HOW DO FARMERS AND SEED PRODUCERS GET INFORMATION AND PROVIDE FEEDBACK ON VARIETIES IN THE PUBLIC DOMAIN: THE CASE OF COMMON BEAN IN EASTERN ZAMBIA?

Maereka, E.K[1]., M. Mwila[2], S. Mudenda[2], S.K. Mudenda[2], M. Zulu[2], A. Chikubi[2], C. Muleya[3] and R.M. Zulu[1]

[1]International Center for Tropical Agriculture (CIAT), Southern Africa Bean Research Network, Lilongwe, Malawi

[2]Zambia Agriculture Research Institute (ZARI), Msekera Research Station

[3]Seed Control and Certification Institute (SCCI), Msekera Research Station

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A Study conducted by the Zambia Agriculture Research Institute (ZARI) and Seed Control and Certification Institute (SCCI) with the International Center for Tropical Agriculture (CIAT)

ABSTRACT

A study was conducted in 2015 to investigate the channels used by farmers and seed producers to access information on bean varieties in the Eastern Province of Zambia, particularly in Chadiza, Chipata, Lundazi and Vubwi districts. Stakeholders, key informants and a sample of 300 bean-producing households were interviewed. Two focus group discussions (FGDs) were also conducted in Chadzombe and Chiwoko Agricultural Camps to contextualize the survey responses. The 300 households produced beans under rain-fed and irrigated wetland conditions, and also grew maize (87 %) and other legumes such as groundnut (66 %) and soybean (61%). Concerning bean production, the majority of respondents (88%) grew only local varieties while 6 % grew only improved varieties, 6% grew both varieties and the remainder (less than 1 %) were unware whether their varieties of choice were local or improved.

Despite the release of 10 improved bean varieties by Zambia Agriculture Research Institute (ZARI) between 2004 and 2014, survey results showed very low levels of awareness and production of these improved varieties among farmers. Reasons cited for not growing improved bean varieties included unavailability of seed, low grain price on the local market (18.8%), high cost of seed (4.2 %) and inadequate knowledge and information on the varieties. The lack of information on improved varieties was closely linked to the use of informal sources for seed acquisition; 51 % of the respondents obtained seed from local grain markets and 21 % through farmer-to-farmer seed exchanges. The study showed however, that these seed sources only supplied varietal information to 4 % of the respondents. While several extension systems exist in Eastern Zambia, the Department of Agricultural Extension/Marketing was recognized by respondents as the main and most credible source of information and skills; cooperatives were second while women groups were the least ranked. Meanwhile, the following weaknesses were conspicuous in the bean variety information flow: i) absence of requests for information from users, ii) absence of clear feedback mechanism that enables farmers to express their information needs, iii) asymmetry from researchers to agrodealers and iv) lack of quality control mechanism on information supplied. Farmers therefore rely on their own- and other farmers' personal experiences to choose bean varieties using sets of characteristics for both local and improved varieties. The farmers' top criterion is high yield, chosen by 65% of respondents, followed by good taste and short cooking time in distant second and third respectively. The combination of criteria is often complex, but contextualized; 'Kapika balesi,' a perceivably fast-cooking variety was the least preferred due to its poor taste. Overall, Lundazi Red was the most preferred local bean type for relish (42 %), followed by Kalima (18 %) and White (17%) and correspondingly, this was reflected in grain abundance in the local markets.

Results from the study call for a critical review of the use of printed materials as the majority of respondents expressed dissatisfaction with publications on improved bean varieties. Informal contacts, on the other hand were considered satisfactory, but respondents lamented the inconsistency and inaccuracy associated with such information flows. The radio continues to be a reliable and desirable information channel among farmers, but a two-way platform would be more appropriate for provision of feedback. Mobile phones, albeit limited ownership, are an emerging and preferable channel. Meanwhile, the respondents preferred access to seed to enable hands-on experiences and extraction of the information they need. Thus, on-farm demonstrations, agricultural shows and longer duration hands-on field trainings were top among the suggested information channels.

ACKNOWLEDGEMENTS

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INTRODUCTION

Agriculture is an important economic activity in southern African countries, including Zambia, where it generates food, jobs and general means of livelihood directly and indirectly. The sector accounts for 20.7 % of the Zambia's gross domestic product (GDP) (FAO, 2013) and actively engages more than 63 % of the country's population (FAO, 2013; MACO, 2004). Agriculture has five categories of farmers in Zambia; subsistence, small scale, emergent commercial, medium commercial and large-scale commercial. While commercial farmers may specialize in crops with well-developed market systems, the risk-averse smallholder farmers (Binswinger, 1980; Dillon and Scandizzo, 1978) often require a diversity of crops including food legumes and vegetables for income, food and nutrition security and resilience to the changing climate. Among the food legumes grown by small holder farmers in Zambia is the common bean, a crop with potential to raise farm incomes in Zambia, but often limited by among other factors, the lack of access to quality seeds of improved varieties (CIAT, 2012). Overall, the smallholder sector is often characterized by low productivity, more so with the current climate change-induced unpredictable weather patterns.

Past efforts by the Zambian government to increase crop production and productivity among smallholder farmers, including the distribution of inputs, were mostly focused on the main staple maize. The recent renewed global attention to legumes, epitomized by the proclamation by the United Nations in 2013 to declare 2016, the International Year of the Pulses (A/RES/68/231: http://www.un.org/en/events/observances/years.shtml), also triggered the Zambian Government's agricultural input support programme to include some legumes such as common bean to promote production, productivity and consumption thereof.

The initiatives indicated above can only make an impact when farmers become aware of, and use these technologies to improve the status of erstwhile neglected crops. While the active involvement of the private sector in the marketing of hybrid seed of maize (Byerlee and Eicher, 1997: Smale and Jayne, 2003) and other cash crops tremendously enhanced use of new varieties and increased yields, the case has been different for legumes; poor access to quality seed and low yields have been persistent.

The use of improved varieties to increase yields may sound very obvious, but it is worth noting that the decision to use and adopt new technologies and varieties is often triggered by information

(Coudel and Tonneau, 2010), an integral part of the knowledge cycle. Understanding this critical role of information is very crucial in technology dissemination. Small scale farmers, often with inadequate information, consider new technologies as risky and uncertain and rely on outsiders' recommendations before trying any new agricultural technology. Farmers are diverse, and so are their information needs (Benard, 2011; Sabo, 2007: Mtega and Benard, 2013: Meitei and Devi, 2009), as influenced by location, type and size of enterprises among other factors. Research to meet the diverse farmers' technology and information needs often fails to meet social demand (Grossetti, 2000), due to inappropriate packaging for different stakeholders (Flaherty et al, 2010) such as farmers, extension and seed producers. Researchers can now take advantage of the recent transformations in information systems and communication technologies (ICT) that now enable dissemination of scientific and technical information (Coudel and Tonneau, 2010: USAID, 2013).

Under the Pan Africa Bean Research Alliance (PABRA), the International Center for Tropical Agriculture (CIAT), Zambia Agriculture Research Institute (ZARI) and other partners in Zambia, have over the years developed and promoted bean technologies including improved varieties in order to enhance productivity among the crop's major producers, the small-holder farmers. The varieties released by ZARI are public goods, and are therefore promoted by various public and private stakeholders, including humanitarian NGOs and both established and emerging private seed companies. Multinational and well-established local seed companies, on the other hand, have also released their own varieties under exclusive licenses. Farmers therefore have access to improved bean varieties from both the public and private domains. When varieties are being disseminated, two products are often bundled together; seed and information, suggesting a strong correlation, but it might not be the case always. Private and public sectors use varying strategies to disseminate seed and information on bean varieties to farmers, and correspondingly with dissimilar results. Edge et al (2011) attributed limited impact of public agricultural research and knowledge systems on rural development to poor accessibility of its outputs. Investment in information on varieties has remained low in Africa. It may therefore be unsurprising that farmers do not know about new varieties. Information needs for bean farmers in Zambia have not been established, despite the prolific release of varieties of this important crop on which people subsist both for food and income apart from maize, sweet potato, seed cotton, tobacco, soybean, sunflower

and groundnut in Eastern Zambia (IAPRI, 2013). Generally, legume food crops form an important part of the smallholder farming systems in eastern Zambia.

Against this background, ZARI working with CIAT undertook a study in the Eastern Province of Zambia to determine the flow of information on bean varieties from research to seed producers and farmers, and document the factors affecting these processes.

Objectives

The main objective of this study was to:

i. Investigate the channels used by farmers in the Eastern Province of Zambia to access information on bean varieties.

The study had the following specific objectives:

i. To measure the effectiveness of current models for disseminating information on bean varieties to end-users and seed producers of various kinds.
ii. To determine the role of local organizations in disseminating information on bean varieties.
iii. To determine the mechanisms used by local organizations to disseminate information on bean varieties.
iv. To determine the existing links between bean variety suppliers and seed producers.

METHODOLOGY

Study sites

The Eastern Province of Zambia (Figure 1) has nine districts with varying climatic and soil conditions. There are three agro-ecological zones identifiable in the Eastern Province of Zambia; the plateau zone and the valley zone extending mostly westwards are punctuated by a thin escarpment zone in the middle. This study was undertaken in four districts: Chadiza, Chipata, Lundazi and Vubwi. The latter was a new district at the time of the study, having been established in 2010 from part of Chadiza District. The four districts receive unimodal rainfall during the November to April main cropping season. Lundazi and Vubwi Districts fall in the north-eastern and south-eastern regions of the plateau respectively and are characterized by sandy soils and normal rainfall in the range 800 to 1000 mm. On the other hand, Chipata District, located on the central part of the plateau, receives rainfall in the range 850 to 1050 mm per season and is characterized by heavier soils. Chipata district experiences a mean annual maximum temperature of 27.8 ^{o} C and a mean annual minimum temperature of 16.3 ^{o} C. The corresponding values for Vubwi district are 27.9 ^{o} C and 13.2 ^{o} C, while those for Lundazi district are 27.1^{o} C and 13.8 ^{o} C respectively.

Study districts and camps

The survey was conducted in two agricultural extension camps from each district: Zozwe and Mbozi camps of Zozwe agricultural extension block in Vubwi District; Hoya and Kapichila camps of Emusa and Mwase agricultural blocks in Lundazi District respectively, and Kalunga and Chiwoko agricultural extension camps located in the Eastern and Western agricultural extension blocks of Chipata district. This survey used deliberate targeting to select the main bean production areas in each district.

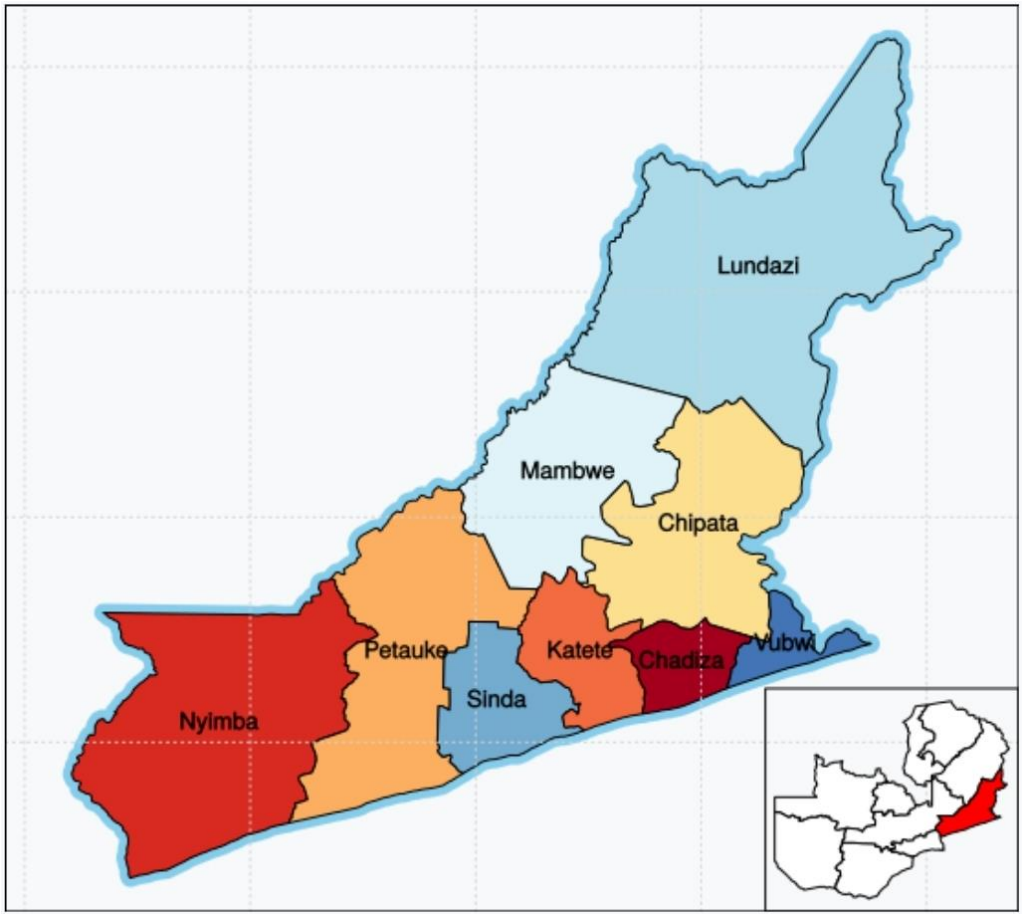

Figure 1: Map of the Eastern Province, Zambia

Data collection

This study had three main components for information collection. In the first component, consultative meetings were conducted by two researchers from CIAT with various stakeholders (key informants) in the bean value chain that included:

i. DACO District Coordinators in Chadiza, Chipata, Lundazi and Vubwi (public extension)
ii. Representatives of seed companies supplying bean seed in different parts of Zambia
iii. Farmer groups/associations, including Muthila Kubili that has been producing quality declared seed (QDS) of legumes
iv. Researchers from ZARI: bean breeders, farming systems scientists
v. Staff from the Seed Control and Certification Institute (SCCI),
vi. Staff from non-governmental organizations (NGOs) involved in agricultural extension services such as Conservation Farming Unit (CFU) and Catholic Relief Services (CRS) and

vii. Some members of Lundazi District Agricultural Stakeholders Innovation Platform (LUASP).

The purpose of the meetings was to understand the context and level of involvement of these various stakeholders in dissemination of varieties of common bean and the associated information in eastern Zambia.

In the second component of the study, a questionnaire was administered in three districts: Chipata, Lundazi and Vubwi, targeting and interviewing 50 bean producing households from each agricultural extension camp. Stratified random sampling was used; willing households were randomly picked from bean growing households. Agricultural extension camp officers selected bean growers from their respective camps. In total, 300 household interviews were conducted face-to-face. Farmers were made aware beforehand of the objectives of the survey through the agricultural camp extension officers. The survey sought to collect household data on variables that were hypothesized to influence bean variety choice. The questionnaire had questions on : a) household characteristics, b) social capital networking, c) land holding, d) crop production activities, e) sources of agricultural knowledge and information, f) bean seed production, g) knowledge and adoption of local and improved varieties of bean, h) household bean consumption and i) preferred traits of bean types. The survey team comprised eight enumerators and two supervisors. The enumerators were drawn from a pool of already trained enumerators available at ZARI, Msekera Station. The enumerators were scientific officers and research technicians with a minimum of a diploma in agriculture and all had hands-on experience working with food legumes. The survey was carried out between 16th and 22nd November, 2015, an opportune time to capture information available as farmers were preparing for the main planting season, which normally starts in December.

The third component of the study comprised two focus group discussions that were conducted with farmers and camp agricultural extension officers in Chadzombe and Chiwoko agricultural extension camps in Chadiza and Chipata districts respectively. The discussions sought to give a better understanding of the farmers' written responses to the survey, and to generate more information on the subject under investigation. The focus group discussions were attended by leading bean farmers from the camps and the respective agricultural camp extension officers; Chadzombe (6 female: 10 male) and Chiwoko (11 female: 25 male). In Chadzombe, the

participating farmers had previously participated in a variety promotion project, jointly implemented by PABRA through ZARI and Plan International between 2000 and 2003. Areas of interest for discussion included; bean types grown by farmers and the reasons, preferences on bean types and preferred sources of information. During discussions, farmers also had the opportunity to share their experiences on bean production.

These processes of data collection were augmented by literature review to develop this report.

Data analysis

Survey data were analyzed using the Statistical Package for Social Scientists (SPSS version 20). Primarily, frequencies, correlations, multiple response analysis and cross-tabulations were performed on the data.

Study Limitations

In this study, it was assumed that farmers had correct knowledge about diseases, pests and other agronomic aspects and supplied accurate information during the study. To improve accuracy of data collected, each enumerator carried bean disease identification charts and samples of local varieties as guides during the interviews. Also, enumerators carried brochures of improved bean varieties released in Zambia for identification by interviewees.

RESULTS

Gender and marital status

This survey characterized both male and female respondents. As shown in Table 1 below, 71.0% of respondents were men while 29.0% of respondents were female. The ages of the respondents varied between 20 years and 80 years of age. Most of the respondents were middle-aged, 36 to 64 years (58.7%) followed by the youth, aged between 20 and 35 years (36.9%). Farmers aged above 65 years represented only 4.4 % of the respondents.

Table 1: Age and sex of respondents

Sex of respondents	Percentage of respondents by age groups (in years) (n=298)			
	20-35	**36-64**	**65 and above**	**Total**
Male	27.5%	41.3%	2.3%	71.1%
Female	9.4%	17.4%	2.0%	28.9%
Total	36.9%	58.7%	4.4%	100.0%

Of these respondents, 89.7% were married, 2.0% were single, while 4.3% and 4.0% were divorced and widowed respectively. Most of the surveyed households had 4-6 members.

Household type

Key decisions were made or completed as a dual by both male and female spouse in 60.1% of the households that responded to the study while female headed households with adult male decision makers was found at 2.1% (Figure 2).

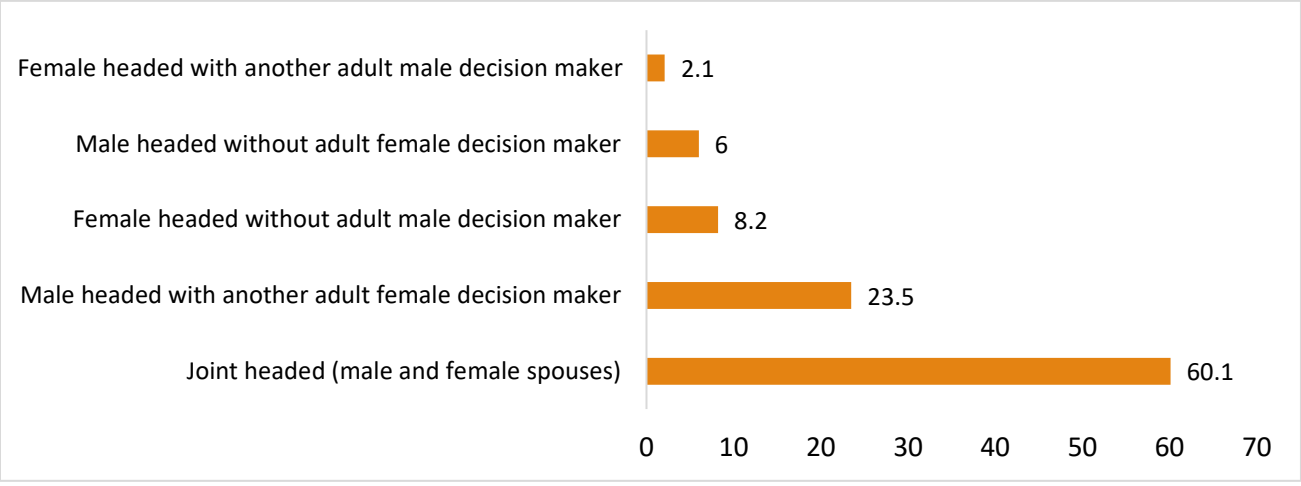

Figure 2: Structure of households that responded to the study

Level of education of household heads

In the three districts, the highest level of education level of the household head (HHH) varied from primary through to tertiary education. The majority farmers only attained primary school education; 49.8% and 52.9% for male and female HHH respectively (Figure 3). Generally, female HHH were less educated compared to their male counterparts; 75 % of the male HHH could read and write while the corresponding figure was 57.5% in female HHH. Also, 16% of male HHH did not receive any formal education at all compared to 21.8% in women.

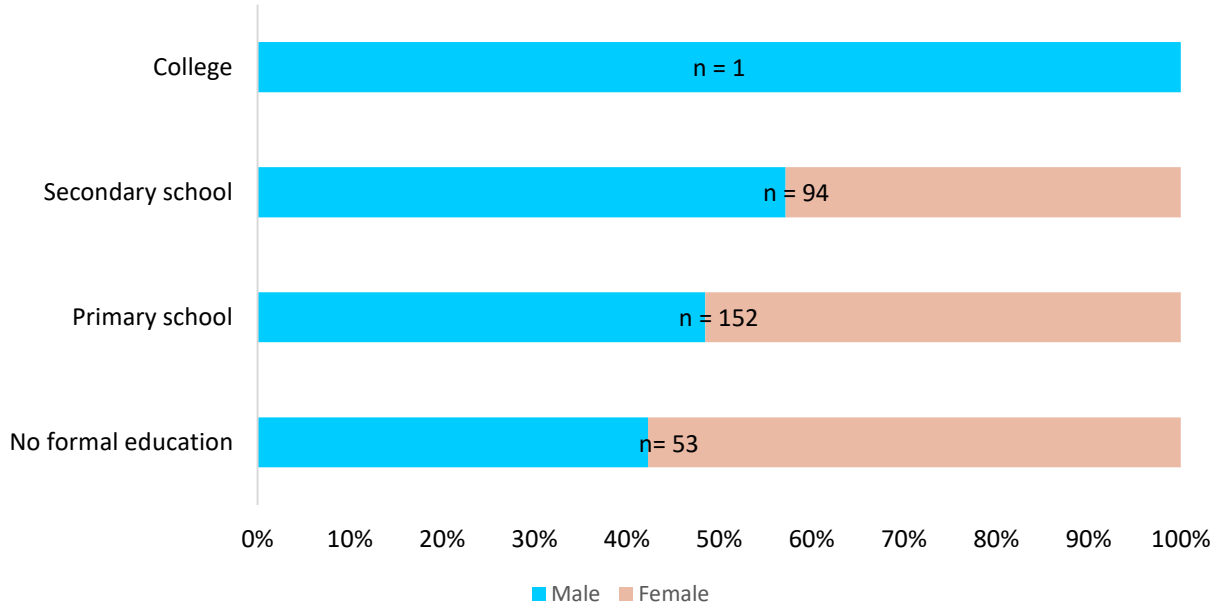

Figure 3: Highest educational level attained by heads of households in the study

Land Holding

The bean farmers provided information on how much access they had to land and how much land was owned or/and rented including amount of land allocated to cereal and legume production for both 2013/14 and 2014/15 seasons. Household land size in the study area varied between 0.25 hectares (ha) and 40 ha. Some farmers also grew crops on less than 5 ha of rented land, only to augment production area in addition to the owned land; no single household solely relied on rented land for crop production. In both 2013/14 and 2014/15 seasons, more than 65 % of farmers had

access to, and owned land below 5.0 ha (Table 2). Interestingly, the percentage of farmers that allocated land to legumes was high (90% and above) in the 0-5 ha range and declined as the land size increased.

Table 2: Access to land among respondents in the study

Land size range (Ha)	Percentage with access	Percentage ownership	Percentage renting	Percent cultivated	Allocation to cereals (%)	Allocation to legumes (%)
2013/14 Season (*n =300*)						
<1 - 5	67	68.3	94.7	77.4	92.6	95.2
>5 - 10	23.1	22.2	5.3	17.4	5.6	4.1
>10 - 15	5.8	5.6	0	2.1	1.4	0.3
>15 - 20	2.1	1.8	0	1.4	0.4	0.4
>20 - 40	2	2.1	0	0.7	0	0
2014/15 Season (*n =300* **)**						
<1 - 5	65.9	66.4	91.7	73.9	91.7	94.4
>5 - 10	23.9	23.9	4.1	20	5.8	5.2
>10 - 15	5.4	5.7	4.2	2.9	1.4	0.4
>15 - 20	2.4	1.5	0	2.5	1.8	0
>20 - 40	2.4	2.5	0	0.7	0.4	0

Social Capital and Networks

District agricultural structure

Within each district, agricultural activities are coordinated through the District Agriculture Coordination Office (DACO), headed by a District Coordinator in the Ministry of Agriculture and Livestock (MAL), Department of Extension/Marketing. The DACO houses the public agricultural extension services. Each district is organized into agricultural extension blocks that are built on agricultural extension camps (Table 3). Ideally, each agricultural extension camp is manned by a camp extension officer, reporting the agricultural block extension officer, but due to staffing limitations this is not always the case on the ground. Agricultural extension camps and blocks are variable in size depending on district size and staffing levels. For ease of management, each agricultural camp is divided, usually into six agricultural zones. Within each agricultural camp, there is a camp agricultural committee (CAC) which comprises the camp extension officer, other extension service providers in the camp and farmer representatives from the zones (chosen by their respective communities). The CAC is chaired by a zonal chairperson. Furthermore, at block and

district levels, there are agricultural committees whose meetings are always chaired by farmers while the DACO provides secretariat services

Table 3: Number of agricultural extension blocks, camps and zones in the four study districts at the time of the study

District	Extension blocks	Extension camps	Manned camps	Agricultural zones[1]
Chadiza	2	16	11	96
Chipata	8	58	48	348
Lundazi	5	44	35	264
Vubwi	1	7	7	42

Source: DACO 2015

The majority of respondents (72.1%) acknowledged the presence of agricultural extension service providers, numbering at least 15 in total in the four study districts (Table 4). While the Department of Extension-MAL was the most known extension provider, reported by 39.1% of the respondents, it is worth highlighting that the respondents were also aware of other notable agricultural extension service providers such as Conservation Farming Unit (CFU: 20.3%), Community Market for Conservation (COMACO - 10.9%), Cargill (6.9%), Mawa (4.7%) and PROFIT^{+} (3.6%). Furthermore, a combined total of less than 2 % of the respondents affirmed the presence of other NGOs such as Total Land Care, Self Help Africa, Village Service Centre, Plan International, Lutheran World Federation (LWF), and World Vision International.

Apart from the organizations above, 78.9% of respondents also reported working with community based farmers' multi-purpose farmers' groups. Notable among the activities of the groups were: the supply of inputs (48.3% of respondents), provision of training and information (27.6%), labour sharing (12.4%), hosting of research trials and technology demonstration (7.1%), crop marketing (6.9%) and seed production (5.0%), seed and savings lending (4.2 %) and income generation

[1] Based on the average figure of 6 zones per camp, but some camps may have up to 8 zones

Table 4: Roles of various categories of stakeholders in extension services in Eastern Province

Organization	Role and modes in extension	Perceived effectiveness and limitations
ZARI/PABRA	▪ Origin of all information on public bean varieties – variety descriptors ▪ Conduct varietal trials, demonstration plots and field days ▪ Actively engage seed companies, seed producers/growers to produce seed of the released varieties	▪ Receive feedback from participatory variety selection guides variety development and required information ▪ Accurate information from experts and variety developers ▪ Distribute publications anywhere in the country ▪ Hands-on coverage limited to research sites only
Department of Extension/Marketing - MAL: District Agriculture Coordination Office (DACO)	▪ Mandated government agricultural extension services ▪ Coordinate extension collaboration among service providers (at zone, camp, block and district) ▪ In charge of Farmer Training Centres ▪ Conduct on-farm demonstrations, field days and agricultural shows	▪ Work with all partners and farmers on all crops ▪ Zonal, Camp, Block and District monthly meetings for issues, feedback and follow-on, but limited staff mean waning farmer visits ▪ Reliable source of quality-controlled information and technologies ▪ Consistent on-farm demonstrations, field days and agricultural shows at all structures
Seed Certification Control Institute (SCCI)	▪ Validates varietal characteristics through NVT[2] ▪ Train seed inspectors, and certified seed and QDS producers ▪ Promote use of good quality seed (seed fairs and other fora) Give seed industry regulatory updates through mass and print media, and exhibitions.	▪ Opportunity for farmers to know about the bean varieties before release ▪ Very limited reach: only two NVT sites in Eastern Province; Msekera Research Station and Masumba, and one seed fair per district. ▪ Does not control the varietal information disseminated by stakeholders and penalty for offenders is non punitive(18 ngwee US$0.015)[3]
Private Seed Companies and Commodity Corporations (e.g. Afri-Seed, Zamseed, , Cargill, COMACO)	▪ Use information on public varieties to market certified seed ▪ Create awareness and promote varieties (demonstrations, field days, information materials and mass and print media advertisements).	▪ Only a few seed companies promote public bean varieties: ▪ Very limited stockists/retail outlets for bean seed in Eastern Province. ▪ No commodity corporations working on the bean value chain in the study districts
Farmers' Groups, Associations and Cooperatives	▪ Coordinate farmers' 'consolidated voice' in advocacy and lobbying ▪ Support input supply, marketing, savings and lending	▪ Voluntary members access information and technologies faster than non-members ▪ Specific to commodity
Non-governmental Organizations (NGOs) (e.g World Vision International, Self Help Africa)	▪ Support farmer resilience and relief ▪ Organize farmer groups and support lead-farmer, private service provider development ▪ Organize field days, food fairs, seed fairs and cooking demonstrations ▪ Promote QDS production by groups	▪ Staff work only with designated farmers ▪ Input starter-kits provide hands-on experience ▪ Work hands-on with farmers beyond field production characteristics to include post-harvest processing/ culinary, nutrition and market ▪ Decentralized farmer-to-farmer and ICT enabled approaches reach masses and provide feedback
Multi-stakeholder Platforms (e.g. LUASP[4], EPLSA[5], Scaling Up Nutrition)	▪ Provide a multi-stakeholder forum for sharing expert developed information, knowledge and technologies – members include PACO[6], DACO, ZARI, SCCI, seed companies, NGOs, agrodealers and farmers ▪ Coordinate extension service providers and joint events.	▪ Quality control and feedback on expert-generated information through farmer-interactive joint visits ▪ Opportunity for reporting and fighting fake seed on the market. ▪ Emphasis is on the use of certified seed only

[2] NVT: National Variety Trial

[3] Exchange rate was US$1:ZMK12 at the time of the study

[4] LUASP: Lundazi Agricultural Stakeholders Innovation Platform

[5] E astern Province Legume Seed Alliance

[6] PACO: Provincial Agricultural Coordination Office

(1.9%). Of particular interest to the bean value chain was one group called Muthila Kubiri which was involved in QDS production for improved bean varieties.

The organizations listed above have shaped the agricultural technology transfer landscape in Eastern Province in the last five years, with the department of agricultural extension/marketing standing out. The majority of respondents reported to have attended agricultural extension events (70.6 %) and training sessions (30.8 %) organized by the department, followed by non-governmental organizations (NGOs) and cooperatives (Table 5). Some of the respondents (4.6 %) were also trained by SCCI as seed producers. The least agricultural extension support came from women's associations (1 %). However duration of trainings was too short for small scale farmers to fully assimilate the technologies as they were conducted on average in three days. On average, agricultural extension camp holds four training sessions per month, (one for each zone) on different aspects of production and marketing of various crops.

Table 5: Households with members attending training or any other extension event organized by service providers in the past 5 years

Type of organization	**Frequency of households** (n=300)	
	Extension event	**Training**
Government extension	70.6%	30.8%
NGOs	12.7%	26.2%
Cooperatives	4.9%	29.2%
Research	3.9%	3.1%
Farmers' group	-	4.6%
SCCI	-	4.6%
Other Government Ministries / departments (other than MAL)	2.0%	-
Faith based organizations	2.0%	-
Women associations	1.0%	-

Source: Survey data

Bean Production in Chadiza, Chipata, Lundazi and Vubwi Districts

The bean crop is grown in various locations that included upland or plateau areas, *dambos*; river and stream basins. In the study districts, most of the farmers' bean fields were located on the upland (73 %) followed by *dambos* (seasonal wetlands / meadow lands) (16 %) and only 10 % had fields located on both the upland and *dambos*. Very few were located in the riverine and or basins (0.3 %). The survey results revealed that 97.6 % of the farmers interviewed owned the pieces of land on which they produced beans while 2 % rented fields and 0.3 % of the respondents shared the pieces of land to produce their bean crop. The bean crop was produced in intercropping (15 % of households) and sole cropping (85 % of the households) systems. Even within intercropping, farmers allocate varying proportions of land manage risks. In the study, 64 % of respondents had less than 25% of bean field as an intercrop, 30.8 % intercropped 25%-50% of the bean field, while a meager 2.6% intercropped more than 75% of their bean fields (Figure 4 a). In these intercrops, the main companion crops for the common bean were reported as maize (46.4 %), sunflower (26.8 %). The rest of the respondents intercropped beans with cotton (7.1 %) and sweet potato (1.8 %) (Figure 4 b).

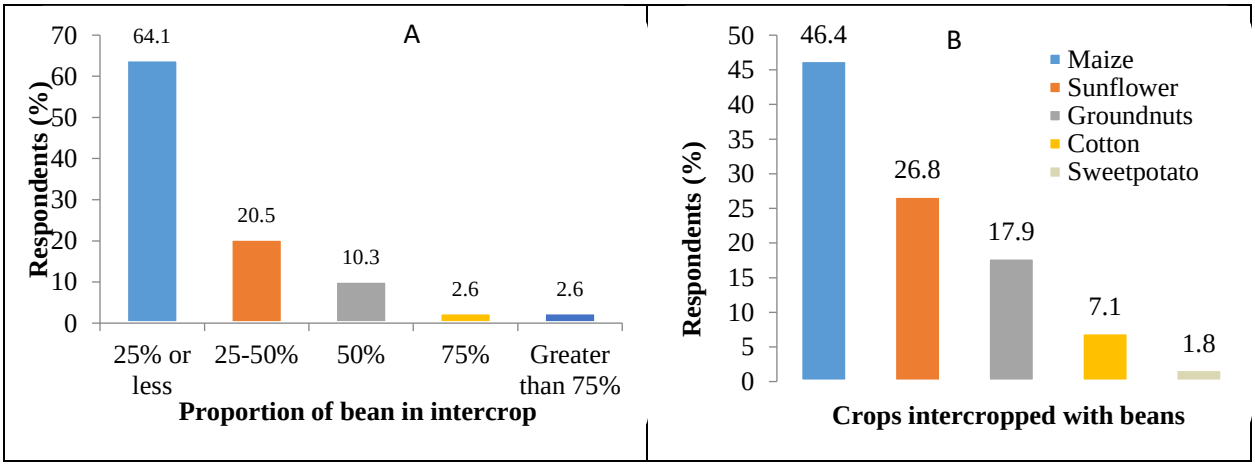

Figure 4: Bean production in intercrops

Organizations that provided technical support to bean production

Despite the heavy presence of extension service providers as highlighted earlier in the report, efforts aimed at promoting common bean production are very minimal; only 17.7% of the respondents reported ever working with organizations that supported the production or marketing of the common bean. As a result, the average bean yields are generally low as highlighted in Table 5 below. These average yields represent a 75 % yield gap between on-station research and on-farm yields.

Table 6: Bean production and yield estimates in the four study districts at the time of the study

District	Estimated 2014 bean grain production (t)	Average bean yield (t/ha)
Chadiza	475.6	0.35
Chipata	864.15	0.60
Lundazi	799	0.48
Vubwi	80	0.22

Source: DACO 2015

The study revealed that farmers planted two types of beans; local varieties and improved varieties. The majority of respondents (87.6 %) planted local varieties while only 5.7 % planted improved varieties while another 6.0 % planted both local and improved varieties. Meanwhile, 0.7 % of the respondents did not know whether the varieties they planted were local or improved.

Bean Variety Awareness and Use

Bean Varieties Released in Zambia

The Plant Variety and Seeds Act (CAP 236) of the laws of Zambia mandates the Seed Control and Certification Institute (SCCI) to assess adaptability, agricultural performance and produce value of varieties in order that only suitable varieties are released in Zambia. Candidate varieties are gazzetted after scrutiny from the Variety Release Committee (VRC), which comprises 12 members

representing multi-stakeholders in the Zambian seed industry. ZARI and SCCI are both organizations in the MAL, but each has a clear and independent mandate. SCCI facilitates the release of varieties including those developed by ZARI. Furthermore, SCCI carries out post-release quality control, which is inspection and certification of all classes of seed except breeder's seed; the first seed to be inspected is therefore pre-basic seed.

On its own, SCCI has an establishment 30 to 40 seed inspectors, seed samplers and analysts, but only had approximately 50 % staff in post at the time of this study. Striving to deliver its mandate with low staff levels, SCCI through its special unit, trains and licenses seed inspectors from the private and public sectors across the country. The institute also conducts training, proficiency testing and accreditation of inspectors once a year, a course that also attracts participants from neighbouring countries. Ideally, each district is supposed to have a seed inspector, hence extension officers, as key technical people, are also targeted for seed inspection and certification training whenever resources permit. Furthermore, SCCI also trains both certified and (QDS) producers, often upon request (demand-driven training) and depending on availability of resources. According the laws of Zambia (Plant Breeders' Rights Act: 2007), seed producers must pay royalties to the public research breeders, but this is yet to be implemented. Meanwhile, seed companies have not started paying royalties and the government incentivizes smallholder legume QDS producers' contribution to variety dissemination by exempting them from paying royalties. Eastern Province has numerous farmer groups that produce QDS of a few bean varieties.

According to the 2015 national variety register, 31 bean varieties are registered in Zambia and of these, 21 are currently on the market; 13 from ZARI and 8 from private seed companies (Table 7). Recent history also shows that ZARI, working in collaboration with various partners, released 11 improved bean varieties between 2004 and 2014. Table 6 below lists these bean varieties registered by SCCI since the first one in 1970. Zambia Seed Company and ZARI varieties, 74 % of the registered varieties, are public while the remaining 26 % are private, and in the hands of four international seed companies. Meanwhile, both local and international private seed companies are also eligible to produce and market public varieties. Six private seed companies currently produce and sell seed of bean varieties generated from public research.

Table 7: Bean improved varieties registered in Zambia up to 2015[7]

Variety	Year of release	Title holder/agent	Public / Private
Boroti	1970	Zambia Seed company Limited	Public
Misamfu Stringless	1973	Zambia Seed company Limited	Public
Misamfu Speckled Sugar	1979	Zambia Seed company Limited	Public
Bat 331	1984	Zambia Seed company Limited	Public
Carioca	1984	Zambia Seed company Limited	Public
Contender	1984	Zambia Seed company Limited	Public
Glamis	1984	Zambia Seed company Limited	Public
NEP 2	1984	Zambia Seed company Limited	Public
Top Crop	1984	Zambia Seed company Limited	Public
Chambeshi (A 197)	1998	Zambia Seed company Limited	Public
Lukupa	1999	Zambia Seed company Limited	Public
Lyambai	1999	Zambia Seed company Limited	Public
Bounty	2004	Seed Co International	Private
Kalungu	2004	Zambia Agricultural Research Institute (ZARI)	Public
PAN 148	2006	Pannar Seeds (Z) Limited	Private
Cardinal	2007	Progeny Seeds	Private
Kabale	2007	ZARI	Public
Kapisha	2007	ZARI	Public
Kabulangeti[8]	2007	ZARI	Public
Speckled Ice	2007	Progeny Seeds	Private
PAN 116	2008	Pannar Seeds (Z) Limited	Private
PAN 128	2008	Pannar Seeds (Z) Limited	Private
PAN 185	2009	Pannar Seeds (Z) Limited	Private
Luangeni	2009	ZARI	Public
PAN 123	2010	Pannar Seeds (Z) Limited	Private
Kalambo	2011	ZARI	Public
Sadzu (Climber type)	2011	ZARI	Public
Mbereshi	2012	ZARI	Public
Lungwebungu	2014	ZARI	Public
Lunga	2014	ZARI	Public
Kware	2015	Klein Karoo Seed	Private

[7] **Source:** SCCI Bean Variety Register 2015
[8] Developed from local variety by the same name

Despite the remarkable number of released improved bean varieties and a comprehensive Zambian seed sector, survey results showed that these improved varieties are still unknown across Vubwi, Lundazi and Chipata districts (Figure 5). Out of the varieties released between 2004 and 2014, the most known improved public variety was Kabulangeti, known by about two thirds of the respondents, followed by Chambeshi, known by about 11 % of respondents (Figure 5).

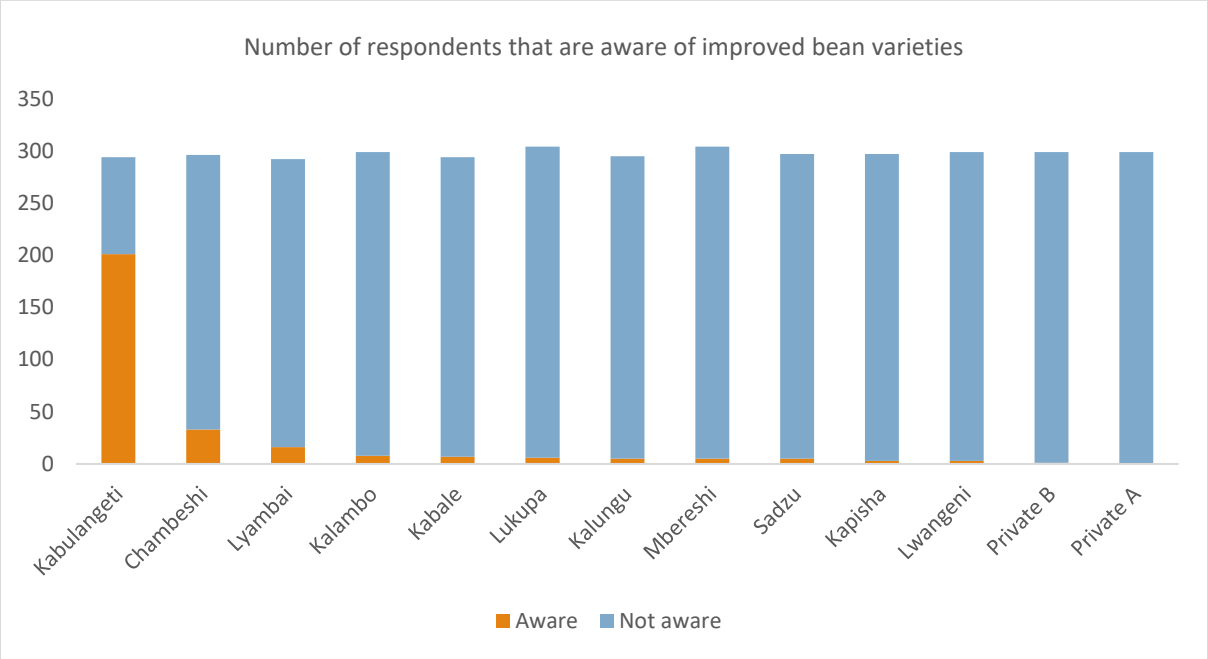

Figure 5: Number of respondents that are aware of bean improved varieties in the study districts

Source: Survey data

Awareness of the other nine public bean varieties ranged between 1 % and 5 % each. Similarly, improved private bean varieties were also unknown in the study districts. The results of the study further showed that of those respondents that were aware of improved varieties, only about 55 % had ever planted improved varieties. Similar to awareness, Kabulangeti recorded the highest number of farmers to have ever planted by the variety (117) followed by Chambeshi (13) (Figure 6)

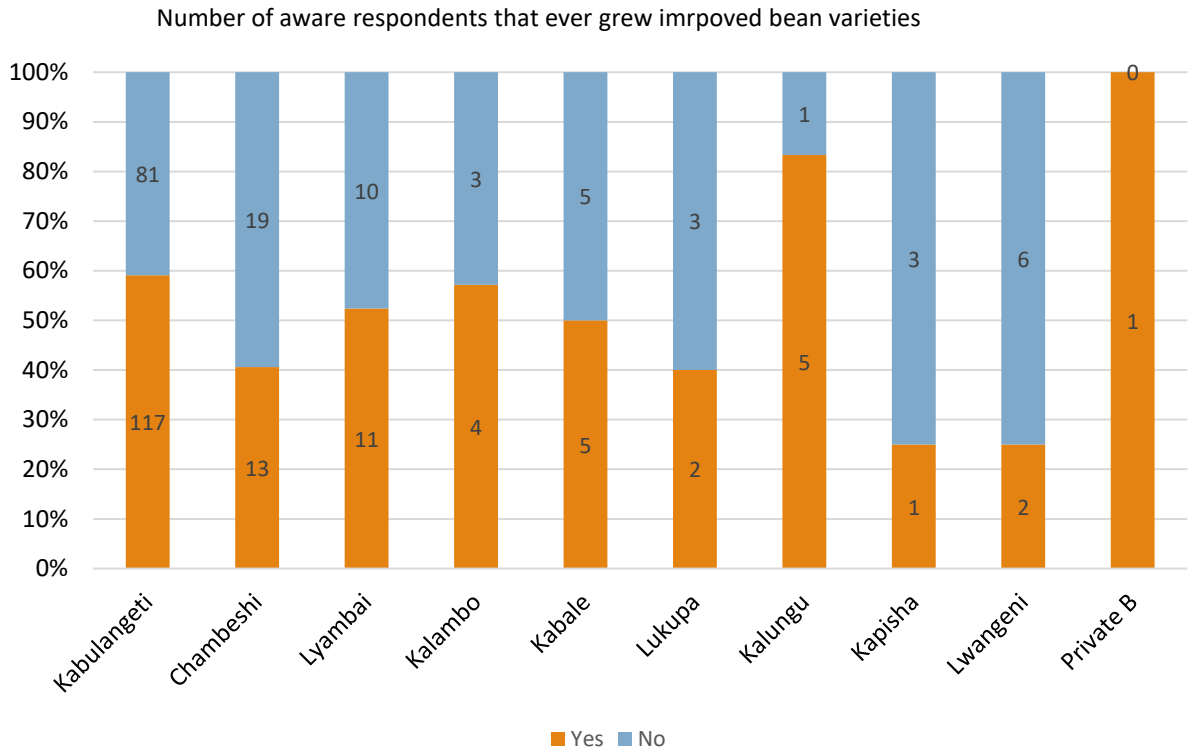

Figure 6: Level of knowledge on improved bean varieties in Eastern Province

Unlike unknown improved varieties, local varieties are the backbone of bean production in Chipata, Lundazi and Vubwi districts. Farmers plant local varieties such as Lundazi Red (red), White, Sweetbeans (small white grained) and Katyetye (cream striped) (Figure 7).

Figure 7: Bean local varieties grown in Eastern Province, Zambia

Overall, the most popular local varieties in descending order of cultivation were: Lundazi Red (22%), White (15.2%), Katyetye (13.9 %) and Kalima (12 %) (Figure 8). However, the data also showed varying district production preferences; each district had its own descending / ascending order of cultivation. The most widely cultivated local variety Lundazi Red in Chipata and Vubwi districts, while in Lundazi district it was Katyetye. In addition to these, Solwezi, a local variety popular in Western Province was also reported to be grown by a few farmers during focus group discussions in Chadzombe and Chiwoko (6.3 % and 2.8 % respectively).

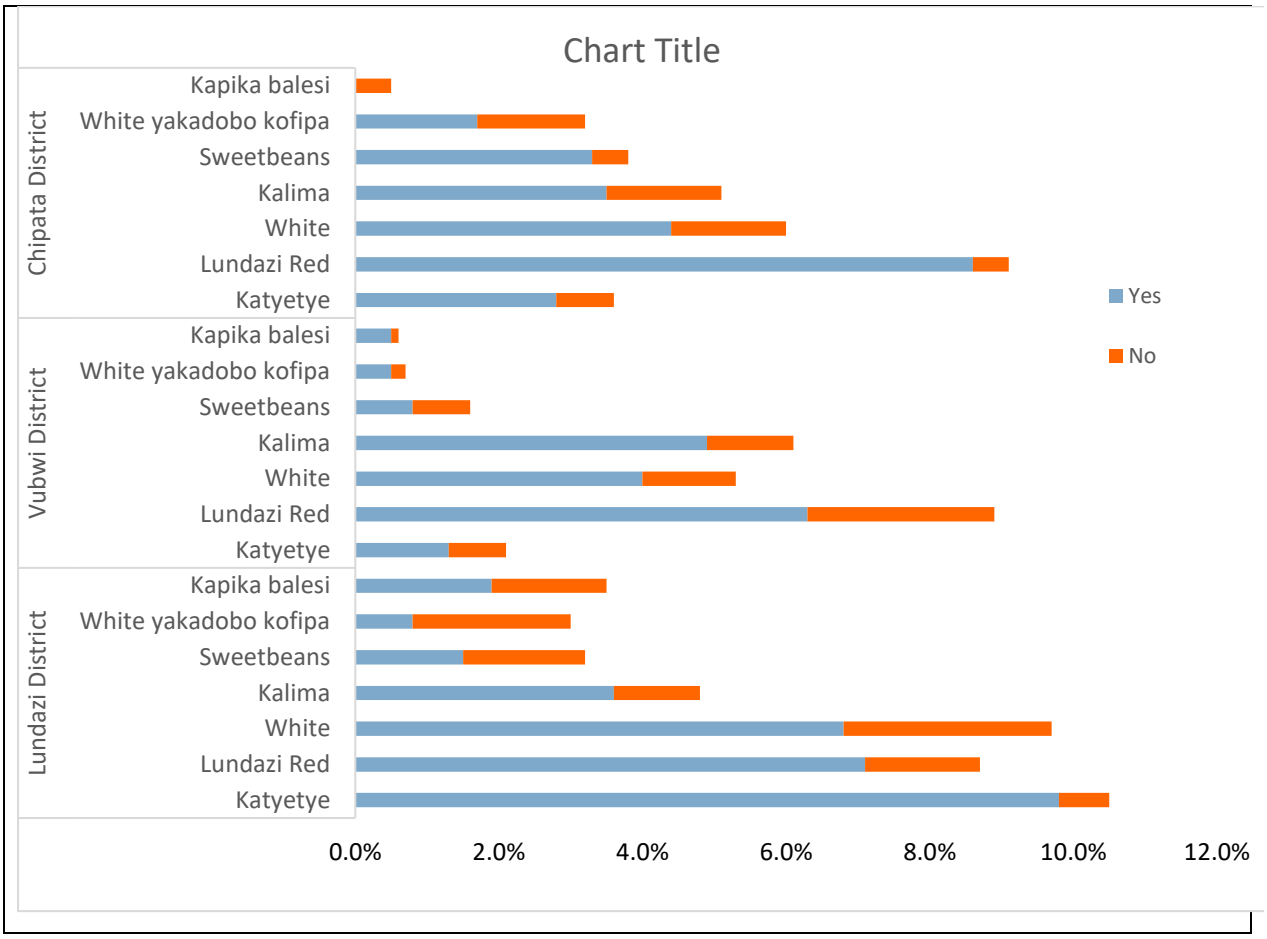

Figure 8: Popularity of bean local varieties in the study districts

Reasons for Not Growing Improved Bean Varieties

Most respondents that did not plant improved bean varieties in the 2014/15 season cited non-availability of seed as the major reason for not planting improved varieties.

Other reasons cited included lack of cash/credit to acquire seed of improved bean varieties, lack of enough land to specifically 'experiment' with unfamiliar varieties and poor taste (for one private variety). The outlook is bleak as respondents indicated they would not grow even already known varieties in future unless the seed is available (65%) and the grain price on the local market improves (18%) (Figure 9). Other farmers also cited organized theft, lack of lines of credit and inadequate information (6 % a piece) as other impediments to future production of bean improved

varieties. Therefore local availability of seed needs improvement for increasing likelihood of improved bean variety uptake.

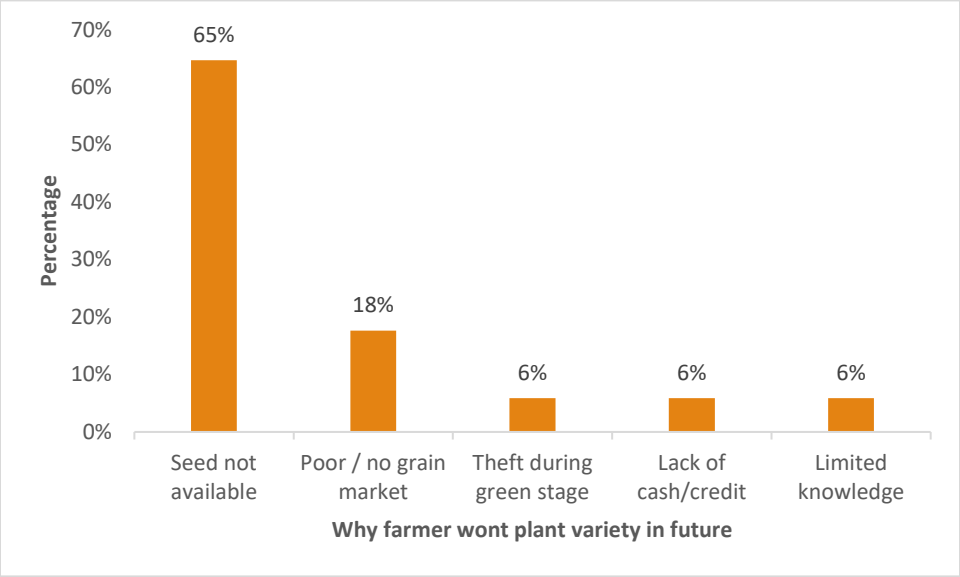

Figure 9: Reasons for not planting bean improved varieties in future

Source: Survey data

One of the major challenges to the formal supply of bean seed is the availability of sufficient volumes of pre-basic and basic seed required by different stakeholders. On one hand, ZARI, the only accredited producer of pre-basic seed of public varieties, has limited capacity contract private producers to meet the demand. On the other hand, stakeholders, facing an uncertain market, do not always do not always commit to their demands. Newly released bean varieties have thus remained unknown and unavailable to farmers and other stakeholders, exposing information systems as both a cause and a consequent. The government recognizes QDS as a seed formal class to ensure farmers using quality material. QDS is the lowest grade of seed that is certified by SCCI according to the QDS scheme (FAO, 2006).

Information needs on bean varieties

Farmers have diverse preferences for the bean crop depending on location and intended production goal. These preferences are based on genetic attributes that constitute varietal quality (FAO, 2010). In this study, most farmers (65%) indicated that high yield is a top priority when selecting both local varieties and improved varieties of bean (Figure 10). Good taste and fast cooking follow on a distant second and third respectively. Of less importance are shattering tolerance and lodging tolerance at 1 % apiece. However, from focus group discussions in Chadzombe and Chiwoko camps, it became evident that farmers prioritize potential marketability as well, especially for a new variety. The focus group discussions further highlighted that diseases and pests can be managed through various approaches; susceptible varieties can therefore be produced under strict management, hence disease or pest resistance cannot be accorded top priority for selection compared to high yield or marketability.

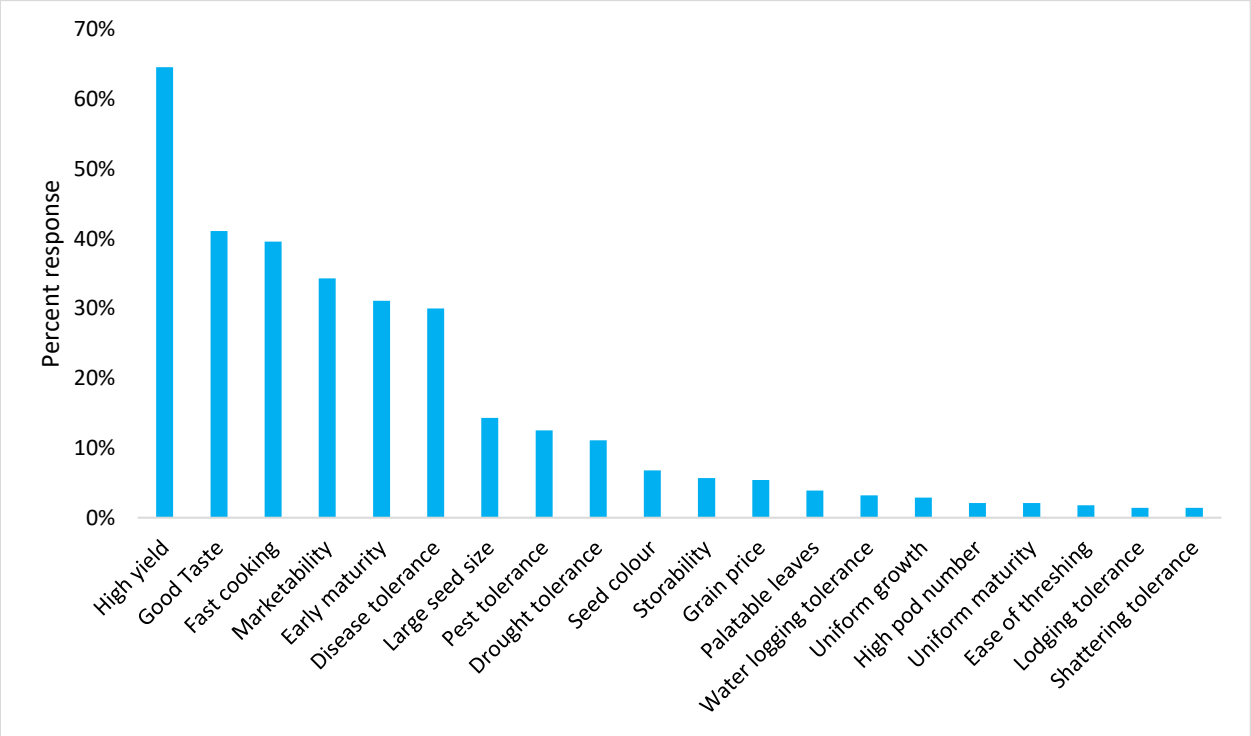

Figure 10: Traits that guide choice of common bean varieties in Eastern Province

Preference for relish

In the study districts, farmers grow the common bean mostly for home consumption. The common bean which is ordinarily consumed as accompaniment (relish) to the main staple was reported to the second most popular relish (14.3% of households), only after vegetable greens, the first ranked consumed by 83.3 % of respondents respectively. From the study, 35.5 % of respondents consumed beans twice a week while a further 34 % consume beans once a week. Understanding the information needs for a suitable relish was therefore key. Bean variety suitability for relish is based on a number of factors, but taste was rated as the number one priority. Lundazi red was the most preferred bean type for relish (42.1 %), followed by a distant Kalima (17.5 %) and White (17.1%) while Kapika balesi was the least preferred type. (Figures 11a and 11b).

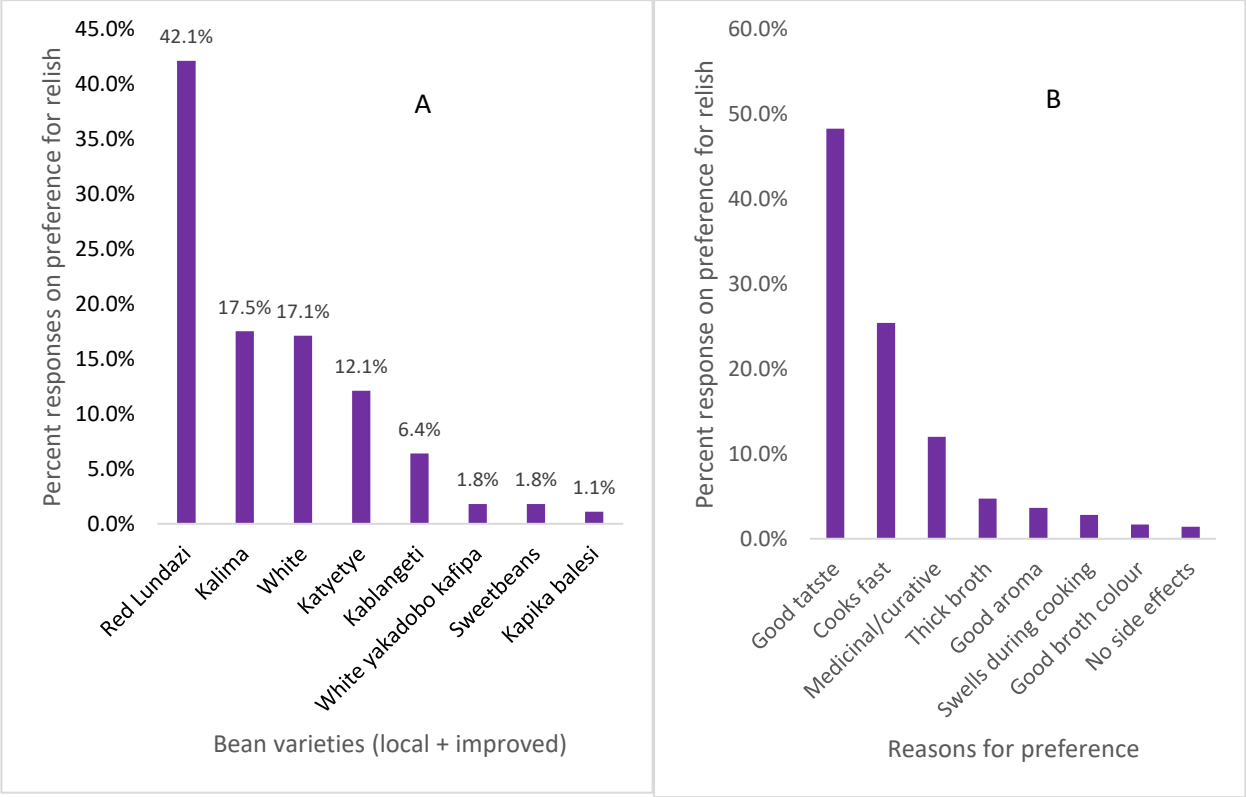

Figure 11: Bean varietal preferences (A) and reasons (B) for selection for relish

Current Sources of Information on Bean Varieties

Survey data shows that bean farmers mainly receive information on bean varieties from informal sources. Bean farmers get varietal information from other farmers as reported by 81 % for local varieties and 62 % for improved varieties (Figure 12). The public extension system only supports information dissemination to 9.9 % of respondents for improved varieties and 3.3 % of respondents for local varieties.

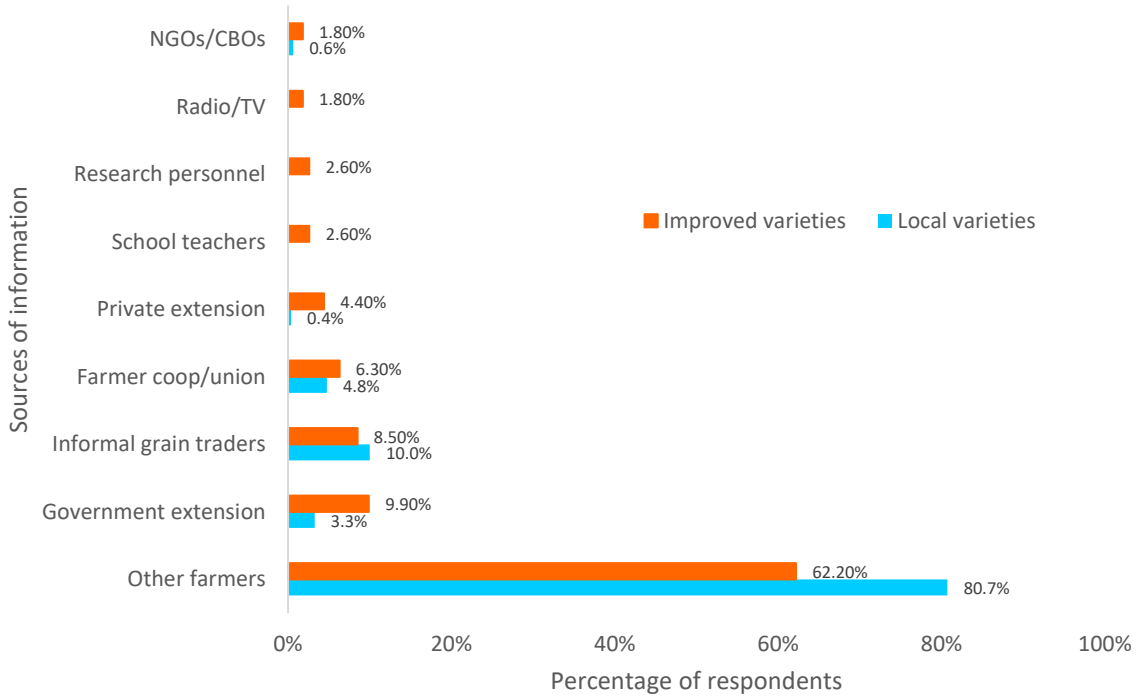

Figure 12: Farmers' main sources of bean varietal information in Eastern Province

Linking information to Main Source of Seed

Seed sources could either be formal or informal, however, survey data shows that the main seed sources were mainly informal. The market was reported as the main source of bean seed for the majority of respondents; 53 % for local varieties and 51 % for improved varieties (Figures 13a and 13b). The second source of bean seed was reported to be fellow farmers. For local varieties, respondents distinguished between main grain market and mobile grain vendors (10 %). The government and NGOs were reported as the least common source of bean seed for both local and improved varieties.

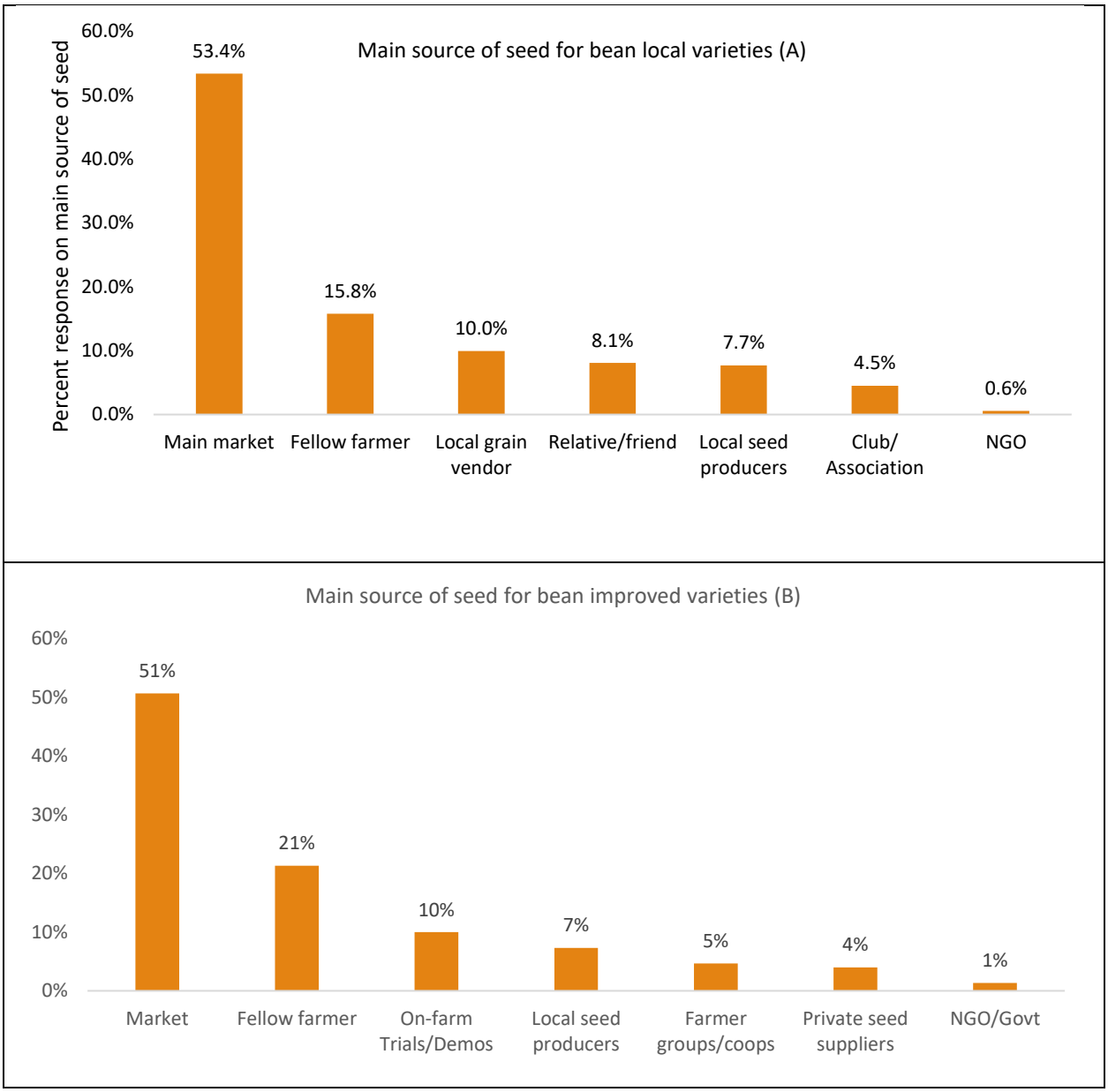

Figure 13: Main bean seed sources for local varieties (A) and improved varieties (B)

Means of acquiring first seed of improved bean varieties

Most of the farmers were willing to pay either directly or indirectly to acquire seed of both local and improved varieties of common bean. On average, 76 % of the respondents made cash purchases to acquire seed across all the seven bean local varieties, and less than 20 % obtained free seed (Figure 14a). For the few farmers that grew improved varieties, the percentages of respondents that spent cash on purchasing seed varied widely from the highest (58%) reported for

the variety Kabulangeti to zero reported for Kabale and Kalungu (Figure 14b). On average, only 1.7 % of farmers that planted improved varieties obtained the seed for free.

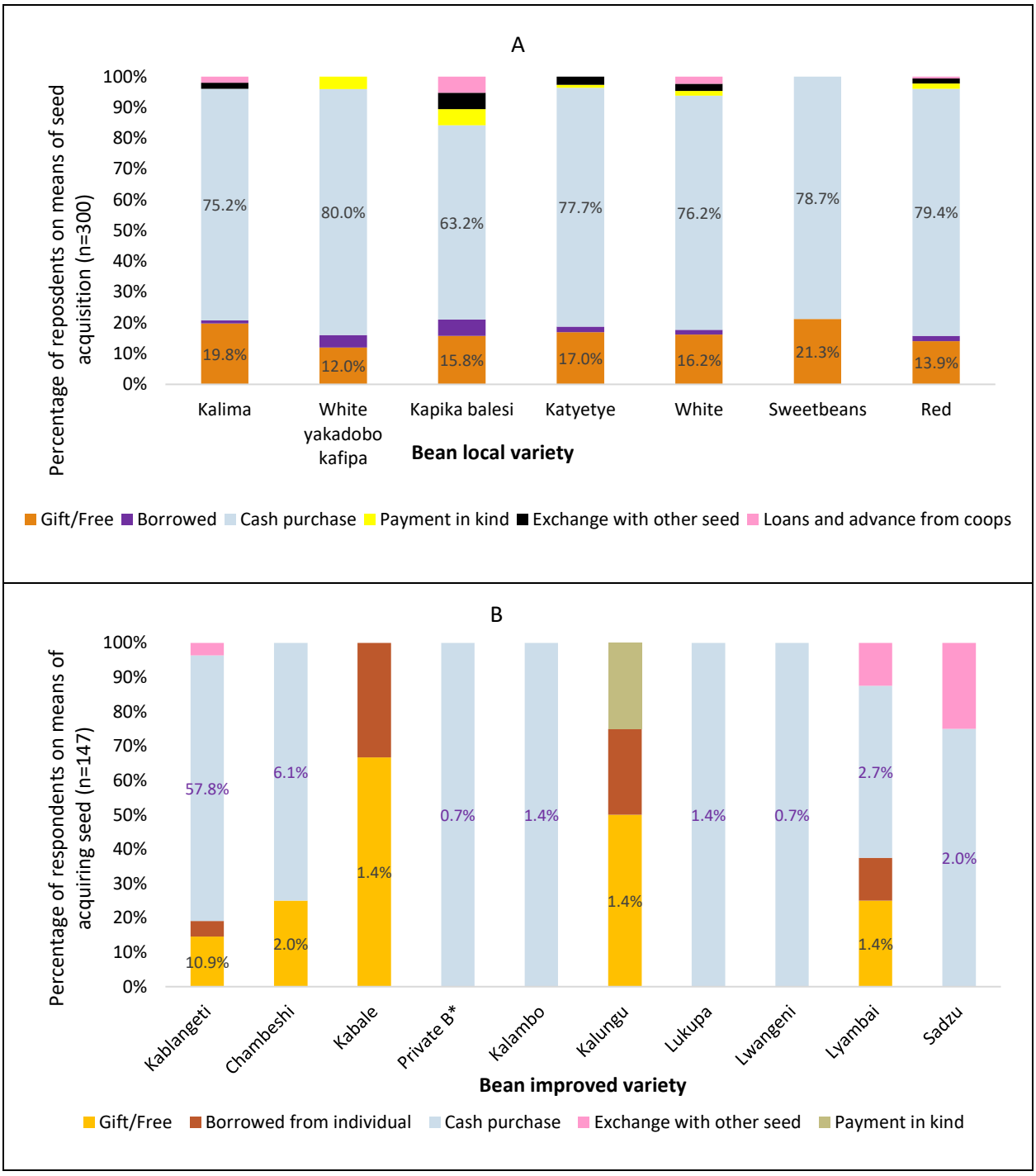

Figure 14: Means of acquiring bean seed of local varieties (A) and improved varieties (B) in Eastern Province

How Information on Improved Varieties Flows

CIAT and ZARI and other partners under the PABRA network have information about bean improved varieties online through the PABRA database available on the PABRA website (http://pabra-africa.org/) (Figure 15). The PABRA website showcases PABRA's research on bean by theme and location, impact being created in Sub-Saharan Africa and the resources such as manuals, handbooks and scientific publications. It has an integrated blog and is linked to social networking sites like Facebook (https://www.facebook.com/PanAfricaBeanResearchAlliance), Flickr (http://www.flickr.com/photos/103874658@N03/) and Twitter (https://twitter.com/_PABRA) to increase interaction between PABRA and users of bean research information. Anyone, including agricultural extension personnel can make use of the PABRA website and on-line database to inform farmers on developments in bean research and particularly on varieties. At country level, ZARI, using the information presented to the VRC, compiled a pictorial booklet that describes bean improved varieties released between 2003 and 2014 (Figure 15 - insert).

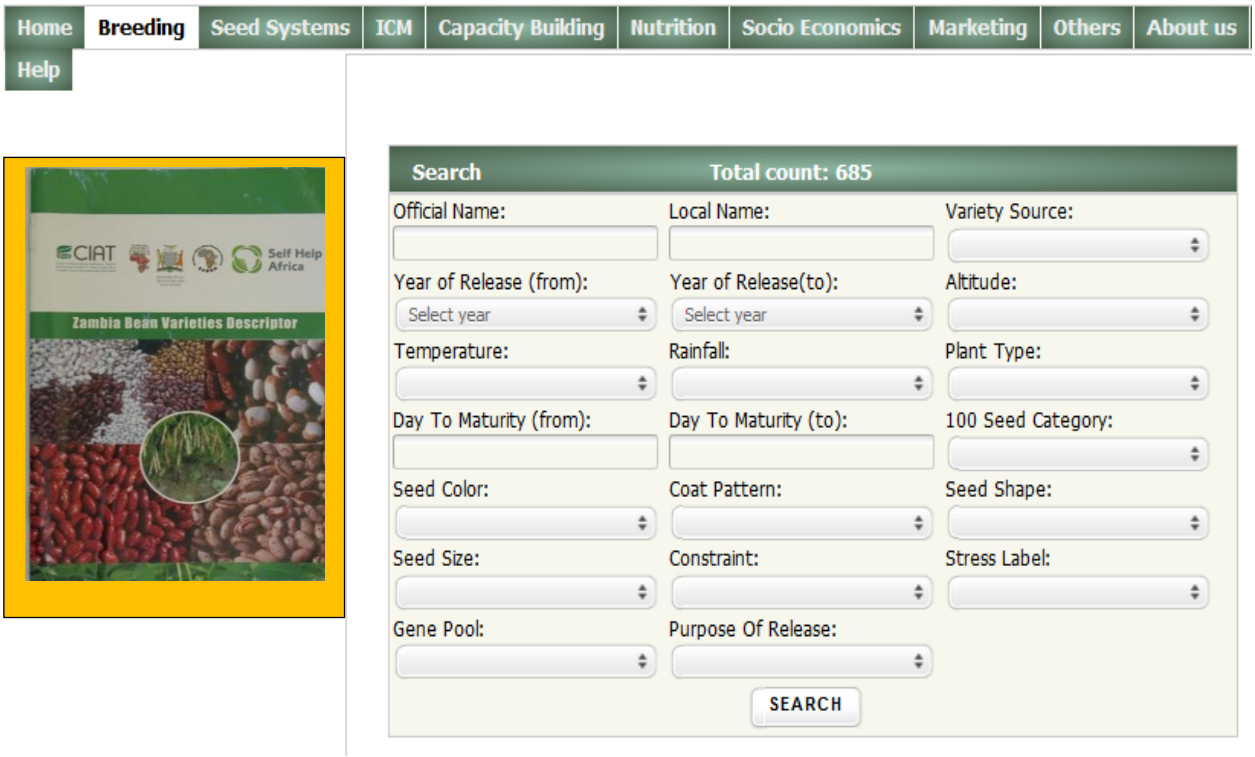

Figure 15: Screenshot of the PABRA database, and (insert) the Zambian Bean Variety Descriptor

The Zambian Bean Varieties Descriptor describes important varietal characteristics including grain colour, flower colour, days to maturity, seed size, potential yield and market potential. Apart from the booklet, ZARI also uses varietal pamphlets, posters, on-farm trials, demonstration plots and exhibitions and other media to communicate to various stakeholders about bean improved varieties. Meanwhile, ZARI is mandated to carry out research, and therefore relies on other stakeholders such as the Department of Extension, NGOs, seed companies and others to reach out to farmers. Furthermore, the various bean stakeholders also use channels of choice to communicate to farmers. Figure 16 gives a schematic presentation of how information flows in the bean value chain.

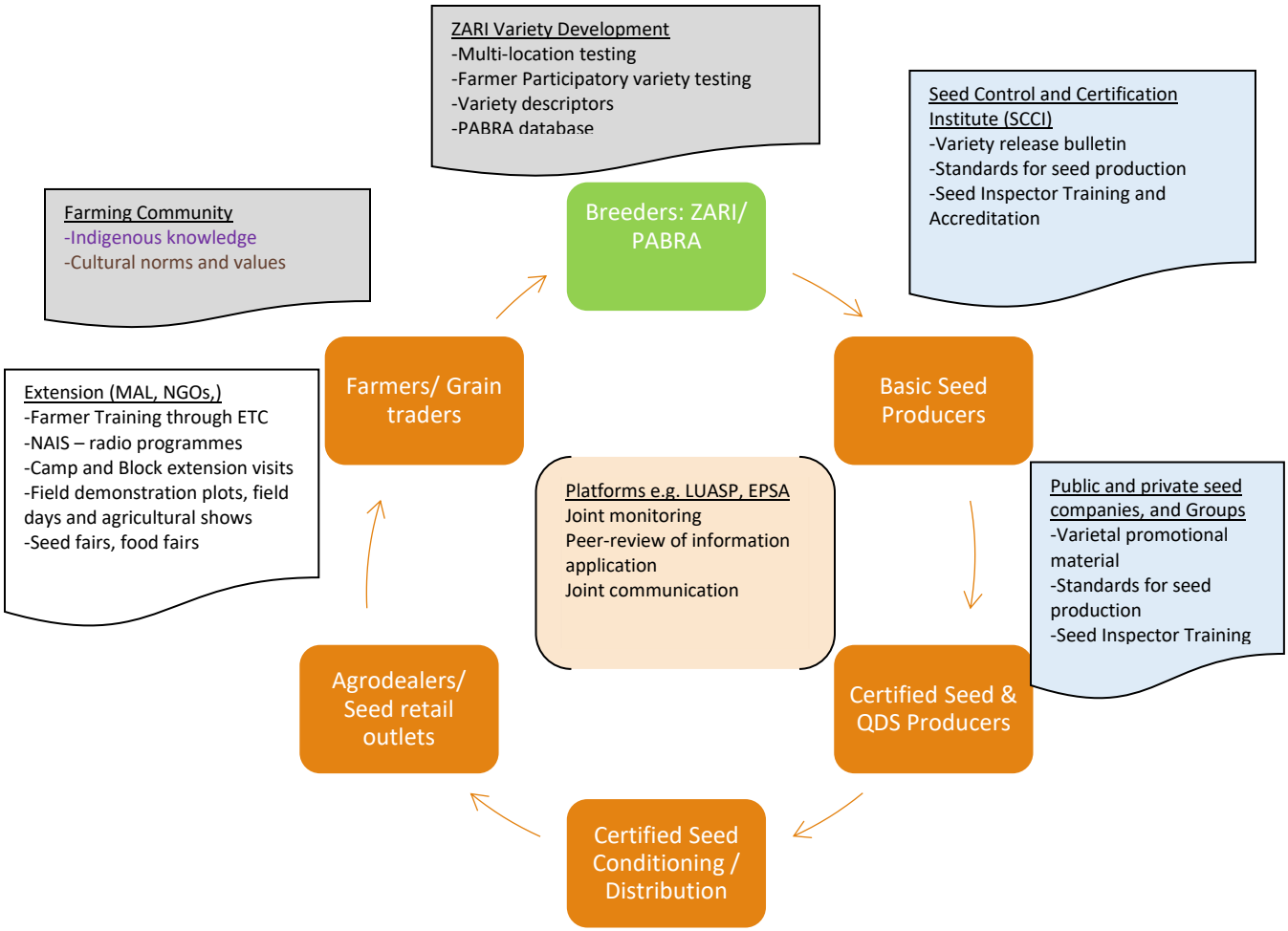

Figure 16: Schematic presentation of formal varietal information flow from ZARI to farmers

Farmers reported receiving information on improved bean varieties through various channels, but the four main channels in descending order of frequency were informal contacts (29%) agricultural camp meetings (18.7%) agricultural shows (13.8%) and field days (12.7%) (Figure 17). Radio programmes were also reported to be an important information channel by 10.8 % of the respondents.

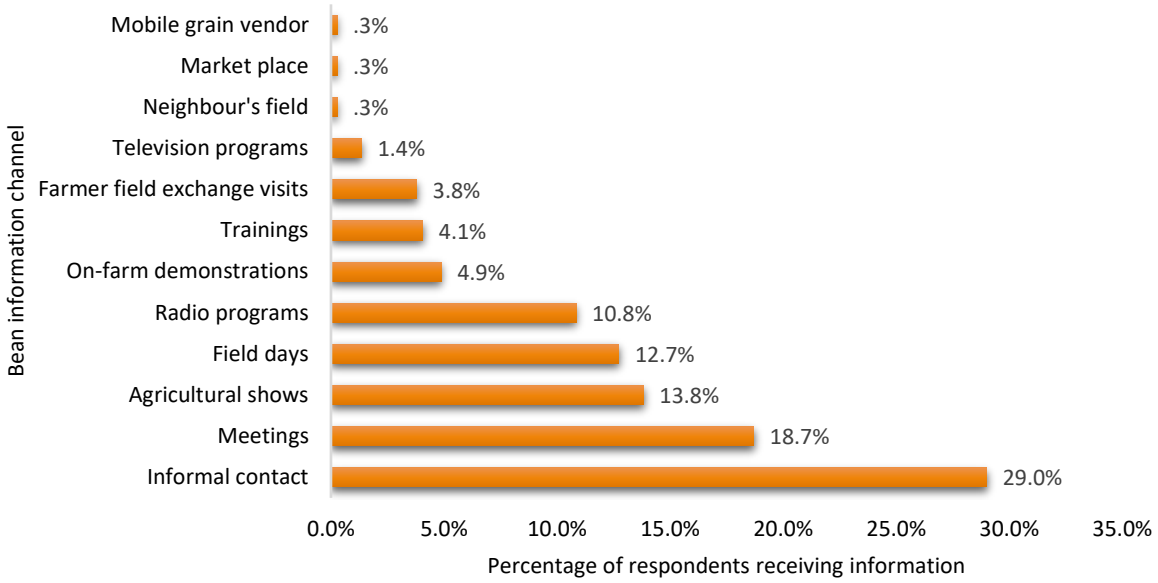

Figure 17: Channels through which farmers receive bean varietal information

Agricultural zones, being the smallest units for the public extension, provide an opportunity for a small number of farmers (20-25) to meet frequently, hence they are a frequently used channel of information. Agricultural zones, which number more than 600 in the study districts together with Farmer Training Centres, also host demonstration plots and field days, suggesting a high number of demonstration plots and field days by the DACO only. More on-farm demonstration plots and field days are also held by other different stakeholders such as seed companies, farmers groups or cooperatives. For instance, CFU annually hosts close to 460 field days in Chipata district alone through its network of lead farmers, while Muthila kubili, a farmers' group hosts six field days every year. ZARI-Msekera Agricultural Research Station hosts the main provincial field day, but there are many other field days hosted at Farmer Training Centers (FTC), camp and block level. At times, field days are combined with food fairs and cooking demonstrations where farmers get an opportunity to further understand the varieties under promotion.

Establishment of demonstration plots is usually preceded by hands-on training at the FTCs or on-farm. DACO has calendar training events in each camp. On average, each agricultural extension camp conducts 20 training events between June and October every year. In addition, demand-driven trainings are also conducted by the DACO while other stakeholders also conduct training sessions. The training of trainers (ToT) model is widely used in Eastern Province by both the

government and other stakeholders, as the lead farmer approach is increasingly getting common. For instance the projects Conservation Agriculture Scaling Up (CASU) and Expanded Food Security Pack (EFSP) had more than 2000 lead farmers in Vubwi district alone. Similarly, in Lundazi alone, CFU had 130 lead farmers and each lead farmer targeted to train at least 50 farmers every year. Also, Mawa had more than 500 lead farmers in Chipata and Lundazi to disseminate technologies. To further recruit more farmers, technologies and their impacts were also showcased through exhibitions such as agricultural shows.

Agriculture shows are coordinated by the DACO's office. They are held at camp, block, district, provincial and national levels and are mandatory from block level upward. Chipata district holds a minimum of 10 agricultural shows, (8 blocks, 1 District Show and 1 Provincial Show), Lundazi district holds an average of 15 shows (at least 1 district, 5 block shows) while Vubwi holds a minimum of two (1 block and 1 district). Farmers are involved in organizing shows through the various show society committees comprising farmers, agriculture extension officers, camp agriculture committee (CAC) and other partners. These shows, which are open to every member of the public, provide an opportunity to showcase and learn about agricultural technologies available from public and private stakeholders, including bean local and improved varieties (Figure 18).

Figure 18: Typical agricultural show exhibition stand (A) and bean variety displays (B)

Similar to the agricultural shows, are seed fairs that display varieties planted by farmers. Seed fairs are organized mostly by NGOs in collaboration with SCCI. The legume seeds displayed and sold at seed fairs are required to be certified by SCCI to be of QDS class at least. Each district hosts at least one seed fair per year, advertised in advance through various media including the radio.

At least six public and private radio stations broadcast in the study districts. The main public stations are Zambia National Broadcasting Corporation (ZNBC) Radio 1 and Radio 2. The private radio stations include Radio Breeze, Radio Maria, Feel Free Radio and COMACO Farm Talk. Community radio stations such as Chikhaya also operate in the province. Furthermore, farmers living along the Zambia-Malawi or Zambia-Mozambique border especially in Vubwi district, also listen to Malawi-based radio stations such as Radio Mchinji and Zodiak. While these radio stations, except COMACO Farm Talk, do not exclusively broadcast on agriculture, they have specific agricultural slots on which stakeholders may convey specific messages in choice languages. For instance, the National Agricultural Information Services (NAIS) runs a program from Monday to Friday at 0645 hours on ZNBC Radio 2. One regular and popular programme from NAIS is the one-on-one interviews with farmers to discuss technology application in specific contexts. Similarly, CFU has call-in and role-playing radio programmes. Also, as reported in Vubwi district, NAIS organized farmers into listening groups for Radio Farm Forum (Mudziwatu – You know) from Radio Mchinji which tackles topical issues including technologies such as varieties.

Understanding Demand for Information

Out of all the available channels, farmers were requested to indicate whether they requested for information to be supplied in the way it was. Generally, the majority of farmers did not request the information they received, except for through the informal contacts (Figure 19a). The number of farmers requesting for training, agricultural shows, field days and meetings was smaller than those who did not request. The most requested formal channel of information flow was the radio Television programs followed by on farm demonstrations and field exchange visits. Surprisingly, no respondent ever requested for publications. Despite generally not requesting for the information, farmers still viewed current channels used positively. The majority of respondents generally reported satisfaction with the current channels, except for publications that were disliked

by all respondents (Figure 19 b). The least proportion of dissatisfaction was reported for zonal meetings for which only one out of 54 respondents reported dissatisfaction.

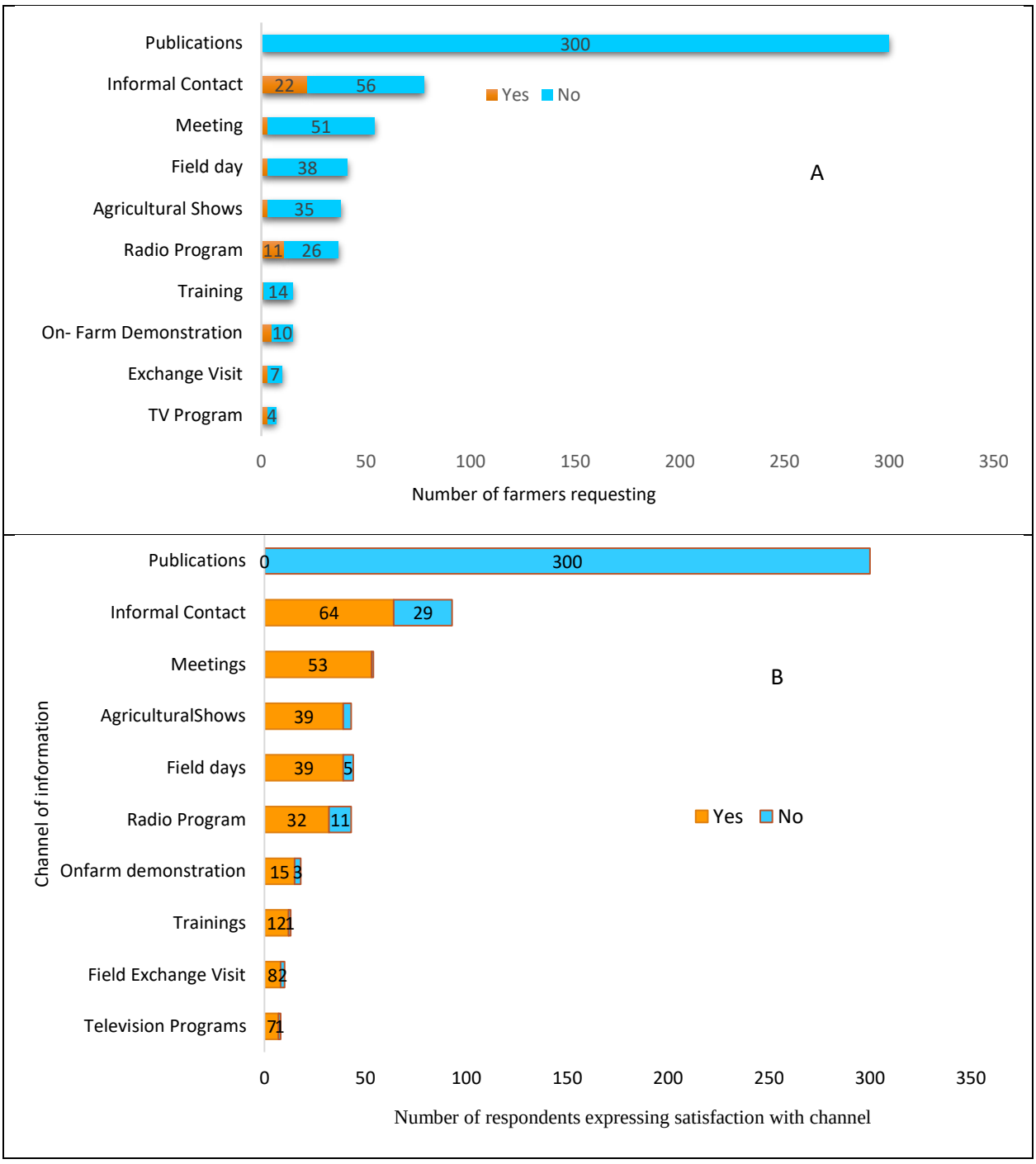

Figure 19: Farmers' levels of request (A) and satisfaction (B) with specific information channels

Focus group discussions and key informant interviews highlighted the traditional one-sided nature of communication between farmers and agricultural research and extension personnel. Efforts were under underway however, to provide for feedback and help improve the quality of information. Table 8 summarizes how feedback was provided for and captured.

Table 8: General provisions for feedback in bean improved varietal information system

Communication channel /Issue	Means of farmers' feedback
Variety trials	▪ Participatory variety selection (PVS) is all about feedback ▪ Feedback from the farmers is normally variety performance and rarely on information provided.
Meetings, field days, shows, training evets, seed fairs	▪ Post-event clarification with the camp officer. ▪ Bi-weekly and monthly meetings at zone, camp and block level are used to compile feedback – experts can be invited to provide clarification to the CAC ▪ Farmers' associations, unions, cooperatives and groups provide a consolidated position. ▪ SCCI takes samples of seed at fairs for quality control
Radio programmes	▪ NAIS conducts one to one interviews with farmers ▪ Lead farmers compile feedback which can be discussed through a radio forum with experts / panelists

Suggestions on enhancing farmers' access to information on improved bean varieties

After expressing dissatisfaction with some information channels, farmers suggested a number of improvements for enhanced access to information on bean improved varieties. The top two were hands-on training and zonal meetings, suggested by (20%) and (19%) of the respondents respectively (Figure 20). On-farm demonstration plots and field days and radio programmes were the third and fourth channels suggested by (14.2%) and (13.8%) respectively. At the bottom of the list were grain markets, local agrodealers and traditional leadership, each suggested by 0.4% of the respondents. The use mobile phones was not suggested by farmers due to low ownership levels.

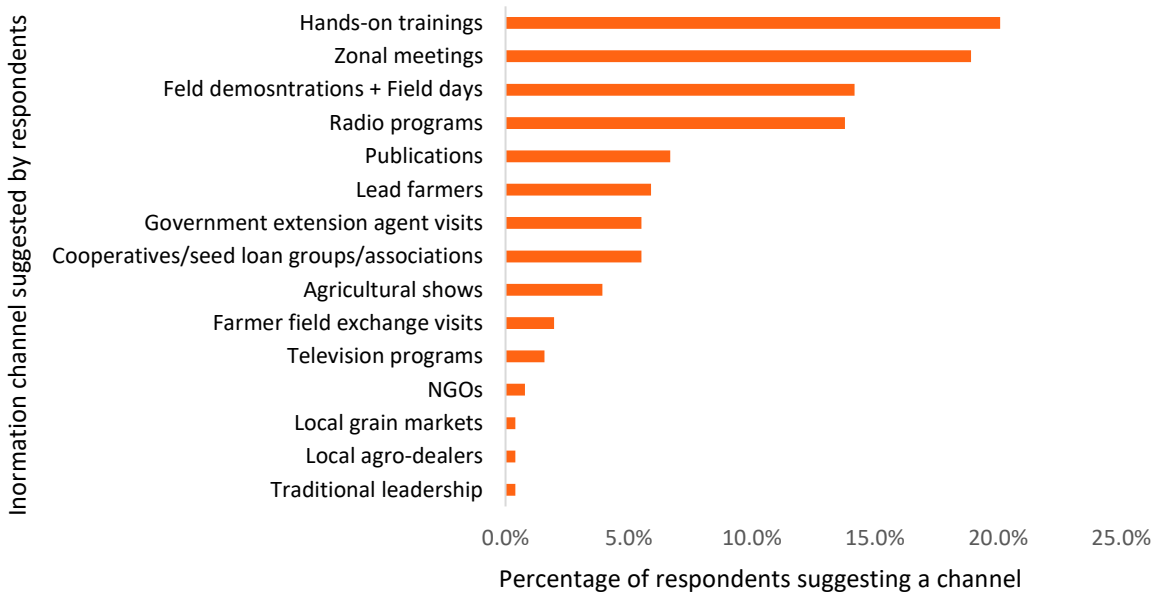

Figure 20: Farmers' suggested channels for enhanced access to information on bean improved varieties in Eastern Province

Apart from the suggestions from farmers, there are efforts elsewhere to make information demand-driven. For instance, in Malawi, MULIMI Hotline, organized by Farm Radio Trust provides an opportunity for farmers to call in and request for pre-recorded information. Similarly, courtesy of Human Network International (HNI), mobile phone enabled extension systems are now available in a number of countries including Madagascar, Malawi and Ghana (http://hni.org/what-we-do/3-2-1-service). These interactive phone-based extension systems present a vital link to continuous improvement in content development using the information needs captured through the call log. Figure 21 is a schematic presentation of the guide to phone-based extension. Also, there are opportunities to disseminate information on varieties bundled together with other agricultural information. For instance, CFU offers vouchers to lead farmers (Figure 21 insert) to redeem specific inputs including seed of various crops. This presents an opportunity for specifying some bean varieties and their information for guide choices. Furthermore, the Zambia National Farmers' Union (ZNFU), through the District Association Office offers market updates by province; this can also be made specific about varieties, their characteristics, market prices and buyers as well.

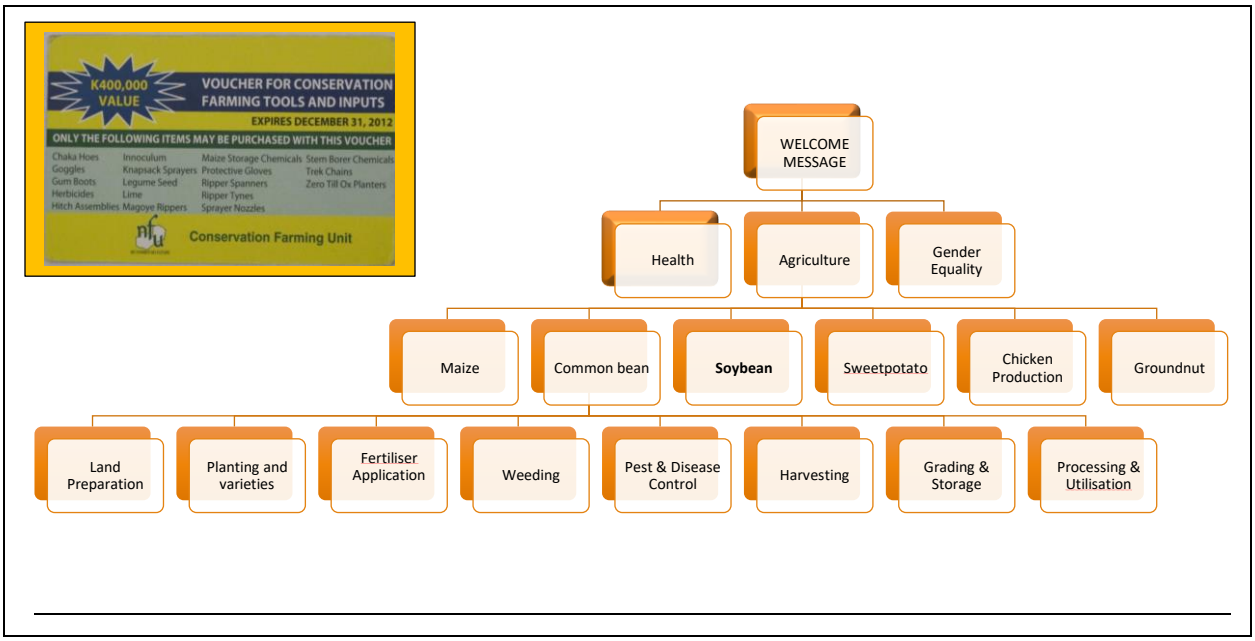

Figure 21: Process flow for mobile phone-based extension system and a typical CFU input voucher (insert)

At the time of the study, the public extension system was gearing towards ICT-enabled extension services. For the pilot phase, nine Android tablets were purchased for extension officers in Chipata district. Rollout was expected after positive evaluation of the pilot phase. To further support variety and information dissemination, PROFIT^{+} developed and supported community agrodealers in Eastern Province.

Meanwhile, there were nutrition initiatives in Eastern Province could also support dissemination of information on bean improved varieties, particularly the importance of bean in food and nutrition security. Scaling Up Nutrition (SUN) is a multi-sectoral approach which was working through Ward Nutrition Coordinating Committee (WNCC) to address the problems of malnutrition. Its activities included bean production and utilization in the agriculture-to-nutrition pathway. Common bean varieties were disseminated with information such as, yield potential, adaptability, cooking time, nutrient content, particularly iron and zinc and any other characteristics that are of interest to household food and nutrition security.

Correlation analysis on knowledge of improved bean varieties.

To understand the relationship between socio-demographic characteristics and knowledge and use of bean varieties, a correlation analysis (Doss et al., 2003) was performed on the data.

The correlation analysis showed that the factors related to awareness and use of bean improved varieties included the age of the respondent, highest level of education attained by the household head, household type, history of hosting of on-farm trials or demonstration plots, attending of field days, participation in farmer exchange visits and attending training (Table 9). The age of the respondent was positively and significantly ($r = 0.126$: $p < 0.05$) correlated to the awareness of the bean improved variety Kalambo. Similarly, more years of education by the household head significantly ($p < 0.01$) increased the likelihood of farmer being aware of improved variety. Farmers who hosted on-farm trials were more aware of improved varieties. This is seen from the positive correlations between this variable and improved varieties such as Chambeshi, Kalambo, Kalungu, Lymbai, Mbereshi and Private B with the highest significance at 0.01.

Table 9: Bean improved variety correlation analysis.

VARIABLES	VARIETIES								
	Chambeshi	Kabale	Kalambo	Kalungu	Kapisha	Lyambai	Mbereshi	Sadzu	Private B
Age of Respondent			.126*						
Highest level of education attained by HH head						.162**			
Household type in making Key decisions		.122*				.189**			
Ever hosted on-farm trial in last five years	.142*		.229**	.324**		.257**	.139*		.349**
Ever attended field day in last 5 years	.185**								.205**
Ever hosted demonstration plot in last 5 years	.133*			.227**		.166**			.272**
Ever participated in farmer exchange visit in last five years		.193**		.238**					.272**
Received training in planting	.150*	.241**	.215**	.121*		.271**		.120*	
Received training in spacing	.178**	.261**	.129*	.134*	.120*	.222**		.133*	.117*
Received training in weeding	.139*	.252**	.122*	.129*	.115	.286**		.127*	.113
Received training in fertilizer application	.183**	.264**	.131*	.137*	.121*	.302**		.135*	.118*
Received any training in herbicide use	.162**	.289**		.152**	.136*	.253**		.153**	.129*
Received training in disease/pest management	.226**	.293**		.155**	.138*	.298**		.155**	.132*
Received training in post-harvest technologies	.147*	.301**		.160**	.142*	.308**		.160**	.134*
Received training in soil/water management	.172**	.297**		.157**	.140*	.303**		.158**	.132*
Received training in seed production	.173**	.343**	.145*		.165**	.359**		.187**	.151**

**Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed).

GENERAL DISCUSSION

Land allocation data in this study confirmed the small scale nature of legume production; the propensity to allocate land to legumes generally declined with increase in landholding size. Meanwhile, the participation of more men than women in this study shows men's growing interest in a previously 'woman's crop,' as a result of the crop's recent gains in economic value.. The involvement of men has however, not translated into use / adoption of technologies as reported elsewhere (Lopes, 2010). Similarly, the high proportion of youthful farmers, known for more risk-taking (Adesina and Forson, 1995) than the old ((Zavale et al., 2005) and high literacy rates reported in this study could not translate into awareness and use of bean improved varieties. This indicates that exposure levels were very low in the study districts. Exposure to these varieties will therefore, likely increase awareness and use of improved varieties in the study districts as educated farmers are better at acquiring and synthesizing information and adapting to change compared to the uneducated (Feder et al., 1985: Adegbola and Gardebroek, 2007). The correlation analyses in this study also corroborates the study by Lopes (2010) which also reported increasing likelihood of improved variety use and adoption as household head's years of schooling increased .

Local varieties are widely known through knowledge and information passed down through tradition and culture. In the study districts, some bean local varieties were popular for taste (Katyetye) and relatively short cooking time (White). Apart from these clear attributes, inaccurate or unverified information has been passed down with these local varieties. For instance, the farming communities in Lundazi district widely believe that red bean types with their deep brown-reddish broth when cooked, ('*zamusuzi ngandopa*' - the ones with soup which looks like blood in ChiTumbuka, a local vernacular), also augment blood levels in the body. For this reason, the variety Lundazi Red is perceived to be highly nutritious hence preferred for relish, in addition to its taste. Similar strong, unfounded beliefs also influence production and consumption of white bean grain in some parts of Malawi, where it is widely believed that consuming white beans causes blindness. In addition to myths, inconsistencies in local variety names places doubt over the reliability of traditional variety nomenclature and its associated traditional information system. For instance, in this study, the variety 'Sweetbeans' of Lundazi district was morphologically dissimilar from that of Chadiza and Chipata. Similar inconsistencies were also reported between traditional variety names, molecular markers and agro-morphological traits in other crops in studies

elsewhere: cassava in Uganda (Kizito *et al*., 2007) and sorghum in Mali (Chakauya *et al*., 2006) and Zimbabwe (Mujaju *et al*., 2003; Mujaju and Chakauya, 2008). This therefore calls for a better understanding of farmers' distinguishing descriptions and the judicious use of visual aids and molecular tools in verification.

The high awareness of Kabulangeti, supports the notion that a combination of formal and non-formal channels (Maredia et al., 1999 : McGuire and Sperling, 2016) may be necessary for rapid dissemination of improved varieties. After PVS trials and on-farm demonstration, seed of the improved Kabulangeti was distributed through informal channels to replace the original traditional /local type (Muimui personal communication)[9]. Similarly, informal systems were used for rapid diffusion of improved root rot resistant bean varieties in western Kenya (Otsyula et al, 2004) and maize in Mexico (Bellon and Risopoulos, 2001) in the face of inadequate formal structures. Various cash and barter transactions are often used in seed acquisition, but some desperate farmers may even resort to surreptitious expropriation from another farmer's field (Badstue *et al*., 2002; Mbabwine *et al*., 2008). For instance, during this study, there were no identifiable outlets stocked with bean seed in the four districts, despite the imminent rainy season then; a situation that leaves needy farmers to source planting materials from diverse traditional or informal sources (Almekinders *et al*., 1994; Hardon and de Boef, 1993; Tripp, 2001; Cromwell *et al*., 1992; Muthoni and Nyamongo, 2008; Thijssen *et al*., 2008). The choice between local markets and other informal sources often depends on the distances involved and trustworthiness (Hodgkin *et al*., 2007). In this study, cash was the main means of seed acquisition, but proximity, convenience and price were the drivers of choice to markets.

In general, farmers depend on the seed provider / supplier for varietal information on traits such as consumption characteristics, environmental adaptation, seed quality and other traits to manage their crops. From this study, it was clear that farmers were looking for varietal information on productivity, culinary and market characteristics. The top priority was to enhance food production since the main purpose for growing bean was for home consumption, especially for the local

[9] Kennedy Muimui, Breeder and Coordinator of the Zambian Bean Research Programme. ZARI, Misamfu Research Station. Box 410055, Kasama, Zambia

varieties. In Zambia, particularly in the Eastern Province, the low level of awareness on bean improved varieties acan be attributed to, first, the information asymmetry between research and extension. ZARI/PABRA have the information available through the PABRA database, variety descriptors, pamphlets and other publications, but these are not available to local extension agents. Second, bean varieties grown in the study districts are obtained through informal channels. These channels typically have very limited or inadequate information about crop varieties (Tripp, 2001: Badstue et al, 2007). In light of the situation, farmers learn from each other through organized exchange visits and other ordinary and random meetings as highlighted during focus group discussions in this study.

Correlation analysis in this study demonstrated that access to seed and making personal observations through hosting demonstration plots, field days and training increased the chance of farmers being aware of bean improved varieties. This highlighted farmers' reliance on their own learning and personal experiences in light of varietal information inadequacies when seed is obtained from the market or other farmers. The respondents therefore, viewed the seed itself as a piece of coded information, which can only be decoded through planting hence their preference for physical access to seed not just virtual information. Farmers' own 'decoding' from the source (seed) is crucial for traits such as cooking time and taste that are often subjective and not expressed by the ZARI/PABRA breeding programmes. Similarly, for pest / disease tolerance and local adaptation, farmers want to have own experiences. For this reason, farmers also highly regard neighbours' testimonials as truthful and applicable, hence the first ranking of neighbours and other farmers as a source of information and knowledge in this study. Similar observations on strong social ties being influential in extension were also reported in Nigeria (Adomi *et al.,* 2003), and Tanzania (Matovelo *et al.,* 2006) and Vietnam (Hoang *et al.,* 2006).

The public extension system, with 5000 officers in Eastern Province, was also cited as an important source and channel of information, often beyond one crop or variety, unlike 'specialized' private extension officers. However, at the time of the study 32 %, 17 % and 20% of the camps were unmanned in Chadiza, Chipata and Lundazi districts respectively. Farmers however, bemoaned a waning frequency of visits by extension officers, a trend also reported in Nigeria (Adomi *et al.,*

2003) and Vietnam (Hoang *et al.,* 2006). Despite having the widest coverage in both area and crops in the study districts, it worth noting that overall, Zambia's public extension had a lower number of officers compared to countries of similar farming population size such as Malawi and Zimbabwe (Swanson and Davis, 2014). For instance, Chipata district with approximately 100,000 farmers, only had 48 agricultural camp extension officers. The number of farmers to one extension worker was therefore 2083, which was too high compared to 635 in Ethiopia and 714 in China (Davis et al., 2010). This extension officer-to-farmer ratio made it nearly impossible for public extension officers to attend to individual farming households especially given that the public extension also advises on multiple crops.

Unified or decentralized extension systems therefore become critical as there is also private / NGO/ cooperative extension, which however focuses on specific value chains or technologies targeted by the enterprise such as conservation farming (CFU), cotton (NWK), soybean (Cargill) and tobacco. Equally, coordination becomes key to leverage on all structures that support agricultural extension. All extension activities are, however coordinated by public extension officers; agreements are made on mode of operation to ensure complementarity among extension service providers. Hoang et al. (2002) commended the strength of similar approaches in Vietnam where extension services were built around government-led structures known for their effectiveness in elucidating directives. Two interesting elements in Eastern Province were the peer-review quality control system in information application among stakeholders and a requirement for all extension agents to work through the camp agricultural committee (CAC). The CAC comprises the government agricultural camp extension officer and selected farmers. Despite these checks to support consistency and accuracy of extension messaging, farmers still applauded the accuracy of varietal information from the public extension over the private sector with vested interests.

In addition to the public extension system other stakeholders such as farmer groups and cooperatives were also important sources of agricultural information and knowledge in the study districts. Groups and associations supply inputs and information on varieties for specific markets. Elsewhere, mass organizations were also reported to be key for mobilization, information and advocacy in extension systems (Hoang et al., 2002). ZARI / PABRA can therefore strengthen local

groups and associations in both varietal information dissemination and seed production for bean improved varieties. In addition to farmer groups, lead farmers have become influential in technology and information dissemination in Eastern Province. It has been considered to highly effective as the lead farmers teach by demonstrating in their own fields and have strong testimonials about what they promote. Some organizations such as CFU advertised their lead farmers on radio for ease of identification by other farmers. Lead farmers train other farmers and conduct numerous meetings with other farmers, contributing to the reasons why training and meeting were highlighted as important channels of information in this study.

While the radio, with its wide coverage presents a good opportunity for dissemination of information, it remains underutilized. Similarly, in Mozambique information on varieties is hardly disseminated through radio despite the existence of Memoranda of Understanding between the agrarian research institute (*Instituto de Investigação Agrária de Moçambique* - IIAM) and community radio stations (Maereka et al., 2015). The main limitations for the radio was farmers inability to visualize the varieties described and inability to provide and receive instant feedback, since most were pre-recorded programmes.

Use of publications has been report as low among smallholder farmers due to a general absence of the reading habit (Adomi *et al.*, 2003: Mosia and Ngulube, 2005), but in this study farmers still highly recommended publications under suggested channels for future information dissemination. It therefore suggests that their dissatisfaction with publications was not about the channel *per se*, but about the inappropriate packaging of the information. Despite carrying pictures of the bean improved varieties, the ZARI bean variety descriptor is in English only. Some pamphlets, according to key informant interviews reported to be too technical for use by local extension personnel and farmers. Furthermore, copies of the booklet and pamphlets on bean varieties, which are usually displayed at exhibitions, were mostly unavailable available for regular use as reference material by extension personnel.

Agricultural shows were considered effective because varietal information was always provided by technical people manning the exhibition stands. At agricultural shows, varietal information is

also provided through brochures, booklets and posters on production and utilization, and at times food products are displayed and tasted. However, the limitation is that the main agricultural shows with more participation of organizations tend to be far from farming communities, hence only a few farmers may attend. Similar to agricultural shows, seed fairs also display seed of varieties. To enhance seed quality control at seed fairs, SCCI has to be represented and participants have to conform to standardized and accurate labelling of seed on displays / sale. However, offenders pay a gazzetted nominal penalty of 18 ngwee (ZMK0.18). Food fairs and cooking demonstrations are normally held in combination with field days, and are effective in disseminating culinary characteristics as farmers compare taste and cooking times of varieties. For example, in group one discussion some participants reported the varieties Lwangeni and Kapika balesi, as fast-cooking but would get mashed fast before being well-cooked, had a flat taste, however but they were still grown due to their high yield.

CONCLUSIONS

Despite its pluralism, the current formal information flow on bean improved varieties is defective; coordination of the collaboration between research and extension needs improvement, especially to address information asymmetry. The use of farmer-to-farmer extension approaches is growing; emerging innovations include combining lead farmers with the CAC, use of private service providers (PSPs), and promotion of community agrodealers to bring certified inputs closer to farmers. ZARI Bean Research Team can also leverage on cooperatives' experience in disseminating inputs and varietal information in other crops. Backing the idiom, "seeing is believing, but feeling is the truth," farmers prefer own experiences with varieties, and hosting field activities and events to enhance their knowledge on varieties. It is therefore necessary to jointly disseminate seed and information in order to de-link from farmers' current over-reliance on informal channels that do not provide accurate information.

Information needs for small scale bean farmers are not met as the extension system often generalizes the needs in 'one-way' communication, which at best, provides latent feedback. On the other hand, subsistence bean farmers are not accustomed to requesting for information. The implementation of demand-driven information services will likely open opportunities for two-way communication, hence improve the quality of information. There is promise for the use of mobile phone-based extension messaging as farmers perceive it to be very quick, convenient and desirable albeit the low gadget ownership levels. Meanwhile, the radio still remains a popular, trusted and desirable information channel among farmers.

Certified and QDS producers derive marketing points based on varietal information supplied by research and extension personnel. The campaign against counterfeit seed which includes provision of accurate varietal information; is however, dampened by SCCI's lack of mandate on quality control on information provided by seed suppliers, and a non-deterrent penalty for offenders. Peer-review processes at ZARI planning and review meetings, innovation platform meetings and DACO monthly meetings are key in quality control of information provided to farmers and seed producers,

but this applies only to those operating within the confines of formal extension and seed quality assurance systems.

Knowledge and use of improved bean varieties were very low in this study, but the demographic data suggest wider future knowledge and use of bean improved varieties only if farmers are exposed.

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