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Seasonal challenges and opportunities for smallholder farmers in a mining district of Zambia

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Zambia's efforts to diversify from mining to agriculture have seen many interventions aimed at improving the productivity of smallholder farmers. These efforts have produced poor results, as productivity has remained low. This study used 121 semi structured interviews, two focus group discussions and several key informant interviews to investigate smallholder farmers' challenges over the course of a farming season, focusing on the main farming operations during different phases of the farming cycle. Results show that labour shortages during land preparation and weeding; and limited access to mineral fertilizer and hybrid seed constrain most households (83%) ability to increase total cultivated land. All the households engaged in rain-fed maize (*Zea mays*) production, while only 33% produced irrigated crops. The over dominance of maize production was a response to the opportunity provided by state subsidization of inputs and maize pricing, as well as the liberal macro-economic environment. Post-harvest losses due to pests were reported by 42.1% of the respondents; 25% cited high transport costs while 25% lamented the low market prices for farm produce immediately after harvest as important challenges. Proximity to an international border and an atmosphere that encourage private sector investment and cross border trade were important opportunities for the famers to sell off their production. Additionally, being in a relatively highly populated mining district provided local market opportunities not available to farmers in rural areas. It is concluded that understanding of challenges and opportunities over the course of a farming season would aid development actors in designing and implementing appropriate interventions.

Key words: Agricultural productivity, weeding, markets, rain-fed, farming inputs, Mufulira.

INTRODUCTION

The Southern African country of Zambia is renowned for its large copper deposits. Upon its attainment of independence from Britain in 1964, the country embarked on a very ambitious socialist development agenda

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financed by copper rents. The government formulated and implemented highly interventionist agricultural policies aimed at increasing the productivity of smallholder farmers, as well as increasing their sales and agricultural incomes. State interventions in the agricultural sector were mostly focused on maize (*Zea mays*) and included the provision of producer subsidies for maize seed and mineral fertilizers; the setting of pan territorial floor prices, and marketing of maize grain.

In the mid-1970s, the price of copper on the world market collapsed. During the same period, the price of oil on the world market quadrupled. Between 1974 and 1985, gross domestic product (GDP) growth rate averaged only 1% per annum, which was well below the population growth rate of 3.3% (Saasa, 1996). Zambia experienced an economic depression which the state tried to offset by borrowing heavily from international lenders, but only worked to push the country into a debt crisis. After several false starts, the state finally agreed to implement the International Monetary Fund's Structural Adjustment Programme (SAP) in l989. SAP was premised on neo-liberal principles of a free market economy and hence *inter alia* demanded the removal of agricultural subsidies and privatisation of national parastatal companies.

Privatisation of mining parastatals led to retrenchments of mine workers and the collapse of many business firms that had been dependent on mining activities. The region hardest hit was the Copperbelt Province of Zambia, whose local economy was highly dependent on the economic health of the mines. With thousands of job losses, the residents of the Copperbelt province suffered. Poverty increased as households lost their stable incomes, and smallholder farmers' production drastically reduced due to the abrupt removal of agricultural subsidies. Zambia's real per capita GDP declined by more than 20%, between 1991 and 1995 (IMF, 1999). As a way of mitigating the adverse effects of SAP, several interventions were planned and aimed at diversifying away from mining into the agricultural sector. It was envisaged that by helping smallholder farmers-who now included former mine workers and their families improve their productivity, they could reduce household food insecurity, and poverty; and also make the Copperbelt economy less vulnerable to the vagaries of copper mining. Smallholder agriculture thus became a focal point for many development actors who employed diverse strategies and approaches but all with similar goals. Most approaches focused on the improvement of smallholder agricultural productivity and production through increased use of modern agricultural technologies. The state focused on provision of hybrid maize seed and mineral fertilizers to smallholder farmers through a nationwide subsidy programme known as the Farmer Input Support Programme (FISP). Smallholder farmers that were beneficiaries of FISP received a package of 200 kg of mineral fertilizer and 10 kg hybrid maize seed. This is sufficient for half a hectare and is expected to result in maize yield of 3 tons ha^{-1}. Public expenditure on FISP is large. In 2007, the FISP accounted for 35 to 60% of the overall public budget to Agriculture (Xu et al., 2009). Jayne et al. (2007: 6) reported figures of 63 and 80% in 2004 and 2005, respectively of agricultural ministry expenditure on FISP.

Significant resources and efforts have been expended on the smallholder farming sector as a means to improve its productivity and concomitantly reduce household food insecurity and poverty. These resources and efforts have been expended on interventions that are focused on improving smallholder farmers' access to agricultural technologies, while FISP also links smallholder farmers to markets through the purchase of maize by the state. Despite all these efforts, smallholder farmers' productivity has remained low (Scott, 2011; Nguleka, 2014) and their poverty levels remained high (Jayne et al., 2011). Low adoption levels of agricultural technologies that technocrats espouse as having the ability to greatly increase agricultural productivity seem to point to a complexity of factors mediating smallholder farming households' low productivity. The technology focused approaches to agricultural productivity improvements ignore the local micro environments and wider structural challenges that characterise smallholder farmers' environments.

The persistent challenge of low agricultural productivity and related challenges associated with smallholder farming households needs to be investigated so as to draw out lessons that could be useful for addressing the said challenges. Thus, this study had two objectives: To (i) explore what smallholder farming households consider to be salient challenges and opportunities that characterize their main farming operations over the course of an entire farming season; (2) investigate how wider macro-economic policies, the bio-physical environment and socio-cultural institutions influence smallholder farming households' challenges and opportunities. The study finds that smallholder farmers' challenges over the course of a farming season are interlinked and the constraints at any given phase of the farming cycle mediate the actions the farmers take at other phases later in the season. The larger macro-policy environment and location provide market opportunities and spur the production of rain-fed maize and irrigated crops. Access to resources at household level and wider structural challenges and opportunities must be considered in the design of agricultural interventions for smallholder farming households.

METHODOLOGY

Overview of the study area

The study was conducted in Mufulira District, one of the mining districts in the Copperbelt province of Zambia. The study sites were

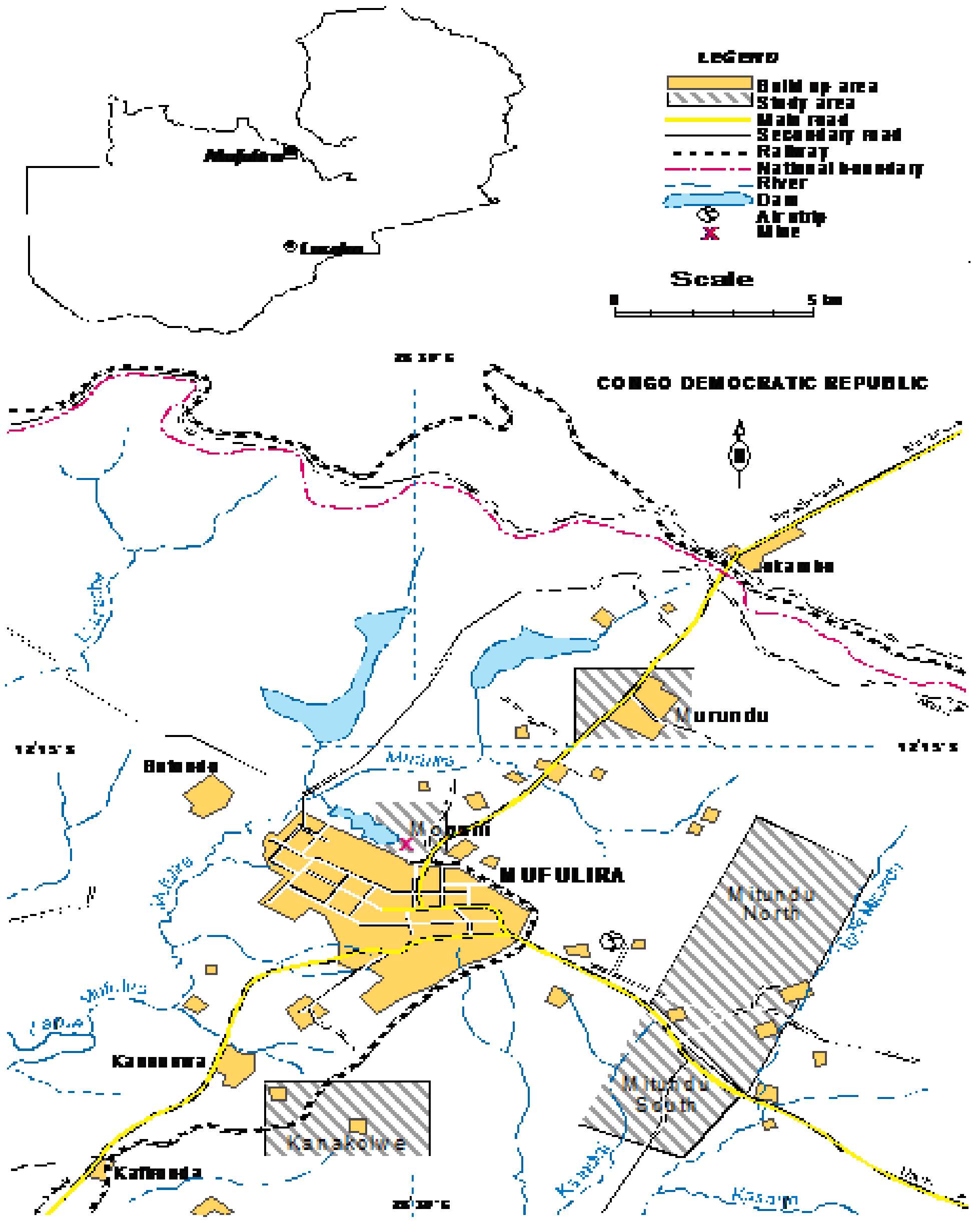

Figure 1. Map showing the location of Mufulira district and the study areas.

Mupena, Murundu, Mitundu and Kanakolwe areas (Figure 1). The district borders the Democratic Republic of Congo in the north, and is well connected to other districts in the province by road. The district's population was projected to be 183,268 in 2014 based on the 2010 National census results; and has a population density at 98.7 persons per Km^2 (Central Statistical Office (CSO), 2013). This is much higher than the national average population density of 17.3 persons per km^2. The district is located in the agro-ecological region that receives uni-modal seasonal rainfall of 1200 mm and above annually, has a crop growing season of 190 days and low probability of drought and cooler temperatures during the growing season (GRZ, 2002). Agricultural activities are common in its urban environs and dominant in the peri-urban areas, predominantly smallholder crop production. Smallholder crop production - which is mostly rain fed - is focused on crops such as maize, cassava (*Manihot esculenta*), groundnuts (*Arachis hypogaea*), sweet potatoes (*Ipomea batatas*), common beans (*Phaseolus vulgaris*), pumpkins (*cucurbitaceae spp*), and other cucurbits.

Research strategy and data collection tools

Fieldwork for this study was carried out between June and August 2014. Quantitative and qualitative research strategies were employed. A quantitative research strategy emphasizes quantification in the collection and analysis of data and embodies a view of social reality as an external, objective reality (Bryman, 2012). Conversely, Creswell (1998) observed that a qualitative research strategy emphasized the multiple dimensions of a problem or issue and displayed them in all of their complexity, including the ways in which individuals interpreted their social world. The quantitative strategy was used for conducting a household survey during which data was collected from a sample of 121 households in the study area on variables such as input use, tillage systems, crop and livestock production, challenges faced in farming, and associations with farming organizations and development agents. The 121 households were selected on the basis of their participation in a recent agricultural development project.

A qualitative strategy was employed to obtain in-depth and contextual information on aspects such as land tenure, and roles of development actors (both state and non-state) who were identified to be significant local players. In this vein, key informant interviews and focus group discussions (FDGs) were conducted. The key informant interviews were conducted with eight agricultural experts, three local political and business leaders, and four longtime residents known to have knowledge and experience on the research topic and study area. Two FGDs, each comprising ten women and men smallholder farmers were conducted. Combining many data collection tools is fruitful as it makes it possible to examine the same phenomena from different perspectives.

Data analysis

Thematic analysis was used to systematically examine the answers to each question from the household survey for themes. Categories were created to include the whole range of answers given to each question by all the respondents. Each response was then examined and placed in the relevant category. The qualitative data software QDA Miner 3.2 (Provalis Research, 2009) was employed to come up with categories. Frequencies and percentages were then calculated for each category, to determine how common certain views were. The FGDs - which had been recorded using digital recorders, were transcribed. The focus group discussants and key informant views were incorporated into the results and discussion section.

Literature review

Smallholder farmers in Sub-Saharan Africa face many challenges. The per capita growth rate of agricultural Gross Domestic Product (GDP) was negative during the 1980s and 1990s, though improvements have been noted since 2000 (Denning et al., 2009). The challenges are due to a multitude of factors which range from bio-physical (Mpandeli and Maponya, 2014), socio-cultural, economic and institutional to macro-policy environments. Given the great diversity among smallholder farming environments, the concomitant variations in agricultural systems and practices mean that various groups of factors interact in a myriad ways. Despite the diversity, smallholder farming systems are characterized by some common features and common challenges. Depletion of soil fertility, along with the related problems of weeds, pests, and diseases, is a major bio-physical cause of low per capita food production in Africa (Sanchez, 2002).

Although African soils present inherent difficulties for agriculture; analysts generally agree that a fundamental contributing factor has been the failure by most farmers to intensify agricultural production in a manner that maintains soil fertility (Morris et al., 2007).

Dependence by smallholder farmers on erratic rainfall under a patchy mosaic of agro climates and the vagaries of weather has prevented Sub-Saharan Africa (SSA) from experiencing the Green Revolution (Eicher, 1995; Enete and Amusa, 2010) and climate change poses a considerable challenge (Arslan et al., 2015). The projected combined impacts of climate change and population growth suggest an alarming increase in water scarcity for many African countries. This will curtail the ability of irrigated agriculture to respond to the expanding food requirements of tomorrow's Africa and much greater emphasis will have to be given to increasing the productivity of global rain-fed agriculture which currently provides 60% of the world's food (Cooper et al., 2008).

The seasonal nature of agricultural production causes peaks and troughs in labour utilization on the farm, and creates food insecurity due to the mismatch between uneven farm income streams and continuous consumption requirements (Ellis, 1999). Lean season or hunger periods, which are periods of severe food shortages and low consumption levels, are common (Norton et al., 2005). Low levels of mechanization (Nkamleu et al., 2003); minimal use of external inputs such as hybrid seed, mineral fertilizer, and herbicides; high transport costs and inadequate institutional support have precluded productivity increases (Denning et al., 2009; Mpandeli and Maponya, 2014). Evenson and Gollin (2003) noted that although large numbers of high yielding crop varieties were released in SSA in the 1960s and 1970s, adoption by farmers was low, and yield growth made only minor contributions to production growth. They attributed this in part to the agro-ecological complexities of the region and a lack of irrigation facilities. Generally, performance of irrigation projects has been disappointing globally (Valipour, 2014) and SSA is not an exception.

Poor infrastructure and related high transport costs (for both inputs and surplus production), inadequate institutional support (Enete and Amusa, 2010), slow development of input and output markets (Binswanger-Mkhize, 2009), political instability, price shocks and limited financing options (Fan et al, 2013), diverse agro-ecological complexities (Diouf 1989), low fertilizer use, and the limited availability of suitable high yielding varieties and other modern technologies have all contributed to low agricultural productivity growth in Africa. In 2002, fertilizer nutrient consumption in SSA was estimated at 8 kg ha^{-1}, much lower than other developing regions (Morris et al, 2007:2). Dependence on simple manual tools for performing major farming operations leads to drudgery (Ezeibe et al, 2015), low yields and low incomes, and perpetuates low productivity. Collier and Dercon (2014) summarized the smallholder African agriculture as a vast and only slowly changing number of poor smallholders contributing most of agricultural output, with low yields, limited commercialization, few signs of rapid productivity growth, and population–land ratios that are not declining.

From the late 1960s to the 1980s, many governments in SSA actively intervened in the agricultural sector in an effort to increase agricultural productivity. Strategies employed were varied and included state farms and irrigation programmes, collectivization, direct fertilizer subsidies and other agricultural input credit programmes (Denning et al., 2009) and output market pricing (Holmen, 2005; Banful, 2011). Other development actors such as international development organizations and international research organizations employed various development interventions to address the low agricultural productivity with a lot of enthusiasm about their benefits. However, agricultural technologies that had performed excellently on research stations were poorly adopted by farmers and failed to address farmer constraints. More commonly the lack of uptake occurred because farmers were constrained in resources, such that investment in a new technology not only influenced what must be done in one field, but involved trade-offs with other activities from which the farmers generated their livelihoods (Giller et al., 2009).

After the generally dismal performance of most agricultural interventions in SSA in the recent past, it has been recognized that incorporation of farmers' perspectives is critical. Smallholder farmers have an intimate knowledge of local soil and climate, often accumulated over generations that give them an advantage in tailoring management to local conditions and the flexibility to quickly adjust management decisions to site, seasonal and market conditions (Deininger and Byerlee, 2012). Incorporation of farmer perspectives in agricultural technology development has been espoused to contribute to the development of technologies suited to diverse environments in which smallholder farmers operate. This study therefore focused on investigating smallholder farmers' interpretation of their main constraints and opportunities during the main phases of the farming cycle. The phases considered over the course of a farming season were land preparation, sowing and fertilizer application, weeding, harvesting, post-harvest storage and marketing.

RESULTS AND DISCUSSION

Results from the semi-structured interviews showed that all the 121 respondents utilized hand held hoes as their main farming implement during tillage and weeding operations. The main tillage systems used in the area are ridges and flat culture. Being manual systems, both require high labour inputs which are mostly supplied by household members. About 60% complained about the high labour requirements for weeding and complained that they found weeding especially challenging as it has to be done within a short period characterized by many days of heavy rainfall which occasionally prevents them from working. Labour shortages during critical farming operations are a pervasive feature of smallholder farming in SSA. Ezeibe et al. (2015) reported labour shortages and drudgery experienced by smallholder cassava farmers in Nigeria. As observed by Nyamangara et al. (2014), labour limitations, especially for weeding, and low levels of mechanization for both land preparation and weeding have been reported to lead to a reduction in the area under cultivation by up to 50% in SSA. All the households interviewed produced rain fed maize while about 69% produced groundnuts (Table 1).

Maize production had a clear dominance and was cited to have the most challenges. When asked about crop production challenges, all the respondents gave responses related to maize production. The most cited challenge was the inability to access sufficient quantities of mineral fertilizers for their maize production (84.3%). This was either due to the quantities accessible through the state subsidy programme FISP being inadequate (10%) or their inability to access the subsidized inputs due to failure to meet their contribution towards the subsidized inputs (11%). Smallholder farmers contributed ZMW 100 (USD 16) for every 50 kg bag of mineral fertilizer accessed through FISP and received a free 10 kg bag of hybrid maize seed. In theory, each smallholder household with a member belonging to a registered farmer cooperative and cultivating up to 5 hectares can access 4 × 50 kg bags of mineral fertilizer and 10 kg of free seed. The fertilizer allocation must constitute two basal dressing (N: P_2O: K_20, 10:20:10) and two top dressing (46% N) bags of mineral fertilizer. In practice, not all qualified smallholder farmers are able to obtain them and even then not in the quantities stipulated. According to the agricultural officers in the district, the demand for FISP inputs outstrips the supply; The District Agricultural Committee allocates FISP packs to agricultural camps based on the number of farmer cooperatives in each camp. During the 2013/2014 farming season, 7837 FISP packs were received from central government. These comprised 7140 maize, 480 sorghum, and 217 groundnut packs. The district had a total of 440 registered cooperatives among which these packs were shared. The criteria for registering a farmer cooperative with the Ministry of Agriculture are: (i) cooperative must be located in a designated agricultural camp, (ii) cooperative must have a minimum of ten (10) members, and (iii) be registered as a business entity.

Other than being inadequate, the FISP inputs were delivered late as complained by 61% of the respondents. They narrated that the maize seeds and basal fertilizers where delivered several weeks after the first opportunity

Table 1. Rain fed and irrigated crop production in the study area.

Rain fed crops	Percentage of household producing crop n=121	Irrigated crop	Percentage of household producing crop n=121
Maize	100	Tomatoes	24.8
Groundnuts	68.6	Cabbage	23.1
Cassava	52.1	Egg plant	5.8
Sweet potatoes	51.2	Okra	4.1
Common beans	28.1	Rape	24
Pumpkins	12.4	Onions	4.1
Chickpeas	5	Others (chillies, green pepper, spinach, amaranthus)	5
Soya beans	9.9	-	-
Millet	5.8	-	-
Others (sunflower, pop corn)	3.3	-	-

Source: Field data (2014).

for planting had elapsed and occasionally when the growing period left was too short for the maize varieties delivered. The medium to late maturing maize varieties are recommended for the district. These require a growing period of 120 to 140 without which yields are adversely affected. One farmer complained as follows:

"The inputs are delivered late and at different times. They start by delivering the urea, then later they bring D-Compound (D-compound is a pre-emergence basal dressing fertilizer, to be applied before the seeds have germinated, while urea is applied when the maize is at knee height.) and seed. What can we do with Urea before seeds?" (Interview with respondent, August, 2014).

The FISP input delivery dates ranged from the first week of December to February. It was too late to use inputs received in February for the season under study and farmers kept these for the following season. Late delivery of FISP inputs results in most recipients sowing late. A few of the farmers sowed recycled (F1 generation) seeds which they complained gave very low yields. Late sowing "brings its own problems", said one respondent. These problems include rodents eating the seeds before they germinate. This happens because when sowing is delayed, weeds grow and harbour rodents. Farmers also complained of receiving expired maize seed and inappropriate varieties. Late sowed seeds also result in low yields. The low yields are inimical to the FISP's objectives of improving farmer productivity. Key informants cited several reasons for the pervasive inefficiencies characteristic of FISP input delivery nationwide and despite the state's rhetoric to the contrary. Procedures for importation of mineral fertilizers into the country and selecting transporters of FISP inputs annually are very bureaucratic. Even in the rare cases when FISP inputs are delivered to district agricultural offices on time, allocating to co-operatives also takes time. Smallholder farmers face constraints in raising the funds required as their contribution towards the FISP inputs and co-operatives wait until the last moment before submitting their monetary contributions in order to help as many of their members as possible. In the words of one key respondent, "sometimes the inputs stay for a month at the district agricultural office without being given to the farmers, all because of bureaucracy ".

Some respondents (22%) reported their need to perform weeding operations 2 to 3 times per season due to pernicious weeds. About a quarter hired-in labour to supplement household labour at USD 20 for a 50 m × 50 m area on average. It was observed that weeding is an important bottleneck and limited the acreage of land tilled as "tiling large areas resulted in them being abandoned after failing to weed". The mean land size tilled per season was 1.5 hectares (standard deviation =1.4) out of mean total land owned of 6.2 hectares. Thus just slightly less than a quarter of the total land owned was under cultivation. This is higher than the national average land size holding of 3.27 hectares (Tembo and Sitko, 2013). It is therefore argued that access to land is not a prime challenge, and other factors preclude expansion of cultivated land area.

The use of herbicides among the farmers was low. Household labour was mostly used for weeding, while some households hired-in labour at around USD 20 for a quarter hectare. Commonly used herbicides cost ZMW 90 (USD 14.4) per litre, which is sufficient for a quarter hectare, and lower than the cost of hired labour. Some farmers had reservations against using herbicides due to their perceived adverse effects on soils. As one farmer put it, "the [agricultural] plot belonging to [named] orphanage was scorched after herbicides were applied.

Table 2. Crop sales by farming households in study area, Mufulira.

Crop sale patterns by households	Percentage (n=119)
Sold maize only	8.4
Sold maize and other crops	56.3
Households that sold maize	**64.7**
Did not sell maize but sold other crops	17.6
Did not sell any crops	17.6
Sold some crops	**82.4**

Source: Field data (2014).

Up to date, nothing grows there, just a bare batch of soil remaining". Another farmer believed that herbicides scorch the soil when they are continuously used for five years. Others complained of having had challenges in following the herbicide application instructions, while the women farmers observed that it was men's work to spray herbicides and thus outside their domain.

Transporting crops from the fields to homes upon harvest was a challenge for 30.6% of the farmers. The harvest was ferried from the fields to homes by carrying on the head, using own or hiring bicycles; and hiring vehicles. The farmers paid up to USD 80 per trip using hired vehicles. Labour shortages were experienced by 25.6% while 9.9% lacked the funds to hire-in labour to help with the harvesting of crops. Those that hired-in labour paid USD 0.8 for every 50 kg bag of maize harvested. Efforts were made to harvest crops as quickly as possible, as delays resulted in pest attacks (by rodents, weevils and termites) and thefts, according to the farmers. Over a third (36.4%) reported not facing any challenges with harvesting their crops.

Post-harvest challenges were experienced with storage of maize and pest infestations. 15% complained of not having adequate storage facilities for their maize while 42.1% said their stored crops were attacked by pests. Use of insecticides was common although some reported pest infestations despite using insecticides. Common crop pests were weevils, termites and rats. One farmer lamented that the insecticides stop working after six months and weevils infest the stored maize while others asserted that wrong application of insecticides reduces their efficacy. One woman respondent explained that most farmers used a wrong method of drying maize of putting in on the roof tops of their houses and exposing it to direct sunlight instead of air drying it in the shade. Ten percent of the respondents reported that they could not afford to buy post-harvest insecticides while those that purchased them spent an average of USD 6 on their purchases annually.

Crop marketing went on smoothly for 35.6% of the respondents while the rest faced challenges. A quarter (24.8%) complained about the high costs of transporting produce to markets while 20.7% bemoaned the highly fluctuating prices for farm produce. They observed that due to over-supply at harvest time, prices of farm produce were low and variable. Prices improve a few months after harvest (around December to February) when food stocks are low for most households, that is, during the hunger or lean period. Processing of farm produce such as vegetables would help extend their shelf life and farmers would be able to earn more income from the value addition. Most farmers sale their surplus harvest immediately after harvest as they do not have storage facilities. The majority (82.4%) of the farmers interviewed sold part of their produce (Table 2).

Maize sales dominated immediately after harvests. The maize was mostly sold to the local milling company and not to the state maize buying agency, the Food Reserve Agency (FRA). The farmers explained that they preferred to sell to the privately owned milling company because they did this at a price higher than that offered by FRA and they were paid cash on delivery whereas with FRA they had to wait for weeks or months to get their money. The local milling company purchased a 50 kg bag of maize at ZMW 70. A total of 18,764 metric tonnes of maize were purchased by the local milling company from farmers. The maize is milled into flour and the by-product, maize bran (Marketing manager, pers. com). The presence of the privately owned milling company is a good opportunity for the smallholder farmers as it provides a good steady market. Respondents also reported selling their farm produce to traders from the neighbouring Democratic Republic of Congo (DRC). Their location near the DRC which is a huge market is thus another important opportunity.

Irrigated crop production was engaged in by 33.1% of the respondents. This is an increasingly important activity for farmers that have agricultural plots adjacent to perennial streams as they draw the irrigation water from such streams. Crops commonly produced under irrigation (Table 3) are on high demand from urban residents. Irrigated crop production has great potential in the district due to the relatively large urban population, proximity of peri-urban areas to the central business district and roads

Table 3. Average market prices of irrigated crops during the 2013/2014 farming season.

crop	Price during rainy season (zmw)	Price during dry (off) season (zmw)	Averag amounts sold per household annually
Tomatoes (box)	200	70	76
Cabbage (50 kg sack)	80	40	83
Rape (50 kg sack)	150	100	20
Chinese cabbage (50 kg sack)	150	70	20
Okra (25 kg)	70	120	3
Amaranthus (50 kg sack)	20	50	10
Egg plant (50 kg sack)	120	120	30
African egg plant (25 kg sack)	25	60	-
Sweet potato leaves (50 kg)	30	80	50

1 USD = ZMW 6.25 in July 2014. Source: Field data (2014).

that remain passable throughout the year. Farmers with irrigated plots complained that it was very hard work for most of them as they have to ferry water in buckets to irrigate their crops. They also complained about soil diseases and pollution from the local mine which releases sulphur dioxide fumes that scorch their crops.

Extension services provided by public extension officers were perceived to be adequate by 61.7% of the respondents, while the rest had complaints. Some (26.1%) thought extension officers were not available to provide services such as trainings in crop management and provision of advice. A few (7%) felt the extension officers were selective in their provision of services for example, allocation of FISP inputs to farmer cooperatives while some (3.5%) complained that the veterinary extension officers were inaccessible and expensive as they demanded the farmers to offset their transportation costs. Others complained that extension officers did not provide enough training sessions annually, and the few times that they did, it was to groups with no follow up to individual farms. A key informant from the veterinary department explained that due to very low staffing levels, it was challenging for the department to attend to all livestock farmers when needed. They had sought to overcome this challenge by training a selected group of locals in basic veterinary to work as community veterinary assistants. These veterinary assistants provide services such as vaccinations, de-worming, birthing, and diagnosis of common livestock diseases.

The results reveal major bottlenecks and opportunities at different phases of the farming cycle in a single season experienced by households (Figure 2). As observed by Jayne et al. (2010) there appears to be a vicious cycle in which low surplus production constrains smallholders' ability to use productive farm technologies in a sustainable manner, reinforcing semi-subsistence agriculture.

Other than the household level environment, smallholder farmers also have to deal with wider processes due to policies. These include the national agricultural policy on farming inputs and support for maize prices. Zambia's agricultural policy is highly maize-centric and has historically been dominated by maize for political-economic reasons. This study observes that the farmers focus on mineral fertilizers for nutrient amendments and ignore other nutrient sources such as leguminous crops and trees. This seems to be a reflection of the state's focus on external inputs for agricultural productivity improvements. Farmers also focus on maize production in response to the policies targeting maize production and marketing.

Farmers also have to contend with bio-physical factors such as the high seasonal rainfall, high temperatures and low inherent soil fertility. The high temperatures cause leaching of nutrients and subsequent low soil fertility (Kapungwe, 2013). The high rainfall also limits the weeding opportunities available for farmers dependent on manual weeding. The high temperatures during the hot dry season are associated with poultry diseases. Outbreaks of new castle diseases were cited as responsible for a large reduction in the local population of free ranging chickens.

Unlike most smallholders in Zambia whose land rights are held under customary tenure, the smallholders in the study area access land that is held under leasehold tenure. This entails secure and private land rights. It also means that there are no communally owned grazing areas. This restricts livestock farmers to either stall feeding or tethering the livestock within their yards. Such livestock farmers face challenges of securing sufficient quantities of fodder. Livestock husbandry is not common in the area.

Zambia's liberalized market economic policies have spurred the development of private agro companies which provide various agricultural services. These policies have provided both opportunities and challenges

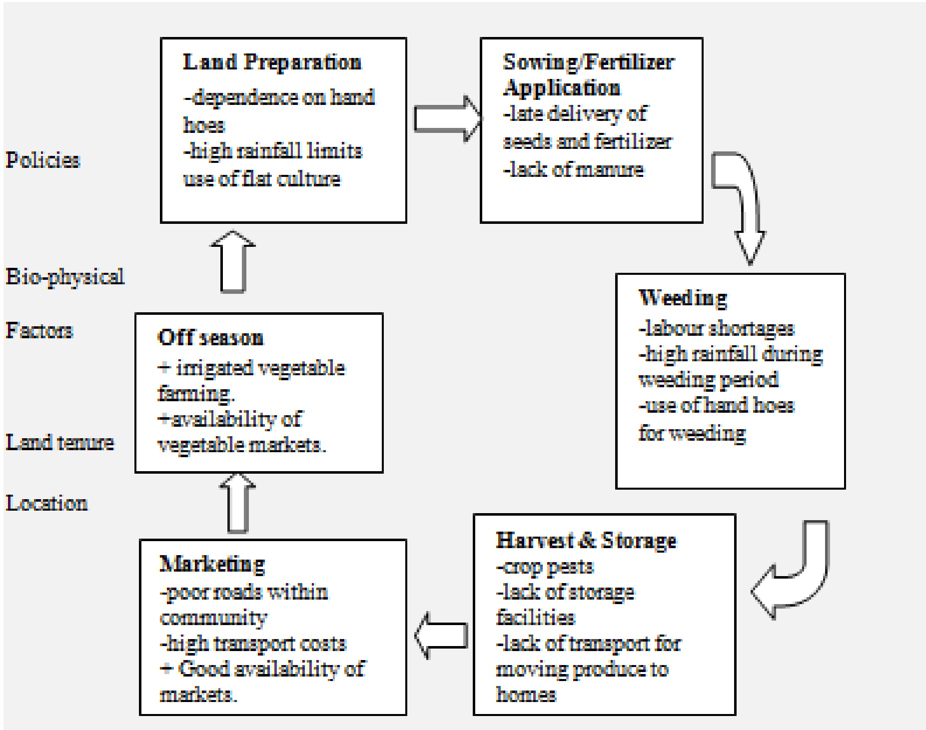

Figure 2. Opportunities (+) and challenges (-) at different phases of the farming cycle in the smallholder farming sector.

for the local smallholder farmers. For instance, the existence of a private milling company that purchases maize from farmers and pays them cash on delivery has provided a very welcome option for smallholder farmers who hitherto sold their maize to the Food Reserve Agency and endured months of hardship as they waited to be paid.

Conclusion

This study has shown that smallholder farmers in Mufulira, Zambia face challenges throughout the farming season, during every major phase of the farming cycle. These challenges range from limited access to external inputs, use of manual tillage methods and shortages of post-harvest storage facilities. Other challenges result from the bio-physical, policy environment, and the location of the study area. The high rainfall has resulted in leached and highly acidic soils which require annual nutrient amendments. The maize-centric agricultural policy mediates the decisions made at household level, which reveal a propensity for maize production and focus on mineral fertilizer utilization. The location of the study area in a relatively densely populated mining district and in very close proximity to the international border with the Democratic Republic of Congo presents a good and steady market for both rain-fed and irrigated crops throughout the year. The study concludes that consideration of locally important factors and the myriad ways in which they interact to mediate farmers' decisions is an important consideration in any development intervention aimed at addressing smallholder farmers' productivity challenges. The findings also point to the need to consider the entire farming cycle when planning interventions, as bottlenecks at all major phases of the farming cycle influence the decisions that are made at any one point. In addition to this, wider policies and institutions also affect farming households decisions and their choices about agricultural productivity enhancing technologies.

Conflict of Interests

The authors have not declared any conflict of interests.

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