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**The Changing Structure of the Maize Seed Industry in Zambia:**

**Prospects 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 Provitamin A-rich varieties. We argue for exclusive rights is to preserve product differentiation, and ensure standard seed quality to protect the brand. Risk-sharing arrangements with any company that takes up this product are essential. Building and maintaining a unique brand of Provitamin A-rich maize that clearly distinguishes it from the many varieties that exist on the market will be fundamental to successful diffusion strategies. While inclusion in the subsidy program is one necessary component of a successful strategy, we also recommend that HarvestPlus continue to invest in other development initiatives to create awareness and promote orange maize with the aim of enhancing nutritional status.

## 1. 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 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 during the 1990s. Even so, five major seed companies in seed market as small as Zambia’s (on a global scale) is remarkable. Competition among seed companies in Zambia is intense.

These structural features raise important questions concerning the marketing strategy for any new cultivar in Zambia, and in particular Provitamin A-rich varieties, which are bred via conventional plant breeding methods to reduce prevalent vitamin A deficiency in Zambia. Reflecting their beta carotene content, these cultivars exhibit orange-colored grain and a deep yellow *nshima*, the stiff porridge, which is the most heavily consumed local maize dish. Participatory rural appraisals and interviews during farmer field days suggest that farmers appreciate the sweetness of orange maize, relative to white maize, when prepared as *nshima* or boiled on the cob. A unique attribute of these varieties will be their nutritional content. In an oligopolistic market where the government continues to play a major interest, but where many varieties are grown, what will be the elements of a successful marketing strategy for orange maize varieties? How should orange maize varieties be positioned in the maize seed market so as to achieve a significant impact on nutrition?

The purpose of this study is to better understand the institutional and organizational context for supplying Provitamin A- rich hybrid seed to smallholder maize farmers in Zambia. The 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.

## 2. 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), although there was some seed industry activity via colonial connections to Zimbabwe, the Zambian industry as a whole was pre-industrial. The industry continued to emerge immediately following independence, but did not gain momentum until the establishment in 1981 of Zamseed. The liberalization policies of the 1990s mark the expansion phase of the maize seed industry. Today, while a number of aspects of the industry now suggest that it is approaching maturity, other aspects, such as the continued role of the government, are reminiscent of earlier periods.

### *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. The orientation of maize research, as in Zimbabwe (then Southern Rhodesia), Kenya and Malawi (then Nyasaland) the NARS, like others in the region, was originally geared toward the needs of expatriate commercial farmers. In Zambia, commercial farmers produced maize to feed mine workers, alongside other export crops and horticultural crops for the resident European population. The research network in Zambia, distributed across agro-ecological zones, dates to the 1920s, with the first permanent station at Mount Makulu, which was established about 1950.

At that time, Zambia (Northern Rhodesia) relied on its Federation partner Southern Rhodesia (now Zimbabwe) for maize seed suitable for its 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.

### *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 Organisation (FAO) funding, and developing a broad range of improved open-pollinated varieties as well as hybrids. After independence, Zambian breeders began producing SR52 instead of importing the seed, but lines were not maintained well 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 planted late for a number of reasons, including that they prepared the fields with hand hoes and waited to plant commercial maize until after local maize and other family food crops were planted. Between 1984 and 1992, Howard (1997: 50) reported that nine dent hybrids and two improved open pollinated varieties (IOPVs) were released. The hybrids yielded more than SR52, were earlier-maturing, and in all but the most adverse environments, yielded more than local maize, 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 areas among smallholders, and substantial increases in maize production between the 1975-9 and 1985-9 periods (op.cit).

Among a number of policy factors, such as subsidized credit for seed and fertilizer purchase, 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 a commercial seed company organized (Zambia Seed Company, or Zamseed) 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 this seed company were to organize the multiplication of seed varieties developed by NARS researchers and to carry out their processing, storage and distribution to farmers.

Howard (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%).

### *Stage 3. Expansion: Liberalization*

By this time, however, it became obvious that the system combining controlled input and product marketing and 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” (Howard and Mungoma 1997: 56) from 23 to 45. In 1996, Zamseed’s market share of maize seed was still 65%.

During that period of time, research was also initiated by three now long-established private enterprises who remain major players in the Zambian maize seed market to date: Zamseed (privatized), Maize Research Institute (MRI) of Zambia, Ltd., and the Seed Company of Zambia (SeedCo.), with a parent company in Zimbabwe. 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 which has operated in various forms since its creation in 1940, initially depending on government research for breeding material and beginning its own research in 1973 (Elliott and Perrault 2006). A fourth major player has been Pannar. Pannar was founded in 1958 in 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 1950s through the 1970s originated with Zambia Seed Company (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 assured delivery of seed and fertilizer at subsidized prices and purchase of maize grain. Although demand for improved open-pollinated varieties (IOPVs) increased, these offered a much lower potential for cost

recovery, as farmers, to reduce their own costs, did not renew 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, have been summarized by Flaherty and Mwala (2010). After a strong increase through 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. Research capacity returned to the levels of the mid-1990s in 2008, but 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 that year, 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.

#### *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 (Figure 2, De Groote et al. 2012). Mwala and Gisselquist (2012:3) 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” (Mwala and Gisselquist 2012). Their study of 31 private companies, as well as non-governmental and public organizations showed that 105 of a total of 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, the Zambian Agricultural Research Institute (ZARI), national agricultural research organization, NGOs, and community-based organizations (CBOs). Six of the companies were private, including 3 national companies, 2 regional companies, and 1 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, produces and processes 2000 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% of the operational cost is attributed to seed production and processing alone. These cost outlays are excessive without credit, and were met when seed companies were public by government subventions. In addition, the growth in the number of plant breeders in the region has failed to keep pace with the number required in the 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) estimates of 81 percent, including saved improved seed, in 2006. Estimates from the HarvestPlus baseline survey place adoption in the major maize-producing areas at 68.4% for F1 named hybrids in 2010/11, and an additional 19.2% for recycled hybrids, IOPVs or hybrids that farmers could not name—or an overall adoption rate, including saved improved seed, of 88% (De Groote et al., 2012).

Tonnage of maize seed sales was nearly 5000 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, 2600 mt were sold in Malawi in that year, and 6224 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 that are twice as high as that of IOPV seeds in Zambia.

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 among the 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 2 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 independent steps to unilateral 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. As did Langyintuo et al. (2010), Kassie et al. (forthcoming) find that the foremost challenge reported by all seed companies except multinationals was the lack of basic seed (high-quality, genetically pure parent stock needed to plant extensive areas required to produce 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 continue 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. In general, 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; 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 provision of public services for domestic seed companies and direct or indirect support from the government. 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 who have been afforded tenders by the government to participate in government programs.

In Zambia, the subsidy scheme now known as the Farmer Input Support Programme (FISP, previously FSP, or Fertilizer Support Programme) includes both fertilizer and improved maize seed. Recently, research by Mason and Ricker-Gilbert (2012) in Zambia found that the FISP was “crowding out” with respect to maize seed demand in addition to 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.

At the time of this writing (December 2012), FISP requires 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 farmer groups (Cooperatives, Associations, Clubs e.t.c). The CAC decides whether to approve a farmer and sends the list of approved farmers to the District Agricultural Committees for ratification. On receiving their inputs through their various farmer 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 will be 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 purchase any maize variety (or any other farm input) in stock at the agro-dealer, as long as the farmers are 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 government office to dispersed agro-dealer shops.

### **3. Household survey evidence**

Baseline data collected by HarvestPlus in 2011 from 1128 farmers in the major maize-growing areas of Zambia (Central, Copperbelt, Eastern, Lusaka, Northern and Southern Provinces) are also summarized by De Groote et al. (2012). The authors found that of the

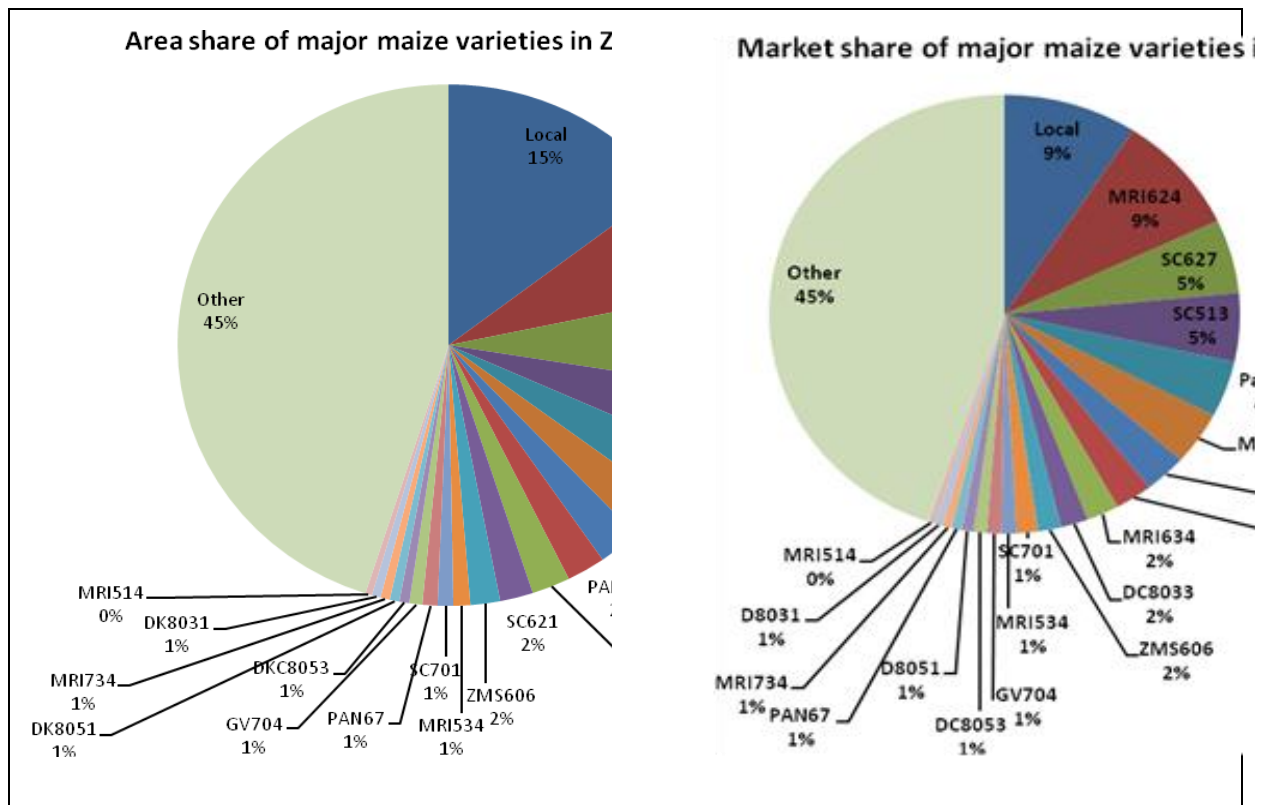
total of 203 improved maize varieties released in Zambia, farmers surveyed planted more than half (106) of these during the 2010 rainy season, as well as numerous local varieties, recycled, and unnamed modern varieties. Details of the sample design are found in the report.

Perhaps the most striking result of the survey was the small total area and area shares planted to any single improved variety in Zambia. No single improved variety covered more than 10% of maize area, with only two varieties covering more than 5% (Figure 1)<sup>1</sup>. 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 that are fairly recent releases; 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.

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<sup>1</sup> National Crop Forecast Survey collected by CSO in the same year support this general finding, based on a sample of over 14,000 farmers.

**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 Provinces. 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 Provinces. The fourth hybrid, SC 513, is early to medium in maturity and is grown more often in AEZ I and II, but is not grown in Northern Province. The most popular late maturing hybrid, MRI 744, is grown mainly in region III. Found in all regions, MRI 744 appears not to be grown in the drier Eastern and Southern provinces because farmers in these areas need earlier maturity to escape dry spells.

National and provincial 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 collected from a stratified random sample of 1128 farmers. Data in the second column were estimated in the same way from the national Crop Forecast Survey, implemented by the Central Statistical Office for the same agricultural season, and including only seed reported to be F1. The number of farmers in the subsample of hybrid maize growers was over 14,000. The two series of estimates vary in terms of magnitude but less in terms of company rank. In order of the size of their market share (percent of reported farmer purchases), Zambia's leading companies in the major maize-producing areas of the country are Seedco, MRI, and Pannar, followed by Zamseed. Monsanto and Pioneer follow, at much lower percentages. The first three companies occupy over three-quarters of the market, according to either data source.

**Table 1. Market share of maize seed sales in 2010/11 season, by company**

	HarvestPlus Survey Data	National Crop Forecast Survey Data
Zamseed	7.91	9.42
AFGRI	0.11	0.062
Pannar	23.5	14.0
MRI	25.8	26.7
Seedco	27.9	38.1
Progene Seeds	0.24	0.33
Monsanto	9.46	1.77
Other companies	0.21	0.179
ZARI-MACO	2.42	0.173
Pioneer	0.96	.085
Don't know, unnamed	1.54	8.66
Total	100.00	100.00

Source: Authors, based on 2011 HarvestPlus baseline survey and Crop Forecast Survey (CFS) data collected by the Central Statistical Office (CSO) of Zambia. 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= 1,426,208.

#### 4. Perceptions of key informants

Key informant interviews were conducted in December of 2010 and August 2012, with representatives of major stakeholders in the Zambian maize seed industry: 1) Pannar seed company, 2) Kamano seed company, 3) Zamseed, 4) SeedCo, 5) Maize Research Institute (MRI), 6) Pioneer, and 7) the Ministry of Agriculture and Livestock Development (see list of key informants in Annex 1). Selection of company stakeholders was purposive. Respondents include representatives of the major national (Zamseed, MRI), regional (Seedco, Pannar) and multinational (Monsanto, Pioneer) players in the Zambian seed industry, as well as a Kamano seed company, a smaller company that has worked closely with CIMMYT and also participated in trials of orange maize. Companies span the pre- and post-liberalization period, and include those with the longest experience (Zamseed) as well as newer entrants (Monsanto, Kamano). In addition, the role of the FISP in the maize seed industry underscored the importance of interviewing government staff who are familiar with the subsidy program.

Interviews were semi-structured. Respondents were asked to discuss three issues: 1) proposed modalities for commercializing Provitamin A-rich, orange maize, including whether or not they recommended exclusivity; 2) company experience concerning what constitutes a successful (widely adopted) variety; and 3) perceptions regarding the impacts of the FISP on their operations.

Given the evidence that no single variety or company dominates maize-growing areas in Zambia, even within provinces, and the large number of varieties (produced by various companies) 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, advocating for exclusivity in the commercialization of specific orange maize varieties because companies need to protect their investments in promoting a differentiated product and capture market share in a highly competitive market.

SeedCo has the largest overall market share in Zambia. Regarding market success of varieties, SeedCo's experience is that uptake usually begins slowly, and popularity is augmented through various promotional techniques, such as "buy one—get one free," as competitions and community radio adverts. SeedCo estimates that it spends in the range of 20% of the company budget on marketing and promotional activities.

As did the other business representatives of seed companies interviewed, SeedCo preferred the concept of exclusivity, for similar reasons as those cited above. One seed company would be accountable for product quality, and buyers will know where to find assistance when faced with difficulties. 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 perceives itself to be strongest in Southern Province, followed by Central Province. Our data confirm that MRI has the second largest share of the national market after SeedCo, but the market shares in the HarvestPlus data are highest for MRI 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% of the gross revenue from seed sales. Overall, marketing and promotions account for about 25% of the company's budget. Distribution costs are the major component of this share.

MRI reported that FISP supported the company's activities through facilitating a large-scale popularization of MRI products among smallholder farmers—many of whom may not have known the characteristics of the maize hybrids previous to benefiting from FISP. Benefiting from FISP enabled many smallholders to test and become familiar with hybrids

that might not have been supplied to them or that even if supplied, they might not have purchased otherwise. According to the MRI representatives, the e-voucher system is a promising new approach that should further liberalize the input market. With respect to commercializing orange maize, MRI representatives did not express concern about exclusivity in principle. However, it is important for a company to be able to differentiate its products and MRI, like Pannar, considers itself to be a conservative company and a reputable seed industry leader that invests in new products only after careful evaluation. Any product sold by MRI must add value to the portfolio.

Pannar is the largest independent seed group in the RSA, one of the largest seed suppliers across Sub-Saharan Africa, and, according to the HarvestPlus baseline survey, it 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 in its portfolio. The performance of any new variety must be carefully evaluated. The most successful Pannar cultivars have been those with the best agronomic performance. Many of the varieties released in Zambia are high yielding and competitive. According to the Pannar representative interviewed, resistance to storage pests is an important trait that might make a difference in the seed market by differentiating the hybrid. However, Pannar representative thinks that if consumers prefer the nutritional benefits of orange maize, nutrition attribute may influence farmer adoption.

According to the Pannar representative, 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 marketing context. Nonetheless, according to the Pannar representative, the modus operandi of FISP has in the past favored some companies over others. The new e-voucher system is clearly a step toward greater and more open competition in the maize seed market, but the company is concerned about the technical realities of operationalizing the program, falling short of demand in this season, when the program will function as a pilot test, and the implications of these challenges for scaling up the approach.

Zamseed estimates that it spends up to 10% of the company budget on promotional activities, or \$80,000 per annum. A successful variety has a unique identity with features that are liked and easily recognized by clients. Promotional activities include highly visible branding of vehicles, establishment of a network of on-farm and roadside demonstrations, distribution of information through various media, and distribution of free 250gram packs of seed (about 2 mt total). Seed is sold in 2kg, 5kg, and 10kg packs, to maximize appeal to cash-constrained, smallholder farmers. Zamseed collaborates closely with the Zambian National Farmers Union in order to “reach out” to a larger number of farmers through demonstrations and information diffusion. Finally, Zamseed is always been one of the participating companies in the FISP.

Zamseed concurs with exclusive rights to sales of orange maize varieties. Common varieties are not well promoted, and when multiple suppliers are involved, the quality is compromised since there is no clear accountability or responsibility for 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 Kamano 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 Kamano representative is of the opinion that a special brand and market will need to be developed for orange maize.

Kamano Seed Company is a small, emergent company based in Zambia that has not been involved in research and development and has not marketed its own varieties. Initially, Kamano sold only legume seed. The company then used the sales of maize IOPVs obtained from CIMMYT to develop networks among small-scale farmers with limited resources, and also in forming networks of agro-dealers in North-Western Province. Many of their clients have been NGOs. Eventually Kamano introduced maize hybrids, and currently, maize seed sales are the major activity of the company. Maize hybrids sold by Kamano have also been obtained from CIMMYT.

From Kamano's perspective, market success is associated with the development of a specialized market that services grassroots smallholder producers, including mobile seed sales. Kamano also argued for the importance of exclusivity in commercialization, since Kamano have already invested in promoting orange maize through their demonstration programmes. Kamano noted that strong competition in the Zambia maize seed industry exists, as evidence by the entry of 14 companies in a recently advertised government tender. According to the Kamano representative, unless seed rights were assigned specifically to smaller companies, larger companies with dominant market shares would drive smaller companies out of the market. For example, even with FISP, Kamano Seed has benefited so far only as a supplier of legume seed, being an area in which few other companies participated.

Pioneer Seed expressed interest via the global head office of DuPont to include Provitamin A-rich maize varieties in its project portfolio. Pioneer spends at least 5% of each country budget on promotional activities, including demonstrations. At present, Pioneer hosts at least 600 demonstrations throughout the country, on the roadside and on farms. Pioneer echoed the perception of the Zamseed maize breeder that free access to orange maize varieties will improve competition and the company is interested in acquiring and improving orange maize regardless of how many other companies are involved.

An entirely different perspective 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 free, with conditions or incentives that encourage commercialization. For example, during the first two years, seed companies could be requested to meet set targets of seed quantities and provided with incentives to meet the targets. Parental seed could be provided based on requests and upon assessing the company's capacity to maintain seed quality standards. 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.

Several arguments were cited 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. On the other hand, there is 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. Exclusivity would then associate the promotion with a single company, mixing the public good (nutritional welfare of Zambians) and private attributes (seed market) of technology.

## 5. Conclusions

Originally an industry dominated by a single, government-managed seed company, the maize seed industry today includes a highly competitive array of multinational, regional, and local maize seed companies, with varying intensity 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 improved open-pollinated varieties. 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 its lifetime, the primary buyer of maize seed has been the government. Sales to the government has guaranteed and market and the distribution of seed through subsidies to a widely dispersed, differentiated, and uncertain, smallholder clientele. From the perspective of participating seed companies, subsidies have popularized varieties and helped to create loyal customers, absorbing many of the transactions costs that would have been borne directly by companies.

At the same time, how well FISP responds to farmer demand for specific varieties is unclear. Furthermore, not all companies have participated in FISP. Market risk and uncertainty have also constituted barriers to market entry and growth of new local seed companies, especially given preferential arrangements under FISP. Evidence is also accumulating in Zambia and elsewhere in Sub-Saharan Africa that in the maize seed industry, as well as 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 in farmers' fields, and the equity in their spatial distribution. Over the past ten years, 2003 to 2012, an average of 16 new maize varieties were released per annum. This scenario meant that each season, farmers were presented with a wide choice of possibilities for maize production. This situation may have been responsible for the lack of domination of the market share by any one variety, with the most popular variety occupying only up to 10% 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 reflects demand or supply (in particular, operational implications of the past subsidy programs) considerations.

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 are 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.

Considering that Provitamin A-rich maize is little known and different, its market is unpredictable. Risk-sharing arrangements with any company that takes up this product was essential. Building and maintaining a unique brand of Provitamin A-rich maize that clearly distinguishes it from the numerous 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 brand identities of their existing white maize varieties. In addition, HarvestPlus will continue investing in its own initiatives to create awareness and promote orange maize with the aim of accelerating adoption.

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