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The Changing Structure of the Maize Seed Industry in Zambia: Prospect for Orange Maize

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ABSTRACT

Zambia's maize seed industry is one of the strongest in the region, and smallholder farmers grow numerous varieties, with no single variety dominating more than a small share of maize area. Yet, the foremost consumer (purchaser) of maize seed over the past decade has been the Government of Zambia because of the reliance of the seed market on input subsidy programs. The seed market, which is highly competitive, is dominated by a few large companies despite the entry of many enterprises since liberalization. This paper reviews the changing structure of the maize seed industry in Zambia and presents findings of baseline and key informant interviews, in order to propose elements of a marketing strategy for the seeds of provitamin A-rich maize varieties. We discuss the merits of liberalizing germplasm provision to all seed companies vs those of exclusive rights to preserve product differentiation and ensure standard seed quality to protect the brand. We find that exclusive or not, risk-sharing arrangements with any company that takes up this product would be essential. Regardless of the involvement of the seed companies, building and maintaining a unique brand for provitamin A-rich maize that clearly distinguishes it from the many varieties that exist on the market will be fundamental to successful delivery strategies. While inclusion in the subsidy program is one necessary component of a successful delivery strategy, we also recommend that HarvestPlus and its partners continue to invest in other initiatives to create awareness and promote orange maize with the aim of ensuring adoption and ultimately improving nutritional status.

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I. INTRODUCTION

Farmers interviewed during the 2011 baseline survey conducted by HarvestPlus in Zambia identified 103 named varieties grown in the major maize-producing provinces of the country. No individual cultivar was planted to more than 10% of the total maize area, and cultivars appeared to be distributed “equitably” nationally and within regions (De Groote et al., 2012). At the same time, the maize seed industry has two features that are in some sense “inequitable.” First, the foremost consumer (purchaser) of maize seed over the past decade has been the Government of Zambia because of the reliance of the seed market on input subsidy programs. Second, the seed market is dominated by a few large companies despite the entry of numerous enterprises since the liberalization of the seed industry in the 1990s. Even so, five major seed companies in a seed market as small as Zambia’s is remarkable and results in intense competition.

These structural features raise important questions concerning the marketing strategy for any new maize cultivar in Zambia, particularly provitamin A-rich varieties that are bred via conventional plant breeding methods to reduce prevalent vitamin A deficiency in Zambia. Due to their beta-carotene content, these cultivars exhibit orange-colored grain and a deep yellow nshima, the stiff porridge that is the most commonly consumed local maize dish. Consumer acceptance studies reveal that even in the absence of information about its nutritional benefits, consumers like the various sensory attributes (e.g., taste, appearance and texture) of nshima made with orange maize as much as those of nshima made with conventional white maize (Meenakshi et al., 2012). Moreover, when provided nutrition information consumers are willing to pay a price premium for orange maize compared to white or yellow varieties. Similarly, participatory rural appraisals and interviews during farmer field days suggest that farmers appreciate both the consumption and production characteristics of orange maize, relative to white maize (Chibwe et al., 2013). Therefore from maize grain (consumer) and seed (producer) demand side, there shouldn’t be any obstacles to adoption and consumption of these orange, provitamin A-rich maize varieties.. .

The purpose of this paper is to investigate the supply side issues, i.e., to better understand the institutional and organizational context for supplying provitamin A-rich hybrid seed to smallholder maize farmers in Zambia. Specifically, we aim to shed light on two questions: In an oligopolistic market where the government continues to play a major interest, but where many varieties are grown, (1) what should be the elements of a successful marketing strategy for orange maize varieties, and (2) how should orange maize varieties be positioned in the maize seed

market so as to achieve a significant impact on nutrition?

The rest of this paper unfolds as follows. Next section summarizes the findings of previous empirical studies about the evolution of the Zambian seed industry. Section 3 reports relevant findings from the baseline study. Points raised during key informant interviews with main stakeholders in the maize seed industry are presented in section 4. In the final section, we draw conclusions and raise points for consideration by HarvestPlus and its partners as they embark upon a market strategy for orange maize seed.

II. MAIZE SEED INDUSTRY IN ZAMBIA

We can consider the changing structure of the Zambian maize seed industry in terms of four phases, or periods, as suggested by Morris et al. (1998) and Rusike (1995). During the pre-independence period (through 1964), the Zambian industry as a whole was pre-industrial although there was some seed industry activity via colonial connections to Zimbabwe. The industry continued to expand immediately following independence but did not gain momentum until the establishment in 1981 of a commercial seed company, the Zambia Seed Company (Zamseed). The liberalization policies of the 1990s mark the expansion phase of the maize seed industry. Today, while many aspects of the industry suggest that it is approaching maturity, other aspects, such as the continued role of the government, are reminiscent of earlier periods.

A. Stage 1. Pre-industrial: Pre-independence

Howard’s (1993) study describes in-depth the structure and evolution of the national agricultural research system (NARS) and maize research in Zambia from the pre-independence period. As in Zimbabwe (then Southern Rhodesia), Kenya, and Malawi (then Nyasaland), the orientation of maize research in Zambia was originally geared toward the needs of expatriate commercial farmers. In Zambia, commercial farmers produced maize to feed mine workers and grew other export and horticultural crops for the resident European population. The research network in Zambia, distributed across agroecological zones, dates to the 1920s with the first permanent station at Mount Makulu, which was established around 1950.

At that time, Northern Rhodesia (now Zambia) relied on its Federation partner Southern Rhodesia (now Zimbabwe) for maize seed suitable for commercial farmers. Southern Rhodesia had a hybrid maize breeding program as early as 1932, which developed the SR52 and SR11 hybrids and a white version of the open-pollinated variety called Hickory King (from the US). Small-scale farmers, who could not afford

inputs or meet the higher management requirements, planted unimproved maize varieties, which were open-pollinated, long-season, and typically flinty in grain texture. It is likely, however, that many of them experimented with the seed grown on neighboring commercial farms. Except for some local variations in grain color, all maize varieties bred for commercial farmers and grown by small-scale farmers for subsistence were white in color.

B. Stage 2. Emergence: Post-independence

Howard's research is also the basis of our description of the period immediately following independence in 1964. Initially, the focus of the research remained the same because of the economic pre-eminence of mining and the need to provide cheap food to a relatively large urban population. A major turning point occurred during the mid-1970s when the collapse of copper prices led the government to explore the potential for small-scale farming. A number of maize breeders worked for the NARS in subsequent years, supported by British, Yugoslav, Swedish, US, and United Nations Food and Agriculture Organization (FAO) funding, and developed a broad range of improved open-pollinated varieties (IOPVs) as well as hybrids. After independence, Zambian breeders began producing SR52 instead of importing the seed, but lines were not well maintained and breeders were obliged to "clean" them. SR52 was re-released in a "purified" form in 1984 as MM (Mount Makulu) 752. In the late 1970s, the first Zambian professionals joined the maize breeding program.

As maize breeders focused on smallholder needs, they began to develop shorter-season hybrids that were tolerant of late planting. Smallholders often planted late because they needed additional time to prepare their fields with hand hoes or preferred planting local maize and other family food crops first. Between 1984 and 1992, Howard and Mungoma (1997) reported that nine dent hybrids and two IOPVs were released. The hybrids yielded more than SR52, were earlier-maturing, and yielded more than local maize in all but the most adverse environments, even without fertilizer. These were double and three-way crosses, which were stable when re-planted as second generation seed. These releases were tremendously popular, leading to a doubling of hybrid maize area among smallholders and substantial increases in maize production between 1975–1979 and 1985–1989 (op.cit).

Among a number of policy factors, such as subsidized credit for seed and fertilizer purchase and the expansion of the cooperative depot system, investment in the seed industry was a fundamental ingredient in achieving these changes. In 1980, the Agricultural Sector Support Program funded by the Swedish International Development

Cooperation Agency (SIDA) contributed substantially to seed industry startup. The program led to the formation of Zamseed, which was organized as a joint venture between the government and private entities, established the Seed Control and Certification Institute, and provided training for research extension and the seed industry. At that time, major shareholders in Zamseed were the Government of Zambia, the Zambia Seed Producers' Association (ZSPA), Zambia Cooperative Federation (ZCF), Svalöf (a Swedish seed company), and Swede Fund. The general objectives of Zamseed were to organize the multiplication of seed varieties developed by NARS researchers and to carry out the processing, storage, and distribution of these varieties.

Howard and Mungoma (1997) notes that simultaneous funding by SIDA of both hybrid maize breeding and the seed company generated important synergies. To ensure the success of Zamseed, the company and its advisors strongly endorsed hybrid development. Although Zamseed also produced seed of other crops, maize represented the largest share of revenue by the late 1980s (70–90 percent).

C. Stage 3. Expansion: Liberalization

By this time, however, it became obvious that the system combining controlled input and product marketing, as well as heavy subsidies was fiscally unsustainable. Pressure from the International Monetary Fund, World Bank, and other donor agencies led to a series of market reforms to promote liberalization (removal of restrictions) and privatization (withdrawal of the state). Given the importance of maize as a wage good in Zambia, riots engendered by rising maize meal prices and drought, reform implementation was gradual through the 1990s.

The seed industry was among the first sectors to be liberalized during structural adjustment, and many new seed companies entered the market. These included multinational, regional, and local companies. As a result, the number of maize hybrids and IOPVs available to Zambian farmers "doubled between 1992 and 1996" from 23 to 45 (Howard and Mungoma 1997). In 1996, Zamseed's market share of maize seed was still 65 percent.

During the 1990s, research was also initiated by three private enterprises who remain major players in the Zambian maize seed market: Zamseed (by then privatized), Maize Research Institute (MRI) of Zambia, Ltd., and the Seed Company of Zambia (SeedCo). MRI was the first totally private seed company in Zambia and was established by leading maize breeders previously employed by the government. SeedCo is a Zimbabwean company that has operated in various forms since its creation in 1940, initially depending on government research for breeding material but beginning its own research in 1973 (Elliott and Perrault

2006). A fourth major player has been Pannar. Pannar was founded in 1958 in the Republic of South Africa (RSA), initiated its programs in 1960, and was the first company in the RSA to register a maize hybrid for the local market.

De Groote et al. (2012) confirm the positive effect of seed liberalization on the evolution of the numbers of varieties released, as well as the number and types of companies releasing them. Only five varieties were released during the 1960s. None were released during the 1970s, and 11 varieties were released during the 1980s. All varieties released from the 1950s through the 1970s originated with Zamseed. In contrast, 60 new maize varieties were released during the liberalization of the seed industry in the 1990s.

In and of itself, more varieties released did not translate into more varieties grown. Elliott and Perrault (2006) report that, until the liberalization policy, the market for hybrid maize was significant and growing. When the market was liberalized, the demand for hybrids fell dramatically because the government no longer ensured delivery of seed and fertilizer at subsidized prices or purchase of maize grain. Although demand for IOPVs increased, these offered a much lower potential for cost recovery, as farmers reduced costs by not renewing their seed stock annually. In fact, adoption rates and overall maize productivity declined in Zambia during the late 1990s relative to the 1980s, while smallholder farmers diversified to other crops (Smale and Jayne 2010).

Long-term investment trends in agricultural research in Zambia, measured in terms of purchasing power parity prices (PPP), have been summarized by Flaherty and Mwala (2010). After a strong increase in the 1980s, structural adjustment led to a sharp decline in public research and extension capacity during the 1990s. Data show another period of growth followed by a contraction from 2002 to 2007, primarily due to a government hiring freeze. In 2008 research capacity returned to the levels of the mid-1990s, however government expenditures on research, of which maize has the largest share of any single crop, were 8 million PPP dollars in constant 2005 prices in 2008, compared to 10 million PPP dollars in 2001 and 37 million in 1991 before structural adjustment. The Zambia Agricultural Research Institute (ZARI) is the country's principal agricultural research agency, although two non-profit agencies also conduct research: the Golden Valley Agricultural Research Trust (GART), which more than doubled its capacity in the past decade and focuses on smallholder crop and livestock technologies (including significant investments in maize), and the Cotton Development Trust. Both of these institutions are independent of ZARI.

D. Stage 4. Towards Maturity: Current situation

Over the last decade, 126 new varieties have been released by 14 different companies, and the rights of almost all these varieties are held by private companies. By the close of 2010, 203 maize varieties had been released (De Groote et al. 2012). Mwala and Gisselquist (2012) report that as a consequence of the work by companies such as Zamseed and MRI, Zambia is recognized for its "strong presence in maize breeding in Africa." Their study of 31 private companies, as well as non-governmental and public organizations, showed that 105 of the 113 maize varieties available among actors interviewed were registered by private companies.

As part of a larger regional study, Langyintuo et al. (2010) interviewed 11 seed producing organizations in Zambia, including registered seed companies, ZARI, national agricultural research organization, nongovernmental organizations (NGOs), and community-based organizations (CBOs). Six of the companies were private, including three national companies, two regional companies, and one international company.

The authors also used data from national seed companies in Zambia to estimate the personnel and operational costs of a model seed company that maintains a small maize research facility and produces and processes 2,000 tons of maize seed per year on the local market. In 2007 they estimated that nearly half a million US dollars will be required to run a seed business with one full-time breeder, one seed production specialist, and other supporting staff. The annual maintenance and depreciation charges for fixed capital are valued at about US\$100,000. The authors note that, in general, over 60 percent of the operational cost is attributed to seed production and processing alone. These cost outlays are excessive without credit and were covered by government subventions when seed companies were public. In addition, the growth in the number of plant breeders in the region has failed to keep pace with the number required for private and public breeding institutes, so that recruiting and retaining plant breeders is extremely difficult for emerging seed companies. Without plant breeders, they cannot mount a research program.

Kassie et al. (forthcoming) have recently conducted another regional analysis of the maize seed industry, including seven companies in Zambia. Zambia's industry emphasizes hybrids; and Zambia has one of the highest rates of adoption of improved seed in the region, after Zimbabwe. Taking all hybrids, IOPVs, and recycled materials into account, they estimate improved seed adoption rates in Zambia at nearly 90 percent during the 2010/11 season. This compares well with Langyintuo et al.'s (2010) 2006

estimates of 81 percent, including saved improved seed. Estimates from the HarvestPlus baseline survey place adoption in the major maize-producing areas at 68 percent for F1 named hybrids in 2010/11 and an additional 19.2 percent for recycled hybrids, IOPVs or hybrids that farmers could not name—or an overall adoption rate, including saved improved seed, of 88% (De Groot et al. 2012).

Maize seed sales was nearly 5,000 metric tons (mt) in Zambia during the 2010/11 season, about twice that of the average annual sales in each year from 2007-2009. As points of comparison, 2,600 mt were sold in Malawi in that year and 6,224 mt in Zimbabwe. From 2007/8 through 2010/11, estimates based on the seed industry survey suggest that only between 150 and 250 mt of IOPV seed was marketed, underscoring the national emphasis on hybrids. Applying simple gross margin analysis, Kassie et al. (forthcoming) also estimate that per kg of seed, hybrid maize generates gross margins in Zambia that are twice as high as that of IOPV seeds.

Data reported by both Langyintuo et al. (2010) and Kassie et al. (forthcoming) indicate that despite many constraints, Zambia's seed industry appears relatively better off compared with the other maize-producing countries of Southern Africa. For example, prolonged variety release procedures have often been cited as hindrances to maize seed industry performance and adoption in Sub-Saharan Africa. Kassie et al. (forthcoming) found a mean time to maize variety release of two years in Zambia, with an additional 2.4 years until seed is widely available. These figures compare closely with those reported by Langyintuo et al. (2010) and are favorable relative to other countries studied by the authors. Most authors seem to concur that variety release procedures are too stringent in Zambia. For example, Mwala and Gisselquist (2012) consider current seed regulations to be overly protective. They report that when a company wants to introduce a new maize cultivar, the government requires two years of official tests and collects fees that can exceed US\$2,000—and even then the request can be denied. They suggest that in addition to the harmonization initiative of the Southern Africa Development Community (SADC), Zambia might consider taking steps to relax controls on the introduction of new cultivars.

Regulations that impede germplasm transfer across borders are also common in the region. Protectionist seed policies are understandable for a number of reasons. Langyintuo et al. (2010) and Kassie et al. (forthcoming) find that the foremost challenge reported by all seed companies, except multinationals, was the lack of basic seed that is high-quality, genetically pure parent stock needed to plant extensive areas for commercial seed.

Lack of skills in the many aspects of seed production management was cited as a major challenge. The quality of the physical and technological infrastructure and the high transactions costs associated with delivering a supply of seed to so many dispersed smallholders continues to constrain maize seed industries. The authors note, however, that relative to other countries in the region, Zambian seed companies are more knowledgeable about the demand for their seed. However, for all of the seed industries of the region, Kassie et al. (forthcoming) recommend: improved seed information systems to track seed availability and the range of varieties grown; improved access and utilization of seed production infrastructure; strategic capacity building along the maize seed value chain on skills related to management of seed production and marketing; improved access to financial services for emergent companies; and establishment of market information systems to collect, collate, and disseminate essential information on seed marketing.

Aside from seed regulations, a major form of government intervention in Zambia, as in other countries in the region, has been the provision of direct or indirect support from the government for domestic seed companies. This practice also distorts the evolution of competitive markets at this late stage of maize seed industry expansion. In fact, national, state-managed input subsidies to farmers since 2002 have undoubtedly provided a guaranteed, artificial market for those seed companies that have been afforded tenders by the government to participate in government programs.

In Zambia, the subsidy scheme now known as the Farmer Input Support Program (FISP, previously FSP, or Fertilizer Support Program) includes both fertilizer and improved maize seed. Recently, research by Mason and Ricker-Gilbert (2012) in Zambia found that the FISP was “crowding out” commercial demand for maize seed and fertilizer. Both Mason and Ricker-Gilbert (2012) and Smale and Birol (2013) also concluded, based on different datasets, that FISP has favored larger landholders and better-off farmers.

In 2011/12 maize growing season, FISP required farmers to make a contribution of ZMK 50,000 towards the cost of a 50 kg bag of fertilizer and ZMK 80,000 towards the cost of a 10 kg seed pack (“pocket”). FISP farmer contributions are deposited into a designated government account. Individual farmers apply to the Camp Agricultural Committee (CAC) through their registered farmers' group (cooperatives, associations, clubs, etc). The CAC decides whether to approve a farmer and sends the list of approved farmers to the District Agricultural Committees for ratification. Upon receipt of their inputs from their farmers' groups, farmers sign a FISP Goods Issued Voucher (GIV) document as

proof of receipt. Only farmers have the authority to collect their inputs from their cooperative. Indicators of seed demand and recommended seed varieties are provided by farmers before the planting season via their District Agricultural Coordinators (DACOs).

During the 2012/13 season, a new e-voucher scheme was piloted. This scheme is modeled after a pilot scheme promoted under an FAO project and aims to better integrate agro-dealers into the input supply chain and allow the participation of a wider range of private sector suppliers of seed and fertilizer, while enhancing efficiency of the program. Under this new scheme, farmers may use an e-voucher to purchase any maize variety (or any other farm input) in stock at the agro-dealer. Farmers must be members of a registered cooperative to obtain the right to an e-voucher. Farmers' cash contributions will be made directly to agro-dealers who will be identified by DACOs. Once a farmer presents his/her e-voucher to an agro-dealer, the transaction details will be entered electronically. When the agro-dealer redeems the voucher, the government will transfer the equivalent funds into the bank account of the agro-dealer. Thus, it is up to the input providers to ensure that their products are available with approved agro-dealers and conform to the expected demand of each locality.

In Zambia, and elsewhere in Sub-Saharan Africa, past and current government-managed voucher schemes have been criticized for a tendency toward "clientelism" and capture by local farming elites (Banful 2011; Mason and Ricker-Gilbert 2012; Pan and Christiansen 2012). The new e-voucher plan, if effective, is expected to level the

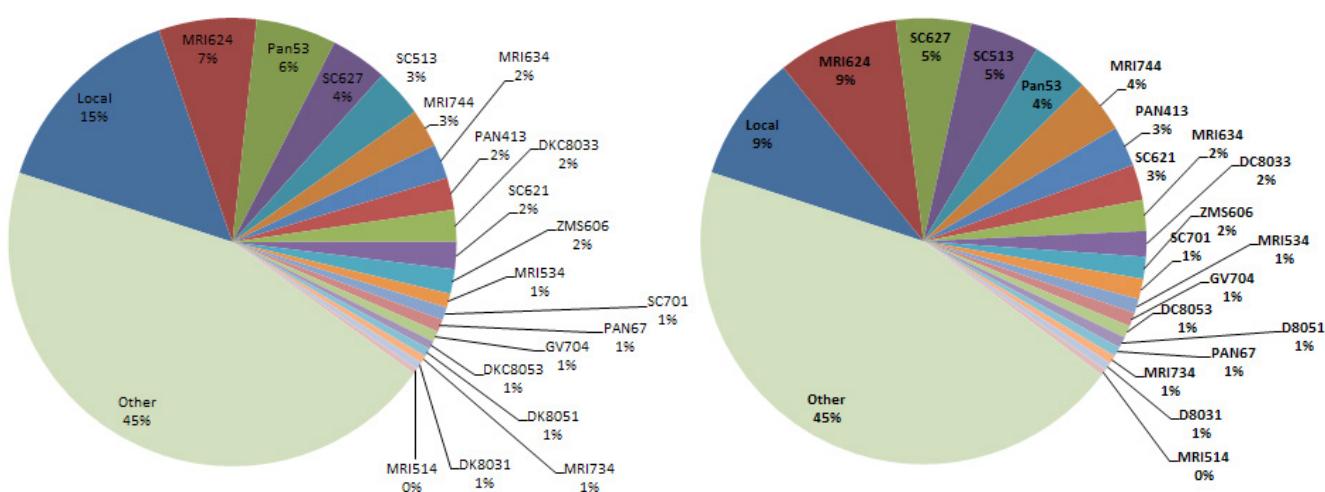
playing field in the Zambian seed industry by devolving competition from a government office to dispersed agro-dealer shops.

III. HOUSEHOLD SURVEY EVIDENCE

In 2011 HarvestPlus collected baseline data from 1,128 farmers in the major maize-growing areas of Zambia (39 districts across Central, Copperbelt, Eastern, Lusaka, Northern, and Southern Provinces). Sampling design, survey administration protocol and the descriptive statistics are reported in De Groote et al. (2012). The authors found that of the 203 improved maize varieties released in Zambia, farmers surveyed planted more than half (106) of these during the 2010/11 maize planting season, as well as numerous local varieties, recycled, and unnamed modern varieties.

Perhaps the most striking result of the survey was the small area share planted to any single improved variety in Zambia. No single improved variety covered more than 10 percent of maize area, with only two varieties covering more than 5 percent (Figure 1)¹. The 20 most popular improved varieties together covered less than half of maize area. A second major result is that all popular varieties are white hybrids, which were recently released; otherwise, they do not seem to have particular characteristics in common. In length of maturity, they range from early to late; grain texture includes very dent to very flint. Variety age is between 3 and 15 years. Estimated variety market shares were even more equitable.

Figure 1: Area and Market Share of the 20 Most Popular Improved Maize Varieties in Zambia



Source: De Groote et al. (2012)

Moreover, hybrids appear to be spatially distributed throughout the maize-growing regions without a clearly defined geographic pattern. Each of the top 20 hybrids is found in all three zones. The top three hybrids (in terms of the number of farmers growing them) are all medium-maturing and found in each of the provinces surveyed. The most popular hybrid, Pan 53, is found more often in Central, Eastern, and Southern. The second, MRI 624, is found relatively less often in Eastern and Northern, and the third, SC 627, is grown less frequently in Eastern and Southern. The fourth most popular hybrid, SC 513, is early to medium in maturity and is grown more often in the Southern and Central but is not grown in Northern Province. The most popular late maturing hybrid, MRI 744, is grown mainly in Northern. Found in all provinces, MRI 744 appears to not be grown in the drier Eastern and Southern provinces because farmers in these areas need earlier maturity to escape dry spells.

National market shares by company are shown in Table 1. Data in the first column are estimated as the company percent of total seed planted by farmers surveyed in 2011, using the HarvestPlus baseline data. Data in the second column were estimated in the same way from the national Crop Forecast Survey, implemented by the Central Statistical Office (CSO) for the same agricultural season, and include only seed reported to be F1, i.e., first generation hybrids. The two series of estimates vary in terms of magnitude but less in terms of company rank.

According to both data sets, Zambia's leading top three companies in the major maize-producing areas of the country are Seedco, MRI and Pannar, and Zamseed makes it to top 5. The first three companies occupy over three-quarters of the market, according to both data sources.

IV. PERCEPTIONS OF KEY INFORMANTS

Key informant interviews were conducted in December of 2010 and August 2012. Selection of company stakeholders was purposeful. Respondents included representatives of the major national (Zamseed, MRI), regional (Seedco, Pannar), and multinational (Pioneer) players in the Zambian seed industry, as well as Kamano seed company, a smaller company that has worked closely with the International Maize and Wheat Improvement Center (CIMMYT) in Mexico and participated in orange maize trials. Companies spanned the pre- and post-liberalization period and include those with the longest experience (Zamseed) as well as newer entrants (Kamano).

Interviews were semi-structured. Respondents were asked to discuss three issues: 1) company experience concerning marketing and what constitutes a successful (widely adopted) variety; 2) perceptions regarding the impacts of the FISP on their operations; and 3) proposed modalities for commercializing provitamin A-rich, orange maize. Not all respondents elaborated on all of these questions, and the summary of these interviews is presented below, by question.

Table 1: Market Share of Maize Seed Sales in 2010/11 Season, by Company

	HarvestPlus Survey Data		National Crop Forecast Survey Data	
	Ranking	Percentage	Ranking	Percentage
Seedco	1	27.9	1	38.1
MRI	2	25.8	2	26.7
Pannar	3	23.5	3	14
Zamseed	5	7.91	4	9.42
Unnamed	7	1.54	5	8.66
Monsanto	4	9.46	6	1.77
Progene Seeds	9	0.24	7	0.33
Other companies	10	0.21	8	0.179
ZARI- MACO	6	2.42	9	0.173
Pioneer	8	0.96	10	0.085
AFGRI	11	0.11	11	0.062
Total		100.00		100.00

Source: Authors, based on 2011 HarvestPlus baseline survey and Crop Forecast Survey (CFS) data collected by CSO. CFS data were provided by the Ministry of Agriculture and Livestock and prepared for analysis with support from Michigan State University. CSO sample size for growers of hybrid seed equals 1,426,208.

A. Company of Profiles and Successful Marketing Strategies

As reported in Table 1, Seedco has the largest overall market share in Zambia. Regarding market success of its varieties, Seedco representative stated that uptake usually begins slowly, and popularity is augmented through various promotional activities, such, as “buy one, get one free,” competitions, and community radio advertisements. Seedco representative estimates that this company spends around 20 percent of its budget on marketing and promotional activities.

MRI perceives itself to be strongest in Southern province, followed by Central. Table 1 confirms that MRI has the second largest share of the national market. According to the HarvestPlus data, MRI's market shares are the highest in Lusaka and Copperbelt, in addition to Central Province. As noted above, MRI has a long history in Zambia and was established by one of Zambia's most experienced maize breeders, Dr. Ristanovich. MRI aims for a marketing and promotions budget that does not exceed 10 percent of their gross revenue from seed sales. Overall, marketing and promotions account for about 25 percent of the company's budget. Distribution costs are the major component of this share.

Pannar is not only the largest independent seed group in the RSA, but also one of the largest seed suppliers across Sub-Saharan Africa. According to Table 1, Pannar has the third largest market share in Zambia. With a strong history of variety release in the region, and a reputation to protect, the research and development department makes the final decision concerning whether to include a variety in their product portfolio. Although located in the RSA, the department conducts trials and field demonstrations in client countries and is conservative when including new varieties.

According to the Pannar representative interviewed, performance of any new variety must be carefully evaluated and the most successful Pannar cultivars have been those which exhibited the best agronomic performance. Many of the varieties this company releases in Zambia are high yielding and exhibit other production traits farmers prefer. Moreover, the Pannar representative interviewed is of the opinion that resistance to storage pests is an important trait that might help differentiate a hybrid. However, he thinks that if consumers prefer the nutritional benefits of a variety, such as orange maize, the nutrition attribute may influence farmer adoption over and above agronomic attributes.

Zamseed representative interviewed estimates that this company spends up to 10 percent its budget on

promotional activities. He defined a successful variety as one that has a unique identity with features that are liked and easily recognized by clients. Promotional activities Zamseed carries out include highly visible branding of vehicles, a network of on-farm and roadside demonstrations, distribution of information through various media, and distribution of free 250 gram packs of seed (about 2 mt total). Zamseed sells seed in 2 kg, 5 kg, and 10 kg packs to maximize appeal to cash-constrained, smallholder farmers. Zamseed representative also stated that this company collaborates closely with the Zambian National Farmers Union in order to “reach out” to a larger number of farmers through demonstrations and information diffusion.

Pioneer representative indicated that this multinational company spends at least 5 percent of each country budget on promotional activities, including demonstrations. At present, Pioneer hosts at least 600 demonstrations throughout Zambia, both on the roadside and on farms.

Kamano, a small, emergent seed company based in Zambia, has initially sold only legume seed. The company used the sales of maize IOPVs obtained from CIMMYT to develop extension grassroots networks among small-scale farmers, and also in forming networks of agro-dealers in Northern and Western Provinces. After several years of selling maize IOPVs, Kamono has recently introduced maize hybrids, and currently, hybrid maize seed sales is the major activity of the company. From Kamano's perspective, market success is associated with the development of a specialized market, including mobile seed sales, that services grassroots smallholder producers.

B. Perceptions on the Impacts of FISP

MRI representative reported that FISP supported this company's activities by facilitating a large-scale popularization its products among smallholder farmers. The representative argued that a great majority of these farmers may not have known the characteristics of their maize hybrids prior to benefiting from FISP. The FISP enabled many smallholders to test and become familiar with hybrids that might not have been supplied to them or that they might not have purchased, even if supplied. According to the MRI representatives, the e-voucher system is a promising new approach that should further liberalize the input market.

Pannar representative was also of the opinion that the overall impact of FISP has been positive in the sense that it has been used as a marketing tool to expand markets to include smallholders who would not otherwise have purchased hybrid seed. The FISP promoted Pannar cultivars and assisted the company to form a group of

loyal customers in what is, as described in the historical section above, a challenging market. Nonetheless, the Pannar representative argued that the modus operandi of FISP has in the past favored some companies over others. He also agrees with the MRI representative in that the new e-voucher system is clearly a step toward greater and more open competition in the maize seed market. He is however concerned about the technical realities of operationalizing the program, the risk of falling short of demand this season when the program will function as a pilot test, and the implications of these challenges for scaling up this approach.

Finally, Kamano representative noted that there is a strong competition in the Zambia maize seed industry, as evidenced by the entry of 14 companies in a recently advertised government tender. He suggested that unless seed rights were assigned specifically to smaller companies, larger companies with dominant market shares drive smaller companies out of the market. For example, even with the FISP, Kamano has benefited only as a supplier of legume seed, since few other companies participate in this area.

C. Commercialization of Provitamin A-rich Orange Maize Varieties

Given the evidence that no single variety or company dominates maize-growing areas in Zambia, even within provinces, as well as the large number of varieties produced by the various companies and grown by farmers, one obvious way to ensure widespread exposure of potential adopters to orange maize would be for many companies to market it. Companies were, in general, not receptive to this idea. Many advocated instead for exclusivity in the commercialization of specific orange maize varieties arguing that companies need to protect their investments in promoting a differentiated product and ensure they capture market share in a highly competitive market.

Seedco representative stated that they preferred the concept of exclusivity, since in that case one company would be accountable for product quality, and buyers will know where to find assistance when faced with difficulties. The Seedco representative argued that since seed companies contract private seed growers to multiply seed, in a liberalized environment, companies that use bad seed growers would compromise overall standards.

MRI representative did not express concern about exclusivity in principle. However, he stated that it is important for a company to be able to differentiate its products, and MRI, like Pannar, mentioned above, considers itself to be a conservative company and a reputable seed industry leader that invests in new products only after careful evaluation.

MRI representative asserted that any product sold by MRI must add value to the portfolio.

Zamseed concurs with exclusive rights to sales of orange maize varieties. Zamseed representative stated that common varieties are rarely well promoted, and when multiple suppliers are involved, the quality is compromised since there is no clear accountability or responsibility for product development and monitoring. Conditions could be built into the exclusive rights that limit the duration of the license and encourage quality monitoring. According to the Zamseed representative, another possible niche to exploit would be the promotion of orange maize as “green maize” (harvested fresh for boiling or roasting), capitalizing on its good taste and higher prices for this product. Finally, the Zamseed representative suggested that a special brand should be developed for orange maize.

Kamano representative also argued for the importance of exclusivity in commercialization, since this company has already invested in promoting orange maize through their demonstration programs. Similarly to Kamano, Pioneer representative indicated that this company expressed interest to include provitamin A-rich maize varieties in its project portfolio. Contrary to other company representatives, however, Pioneer representative suggested that free access to orange maize varieties will improve competition, and Pioneer is interested in acquiring and improving orange maize regardless of how many other companies are involved.

An entirely different perspective to most of the seed company representatives' was provided by a highly experienced Zamseed maize breeder who previously worked with an international public research organization. His advice was to ensure that all orange maize varieties are available to all seed companies for free, with conditions or incentives that encourage commercialization. For example, during the first two years, seed companies could be requested to meet targets for seed quantities and provided with incentives to meet the targets. Parental seed could be provided based on requests and after the company's capacity to maintain seed quality standards has been assessed. He suggested that HarvestPlus could play a role in monitoring seed quality. At the outset, HarvestPlus would have to consider subsidizing the seed multiplication/distribution costs to allow companies to sell their seed cheaper than white varieties as a market penetration strategy.

He cited several arguments in support of this strategy. First, if orange maize became successful as a product, seed companies would seize the opportunity to make a profit and would invest further by developing their own orange maize varieties for both Zambian and international markets, as already occurs for white maize. Second, since

the orange maize market is still very unpredictable, non-exclusive provision of seed would spread the risk across companies. Moreover, there is a high risk associated with entrusting a variety to one company. Furthermore, since HarvestPlus and the government intend to back up the popularization of orange maize with their own promotional activities, exclusivity may create some confusion in the market, as farmers might associate the promotion with a single company, mixing the public good (nutritional welfare of Zambians) and private attributes (seed market) of orange maize.

V. CONCLUSIONS

Originally dominated by a single, government-managed seed company, the Zambian maize seed industry today includes a highly competitive array of multinational, regional, and local maize seed companies with varying levels of investment in maize research. Over 200 maize varieties were released in Zambia before 2010, more than half of these during the past decade by private companies who hold the rights to them. Several of Zambia's maize seed companies are recognized actors across Sub-Saharan Africa. The industry is decidedly focused on maize hybrids as compared with IOPVs. Zambian seed companies have demonstrated their ability for research, product development, and marketing.

Despite the obvious progress in seed market development, Zambia's maize seed industry is confronted by challenges that are common to other countries in the region. First, for much of the lifetime of Zambia's seed industry, the primary buyer of maize seed has been the government. Sales to the government have guaranteed a market for distributing seed through subsidies to a widely dispersed, differentiated, and uncertain smallholder clientele. From the perspective of participating seed companies, subsidies, such as those provided through the FISP, have popularized varieties and helped to create loyal customers, absorbing many of the transaction costs that would have been borne directly by companies.

At the same time, how well the FISP responds to farmer demand for specific varieties is unclear. Furthermore, not all companies have participated in the FISP. Market risk and uncertainty have also constituted barriers to market entry and growth of new local seed companies, especially given preferential arrangements under the FISP. Evidence is also accumulating in Zambia and elsewhere in Sub-Saharan Africa that in the maize seed industry, as well as the fertilizer industry, subsidies tend to favor better-off farmers and local elites, displacing sales to farmers who would otherwise have purchased the seed commercially.

The new e-voucher system is expected to devolve more marketing and distribution costs to seed companies and to make the system more openly competitive. So far, however, the new system has only been tested on a pilot scale.

One of the most impressive aspects of the maize seed industry in Zambia is the large number of varieties grown across farmers' fields and the equity in their spatial distribution. Over the past ten years, an average of 16 new maize varieties was released each year. This scenario means that each season, farmers were presented with a wide choice of possibilities for maize production, possibly resulting in the lack of market share domination by any one variety, with the most popular variety occupying only up to 10 percent market share. The structure of the FISP delivery system over the past decade may also have played a role. Currently, it is unclear to what extent the spatial distribution of maize varieties grown reflects demand or supply considerations (in particular, operational implications of the past subsidy programs).

The structure of the seed industry, and the spatial distribution of maize varieties, raises questions concerning how best to popularize orange maize. Key informants from the seed industry were not unanimous in their perspectives. While most would like to see exclusive rights transferred to a single company, some argue that providing materials free to all companies, with various types of incentives, would be preferable. An argument for exclusive rights is to preserve product differentiation and ensure standard seed quality to protect the brand. An argument for liberalizing germplasm provision is that it would enhance competition and contribute to cost efficiency. Another is that biofortification is a public health intervention, and therefore should not be monopolized by one company.

Considering that provitamin A-rich maize is not well known and different (due to its orange color), the market for it is unpredictable. Risk-sharing arrangements with any company that takes up this product will be essential. Building and maintaining a unique brand of provitamin A-rich maize that clearly distinguishes it from the numerous, mostly white, varieties that exist on the market will be fundamental to successful diffusion strategies. Participating companies have the challenge of creating a brand identity for their newly acquired orange-colored maize without compromising the brand identities of their existing white maize varieties. In addition, HarvestPlus should continue investing in its own initiatives to create awareness and promote orange maize with the aim of accelerating adoption.

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