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A Synopsis of Constraints to Crop Productivity among Smallholder Farmers in Choma District, Zambia

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Abstract
Despite having adequate land for crop cultivation and increased government spending on agriculture inputs support program crop productivity remains constant and at times in decline. This study aimed to explore the constraints to crop productivity in Nakeempa Village of Choma district in the Southern province of Zambia. Nakeempa village was chosen as a study area because it is in the southern part of the country where most of Zambia's maize is produced more so most government agriculture support programs are piloted in this district. A qualitative method approach was used to gather data from the study site; purposive sampling was used to select smallholder farmers and key informants. This research noted that the average yields per hectare for maize, groundnuts, cowpeas and beans in the village in the year 2013 were very low; only 0.91 tons/ha, 0.40 tons/ha, 0.22 tons/ha, 0.34 tons/ha respectively. The main constraints to crop productivity are low use of chemical fertiliser, late delivery of subsidized inputs by the government, lack of modern implements for cultivation, lack of access to finance, a dysfunctional extension system, emergence of institutional silos among government departments, distorted product and input market, uncooperative cooperatives, proliferation of fake seeds and lack of rural infrastructure among others. Lastly, the study recommends a rebuilding of the extension service system, pragmatic shift from maize centric policies and deeper community participation in rural development program design and implementation.
Keywords: agriculture; crop productivity; constraints; smallholder; Zambia

1. Introduction

Agriculture and related agribusiness are the largest employers (85%) globally, contribute to gross domestic product (about 15%), export earnings and agriculture is the main economic activity of rural Africa and a source of food (Africa Development Bank, 2009; Krishna, 1977). However, over the last 40 years, Sub-Saharan Africa has become a net importer of agricultural commodities and staple food. The continent imported more than 15 percent of its basic consumption, at a cost of $ 88billian in 2006 and $119 billion in 2007 (Anseeuw, 2010). The decline in agriculture productivity has resulted in most rural smallholders struggling for survival characterized by inadequate food supply and insecure incomes (Guanziroli, Buainain and Sabbato, 2013; IFAD, 2007). On the other hand, increased agriculture productivity is regarded as the way to reduce poverty and stimulate economic growth (Siegel, 2005).

In Zambia national average poverty level is estimated at 64% while 78% of the people in rural areas live in poverty and the percentage of rural people living in poverty has not changed in the last decade (Ballard, Sitko and Kapembwa, 2015). This is largely a result of production growth at 1% p.a that is too low to sustain a population growth of 3% and is far off the Comprehensive Africa Agriculture Development Programme (CAADP) target of achieving 6% annual agricultural Gross Domestic Product (GDP) growth (ADB, 2009).

1.1 Zambia's agriculture sector in Context

The smallholdings are characterized by low capital injection into their agriculture activities, mostly done by rural dwellers, they grow food for own consumption and they sell some of the surplus, employs household labor that is usually unpaid. As for the large-scale commercial agriculture, the sector is driven by huge capital injection, they grow cash crops (food and non food), the sector employs paid labor force; skilled, semi skilled and unskilled. The sector is also dominated by foreign capital and exists in various forms, plantations, and estates and out grower schemes.

Overall, the agriculture sector in Zambia employs 55.8% of the total workforce (World Bank, 2017). However, it is important to note that in its effort to eradicate rural poverty the government of Zambia dedicates it efforts in transforming smallholder farming into a commercially viable sector, this is clearly enunciated by the government's vision for the agriculture sector, "an efficient, competitive, sustainable and export-led agriculture sector that assures food security and increased income by 2030" (GRZ, 2011). This vision is underpinned by the main goal "to increase and diversify agriculture production and productivity so as to raise the share of its contribution to 20 percent of Gross Domestic Product" (GRZ, 2011). The argument underpinning this goal is that agriculture growth benefits the poor most and therefore, increased agricultural productivity is central to livelihood and food security in Zambia.

1.2 Government Agriculture Initiatives

Zambia's agriculture is divided into three categories; smallholder, medium and large-scale farming. Smallholder farming can be further broken down to A, Band C, the area cultivated by each group is as follows; 0-2 ha, 2-5ha and 5-20 ha respectively. Medium scale producers cultivate 20-100ha and large scale cultivate over 100ha. Smallholder farmers (category A and B constitute 95.3%) of total farmers and they are the focus of this study (Chapoto and Chisanga, 2016).

The government of Zambia and ruling party stresses the importance of agriculture development as a vehicle for poverty eradication and sustainable rural livelihoods. This is shown when one pays attention to the ruling party manifesto and government policy particularly the 7th National Development Plan (FNDP) (GRZ, 2017). Furthermore, the Zambian government adheres to the Maputo Declaration of an allocation of minimum 10% national budgetary resources to agriculture and rural development (AU, 2003). In the year 2014 the government allocated 19% of the national budget towards agriculture. As a result, a number of policies and programs were initiated in an attempt to stimulate crop productivity.

For instance, the FISRI (Farmer Input Support Response Initiative) and CASP (Conservation Agriculture Scaling Up) which focus on improving agricultural productivity among smallholders through promoting the adoption of Conservation Agriculture (CA) (Baudron et. al., 2005). Furthermore, in the 2002 the government initiated Farmer Input Support Program[1] (FISP), which is aimed at improving access of smallholder farmers to inputs and enhancing the participation and competitiveness of the private sector in the supply and distribution of agricultural inputs timely and in adequate amounts (GRZ, 2005). However, increases in FISP financial support has not in many instances resulted in increased productivity. Crop yields remain low and poverty rate at 80% in the rural areas (IAPRI, 2015). In addition, there are allegations that government agricultural policy is biased towards maize production and also mis-targetting of beneficiaries, thereby resulting in the input support programs benfitting the rich with large landholdings (IAPRI, 2015;Hichaambwa, Chamberlin and Sitka, 2016). Nonetheless, nationally there has been increased fertiliser and hybrid use since the introduction of FISP (Chapoto and Chisanga, 2016).

1.3 The Concept of Productivity

Productivity is a ratio of a volume measure of output to a volume measure of input use (OECD, 2001). Using this conceptualization of productivity and how it is measured, this study determined the surveyed smallholder farmers' crop productivity on the basis of crop yield (output per unit of land used i.e. Kg/ha). This is a measure of land productivity that does not include other important inputs such as labor, and other forms of capital, including purchased inputs such as seeds and fertilizers. Fan and Chang (2005), argue that land productivity can help in the determination of total food output among others. Due to the difficulty in collecting costs of other inputs, this study uses gross output, measured in kilograms. Area is defined as total cultivated area for each crop in a particular year and is measured in hectare.

2. Constraints to Smallholder Crop Productivity

Africa's smallholder producers have so much potential however, structural problems and risks reduce the unleashing of this potential (Siegel, 2005). Africa's land tenure is largely in the form of customary ownership and this is in most cases not recognized by financial institution as a form of collateral security when it comes to providing loans to farmers (Diao et al., 2010). As a result, peasant farmers are unable to procure fertilizers, certified seeds and any other technologies that enhance crop productivity. Low input use particularly in developing usually results in decreases in yield that ranges from 30% to 40 % (Li et al., 2010).

Coupled with tenure insecurity is underinvestment in terms of agricultural inputs, research and extension development, irrigation, mechanization, rural infrastructure, rural education and health by African governments (FAO, 2005; Moyo 2014). In Zambia there is limited construction and rehabilitation of multipurpose dams, wells and boreholes, thereby discouraging the promotion of rainfall harvesting technologies and water saving irrigation technologies such as drip irrigation (GRZ, 2004). The problem of limited infrastructure development, particularly the road network, increases the cost of transport for farmers (Krishna, 1977). In other instances, weak infrastructural service is a result of dispersed population that makes it difficult to distribute some services (ibid).

Climate change associated with global warming, which may result in more frequent droughts and lower average rainfall in the Southern parts of the country also hinders achievement of high crop yields (Chisanga, Kafwamfwa, Hamazakaza, Mwila, Sinyangwe, Lungu, 2017; GRZ, 2012). This situation has been exacerbated by the rapid rate of deforestation that has serious consequences on the climate (GRZ, 2012; Umar et al, 2011).
In Zambia, the government plays a key role in agriculture sector. However, policy unpredictability on the part of

[1] FISP is still operational, though an E-Voucher system of input distribution was initiated in 2015/2016 agriculture season to reduce some of the deficiencies of FISP.

the government sector severely weakness private sector participation in the provision of the much needed financial resources and market (USAID, 2010). Unsure of what the producer prices for grains would be some farmers feel discouraged to invest more in certain crops and this undermines productivity. Similarly, fluctuating input prices also present challenges to the farmers as well as entities involved in the value chain.

To boost crop productivity among smallholder farmers, governments focus on improving the knowledge basis of farmers; this is done through the use of extension officers. However, it is important to note that incapacitated and inadequate extension officers may not be able to disburse the knowledge to farmers (Abate, Zuo and Mudimu, 2017). A case in point was the employment of over enthusiastic officers during Ujamaa in Tanzania, the extension officers had conflicts with peasant farmers and this led to decline in crop yields (Krishna, 1977).

New technologies in the form of improved seed varieties, chemicals, irrigation equipment and other forms of mechanical power can enhance crop productivity, for example the Green Revolution in India (Hamukwala, Tembo, Erbaugh and Larson, 2012; Kasie et al, 2011 cited in Kasirye (2012). Slow improvements in seed varieties and increased number of technological dropouts decimate efforts to increase crop productivity among peasant farmers in Sub Saharan Africa (SSA) (Hamukwala, Tembo, Erbaugh and Larson, 2012; Kasirye, 2012). There is strong need to ensure that the benefits of a technology outweigh the costs of adopting that technology, otherwise the dropout rate will remain high, should farmers envisage a high costs of adoption (Kasirye, 2012). In Zambia, conservation agriculture (CA) was also introduced to increase crop productivity but the uptake is low as indicated by continued monocropping (Chisanga, Kafwamfwa, Hamazakaza, Mwila, Sinyangwe, Lungu, 2017).

Poor sources of agriculture finance present challenges to rural producers (Sebatta, Wamulume and Mwansakilwa, 2014). In most cases poor farmers are unable to access credit loans because they don't have the collateral, as such they end up accessing credit from some bogus micro finance institutions and other informal sources that charge higher interest rates (Budget, 2013 cited in Sebatta, Wamulume and Mwansakilwa, 2014). The high interest rate makes it impossible for farmers to accrue savings from their crop sales and they end up cutting on their allocations for crop production. Overall, unsustainable loans are unsustainable and drive the peasants into debt cycles (Hakantu, Wang, Mangulama and Mudimu, 2017).

On the other hand, availability of accessible and cheaper funds does not always translate to agriculture investment, for instance there are tendencies by some peasant farmers to channel crop loans towards non-production activities such as school fees (Sebaha, Wamulume and Mwansakilwa, 2014).

3. Data and Methods

This study was conducted in Nakeempa Village, which is located in Nakeempa Agricultural Camp in Singani Agricultural Block of Choma district, Zambia. The camp has six villages with a total population of 1317 small-scale farmers while Nakeempa village has 398 smallholder farmers. Nakeempa is situated 45 kilometres north of Choma town. In terms of the agro-ecological region, Nakeempa falls under Zone II[1]. . The major crops grown in the village are cereals (maize), legumes (groundnuts and cowpeas), roots and tubers (sweet potatoes). Nakeempa village was chosen for this study due to its potential in crop production.

The study involved a survey of 100 randomly selected Smallholder farmers of which (39) thirty-nine were female and (61) sixty-one were male. The random sampling was based on the official Ministry of Agriculture and Livestock Farmers' village register that was made available to the researcher by the Camp Extension Officer for Nakeempa Agricultural Camp. A total of 130 respondents participated in the study. Two focus group discussions were conducted with a total of twenty-four smallholder farmers (11 females and 13 males). In addition, in-depth interviews were conducted with key informants; the key informants included the MAL (Ministry of Agriculture and Livestock) agricultural officers from Choma District Agricultural Coordinating Office, the Provincial Agricultural Coordinating Office of Southern province and the National Office, Village Headman and the Camp Extension Officer for Nakeempa Agricultural Camp. The key informants were purposively selected.

4. Land Ownership and Crop Cultivation

All the 100 farmers in the sample owned a piece of land. The tenure status of the land holdings for all the farmers in the sample was owned land without title, a characteristic that is shared by most rural households in Zambia residing on traditional land. In Nakeempa village the majority (87%) of farmers reiterated that they have adequate land for crop cultivation and 13% reported that the land was not enough for their crop cultivation. Farm sizes in the sample ranged from 0.5 ha to 4 ha while the average land size for each respondent was about 1.8 hectares.

However, not all farmers were cultivating their land, the major reason attributed to this was lack of

[1] Zambia has three agro ecological zones (Zone I, Zone II and Zone III). The main distinguishing climatic factor is rainfall. The highest agricultural potential is in Zone II whose soils is relatively fertile and receives annual rainfall of about 800 to1000mm.

resources such as seeds and labor for example, one farmer aged 84 years could only cultivate 0.25 ha out of the 3 hectares he owned.

In terms of planted area, maize was the most planted crop followed by groundnuts, cowpeas, bean, sweet potatoes, Bambara nuts and vegetables. The share of the area planted was as follows: Maize was the most cultivated crop with all the 100 households with a total of 82.2 ha, followed by groundnuts with 43 households reporting 6.9 ha, followed by cowpeas with 36 households on a land area of 5.7 ha. Beans accounted for only 29 households with 4.6 ha while the rest (9.2 ha) was used for cultivating other crops such as sweet potatoes and vegetables. As earlier stated, out of the total arable land (179.4 ha) owned by farmers in the sample, 63.8% (114.5 ha) was cultivated in the year 2013. This shows that the village has potential for expanding the area under crop production that would result in increased crop yields. The figure below illustrates the crops cultivated.

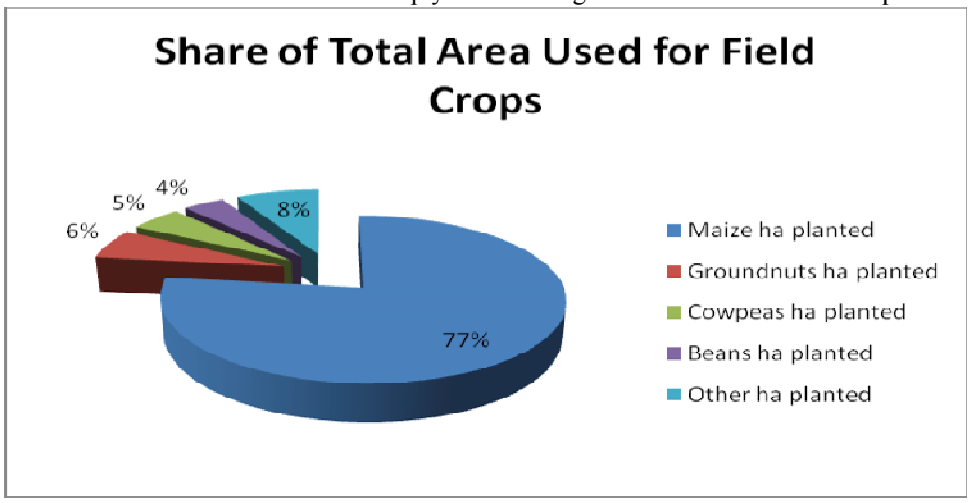

Figure 1. Share Total Area used for Crops

Source: Field Survey 2013

The targeted yields by the Ministry of Agriculture and Livestock for Small-scale farmers in Zambia are, maize-4.7 Metric tonne (MT)/ha; beans and cowpeas- 2.5 MT/ha; groundnuts-2 MT/ha, respectively. It is however important to note that these are just set targets for small-scale farmers in Zambia. Further analysis of available national statistics indicates that whilst groundnut production and area planted have increased considerably in the past four years, yields have remained low, averaging 612 kg (unshelled nuts)/ ha nationally (GRZ, 2010). In Nakeempa, the yield for groundnuts was only 400 kg per ha which is lower than the national average.

4.1 Crop Yields in the 2012/2013 Agricultural Season

Maize was the most cultivated crop (with all the 100 households) with a total of 82.2 ha of land, with a total harvest of 74.8 mt. This was followed by groundnuts (with 43 households) reporting with 6.9 ha and 2.76 MT harvested. The average yields per hectare for maize, groundnuts, cowpeas and beans in the village in the year 2013 were very low; only 0.91 tons/ha, 0.40 tons/ha, 0.22 tons/ha, 0.34 tons/ha respectively. The table below illustrates the expected yields and the actual yields

Table 1. Crop Production Summary

Category	No of Farmers	Area Planted in Ha	Total Harvest in Mt	Yield in Mt	Yield in Kg	Recommended Yield in Mt	Gap in Mt
Maize	100	82.2	74.8	0.9	910	4.7	**3.8**
Groundnuts	43	6.9	2.8	0.4	400	2	**1.6**
Beans	29	4.6	1.6	0.3	340	2.5	**2.2**
Cowpeas	36	5.7	1.3	0.2	220	2.5	**2.3**

Source: Field Data

5. Constraints to Smallholder Productivity

5.1 Limited Agriculture Finance

Agriculture finance is provided in various forms; savings, transfers, insurance and loans (Sebatta, Wamulume and Mwansakilwa, 2014). Access and participation in credit markets enables smallholder farmers to procure inputs on time as well as hire extra labour should the need arise. In Nakeempa access to credit was reported to be a major challenge when it comes to purchasing inputs, equipment and other farming requirements. None of the interviewed smallholders has ever accessed formal credit from the bank or registered Micro- Finance Institutions.

This could be as a result of 3 reasons; firstly, lack of collateral as the land ownership is under traditional/customary tenure therefore it is not considered as form of collateral security by banks, banks prefer freehold title as a form of collateral security. Secondly, most formal finance institutions are based in major towns as such smallholder farmers are unable to travel long distances to seek the services of formal finance institutions. Thirdly, in the study area the farmers have limited financial literacy as indicated by the fact that, none of the farmers admitted being able to write a business plan. Similarly, a study by FSRP (2011) revealed that lack of financial sophistication is particularly an issue in among smallholder farmers in Zambia.

Faced with this predicament of limited sources of formal loans the farmers resorted to obtaining Informal loans (**Chilimbas**[1]) through friends or relatives. A total of 12 respondents reported (9 men and 3 women) that they had occasionally accessed funds from Chilimbas. The loans from Chilimbas system are usually at an exorbitant interest rate, this makes it difficult if not impossible for farmers to make savings for their crop inputs, in the end farmers slide into a debt cycle that exacerbates poverty (Hakantu, Wang, Mangulama and Mudimu, 2017). Shortage of source of finances mostly hinders maize production because Small grains like millet do not require much financing (Hamukwala, Tembo, Erbaugh and Larson, 2012).

5.2 Fertilizer Use and Access to GRZ Subsidies in the Village

The main reason given for a household was not cultivating all the land was the lack of chemical fertilizer. This finding is in line with the broader literature on sub- Saharan Africa and Zambia in particular which talks of lack of inputs as a general problem in the region (Minot, 2007). Sixty-seven (67%) of the farmers reported using chemical fertilizer and the average fertilizer used per hectare in maize was only 155 kgs. Out of this, only 28% of the females reported using fertilizer. The farmers reported not using fertilizer in groundnuts, beans and cowpeas fields. In terms of access to subsidized inputs, the Zambian government has been providing subsidized inputs to smallholder farmers in the country. The input pack subsidized under FISP is mainly geared towards maize. Currently, most recipients got 200 kgs of fertilizer of which half is basal and the other is top dressing plus 10kg maize seed, equivalent for the cultivation of 0.5 hectares of maize (GRZ, 2011). At the recommended rate, this is only enough for 0.5 Ha and yet on average, the farmers in the sample cultivated 1,15 Ha. As such, there is a tendency to miss the recommended fertilizer rates. For example, the recommended application rate in Zambia by MAL is around 400 kgs of fertilizer /ha (GRZ, 2012), but only 38.1% was applied in the study area which is far much lower. Low fertilizer application resulting from low allocation affects crop output in the village resulting in very low productivity and yields. The study found that some farmers use as low as 100 kg (one bag of D compound and one bag of Urea) for a 1 ha maize field and some farmers mixed the two types of fertilizer before applying in the field as a result of fertilizer inadequacy. This practice of mixing fertilizer has negative effects on crop production as fertilizer is supposed to be applied at recommended rates and specific stages of crop production.

This study revealed that out of 100 farmers, only 37 (26 males and 11 females) farmers were provided with subsidized fertilizers and maize seed from the FISP during the 2012/2013 seasons. However, the farmers were of the view that the fertilizer given per household was not adequate to make any meaningful contribution to maize yields and income. In addition, some farmers were receiving considerably less fertilizer from FISP than what they paid for instance 37 farmers who received the inputs; only 22 farmers (17 males and 5 females) indicated receiving the recommended bags of fertilizer. Some farmers received 2 bags of fertilizer instead of 4 bags. In some instance the farmers had to share/break up the input pack2 for all members in the cooperative to benefit. The FISP meant to address low yields and output due to low input use in Zambia is faced with a lot of challenges. Late fertilizer deliveries to farmers' fields have been a salient characteristic of the fertilizer subsidy program. Key informant interviews also revealed serious shortages of subsidized fertilizers at the local level as a result of diversion, fraud and logistical constraints. For example, in the 211/2012 farming season, the warehouse manager who was contract by the DACO' s office to distribute inputs to the farmers had a shortage of inputs due to handling that amounted to 197 X 10kgs seed and 312 bags of fertilizer. This led to some farmers not receiving their inputs. Poor targeting of beneficiaries and widespread political interference were also reported. The table below presents the distribution of beneficiaries under the FISP in the study area during the 2010/11, 2011/12 and 2012/13 growing seasons. Out of 398 small-scale farmers in Nakeempa village, only a total of 148 (**37.18%**), 214 (**53.76%**) and 206 (**51.75%**) farmers were covered during 2010/11, 2011/12 and 2013/14 seasons respectively.

[1] Chilimbas are informal savings 'associations' common both in rural and urban areas in Zambia.
[2] An input pack under FISP consisted 2 x 50 kg bags of D compound fertilizer and 2 x 50 kg Urea and 1 x 10 kg bag of maize seed; enough for 0.5 hectares)

Table 2. Summary of FISP Beneficiaries in Nakeempa Village

Number of Beneficiaries	(Year) 2011		(Year) 2012		(Year) 2013	
	Female	Male	Female	Male	Female	Male
	48	100	78	136	79	127
Total	**(48+100)= 148**		**(78+163) =214**		**(79+127)=206**	

Source: *Field survey, 2013*

The above table shows that the number of females accessing subsidized inputs for the three consecutive years was low despite the fact that there are more female farmers, this could be a result of the patriarchal system that results in men dominating decision making in cooperatives that select beneficiaries for the input program.

5.3 Use of traditional tools

Conventional hand hoeing is the main tillage method in the village, followed by ploughing using animal draught power. Sixty- five percent (65%) of the farmers in the study area use hand hoes for cultivation while 17% use animal power. Eighteen percent (18%) reported using both animal power and hand hoe while none of the farmers in the Nakeempa reported having used or hired a tractor for land preparation. Animal draught power has the potential to improve productivity and efficiency of inputs. According to FAO (2009), use of draught animals for example oxen, could enable the saving of labor, and save time between 5 to 20 times compared to using manual labor only. Furthermore, the use of mechanical power enables the farmers to do deeper tillage in the process breaking the soil crust, improves soil aeration and this increases the chances for better crops.

5.4 Erratic rainfall

Conditions in the agricultural sector are also conditioned by the agro – ecological conditions. The agro-ecological zone under which Nakeempa village falls has average rainfall of 800-1,000 mm/year. However, recent droughts that may be part of the long-term climatic change associated with global warming have led to lower average rainfall in the region. This has resulted in disastrous yields being obtained (Saasa, 2003). Year to year variability in rainfall in the village has been important in determining crop output. Perhaps, the biggest constraint to smallholder agriculture vis-a–vis productivity is the vulnerability of production to variations in the climatic conditions.

5.5 Non Hybrid Seeds

Despite knowing the benefits of using certified seed, only 57 percent of the farmers (39% males and 18% females) used certified hybrid maize seeds, while for the other crops, all the 100 farmers in the sample reported using local seed varieties and recycled seed from previous harvests. None of the farmers reported using certified hybrid seed for beans, groundnuts and cowpeas. This contributes to the low crop yield as recycled seeds tend to be lower yielding and less responsive to good management practices. The main reason given for not using certified hybrid seed was that the price of seed was too high, making it unaffordable for most farmers. Similarly, use of recycled cowpeas seed resulted in an average yield of 0.22 tonnes per ha. This is far much lower that the national average which was 0.42 for the season under review.

In terms of the source of seed in the village, the main source was the agro dealer (private shop) supplied 40% of the seeds followed by previous harvest at 34% and FISP at 26%. The main types of seed used in the village include MRI 624, PAN 413, DK 8033, SC 513, ZM 606, MRI 634, PHB 30D79 and PHB 30G 19.

5.5.1 Proliferation of Fake Seeds

The Seed Control and Certification Institute (SCCI) enforces the Plant Variety and Seeds Act (CAP 236) which regulates the provision of seed in the country (GRZ, 2004). Through this act, SCCI plays the role of contributing to increased agricultural productivity by ensuring that the farming community is supplied with seeds of the highest quality. The selling of fake seed on the market by uncertified traders has been on the increase, this Includes the illegal use of branded seed bags and counterfeit sale of "chalked"[1] seed. As such it is increasingly becoming difficult for the farmers to differentiate between certified hybrid seed and fake seed on the market. In

[1] Chalking, a practice of using green classroom chalks to dye maize seeds so that they look like genuinely certified seeds.

Nakeempa 15% of the farmers interviewed professed to having acquired seeds from unlicensed dealers, this increases their vulnerability to procuring fake seeds. Use of fake seeds exposes the crops grown from fake seeds to multiple stresses such as diseases and lowers the achievement of high crop yields (Abate, Fisher, Abdoulaye, Kassie, Lunduka, Marenya and Asnake, 2017). The proliferation of fake seeds can be attributed to two key reasons, firstly, weak enforcement capacity by the SCCI; Secondly, a monopoly by seed breeders that allows the few available seed breeders to charge exorbitant prices for hybrid seeds.

5.5.2 Low plant population

The plant population in a field determines the expected or potential yield to be harvested. In terms of seed rate per hectare for maize, the seed rate computed as quantity of seed planted per hectare was less than the recommended 20 kgs per hectare for food. This is based on the MAL recommended range of 20 kgs per hectare (GRZ, 2009). Most farmers reported planting 14 to 18kg of maize seed per ha. According to the Senior Agricultural Officer, the low plant population per ha also reduces the yields. For example, the recommended plant population per hectare for maize is 44,000, but for most of the small-scale farmers in the village, had a plant population of 10 000 for maize. It was impossible to compute the seed rate for the other crops because the respondents could not remember the quantities planted. Most farmers don't keep records despite having been trained record farm keeping.

5.6 Labor Challenge

In terms of the type of labor used for the activities on the farm, 77% of the respondents used their own labor while 23 farmers hired labor. Labor shortages affected weeding in time. In the village, households are generally large, but consisted of children that were school going. Only one household in the sample had more than 7 members with all providing labor. For the rest, it was three to six members of the household providing labor. For some farmers in the village, the labor shortages are attributed to old age and illness.

Table 3. Labor Adequacy on the Farm and Persons Responsible

Category	Adequate	Not Adequate	Person Responsible
Land cultivation	39%	61%	Father, mother, children
Planting	68%	32%	Mother, children
Weeding	9%	91%	Mother, children
Fertilization	66%	44%	Father, mother, children
Harvesting	81%	19%	Mother , children

Source: *Field Survey, 2013*

With regards to activities in crop production, Eighty-five (85%) of the respondents mentioned weeding as the most energy demanding task and time consuming activity followed by land preparation. A delay of one week in first weeding may reduce maize yields by one- third and two week's delay in second weeding may reduce maize yields by one-quarter (Chiwele and Ulrich, 1997).

5.7 Distorted Markets

Access to produce and inputs markets has influence on produce prices and crop productivity. Farmer expectations about the output price matter in agricultural production (IFAD, 2001). The smallholders mainly sell their crops (maize) to the government (Food Reserve Agency) and private traders. Groundnuts, cowpeas and beans are rarely sold because they are mainly used for home consumption and retained by households for use as seed. Maize sales in the village ranged from 12 bags[1] to 156 per farmer. Thirty-six percent of the farmers reported having sold maize to FRA[2] or private buyers while the rest did not. Only 8% of the farmers reported selling small quantities of groundnuts to other villagers and traders. The farmers complained over the low price of maize offered by the government, being K65 per 50 kg ($11.5) and has not changed for the past four years, despite increases in the price of inputs on the market. Between 2006 and 2014, the market price of fertilizer doubled.

Proximity to towns where formal markets are located reduces transaction costs in agriculture since smallholders need to access input and output markets. The nearest town market is 45km away from the village and the main road from Nakeempa to Choma town is in a dilapidated state, therefore making the transportation cost high. Information about market prices is both poorly disbursed and difficult to access. Seventy-two percent

[1] A bag is equal to 50kgs
2 Is a government agency that plays a key role in the sale of grains.

of the farmers interviewed stated that they did not have access to market information in terms of the prevailing market prices and the demand of products in different markets. Inadequate agricultural information and timing undermined the potential of farmers to improve their production.

5.7.1Volatile Inputs Prices

The high price of fertilizer was mentioned to be the biggest factors affecting crop cultivation in the village. The prices ranged from K250 (US$25) to K350 (US$35) per 50kgs.Ironically, prices for inputs rose yet price for the main crop maize remained constant for four consecutive years. The cry for chemical fertilizers in the village is extreme. One middle-aged woman, married with four children and one dependent had this to say:

The use of too much fertilizer that is too strong has destroyed the soil fertility. We have been using D compound and urea and that has destroyed the soil. Since the fertility of the soil has depleted, we don't have any other option apart from applying more and more fertilizer as long as we live. The only way to improve the soil is applying manure which most of us don't have because our animals have died due to the East Cost Fever and Corridor diseases.

Another middle-aged man had this to say about the use of fertilizer on his farm:

I did not manage to apply fertilizer on all the maize that I planted. So I did not harvest anything from the area that I did not apply fertilizer. I had a plan of buying more bags of fertilizer, but I failed because of other problems I had. My child was chased from school because we didn't pay the school fees for the term.

5.8 'Uncooperative' Cooperatives

Co-operatives in the agricultural sector play a crucial role in the development of agriculture as suppliers of farming requisites, marketers of agricultural commodities, and the provision of services such as grain storage and transport (GRZ, 2004). Farmers belong to cooperatives mainly to enable them access inputs under the FISP. However, in the study area, despite over half of the respondents being members of cooperatives, clubs or farmer groups, their cooperatives don't do any tangible agricultural income generating activities.

There are twenty-three cooperatives in the village, most of them were formed entirely for accessing subsidized inputs, and however, some of them are dormant. Some farmers in the village don't belong to cooperatives and the main reason given is that they don't have money to pay for membership and shares required to join the cooperatives.

The farmers formed cooperatives so that they could access subsidized inputs. The cooperatives sometimes didn't deliver the inputs the farmers would have paid for as remarked by one respondent: *I paid for 4 bags of fertilizer to the cooperative but only got two bags. I did not even get back my money. I just left the money because I cannot do anything to get back the money. Other farmers were also not given their two bags. So I will not continue buying fertilizer from the cooperative. It is better to buy on our own in our household (Female, widow with 5 children).*

These assertions indicate that some of the cooperatives in Nakeempa have become uncooperative because they are riddled with discontent and oppression of members instead of communality and cooperation that are the hallmarks of cooperatives the world over.

Collecting dues but providing few or no services relevant to agriculture can be attributed to the socialist period[1], when agricultural cooperatives were expected to be politically active and less service provision oriented. Later, some cooperatives were formed purely to get access to donor funding. Due to these issues, the Cooperatives Societies Registrar, a body within the MAL that is responsible for registering agricultural cooperatives, deregisters cooperatives unilaterally if it concludes that they are not carrying out their duties. Interestingly, despite the maladministration recorded in the cooperatives operating in Nakeempa Village none has been deregistered this far.

5.9 Dysfunctional Extension system

Extension is important for bringing new technologies and farming practices to farmers and finding out the problems experienced by farmers in order to conduct appropriate research. In the study area, 57% (19% female and 38% males) of the farmers indicated that they had received extension services while the rest had not received extension services. In terms of the frequency of extension visits, only 18 farmers recorded one visit during the cropping season while 5 recorded one visit during the off-season. Access to agricultural extension services at a level of one or two visits per agricultural year leads to a rise in farmers' crop productivity of 15 percent on average, other factors remaining constant (IFAD, 2009).

In addition, there is severe shortage of extension officers in Nakeempa. The extension officer in charge of the whole village has to provide extension services to 1,317 farmers the whole camp. As such it is practically impossible to visit all the 1,317 farmers. In terms of rating of extension services received by the 57 farmers, 27 reported that they were satisfied, 11 were a bit satisfied while 19 were dissatisfied. To illustrate the shortage of

[1] Socialist period from 1964 to the early 1990s

extension officers, one key informant remarked that: *There is need to improve the staff-farmer ratio that currently stands at 1 Camp Extension Officer: 1,000 farmers. For example, the Camp Agricultural Extension officer in charge of Nakeempa Agricultural Camp has to provide his services to 1,317 farmers in the camp in addition to about another 1,000 farmers in the neighbouring camp because it has no Camp Extension Officer. To make the extension service more efficient, there is need to reduce this ratio to at least 1:400 (District Agricultural Coordinator).*

5.9.1Inadequate funding for Extension Services

Extension service at times is not readily available to the smallholder farmers due to late disbursement of funds and insufficient funding and this prevents the district officers from implementing activities efficiently and on time. Requisites such as fuel and stationary are rarely available and this makes it difficult for extension officers to go in the field to train farmers and monitor their fields during the farming season. The government spends on average 16% (ZMK 88 billion) of its annual public agricultural budget on extension but does not get much from it in terms of productivity improvements (Jayne et al, 2009). Furthermore government spends more on FISP and FRA than extension service, for instance in the year 2015, the 60% of agricultural budgetary allocation was on FISP and FRA (IAPRI, 2015).

5.9.2 Inadequate Support Staff

Inadequate staff at the district level has also affected the operations at the district and National levels. Currently, the district only has one Agricultural Officer who is in charge of crops Instead of the required 6 officers. Subject Matter Specialist Officers from the MAL district office in charge of crops, farm power and mechanization, farm management, cooperatives development, agribusiness and marketing and irrigation development rarely visit the farmers for backstopping and monitoring due to erratic funding The Camp Extension Officer for Nakeempa only has a certificate in general agriculture and it is therefore important for the subject matter specialists to visit and train the farmers on issues that the camp extension officer is unable to deliver on.

6. Institutional Silos

The ZARI is the largest agricultural research entity in the country and its overall objective is to provide high quality, appropriate and cost effective services to farmers, generating and adapting crop, soil and plant protection technologies and practices. For example, the development of high yielding varieties of beans, groundnuts and maize; promoting soil fertility improvement practices. However, this department faces the challenge of inadequate funding, this hinders dissemination of information on technologies for adoption by the smallholders. There is a social science section in the department that is supposed to transfer technologies to the farmers. In the past, the department tried to develop an outreach team but the main problem was funding to go out in the field. As such, a weak linkage has developed between research and extension service delivery to farmers. Hence, this weak collaboration between the research organ and extension services creates institutional silos, a situation whereby departments that are supposed to be coordinating fail to do so and in the end resulting in poor service delivery.

6.1 Limited Irrigation Infrastructure

Smallholder farmers in the village rely heavily on rain fed agriculture and this has exposed them to natural calamities such as droughts. Additionally, the smallholder farmers do not engage in large-scale off-season agricultural production due to lack of irrigation facilities. Irrigation infrastructure includes resources such as boreholes and irrigation systems. It is difficult for farmers to produce on a sustainable basis without this resource. In the sample, a few farmers interviewed were making use of the stream to irrigate their crops using buckets, though this is mainly used for small vegetable gardens. Although some farmers were trained on how to use the treadle pump and drip irrigation, none of them reported using these mainly due to the high cost of acquiring these systems. The lack of irrigation infrastructure in the village poses a serious danger to crop production especially during periods of drought or erratic rainfall. Additionally, the farmers are not able to do early cropping which in most cases results in better yields.

6.2 Poor Road Infrastructure

Infrastructural investments have both complimentary and synergetic effects within agricultural development. Unfortunately, government investment in infrastructure in Nakeempa has been very low for a number of decades. Most rural areas the worlds over are "victims of deficiency produced by decades of neglect of rural development"(Guanziroli, Buainain and Sabbato, 2013). Underdeveloped rural roads and other key physical infrastructure lead to high transaction costs for agricultural particularly transport costs for products to the market as well as farm inputs, in the end this reduces farmers' incomes. At times in Nakeempa high transport costs resulted in farmers cutting down on the quantities of inputs they would procure.

6.3 Soil Fertility

In Nakeempa there is soil degradation and in addition the soils in this area are generally poorer and this makes it impossible to raise crops without using chemical fertilizer. Ninety-two percent of the farmers attributed the low soil fertility to limited land fallowing and rampant use of urea. Uncontrolled use of urea leads to acidification of the soil and a decline in crop yields (Saasa, 2003).

6.4 Conservation Agriculture

The main agricultural technology introduced and currently being promoted in the study area is CA technologies. Conservation farming needs appropriate implements such as ripper, chaka hoe, sprayers, fittereli plant, and herbicides but poor farmers cannot manage to buy these. Some of farmers are reluctant to adopt the new technologies. Similarly, Stars (2011) noted that the attitude of the farmers has been one of the reasons for low yields and stunted agricultural growth in Zambia. Most smallholder farmers do farming as a way of life. Farming as a way of life is characterized by lack of planning and reluctance to adopt new methods.

One key informant remarked*: The adoption of CA has been low because farmers somehow fear technology. The benefits of CA are reaped in the long run and not in the short term. Although the introduction of CA can result in yield benefits in the long-term (and this may be up to nearly 3 to 10 years), in the short-term the benefits are rarely seen. The farmers are scared that if they adopt the technology, they will be in a worse off situation and this has resulted in a lot of farmers not increasing their cultivated area under CA.*

Nonetheless, it is also important to note that some of the farmers practiced crop rotation; they planted groundnuts, beans, sunflower and maize in rotation. Peers influence the rate of adoption for conservation agriculture (Kasirye, 2012). Farmers highlighted that they had learnt that crop rotation works after observing their neighbour's fields.

6.4.1 Stunted Technology Transfer

Participatory Extension Methods were used in Nakeempa, this involved meeting with farmer groups; conducting pilot a experiment in a demonstration plot, farmer field schools, field or classroom training and seminars. Pamphlets, leaflets and newsletters were sometimes distributed; demonstrations at national, provincial and district agricultural shows were also conducted. More so, some farmers are also directly trained to become trainers (Lead farmers) of fellow farmers within the communities that they live. Of those who were trained in agricultural technologies 41 stated that that they explained the innovations to other farmers (multiplier- effect) while (10) did not. The failure to relay the knowledge to other farmers was caused by shortage of funds to procure materials such as lime and equipment and pesticide sprayers that are used in the demonstration activities. For extension services to succeed, there is a need to adequately equip extension officers in terms of their knowledge, skills and resources (Abate, Zuo and Mudimu, 2017).

7. Policy Implications

The government must provide incentives for smallholder farmers that adopt conservation agriculture and this will reduce the rising number of dropouts in conservation agriculture. Whilst the government input support program is laudable it is maize cantered and this leads to a neglect of other crops and dwindling productivity in other crops, moreover the FISP program is more beneficial to richer farmers that have large landholdings. Hence there is need to ensure that smallholders are involved more in policy making, opening up of channels for smallholders to influence public policy (Guanziroli, Buainain and Sabbato, 2013). Additionally, there is no doubt that Zambia's extension service like that of any other African country requires rebuilding; that entails proper and adequate resource allocation and staff capacity building (Paul and Githinji, 2017).

8. Conclusion

This study revealed that the Zambian government made considerable efforts to increase agriculture production and crop productivity among smallholder farmers in Zambia; however, the results were not as pleasing as expected. Smallholder crop productivity was stunted in the 2013/2014 seasons; maize- 0.91 Mt/ha, groundnuts-0.4 Mt/ha, cowpeas-022Mt/ha and beans-0.34Mt/ha. A number of constraints have been noted in this study to be the contributory factors to this low crop productivity, declining soil fertility, labor shortages, a dysfunctional extension system, distorted markets, use of fake seeds, limited sources of agriculture finance, late delivery of inputs, inadequate irrigation and transport infrastructure among others. The study recommends a rebuilding of the extension service, more inclusion of smallhoder farmers in policy making in order to increase targeting of poorer households by input support programs and more allocation of funds towards broader rural development programs, such as the development of transport networks and irrigation infrastructure which are known key drivers of agricultural growth (Chapoto and Chisanga, 2016).

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