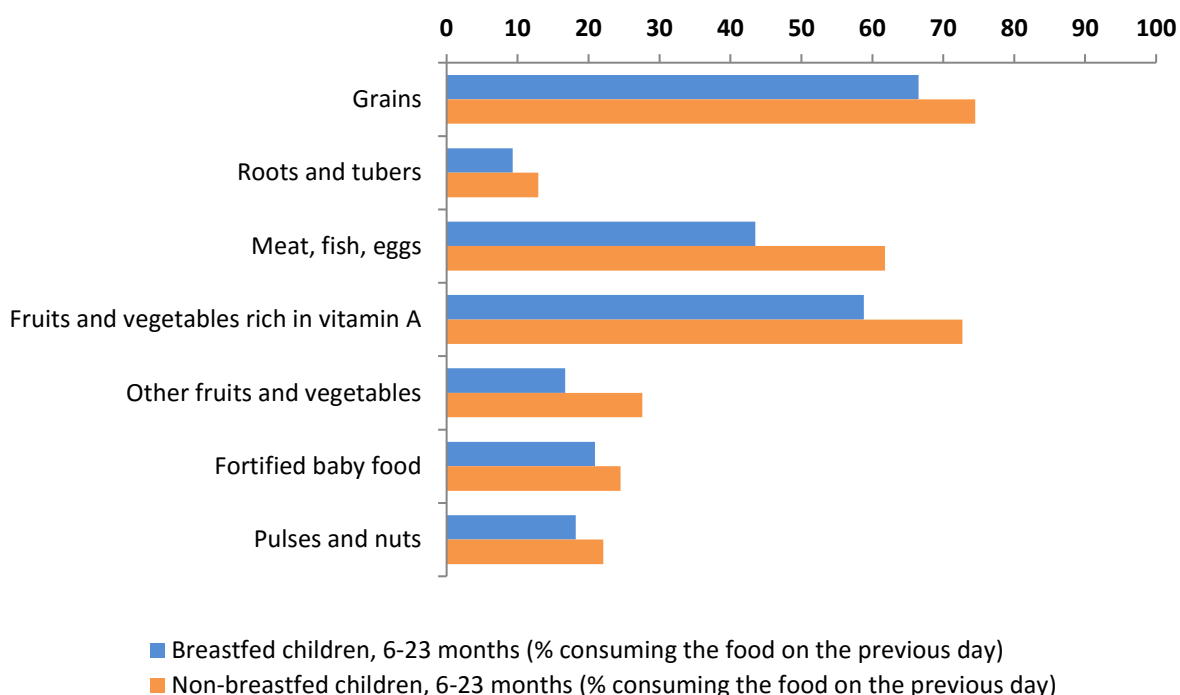
Note: Based on their nutrient profiles, pulses and nuts include groundnuts and soybeans, although these foods are classified by FAO as oilcrops. Coconuts are not included among pulses and nuts because they have low protein content.

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 Zambia, infants' and young children's diets fall short of these goals: only 22% achieved minimum dietary diversity, three quarters consumed foods rich in Vitamin A, and less than half had foods rich in iron on the previous day (Table 2). Both breastfed and non-breastfed children aged 6-23 months were most frequently fed foods made from grains, closely followed by fruits and vegetables rich in vitamin A; other micronutrient-rich foods such as meat, fish and eggs, other fruits and vegetables, and pulses and nuts, were given more rarely (Figure 8). Fortified baby foods, which can compensate for a lack of micronutrients in the diet, were consumed by less than one fourth of breastfed and non-breastfed children.

<sup>2</sup> Source: Food balance sheet for Zambia, 2013, from FAOSTAT, accessed 19 Nov, 2016.



**Figure 8: Percentage of infants and young children consuming foods from selected food groups (2013-14)**



Source: Authors' presentation based on data from Central Statistical Office, Ministry of Health, and ICF International (2014)

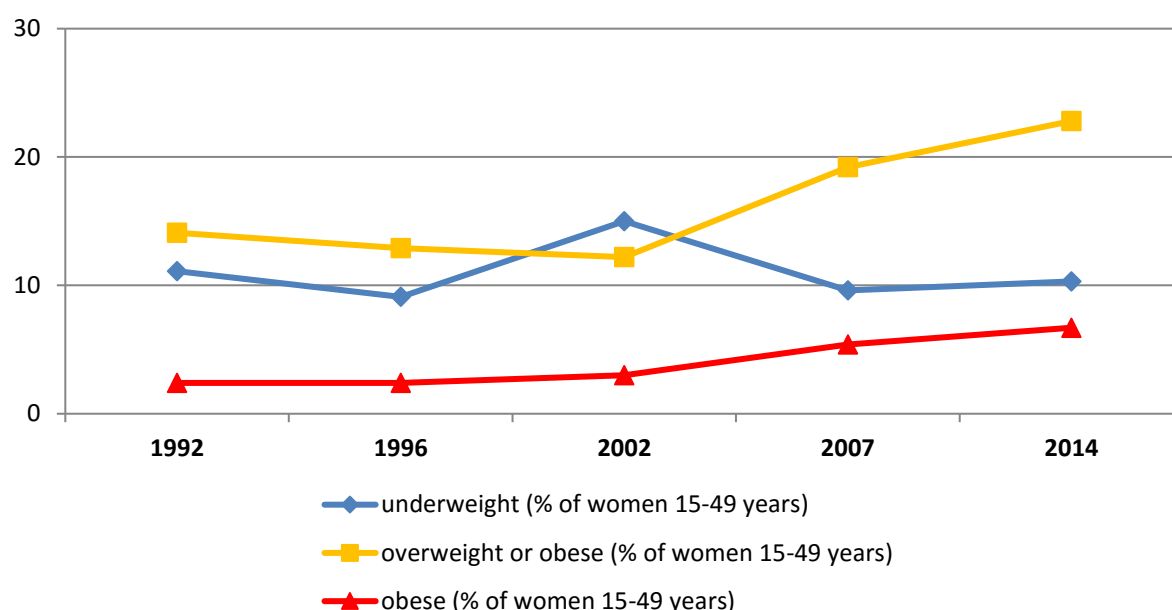
Stunting and wasting are indicators of chronic and acute child undernutrition, respectively. In Zambia, stunting is a severe public health problem with a prevalence of 40%, while wasting affects only 6% of children and has mild public health significance (Table 2). Stunting has declined very little since 1992 – by only 6 percentage points overall – and has even seen transient increases beyond 50% in the last two decades (UNICEF<sup>3</sup>/WHO/World Bank, 2016). Wasting has remained in the range of 5-6% since the early 1990s and has shown no improvement. Overweight in children has a prevalence of 6% and is a moderate public health concern (Table 2).

Overweight and obesity are risk factors for chronic diseases such as diabetes (Must and McKeown 2012). Nearly 30% of adults in Zambia are overweight or obese (Table 2). According to data from the Demographic and Health Surveys (DHS), the combined prevalence of overweight and obesity slightly declined among women of reproductive age between the early 1990s and 2002 but has almost doubled since then, whereas the prevalence of obesity has more than doubled (Figure 9). The prevalence of underweight came down from a peak in 2002, but has barely improved overall since 1992.<sup>4</sup> Without a doubt, underweight among women needs to be reduced, but its 10% incidence rate and rates of overweight and obesity above 20% do not support the notion that undernourishment is particularly widespread or severe in Zambia.

<sup>3</sup> UNICEF = United Nations International Children's Emergency Fund

<sup>4</sup> See Annex A for definitions of overweight, obesity, and underweight.

Figure 9: Underweight, overweight and obesity among women of reproductive age (1992-2014)



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

Vitamin A deficiency is a risk factor for blindness and for mortality from measles and diarrhea in children aged 6-59 months (Imdad et al. 2010; Imdad et al. 2011). In Zambia, about half of all children in this age group are estimated to be vitamin A deficient (Table 2). Almost 60% of children aged 6-59 months and close to 30% of all women of reproductive age suffer from anemia (Table 2). About half of the global burden of anemia can be attributed to iron deficiency (WHO, 2015b). Anemia is also caused by malaria, which is still common in parts of Zambia (University of Oxford, 2015).

Table 3: Child feeding practices by region, 2013-14

Share of children 6-23 months consuming:					
4+ food groups		Foods rich in vitamin A		Foods rich in iron	
Region	(%)	Region	(%)	Region	(%)
Copperbelt	35	Eastern	78	Copperbelt	61
Lusaka	28	Luapula	77	Lusaka	59
Southern	28	Copperbelt	77	Southern	55
Northern	22	Southern	76	North-Western	52
Muchinga	21	Western	75	Western	49
Western	17	Lusaka	75	Muchinga	44
Central	15	North-Western	75	Central	44
Eastern	15	Muchinga	74	Luapula	43
Luapula	13	Central	72	Northern	38
North-Western	12	Northern	68	Eastern	37

Source: Central Statistical Office, Ministry of Health, and ICF International (2014)

Notes: GIC regions are highlighted in red. See Annex A for definitions of the indicators.

Regionally disaggregated data are available for indicators of nutrition status and child feeding. The diversity of infants' and young children's diets is highest in the Copperbelt region and particularly low in the Luapula and North-Western regions (Table 3). The share of children consuming foods rich in vitamin A is quite favorable throughout the country, with only the Northern region lagging behind. Foods rich in iron were most frequently consumed by children in the Copperbelt and Lusaka regions (which hosts Zambia's capital city), whereas much smaller proportions of children benefited from these foods in the Northern and Eastern regions. The prevalence of stunting in children is highest in the Northern region, and lowest in the Lusaka region (Table 4). Wasting is elevated in the Luapula region, and the Lusaka region has the highest proportion of overweight children. Regarding overweight and obesity in women, they are most prevalent in the Lusaka and Copperbelt regions (Table 5). The highest prevalence of underweight among women is observed in the Northern, Muchinga and Western regions.

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

Prevalence among children under five:					
Stunting		Wasting		Overweight	
Region	(%)	Region	(%)	Region	(%)
Lusaka	36	Northern	4	Western	3
Western	36	Muchinga	4	Southern	5
Copperbelt	36	Southern	4	Luapula	5
North-Western	37	Central	5	Copperbelt	5
Southern	37	Eastern	5	Muchinga	5
Central	43	Copperbelt	6	Northern	5
Luapula	43	Western	7	Eastern	6
Eastern	43	Lusaka	7	Central	7
Muchinga	44	North-Western	8	North-Western	7
Northern	49	Luapula	13	Lusaka	8

Source: Central Statistical Office, Ministry of Health, and ICF International (2014)

Notes: GIC regions are highlighted in red. Data on anemia among children are not available at the regional level. See Annex A for definitions of the indicators.

**Table 5: Women's nutrition status by region, 2013-14**

Prevalence among women of reproductive age (15-49 years):					
Underweight		Overweight + obesity		Obesity	
Region	(%)	Region	(%)	Region	(%)
Eastern	8	Western	10	Western	1
Lusaka	8	Northern	12	Northern	2
Copperbelt	9	Luapula	13	Luapula	2
North-Western	9	Muchinga	13	Muchinga	3
Southern	9	North-Western	15	Eastern	4
Central	11	Central	19	North-Western	4
Luapula	11	Eastern	20	Central	5
Northern	14	Southern	22	Southern	6
Muchinga	14	Copperbelt	30	Copperbelt	10
Western	20	Lusaka	35	Lusaka	13

Source: Central Statistical Office, Ministry of Health, and ICF International (2014)

Notes: GIC regions are highlighted in red. Data on anemia among women are not available at the regional level. See Annex A for definitions of the indicators.

At the national level, anemia has the highest prevalence out of all indicators of children's nutrition status (Table 2). However, regionally disaggregated data are not available. Under the assumption that half of all anemia is due to iron deficiency, iron deficiency anemia among children is a moderate public health concern in Zambia as a whole.<sup>5</sup> Stunting has severe public health significance in the Northern, Muchinga, Eastern, Luapula, and Central regions, and moderate significance in all other regions (Table 4). Wasting levels are mild in the North-Western, Lusaka, Western, Copperbelt, and Eastern regions, and moderately high in the Luapula region. Overweight in children is a moderate public health problem in all regions except for the Western region, where it has only mild significance.

Of all the indicators of women's nutrition status, anemia has the highest prevalence at the national level (Table 2 and Figure 9). However, once again, no regionally disaggregated data are available. In 7 out of 10 regions, the combined prevalence of overweight and obesity surpasses the prevalence of underweight among women, and the discrepancies are especially large in the Lusaka and Copperbelt regions (Table 5). In the Muchinga and Northern regions, the prevalence of underweight is slightly higher – and in the Western region markedly higher – than the combined prevalence of overweight and obesity.

In summary, over- and undernutrition coexist in Zambia and micronutrient deficiencies are widespread. Dietary energy supply needs to increase in disadvantaged regions, ideally without spurring further increases in overweight and obesity in better-off regions. The diet should be diversified and diet quality be improved by developing value chains for micronutrient-rich foods such as vegetables, fruits, animal-source foods, pulses and nuts. The supply of milk, meat, fish, fruits and vegetables is especially low, and the decline in the supply of these foods since 1990 needs to be reversed. Increasing the supply of animal-source foods and pulses and nuts would raise protein and micronutrient supply and help to diminish the heavy reliance of the Zambian diet on starchy staples. The fortification of staple foods and the production of fortified baby foods could be addressed at the processing stage of the value chain to enhance micronutrient intakes. Promoting biofortified staple foods, such as vitamin A-rich orange-fleshed sweet potatoes, yellow cassava and the orange maize developed by HarvestPlus, would be another option to improve the diet.<sup>6</sup>

In addition, reducing the aflatoxin contamination of foods is important to improve food safety in Zambia. 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 Zambia, aflatoxins and fumonisins (another type of mycotoxins) were found in maize, the main staple food (Kankolongo et al., 2009). Groundnuts were also contaminated with aflatoxins, and particularly high concentrations occurred in peanut butter (Bumbangi et al., 2016; Njoroge et al., 2016). Aflatoxins in maize and groundnuts may impede Zambia's progress in reducing the high stunting rate of children (Ismail et al., 2014).

A look at the regions shows that the Northern and Luapala regions perform poorly on some, but not all indicators of nutritional deficiencies. The picture is not consistent enough to strongly suggest prioritizing these two regions for interventions and agricultural innovations; stunting in children, for example, is also high in Muchinga, and underweight is high for women in the Western region. It is clear, however, that overweight and obesity are significant problems in Lusaka and Copperbelt, and that these regions should not be targeted with interventions aiming to increase dietary energy supply.

Zambia 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 <http://scalingupnutrition.org> for more information.

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<sup>5</sup> About half of the global burden of anemia is attributable to iron deficiency (WHO, 2015b). Since the prevalence of anemia among children in Zambia amounts to 59%, the prevalence of iron deficiency anemia can be estimated to be roughly 30% and lies within the range of 20-39% that denotes a moderate public health problem (see Annex A).

<sup>6</sup> See <http://www.harvestplus.org/what-we-do/crops>.

## 1.4 Data on most relevant crops and value chains

### 1.4.1 Production

Maize, sugar cane and cassava are important crops in Zambia. Cotton is also widely produced, while soybeans rank high in terms of value of production (see Table 6).

**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	47.9	Sugar cane	40.3	Maize	66.7
Groundnuts, with shell	9.1	Maize	29.5	Cassava	20.9
Seed cotton	8.9	Cassava	10.6	Soybeans	7.1
Cassava	7.9	Vegetables, fresh nes	3.5	Pulses, nes	2.8
Soybeans	4.7	Wheat	2.5	Millet	1.6
Tobacco, unmanufactured	2.8	Soybeans	2.3	Sorghum	0.9
Pulses, nes	2.8	Seed cotton	1.8		
Sunflower seed	2.5	Sweet potatoes	1.7		
Vegetables, fresh nes	2.1	Groundnuts, with shell	1.2		
Sweet potatoes	2.0	Cottonseed	1.2		
				Groundnuts:	no data

Data: average 2012-2014, FAOSTAT, accessed 19 January, 2017

\* Gross Production Value (constant 2004-2006 million US\$), data: average 2011-2013, FAOSTAT, accessed 19 January, 2017

Note: GIC value chains marked in red; nes refers to Not elsewhere specified

### 1.4.2 Trade

Palm oil is the most important import good in Zambia and accounts for 19% of total import volume and 20% of total import value. It is followed by groundnut, which accounts for nearly 9% of the total import value (see Table 7). Maize accounts for almost 40% of the total export volume and 23% of the total export value. Furthermore, sugar, cotton and tobacco are important export goods. Soy and soy products only account for less than 8% of total import value and about 1% of total export value (see Table 8).

**Table 7: Zambia's imports**

Import volume (tons)		Import value (US\$)	
Top 10	Share of Total	Top 10	Share of Total
Oil, palm	19.3	Oil, palm	20.3
Groundnuts, shelled	8.9	Food prep nes	7.2
Beer of barley	6.5	Oil, soybean	5.8
Food prep nes	5.2	Groundnuts, shelled	5.4
Oil, soybean	5.1	Beer of barley	4.5
Malt	4.6	Milk, whole dried	3.4
Rice – total (Rice milled equivalent)	4.4	Margarine, short	2.6
Cake, soybeans	3.4	Malt	2.4
Oranges	2.7	Cigarettes	2.3
Apples	2.6	Pastry	2.3
Rank 33: Soybeans	0.5	Rank 15: Cake, soybeans	1.8
		Rank 50: Soybeans	0.2

Data: average 2011-2013, FAOSTAT, accessed 19 January, 2017

Note: GIC value chains marked in red; nes refers to Not elsewhere specified

**Table 8: Zambia's exports**

Export volume (tons)		Export value (US\$)	
Top 10	Share of Total	Top 10	Share of Total
Maize	39.7	Maize	23.2
Sugar, raw centrifugal	17.9	Cotton lint	14.1
Cotton lint	5.0	Tobacco, unmanufactured	13.4
Molasses	4.4	Sugar, raw centrifugal	11.1
Flour, wheat	4.3	Beverages, distilled alcoholic	5.4
Bran, maize	3.4	Flour, wheat	3.6
Cottonseed	3.4	Crude materials	2.4
Tobacco, unmanufactured	3.1	Oil, olive residues	1.7
Sugar refined	1.9	Pastry	1.7
Cake, soybeans	1.5	Cottonseed	1.6
Rank 34: Soybeans	0.2	Rank 16: Cake, soybeans	1.1
Rank 45: Groundnuts, shelled	0.1	Rank 39: Soybeans	0.1
		Rank 53: Groundnuts, shelled	0.0

Data: average 2011-2013, FAOSTAT, accessed 19 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

#### 1.1.1.1 International

International support through research and project/programme implementation for agricultural growth and development in Zambia is also offered through various organizations/institutions. Notable ones include:

- The United Nations Food and Agriculture Organization (FAO);
- The United Nations Development Program;
- International Fund for Agricultural Development (IFAD);
- World Food Programme;
- World Bank;
- Countries such as the United Kingdom or European Union, Sweden, Norway and Finland;
- United States Agency for International Development (USAID);
- Japan International Cooperation Agency;
- Indaba Agricultural Policy Research Institute (IAPRI);
- The Consultative Group on International Agricultural Research (CGIAR):
  - World Fish Centre;
  - Center for International Forestry Research;
  - International Food Policy Research Institute (IFPRI);
  - International Institute of Tropical Agriculture (IITA);
  - International Potato Center;
  - International Center for Tropical Agriculture;
  - The International Crops Research Institute for the Semi-Arid Tropics;
  - HarvestPlus;
  - World Agroforestry Centre;
  - International Centre for Maize and Wheat Improvement.
- International Sorghum and Millet Collaborative Research Support Programme

Other regional organizations also contributing to agricultural development in the country include:

- African Development Bank (AfDB);
- Forum for Agricultural Research in Africa (FARA);
- Centre for Coordination of Agricultural Research and Development for Southern Africa;
- Coalition for African Rice Development;
- SADC - Genetic and Plant Resources Research Institute;
- Common Market for Eastern and Southern Africa (COMESA).

#### **1.1.1.2 National**

Agricultural research in Zambia is largely undertaken by the Ministry of Agriculture through the Zambia Agriculture Research Institute (ZARI), the Golden Valley Agricultural Research Trust (GART), and by the Ministry of Fisheries and Livestock Development through the Central Veterinary Research Institute. The University of Zambia (UNZA), National Institute for Scientific and Industrial Research and of late Mulungushi University also undertake research. Thus innovations are locally developed through the above institutions.

In July this 2015, FARA, in partnership with the German Government, represented by the Center for Development Research (ZEF) of the University of Bonn under its 'One World No Hunger' initiative, entered into an agreement with ZARI in implementing PARI. ZARI is currently playing the role of lead implementing institution for the PARI in Zambia.

### **1.5.2 Innovation Platforms**

From 2005 to 2015 there were at least 16 agricultural Innovation Platforms (IPs) functioning in Zambia. Of those, eight were covering cassava innovations, other IPs were dedicated to maize, rice, sorghum, soy, wheat and conservation agriculture. The IPs were funded by international embassies, national and pan-African agricultural projects (mostly the Support to Agricultural Research for Development of Strategic Crops in Africa Project [SARD-SC]). For instance, during the 2013-2014 period, maize Innovation Platforms were established by the IITA's facilitated SARD-SC Maize Programme in four districts of Zambia, namely Mkushi, Serenje, Katete and Monze. Participating members included Zambian ministries, agricultural organizations, the private sector and banks, as well as directly involved actors along the value chain, such as farmer representatives, transporters and processors. The concept of commodity-based IPs is still in its infancy stage in Zambia and most agricultural stakeholders to-date are generally unaware of the workings and benefits of IPs, which explains in part the low number of IPs (Chomba et. al., 2016). There are therefore plans to enhance/increase awareness on IPs, through PARI activities.

### **1.5.3 Extension system and organizations**

The NAIP (2013) discusses the challenge of limited extension services as follows: "As of March 2011, the Principal Methodology Extension Officer estimated that the extension officer to farmer ratio in Zambia is only 1:900. This is in line with the IFPRI/RENEWAL study (Yamauchi et al., 2009) whose findings indicate that the Agricultural Extension worker-to-farmer ratio was 1:800. This far exceeds the recommended level of 1:400". It further remarks that most of extension officer's time is spent dealing with logistical issues rather than the actual provision of extension services. As a cause for insufficient extension services, the World Bank names incomplete implementation of public policies. Where public services are lacking, the private sector has, to some degree, taken over the costly provision of extension services. However, missing public market infrastructure and weak law enforcement (including contract enforcement) are hampering this development. High crime rates and farmers disregarding agreements discourage private sector investment. The share of public expenditures on extension services is insufficiently low, as the government mainly subsidizes farm inputs (World Bank, 2007). The

## ***Program of Accompanying Research for Agricultural Innovation (PARI)***

Participatory Extension Approach is currently widespread in the provision of agricultural extension services in Zambia.

### ***1.5.4 Private research and development activities***

Building and establishing strong collaborations among the national, regional and international centers (public and private) that are involved in agricultural research and development (R&D) is encouraged in order to improve efficiency and reduce costs throughout the value chains.

The Ministry of Agriculture through ZARI has well-established links with a number of local, regional and international research institutions. As such, ZARI has signed agreements with some of these institutions, to their mutual benefit. These agreements include capacity building (both short and long term), research project funding and equipment financing. ZARI's agreements with local institutions include those with the Zambia Seed Company, GART, the Cotton Development Trust, UNZA and the Programme Against Malnutrition. On the international side, some on-going agreements include those with the following institutions:

- i. International Institute for Tropical Agriculture (IITA);
- ii. International Centre for Maize and Wheat Improvement;
- iii. International Sorghum and Millet Collaborative Research Support Programme;
- iv. International Institute for Communication Development;
- v. The International Plant Protection Convention;
- vi. The International Treaty on Plant Genetic Resources for Food and Agriculture; and
- vii. The Alliance for a Green Revolution in Africa.

The assistance from and/or collaborations with these local and international organizations has complemented government efforts and has enabled ZARI to meet some of the objectives and targets set out in the development plan.

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

The agriculture sector continues to face several challenges such as:

- Low agricultural production and productivity;
- Erosion of indigenous livestock and plant genetic resources;
- Dominance of monocropping (maize) among small-scale farmers leading to one-dimensional nutrition;
- Low private sector participation in agricultural development, especially in agricultural marketing;
- High levels of food and nutrition insecurity, particularly at the household level;
- Poor coordination among key players dealing with food and nutrition causing persistent malnutrition despite the increase in agricultural production;
- Poor food storage at the household level;
- High dependence on rain-fed agriculture, exacerbated by low levels of irrigation, especially by small scale farmers;
- Diminished investment in agricultural R&D;
- Inefficient agricultural extension service delivery;
- Low levels of agricultural mechanization among smallholder farmers;
- Inefficient agricultural markets for inputs and outputs;
- Limited access and availability to agricultural finance and credit facilities;
- Reduced net value of agricultural exports, particularly for horticulture, floriculture and fish products, although the overall value of non-traditional exports has been rising due to the inclusion of exports of timber, honey and handcrafts;



- Need for inclusive growth as rural poverty rates remain high;
- Unsustainable use of natural resources;
- Land degradation due to natural and human induced factors;
- Inadequate mechanisms to deal with disaster risk management (insurance, early warning systems);
- Low adaptation and resilience to the effects of climate change;
- Inadequate mainstreaming of gender and governance issues, and HIV/AIDS<sup>7</sup>;
- Agriculture not perceived as a rewarding business among youth (Chomba et. al., 2016).

In the continued effort of enhancing the performance of the agricultural sector, the vision of the revised NAP is: *“To attain sustainable agricultural production which will enhance competitiveness, profitability, food and nutrition security and contribute to employment and income generation, national economic development and contribute to poverty reduction by 2020”* (NAIP, 2013).

To support and/or complement the implementation of NAP and the Vision 2030, Zambia has signed the CAADP Compact and formulated the NAIP 2014-2018, under CAADP. The NAIP seeks to identify priority investment and policy changes that would result in robust agricultural growth that lessens the incidences of rural poverty.

## 1.7 Potential areas for investment in Zambia

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 sustainable agricultural productivity driven by 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 assessment for Zambia<sup>8</sup>

Expected agricultural growth performance:

- Zambia has only increased its agricultural growth by more than the 6% required by the CADDP for two of the ten years between 2005 and 2014 ([www.resakss.org](http://www.resakss.org));
- However, Total Factor Productivity in Zambia had improved by 27% between 2001 and 2008 (Fuglie and Rada, 2011), indicating substantial improvement in country's innovation performance.

Government commitment:

- Zambia has a track record of political commitment to foster sustainable agricultural growth by being modestly active in the CAADP process and having completed five out of the eight steps in the CAADP process ([www.resakss.org](http://www.resakss.org));
- However, the Zambian government has only invested more than 10% of total government expenditure (CAADP target) into the agriculture sector for three of the years between 2005 and 2014<sup>9</sup>;

<sup>7</sup> HIV/AIDS = human immunodeficiency virus/ acquired immune deficiency syndrome

<sup>8</sup> Details on the data sources and methodology used in the assessment can be found in Husmann et al. (2015)

<sup>9</sup> [www.resakss.org](http://www.resakss.org)

- In addition, Zambia spends only 0.4% of its agricultural GDP<sup>10</sup> on agricultural R&D, which is much lower than Sub-Saharan Africa's average and the African Union target value of 1%. This indicates that Zambia's investment into agricultural innovation is not yet sufficient.

Food and nutrition security progress and need:

- Zambia is not prioritizing actions for hunger and malnutrition reduction, and the prevalence of undernourishment has even increased by about 5% between 2001 and 2011.
- The country also has one of the highest rates of malnutrition-related stunting in the world with 45% of children under the age of five being stunted (World Bank, 2009).
- Several interconnected causes of child malnutrition include: inadequate dietary intake, low micronutrient content in most major foods consumed at household level, infrequent and inadequate consumption of nutritious food and low diversity of such foods, high disease burden and coupled with high poverty levels, especially in rural areas.
- In addition, Zambia has a very high Global Hunger Index (GHI) score value of 24.4, reflecting an alarming level of hunger (von Grebmer *et al.*, 2014)<sup>11</sup>. This makes the investment into the agricultural and food sector in Zambia very urgent in order to fight the high rate of food insecurity.

**Table 9: Zambia performance indicators**

Indicator	Indicator score	Overall score
1. Number of years with more than 6% agricultural growth (2005 to 2014)	2	20
2. Percentage point change in TFP index between 2001 and 2008	27	100
3. Number of years with more than 10% government expenditure (2005 to 2014)	3	30
4. Average share of agricultural GDP spent on R&D (2005 to 2011) in %	0.4	38
5. Steps in CAADP completed	5	63
6. Percentage point improvement in undernourishment between 2001 and 2011	-4.9	0
7. Global Hunger Index (2014)	23.2	100
Total score (weighted)		51

Data source: Husmann *et al* (2015)

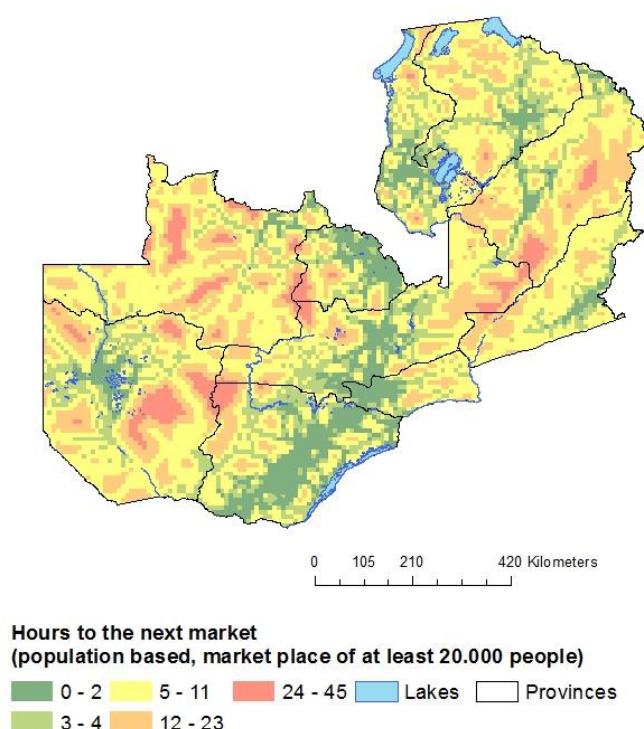
Note: TFP refers to Total Factor Productivity

Overall, the economic, political, and social/nutrition framework in Zambia recommends modest investments into the agricultural and food sector of the country.

The selection the value chain on which to focus 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 10 presents the average time (number of hours) it takes to reach the nearest market place of at least 20,000 people in Zambia.

<sup>10</sup> [www.asti.cgiar.org](http://www.asti.cgiar.org)

<sup>11</sup> GHI score Values 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).

**Figure 10: Distance to market**

Data sources: Hours to next market - HarvestChoice, 2015;

Administrative areas: <http://www.gadm.org/>, accessed 20.9.2015

Inland water bodies: <http://www.diva-gis.org/gData> (water bodies), accessed 20.9.2015

## 2 Most relevant value chains in Zambia

The value chain approach (VCA) is becoming popular for agricultural development in Zambia. The VCA framework utilizes participatory methods to engage chain actors/participants as well as their facilitators in carrying out mapping and analysis, and it encourages the value chain actors to work together in order to improve performance in the entire value chain. Value chain approaches are based on models that focus on addressing critical challenges or constraints and opportunities in a selected value chain. The VCA also aims to obtain more detailed information on the various chain functions, actors, activities, costs, processes, opportunities and risks related to the flow of a particular commodity and its associated services, starting with the input suppliers, producers and ending with the targeted consumers.

Undertaking a Value Chain analysis is of assistance in:

- Creating a common or shared vision among chain players/actors and helps in identifying challenges and opportunities, thus facilitating the development of collaborative relationships;
- Promoting enterprise development;
- Improving food quality and safety;
- Determining the quantitative ways to measure value-addition and understanding of the distribution of returns amongst the various players;
- Promotion of coordinated linkages among the value chain actors e.g. producers, processors and marketers;
- Improving individual firms' competitive position and/or share in the commodity market.

Below are some of the important and emerging value chains in Zambia:

## **2.1 GIC value chains**

The value chains chosen for the Green Innovation Centers (GIC) include soybean and groundnut in the Eastern province. The milk value chain is also considered in the Choma district in the Southern province.

### ***2.1.1 Soybean***

The soybean value chain provides a promising opportunity for entrepreneurship and food and nutrition security in Zambia. This is largely through its potential for growth due to demand from the livestock feed industry, notably the poultry sub-sector. Additionally soybean is increasingly becoming accepted for human consumption as it provides high quality protein at much lower cost than the most common alternative proteins sources.

Zambia is self-sufficient (a net exporter) in soy production; production for the year 2009/10 is estimated at about 112,000 MT, while consumption is estimated at 90,000 MT (Technoserve, 2010). Commercial farmers predominantly produce and export soy in Zambia (85% of total production). Growth in production has largely been achieved by increasing the area for harvest rather than by increases in yield as the market has grown (ibid). The growth in demand for soybean in Zambia is also promising due to of the excess processing capacity accompanied by good vertical integration (such as with livestock feed manufactures).

Despite strong export market opportunities in Zimbabwe, South Africa and the Democratic Republic of Congo, several constraints continue to hinder the soy value chain in Zambia.

### ***2.1.2 Groundnuts***

Groundnuts and common beans are primarily small-scale farmer crops grown by over half a million Zambian households on about 9% of the total area harvested (see Table 6). Approximately 80% of these food crops are consumed at the household level or within the local area. Groundnuts account for 72 kcal per capita per day on average (FAOSTAT, 2017). Most of the surplus crops enter the informal market chain. There is, however, major potential market demand for both crops in terms of regional and international markets, provided that these crops are produced, harvested and processed according to market specifications. Groundnuts are currently the second most imported good, making up almost 9% of total imports in tons (see Table 7).

Zambia's climate and soil conditions are ideal for growing groundnuts. In the 1960s and 1970s, Zambia was a major exporter of premium-grade groundnuts to the European confectionery market. However, in the 1980s, the private sector was unable to fill the void left by the dismantling of the State-owned parastatal companies such as the National Agricultural Marketing Board, which led to a decline in seed production, lower yields, loss of sorting and grading capacity, increased aflatoxin levels, and loss in farmer, trade and customer confidence. There is currently a remaining revealed comparative disadvantage, indicated by an RCA index as low as 0.04. Nonetheless, development of groundnut production looks promising, judging from a measured average annual yield growth of 11% (see Table 10).

### ***2.1.3 Milk***

The dairy sector in Zambia is made up of 3,000-4,000 smallholder and commercial dairy farmers that produce milk for the formal market, and of about 300,000 traditional cattle-owning households that also produce milk (ACF, 2012; World Bank, 2010). Traditional cattle farmers differ from the commercial farmers in the sense that cattle is viewed by the former as a store of wealth and a means of subsistence and draught power, rather than a commercial business opportunity (Mumba *et al.*, 2013). There is

tremendous room for market growth in the Zambian dairy sector. Out of an estimated total national production of 253 million liters of milk, only 44 million liters go through the formal channels (ACF, 2012). A substantial portion of raw milk produced through informal channels does not reach the formal market. This 'lost milk' is usually consumed or sold locally in unprocessed or fermented form, or wasted (Mumba *et al.*, 2013). Dairy processors in Zambia face shortages of raw milk supply due to increasing domestic demand for dairy products. Therefore, there is pressure for the country to import cheaper and poor quality fresh milk from other countries. Dairy processors need to access larger volumes of the domestically produced raw milk to achieve economies of scale. However, the lack of data on the locations and potential milk volumes needed hinders further investments to expand the network of chilling, procuring and processing facilities in order to tap into the 'lost milk' (Mumba *et al.*, 2013).

## 2.2 Other relevant value chains

### 2.2.1 Maize

Maize is Zambia's main staple food, and provides almost 1,000 kcal/ day per capita to the country's population (FAOSTAT, 2017). It is mainly prepared in the form of a 'thick porridge' called *nshima*. According to the National Food Balance Sheet, maize also receives the most support in terms of the government's budgetary allocation and provision of other agricultural services, compared to other agricultural commodities. However, urban consumption observations indicate some changes in preference, especially among the youth. Among a good number of young urban consumers, rice and wheat products e.g. bread, are becoming preferable substitutes for maize.

Maize production makes up close to half of the total area harvested in Zambia (47.9%) and two thirds of the agricultural production value (66.7%), which makes it the most produced crop in the country (see Table 6). It is the most prominent crop among the small- and medium-scale farmers, who contribute about 80% to the total national maize production. Nevertheless according to the NAIP "due to low yields, combined with limited land holding sizes, very few smallholder farmers are able to produce sufficient crop surpluses to sell" (NAIP, 2013). Research needs assessments also indicate that low crop yields are a result of poor agronomic practices, limited access to agricultural input credit, limited access to extension services and agricultural innovations and technologies among smallholder farmers. ZARI has developed low nitrogen as well as drought-tolerant maize varieties but farmers' access to such varieties still remains a challenge due to poorly developed Innovation Platforms that could otherwise fast track the scaling up of such technologies (NAIP, 2013).

Indeed, in most years, roughly 30 percent of all Zambian smallholders were net buyers of maize. Low yields can be caused by a variety of factors, including low soil fertility, drought, and late planting. Between 2002 and 2008 these factors led to 33% of the maize harvesting area in Zambia being abandoned before harvesting (Garrity, 2010). The highest achieving maize farmers of Zambia reach productivity levels of close to 6 Mt/ha, which is almost 4 Mt more than the national average, indicating great investment potential (NAIP, 2013).

The maize value chain has the highest number of actors in its value chain functions, i.e. input suppliers, producers, processors traders and consumers. The crop is grown in nearly all provinces of Zambia, even where it is not agronomically recommended. Some few commercial farmers also grow maize for livestock feed and sometimes as a winter crop, under irrigation, for human consumption when a short-fall in production is anticipated.

Maize is the major crop bought for and stored/preserved in the national food strategic reserves by the Food Reserve Agency (FRA). Maize is also currently one of the main raw materials in the Zambian livestock feed mill industry.

Maize is Zambia's primary export good, as shown in Table 8, making up almost 40% of exports in tons and 23.2% of exports in value. It is one of the most promising agricultural products for investors, with

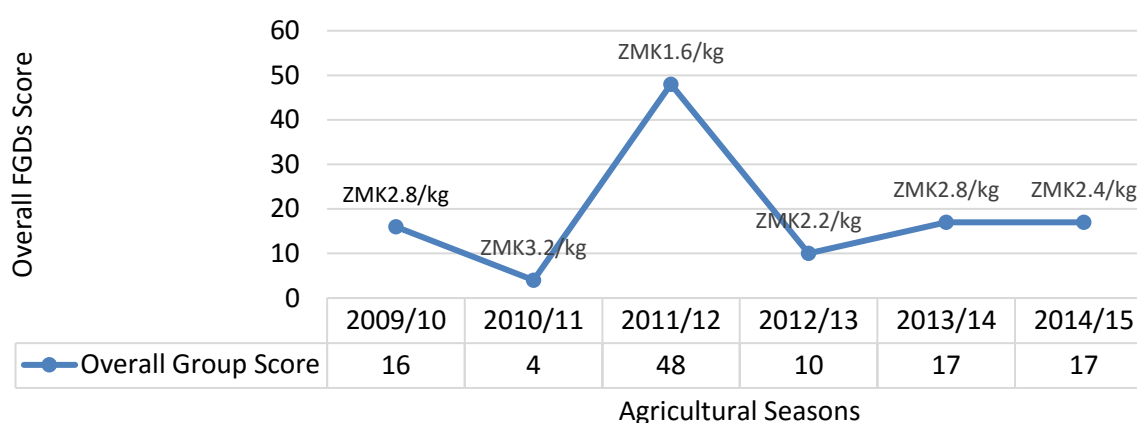
a high Revealed Comparative Advantage (RCA) of 56, high yield growth of 6%, and a remaining relative yield gap of 86% (see Table 10).

### 2.2.2 Cotton

Cotton is produced in Zambia by smallholder farmers whose total land holdings range from as low as 200,000 to over 300,000 hectares depending on the season. Seed cotton is entirely produced on a contract-farming basis, where ginning companies (out-grower companies) provide inputs to farmers on credit and deduct the cost of inputs at the time of marketing the seed cotton. About 99% of smallholder farmers grow cotton through this arrangement and very few farmers grow cotton using their own resources. In 2010, cotton was produced by about 10% of farmers in Zambia. In the NAIP, it is referred to as Zambia's most important cash crop (NAIP, 2013). An area of almost 9% of the total harvested area in Zambia is devoted to cotton production (see Table 6). Cotton is the second most valuable agricultural export good, making up over 14% of the total value of crops exported (see Table 8). With a high RCA index of 70, cotton is one of the most promising agricultural products for the country (see Table 10). Cotton marketing in Zambia is characterized by a number of factors. Typically, farmers enter into an agreement with cotton companies without prior agreement on the anticipated seed cotton price. Farmers are supplied with inputs on loan with the understanding that the cost of the loan will be recovered from the income realized from seed cotton sales. By entering into an agreement, farmers are bound only to sell their cotton to the company that supplies them with inputs on loan. This is, however, not always the case, as some farmers sometimes sell the crop to other buyers (side-selling). Since 2013, companies primarily determine the price of seed cotton without negotiating with the cotton farmers' representative (Cotton Association of Zambia).

The price of cotton has been very erratic in the last six years in the major cotton producing districts of Chipata and Lundazi. Profitability of cotton in terms of the unit cost of cotton per kg has not visibly increased, taking into account the high fluctuations in cotton production costs in the period between the 2009/10 and the 2014/15 season. The price per kilogram (Kg) of cotton, as reported by farmers in the 2009/10 season, was K 2.80 and dropped further to K 2.40/kg six years later in 2014/15 (see Figure 11).

**Figure 11: Cotton price trend in the Chipata and Lundazi districts**



Source: IAPRI, 2016. Trends in side selling and cotton prices in Chipata and Lundazi – 2009/10 – 2014/15 season

Compared to other Sub-Saharan African countries Zambia has average cotton quality and productivity but stands out as it pays the highest average producer price share. After the liberalization of the cotton sector in 1994, the sector has performed promisingly, with production having quadrupled to 80,000 MT per year, while quality and productivity increased. Zambia's cotton sector is now almost entirely independent of government interventions. The two main companies (NWK Agri Services and Cargill Ltd) dominating the market are engaged in fruitful competition and pursue innovation. The level of

concentration among ginners in Zambia has therefore helped the positive development of the sector (Boughton et al., 2003).

### **2.2.3 Cassava**

Cassava is the second dominant national staple food crop after maize, and one of the most important crops for food security in the country (especially in the northern part of the country). It provides about 211 kcal per capita per day to the Zambian population (FAOSTAT, 2017). It is mainly produced in Northern, Muchinga and Luapula provinces, as well as in some areas of the Western and North-Western provinces, making up over 20% of the total production value (see Table 6). The crop is almost exclusively produced by smallholder farmers. It is mostly used for home consumption (over 94 of consumption). Only around 8% of the crop produced is currently marketed locally as fresh root or sold as dried chips. This mainly occurs at informal markets in the Lusaka and Copperbelt provinces. There are some regional exports of dried chips to the Democratic Republic of Congo, mainly through informal cross border markets, such as at Kasumbalesa.

Cassava has a number of advantages compared to maize, and is very much suited for small-scale farmer production in that:

- It is a low input crop (no/limited fertilizer requirement, no annual seed purchase, etc.);
- A large number of small-scale farmers in the high cassava production areas have good production knowledge of cassava;
- It is not affected by drought as it is able to tolerate long periods without rain (once it is established);
- It is mainly grown in high/reliable rainfall areas.
- It can be harvested throughout the year, depending on household needs.

In trying to promote the commercialization of cassava, the government has developed a National Cassava Development Strategy. This decision was made recognizing that cassava is one of the main food security crops in the country and that a number of market development opportunities exist, which have the potential to create substantial additional market pull for cassava. These include use in starch production, in feed mill, for beer brewing, for the milling industry, etc.

Cassava commercialization (through product/market development) is expected to lead to increased incomes by increasing the proportion of the crop that is marketed, which will lead to increased production (market pull). Commercialization of cassava is also expected to lead to an increase in land used for cassava production, providing additional small-scale farmers with both increased incomes as well as food security. Cassava is a major world food crop with global production in excess of 230 million tons per year, with the four major producing countries (Nigeria, Brazil, Indonesia and Thailand) producing almost half the world supply. However, the commercial exploitation of cassava in Zambia is hampered by several factors (see 3.1).

### **2.2.4 Wheat and Rice**

Wheat is predominantly produced by large-scale/commercial farmers using irrigation. Yields vary from 2 tons per hectare in rain-fed production, to 6 tons per hectare when irrigated (NAIP, 2013). It is among the top ten agricultural products in terms of production volume. Zambia usually has surplus wheat production. Between 2011 and 2013 3.6% of the country's export value came from wheat flour (see Table 8). Wheat is one of Zambia's promising agricultural products, since it achieves an average annual yield growth of 5% and demand for the crop is rising, especially among the urban youth.

There are some established rice IPs in the Country, although few. Current additional initiatives include: (i) promotion of Sustainable Rice Intensification Initiative methodology for increased productivity & production; (ii) development of NRDS; (iii) creation of an apex body-Zambia Rice Federation, although it is still weak; (iv) ZARI's on-going programme of local rice variety purification (which has culminated

in the release of Supa-Mg variety); and (v) the development of formal Rice Standards, including Grades, for locally produced and processed rice (activity undertaken in October 2016 under ZARI-PARI and facilitated by Zambia Bureau of Standards).

Rice is predominantly grown by small-scale farmers. Since it is a convenient food to cook and consume, rice is increasingly becoming a mainstream alternative to the traditional staples such as maize and cassava, which nevertheless continue to be eaten by large populations in Zambia and all across Africa. There is also growing awareness in the country that the rising demand for rice is not transient but is rather part of a general trend in food consumption seen across the African, arising from the increasing urban and predominantly young populations. In response to this trend, Zambia has developed NRDS: 2015-2019, whose overall strategic objective is to increase local rice production by at least 50% and also to enhance its competitiveness on the market. Additionally, in recognition of the growing importance of rice as a national cereal staple, the government has designated it as one of the two food commodities purchased by the FRA for the national strategic food reserves.

Rice has reportedly been cultivated in Zambia at a subsistence level for quite a long time but is currently being grown as a cash crop by smallholder farm families and thus offers great potential to contribute to income and employment in the country, especially in the rural areas. A strong supply response by smallholder farmers of diversifying into rice production has been observed. This is not only due to the incentive of rising domestic consumer demand, but also due to the low cost of rice inputs compared to maize or cotton, under the traditional farming system they practice.

The leading provinces, in terms of percentage contribution to aggregate national production are Western, Northern, Muchinga, Luapula and Eastern. According to the Ministry of Agriculture and the Central Statistical Office's Crop Forecasting Survey results, the rice cultivation area has averaged about 36,144 ha over the last six years, of which Western province accounted for 43%, Northern Province 31%, Muchinga Province 17%, Eastern and Luapula provinces 4% each, and the rest of the provinces 2%.

### ***2.2.5 Aquaculture***

Zambia, with funding provided by the Food and Agricultural Organization (FAO), developed a National Aquaculture Strategy in 2004. The National Aquaculture Strategy proposes means and methods of addressing critical issues relating to aquaculture development through input supply (i.e. production and delivery of feeds and seeds as well as the availability of farm credit) and access to extension support and markets. The National Aquaculture Strategy was later followed with the formulation of National Aquaculture Development Plan, starting 2009. Both programs were renewed for the 2015-2020 period.

Aquaculture (fish-farming) is becoming more important, notably in light of the depletion of fisheries in the country's natural bodies of water. Aquaculture is practiced and promoted by both commercial and small-scale fish farmers in impoundments, reservoirs and dams; earthen ponds (small and large); and in cages.

Most commercial fish farms are located in the provinces of Southern, Lusaka and Copperbelt. On the other hand, small-scale fish farmers are concentrated in Northern, Northwestern and Eastern provinces (constituting 80% of the total). The number of small-scale farmers taking up fish farming has been increasing rapidly over the years due to aquaculture projects.

The production systems and practices of fish farming in Zambia are diverse, ranging from extensive to intensive practices and from multi-species to mono species.

### ***2.2.6 Fresh Fruits and Vegetables***

Promoting commercial production of fresh fruits and vegetables (FFV) and increasing access to markets for smallholder farmers have been identified as key ways to stimulate inclusive economic growth and



reduce poverty in Zambia's rural and peri-urban areas. Commercializing FFV production by small-scale farmers represents an attractive strategy on account of its high potential to increase incomes and create both direct and indirect employment opportunities. Equally important is the possibility of involving the resource-poor member of farming households, such as women, youth, and people living with HIV/AIDS, thereby providing them with opportunities to enhance their food security.

## 2.3 Promising agricultural products and value chains

In addition to assessing the returns on investments into institutional innovations in Zambia, 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 10 below. The production share, RCA index, actual yield growth and relative yield gap for the GIC value chain(s) is 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 10: Selection of promising agricultural products /value chains**

Rank by RCA			Rank by Yield progress***		Rank by yield gap		Rank by relevance of crop	
Rank	Name of agricultural product	RCA index (2012)	Name of the crop	Average annual yield growth (2005 to 2012 )	Name of staple crop (rain fed)	Relative yield gap (%)**	Name of agricultural product	Production share of supply (2012)*
1	Oil, olive residues	77	Ground-nuts, with shell	11	Maize	86	Cottonseed Oil	200
2	Cotton linter	70	Soybeans	6	Millet	89	Soybeans	180
3	Bran, maize	56	Maize	6			Sugar	113
4	Tobacco, unmanufactured	10	Wheat	5			Cassava , products	100
5	Beans, green	9	Sweet potatoes	5			Sweet potatoes	100
<b>GIC selected</b>	Groundnuts, shelled	0.04					Groundnut Oil	100
	Soybeans	0.02						

GIC value chains marked in red;

Source: \* Own computation based on FAO 2015 data, \*\* from Van Bussel *et al.* (2015).

Note: \*\*\* a minimum of 0.5% production (volume) share threshold is used as a screening (crop relevance) criteria.

Results of assessment (Table 10):

- The trade potential (RCA index) is high for olive oil residues, cotton linter, maize, unmanufactured tobacco and green beans. This indicates that Zambia has a comparative advantage (in the export) of these commodities. The RCA value for the GIC selected crops of soybeans and groundnuts is

much lower than 1 indicating that Zambia has a comparative disadvantage (in the export) of all these GIC selected crops.

- The yield performance, which indicates progress, suggests that over the CAADP period (2005 to 2012), the value chains selected by GIC (groundnuts and soybeans), maize, wheat and sweet potatoes are the five most promising crops.
- Yield gaps indicate potential from another angle and are observed to be high for rain maize and millet, indicating the high potential return to investing into these value chains.
- In terms of relevance (production share of supply), the leading value chains are cottonseed oil, soybeans, sugar (raw equivalent), cassava and sweet potatoes. The total production of the first two products meets the total demand. The full supply of sugar, cassava, sweet potatoes, and ground nuts (the other value chain selected by GIC) is also produced in the country.

## 2.4 Summary on selection of agricultural products and value chains

This chapter (chapter 2) has presented different relevant and important value chains in Zambia based on different criteria which resulted in the selection of different value chains. In summary, the three top value chains among those selected by the GIC, other relevant value chains, and those identified by analysis of promising agricultural products and value chains are presented in Table 11. The summary table shows that all except one of GIC-selected value chains (common beans) are identified as promising by the analysis of promising agricultural products and value chains. However, none of the value chains discussed in the literature review is present in the analysis of promising agricultural products and value chains.

**Table 11: Summary of all value chains**

GIC value chains	Other value chains	Promising agricultural products and value chains (top 3)			
		RCA	Yield progress	Yield gap	Relevance of crop
Soybeans	Cassava	Oil, olive residues	Groundnuts, with shell	Maize	Cottonseed oil
Groundnuts	Wheat & rice	Cotton linter	Soybeans	Millet	Soybeans
	Aquaculture	Bran, maize	Maize		Sugar
Milk	Fresh fruits & vegetables				

Source: Authors' compilation

## 3 Innovations in value chains in the past 20 years

### 3.1 Main limiting factors

According to the NAIP, general limiting factors faced by the Zambian agricultural sector include (2013):

- Weak extension services and poor research and technology transfer;
- Poor technology uptake (i.e. a minority of farmers use fertilizer or hybrid seed);
- Limited access to inputs;
- Poor price incentives to increase production (low and highly volatile prices due to unpredictable trade policies, counterproductive market interventions, insufficient investment in road infrastructure);
- Limited public investment in market information systems and lack of ICTs; (Kalusopa, 2005)

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- Land degradation due to poor management of forests, pasture, cropland and water resources;
- Empirically poor, not commercially viable returns to fertilizer on Zambia's acidic soils (World Bank, 2010);
- Lack of adaptation to the effects of climate change;

Several constraints continue to hinder the soy value chain in Zambia, including (Technoserve, 2010):

- Relatively high cost base;
- Poor transport infrastructure and uncertainty in the export policy;
- Lack of access to inputs (seed) and technical knowledge (especially pertaining to quality issues) for smallholder farmers;
- High transport costs pose challenges for import/export market opportunities;
- Weak relations between farmers and the private sector (Chomba et. al., 2016).

Limiting factors in the cassava value chain include:

- Low smallholder farmer productivity and production levels;
- Lack of disease-free seed (planting materials) (Chomba et. al., 2016)
- Government maize price subsidies that create barriers-to-trade. The current FRA-discounted price distorts the market and makes it very difficult for cassava chip farmers/processors to compete (major feed-mill companies are willing to substitute thousands of tons of maize with cassava because they can purchase the latter at 70% of the price of maize);
- High transport costs, as most cassava is grown far from Zambia's manufacturing centers (in the provinces of Luapula, Northern, Muchinga and Western);
- Lack of product consistency: failure to secure a regular market, poor procedures, ineffective quality controls and/or lack of farmer awareness has led to non-commercial, inconsistent product quality / specification;
- Lack of traceability: to protect their reputation, share-value, profits, and to avoid litigation, large food companies demand that suppliers provide clear, detailed evidence showing the origin of all food ingredients.

In the cotton sector, liberalization measures are already working to remove the following limiting factors: Weak Cotton Farmers' Association (to enforce contracts and bargain prices), rural credit and input market failure and weak contract enforcement. According to Boughton et al. (2003) funding is needed in the following three areas in order to foster further innovation: "1) investment in development and multiplication of new varieties, 2) improved pest management, and 3) updated raw cotton grading systems."

### **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 Zambia in the last 20 years. The innovations described are considered significant or beneficial because of their widespread adoption, proven positive impact on increasing productivity, as well as their potential to increase incomes, create employment, and adaptability to environmental challenges (such as drought), etc.

#### ***3.2.1 GIC value chains***

Formerly, innovations in the maize value chain mostly focused on increasing yields and pest resistance. In the last two decades, as awareness of malnutrition and vitamin deficiencies in the population grew, new innovations included varieties with increased nutritional value, notably in terms of Vitamin A and protein content. To help farmers adapt to climate change, drought-tolerant varieties were also developed and promoted. "Despite the development and release of improved varieties, it has been

observed that the adoption rate of these varieties by farmers (small scale farmers) is still low. There is therefore need for intensified sensitization and/or promotion.” There are also concerted efforts made to promote a diversity of products using vitamin A-rich maize and quality protein maize. Value addition devices such as the *Maize Sheller* have been popularized to make small farmers’ production cost-effective and competitive (Chomba et. al., 2016).

In 2006, an innovation platform for rice, called System of Rice Intensification (SRI) was established, in which the participating members were the Community Markets for Conservation (COMACO) and the non-governmental organization (NGO) “Centre for SRI Initiative.” The platform successfully trained farmers in improved rice husbandry to increase production and yield. SRI continues to be promoted by NGOs to increase yields for smallholder producers, but receives little support from policy makers (Ibid). Generally, innovations have been centered on increasing productivity, production and aroma. Upland rice types are being promoted to expand rice production and meet rising demand. Acceptance of new varieties by the population depends on aroma; new improved varieties lacking aroma have not been successful on the market. Crop-processing innovations that ensure a quality of rice meeting market requirements have been promoted (Chomba et. al., 2016).

### **3.2.2 Other value chains and cross-cutting innovations**

Improved crop varieties (high-yielding, early maturing varieties), husbandry practices (i.e. herbicides, fertilizer) and crop-processing techniques (i.e. a solar power drying machine) have been developed and promoted in the cassava value chain. However, production and productivity of local farmers still falls short of industrial demand. Government and cooperating partners have shown commitment to further develop the cassava value chain; more innovation platforms were held on Cassava in the last ten years (2005-2015) than on any other crop. The focus point of the platforms was on improved varieties, disease-free planting material, high quality cassava flour and the cassava value chain in general.

Several innovations promoted by the government and the private sector are aiming at lowering Aflatoxin contamination in groundnuts. These include post-harvest practices (promoted by COMACO) and a technology to locally produce and apply the chemical Aflasafe, designed to prevent contamination and mitigate its effects. The chemical is a promising innovation currently in its last stages of field testing. Additionally, innovations in local processing technologies are promoted, with the potential to benefit small-scale farmers and the health of consumers.

Policy-induced cross-cutting innovations include afforestation with soil-enriching trees, energy saving stoves, irrigation technologies, farm mechanization, and promotion of conservation agriculture (Chomba et. al., 2016).

Conservation farming has been shown to be a highly successful innovation in the last two decades. The approach has been introduced in many areas across the country by a coalition of stakeholders including the private sector, government and donor communities. Promoted practices include minimum tillage, crop rotation with nitrogen-fixing species, retention of crop residue for improved soil structure, fertilizer use, and integration of *Faidherbia albida* trees into fields for increased fertility. Further research into improved husbandry practices is underway. Conservation farming has proven to be effective for nitrogen fixation, maintaining vegetative soil cover, improving soil structure and water infiltration, water retention and plant root development. Practicing farmers were able to reduce land preparation costs in the long term while increasing maize yields by 1.5 tons per hectare and cotton yields by 460 kg per hectare. Therefore, smallholder productivity has increased along with food security and family income (Garrity, 2010).

By promoting the ethos of “Farming as a Business” the government-supported Agricultural Support Programme 2003-2008 has achieved positive outcomes for participating communities and households. Results included heightened asset acquisition and decreased food insecurity (NAIP, 2013).

## **4 Suggestions for collaboration**

With Zambia's high potential for agricultural development and diversification from the mining sector for economic growth and poverty reduction, there is huge scope for long-term collaboration between Zambia and Germany. PARI's existing partnerships with Zambia should therefore be utilized as a springboard towards this goal.

Partnership with Germany and Zambia would be based on the strategic commodities and themes as envisioned in the Zambian agricultural development policies. Zambia appears to be behind in terms of innovation platforms, and therefore needs close follow-up with Germany following the signing on the agreement between FARA and ZARI. Collaboration in the area of identifying and coming up with appropriate innovation platforms and/or technology generation for these commodities will be a crucial to generating impact.

A good partnership framework is essential in order for the German–Zambian collaboration to come to fruition. Besides ZARI (and the Ministry of Agriculture, in general), other prospective partners with Germany in Zambia will include the Ministry of Fisheries and Livestock Development, universities, and farmers' organizations/ associations, non-governmental organizations and relevant private sector actors.

The potential for German collaboration in fostering Zambian agricultural growth and development is enormous. This could range from research partnerships for the generation of technology and innovations, to capacity building and developing pathways and systems to translate research outputs into positive socio-economic development outcomes.

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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).<sup>12</sup>

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

Category of public health significance	Stunting	Wasting	Overweight	Iron deficiency anemia
<b>Severe</b>	≥40	≥15	≥10	≥40
<b>Moderate</b>	30-39	10-14	5-9	20-39
<b>Mild</b>	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.

<sup>12</sup> 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/m<sup>2</sup> (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<sup>2</sup> (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<sup>2</sup> (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.

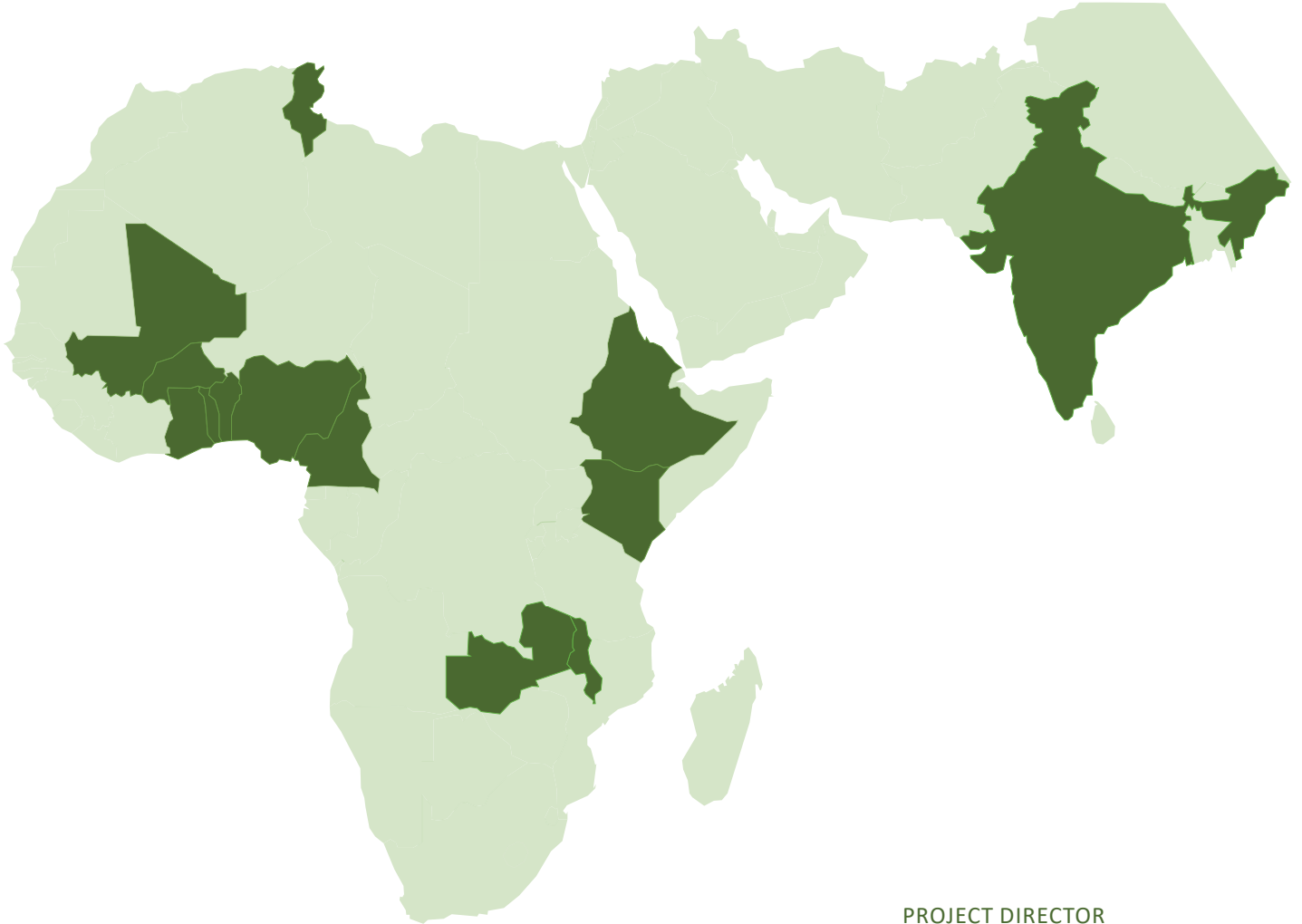
**Anemia in children:** Percentage of children aged 6-59 months with anemia, namely, a blood hemoglobin concentration below 11.0 g/dl.

**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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