IMPACT OF MAIZE BREEDING RESEARCH IN THAILAND: PUBLIC AND PRIVATE SECTOR COLLABORATION

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1. THE MAIZE ECONOMY OF THAILAND

In the last 30 years, the growth of maize production in Thailand has been the result of intensive technology research and development. In close collaboration with CIMMYT, public sector research in Thailand developed several locally adapted and disease-resistant open-pollinated maize varieties (OPVs) until the late 1980’s. These varieties dominated the market and maize area in Thailand up until 1990. Within that period, nearly 2 million ha planted to maize (out of about 4 million ha planted to major field crops) and an annual production of 4 million tons indicated the success of these public sector-developed OPVs. In the 1990s, total maize grain output continues to increase steadily, while the average acreage planted to maize has fallen somewhat and stabilized at around 1.4 million ha per annum.

Beginning around 1990, fundamental shifts took place in the maize seed industry of Thailand, with substantial changes in both production technology and market outlets. In the 1990s, several private multinational and domestic companies produced maize hybrids that began to dominate farmers’ fields. With active promotion from both the public and private sectors, farmers rapidly learned to use new maize hybrids, further indicating the productive collaboration between the two sectors. The private sector has developed their hybrids based on the public sector’s locally adapted, disease resistant OPVs and inbred lines. The good competition among the private sector provided farmers an expanded selection of hybrids available in the market.

In consumption and use, Thailand is no longer a major exporter of maize but a major consumer. Domestic use of maize has increased over the years as a direct result of the expanding livestock industry. Rising urban income, associated increases in the consumption of meat and dairy products, and rising exports of chicken meat to Japanese markets have caused a rapid growth in demand for animal feed including maize. Although most maize output was exported in 1966, by 1996, virtually all maize produced was domestically used, mainly as animal feed. In some years, imports of maize were necessary.

2. ORGANIZATION OF MAIZE RESEARCH IN THAILAND

2.1 Public-Sector Research

2.1.1 National level

The two national-level public organizations undertaking substantial maize research in Thailand are Kasetsart University (KU) and the Department of Agriculture (DOA). KU has a 368-ha experiment station in Nakhorn Ratchasima called the National Corn and Sorghum Research Center (NCSRC, commonly called “Suwan Farm”) that has been doing maize research, particularly breeding work, since

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2 Multiple Cropping Center, Faculty of Agriculture, Chiang Mai University, Chiang Mai, Thailand.
1966. Maize research at Suwan Farm is conducted jointly among university staff members and the NCSRC staff.

The DOA, meanwhile, is officially responsible for government research and policies in maize variety development. Maize breeding work in the DOA is relatively recent compared to that in Kasetsart University.

2.1.2 International level

These two Thai public sector research organizations have good collaboration with CIMMYT. CIMMYT has a regional office in the Department of Agriculture, which has been housed within Kasetsart University campus in Bangkok. The scientists from these institutions conduct collaborative field trials, regular seminars and training programs. The collaboration between CIMMYT and Kasetsart University scientists especially has dated back 30 years when scientists began their work on early Suwan OPVs.

2.2 Private-Sector Research

2.2.1 Multinational companies

Until 1998, only four multinational seed companies operated in Thailand: Pioneer Hi-Bred, Pacific Seeds (Advanta/ICI/Zeneca), Novartis, and Cargill Seeds. Most of the germplasm used for their breeding work come from their mother companies. Within each company, research results, activities and output are shared among the regional branches. Three of these companies established offices in Thailand during the late 1970s or early 1980s. With their Thai staff, they are able to operate with adequate research backup and efficient management. After 15-20 years of operation in Thailand, these companies have acquired the experience and skills in working with farmers, whose strong participation have also helped in their successful breeding programs. Adequate competition among the private companies has provided the industry with a healthy working environment of many positive performances.

2.1.1 Domestic (Thai) companies

Among the seven private companies involved in maize research in Thailand, three are domestic companies. The biggest of these, the Charoen Seeds Group (C.P. Group) is a Thailand-based multinational company involved in all lines of agribusiness, including seeds. The other two companies (Uniseeds and Royal Seeds) are much smaller. Charoen Seeds collaborates with a U.S.-based company, DeKalb Seeds, allowing them to maintain broad access to Dekalb’s germplasm and technology. In 1991, the company successfully commercialized the single cross CP-DK888 hybrid, which has dominated around 50 percent of the hybrid maize seed market for the last nine years. It is very popular among farmers, who by now have become very knowledgeable about hybrids and often firmly express their preferred hybrid varieties.

Beginning in 1999, the structure of the Thai seed industry will again change because the U.S.-based agrochemical company, Monsanto, acquired both Cargill Seeds (international section) and Dekalb Seeds. Since C.P.-Dekalb together with Cargill Seeds holds around 70 percent of Thailand’s seed market, the merger will substantially change the nature of competition as more market concentration takes place.

The smaller domestic companies are more dependent on public-sector germplasm and research, both CIMMYT and KU’s Suwan Farm. These companies have some limitations in their research capacity (both in terms of personnel and budget) compared to multinational companies. However, with good coordination with the public sector, they can make important contributions. They strengthen the healthy competition in the industry, and also provide alternative modes of research and business operations from


what multinational companies have to offer. For example, these smaller companies are more interested than multinational companies in pursuing further research on, and marketing, OPVs and public-sector hybrids.

3. **IMPACTS OF MAIZE RESEARCH**

3.1 **Varetal Releases**

During the last 30 years, KU’s Suwan Farm has released at least 4 OPVs, 10 field corn hybrids, 4 sweet corn and 3 baby corn varieties apart from 46 inbred lines (Table 1). Suwan Farm also released two hybrids in the 1980s and six to seven more in the 1990s. Inbred lines from Suwan Farm are especially valuable to breeding work, both in the public and private sector. Meanwhile, the DOA’s Nakorn Sawan Field Crops Center developed and released NS 1 OPV in 1989 and has some hybrids in the pipeline for release.

The first successful public sector OPV, Suwan 1, was a variety developed from 36 maize landraces from many areas of the world. Downy mildew resistance was incorporated through the introduction of 2 Philippine varieties. From 1975 to 1990, Suwan 1 was very well received by Thai farmers and was also used in other Southeast Asian countries. Today, Suwan 1 is still widely used in breeding work because of its broad genetic base.

The 1990s, however, has been the decade of the private sector. Different private companies release about 3-5 hybrids per year. In 1997, there was a record release of eight new private sector hybrid varieties, six of which were single crosses. During 1988-1997, at least 36 private sector hybrids, suitable for different ecological zones, were released and sold in Thailand (Table 2). Company shares in the seed market ranged from 2-3 percent for a small company to 50 percent for a large company. Farmers are segmented in their preferences of hybrid varieties by their relative association with specific private companies. A few of the more advanced farmers have also become hybrid maize seed contract growers.

In 1997-98, approximately 70 percent of all hybrid maize seed sold in Thailand were single cross hybrids. The private sector was selling 21 single cross hybrids, 2 modified single crosses, 2 double crosses and 11 three-way crosses. Out of the 20 cultivars produced by Suwan Farm, 12 were single-cross hybrids and 3 were three-way-cross hybrids.

3.2 **Seed Production**

With widespread adoption of improved varieties in Thailand, the production of improved seed has become a major activity for both public agencies and private companies. In the public sector, seed production is done by the agencies’ own staff, including hired workers. In contrast, private companies work mostly with contract farmers, who receive close supervision from company personnel. Some small local companies buy Suwan hybrids, hire some technical assistants, and produce F1 hybrid seeds for sale under their own brand names. These companies do not do any research and do not produce new hybrids; they just produce and sell Suwan hybrid seeds. These small companies are essentially producers and marketing agents for Suwan OPVs and hybrid seeds. Suwan Farm encourages these small companies to operate in this way, and it sells regularly inbred lines for the production of these hybrids.

With an estimated 15,000 ton of hybrid seed produced and sold in 1997 (Kriangsak, 1997), there appears around 6,000 farm households and 12,000 ha\(^3\) of land (0.8 percent of all maize area) devoted to hybrid

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3 Assuming a yield level of 1.25 t/ha and farm size of 2 ha per household.
maize seed production. Although some farmers reportedly used F2 seeds in 1998-99, at least 90 percent of maize farmers planted some form of hybrid seed.

Table 1. Public-sector maize OPV and hybrids developed during 1975-1997 and private-sector maize hybrids in the market in Thailand, 1997-98.

<table>
<thead>
<tr>
<th>Seed Company</th>
<th>OPV</th>
<th>SC</th>
<th>MSC</th>
<th>DC</th>
<th>TWC</th>
<th>Baby Corn</th>
<th>Sweet Corn</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Public Sector</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suwan Farm</td>
<td>Suwan 1</td>
<td>Suwan 2301</td>
<td>Suwan 2602</td>
<td>Suwan 2</td>
<td>TSC1 DMR</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Suwan 2</td>
<td>Suwan 3501</td>
<td>Suwan 3101</td>
<td>Suwan 3</td>
<td>HSX 27127</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Suwan 3</td>
<td>Suwan 3502</td>
<td>Suwan 3602</td>
<td>Suwan 4</td>
<td>HSX 11476</td>
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<td></td>
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<tr>
<td></td>
<td>Suwan 5</td>
<td>Suwan 3503</td>
<td>Suwan 3601</td>
<td>Suwan 5</td>
<td>Insee 1</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Suwan 3504</td>
<td>Suwan 3601</td>
<td>Suwan 6</td>
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<td></td>
<td></td>
<td>Suwan 3502</td>
<td>Suwan 3851</td>
<td>Suwan 7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Private Sector</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charoen Seeds</td>
<td>CP-DK888</td>
<td>CP-DK999</td>
<td>CP-DK822</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cargill Seeds</td>
<td>C 922</td>
<td>BIG 919</td>
<td>BIG 717</td>
<td>BIG 727</td>
<td>C 501</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pacific Seeds</td>
<td>Pacific 328</td>
<td>Pacific 700</td>
<td>Pacific 421</td>
<td>Pacific 116*</td>
<td>Hibrix 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Novartis Seeds</td>
<td>Red Iron 45</td>
<td>Venbus 49</td>
<td>Hercules 31</td>
<td>Convoy 93</td>
<td>G 5414</td>
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<tr>
<td>Pioneer Seeds</td>
<td>3011</td>
<td>3012</td>
<td>3013</td>
<td>3014</td>
<td>3248</td>
<td>3006</td>
<td>30A10</td>
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<tr>
<td>Uniseeds</td>
<td>Uniseeds 89</td>
<td>Uniseeds 90</td>
<td>Uniseeds 38</td>
<td>Uniseeds B50</td>
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<tr>
<td>Royal Seeds</td>
<td>Royal I</td>
<td>Royal III</td>
<td></td>
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</tr>
</tbody>
</table>

Note: OPV=Open-pollinated varieties, SC= Single-cross hybrid, MSC= Modified single-cross hybrid, DC= Double-cross hybrid, TWC= Three-way cross hybrid, DOA= Department of Agriculture.

*Released in 1998
Table 2. Summary characteristics of public and private sector maize cultivars released in Thailand, 1966-97/98.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Public Sector (cultivars released from 1966-97/98)</th>
<th>Private Sector (cultivars being sold in 1997/98)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of maize cultivars released, 1966-97</td>
<td>20</td>
<td>36</td>
</tr>
<tr>
<td>Improved OPVs</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>Hybrids: Single cross</td>
<td>12</td>
<td>21</td>
</tr>
<tr>
<td>Double cross</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Three-way cross</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>Others</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Numbers of cultivars released by adaptation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lowland tropical</td>
<td>20</td>
<td>36</td>
</tr>
<tr>
<td>Numbers of cultivars released by grain color</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow</td>
<td>20</td>
<td>36</td>
</tr>
<tr>
<td>Numbers of cultivars released by grain texture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flint</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Semi-flint</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Semi-dent</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>Others (baby, sweet corn)</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Numbers of cultivars released by maturity class</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extra early (&lt;100 days)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Early (100-110 days)</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>Intermediate (110-120 days)</td>
<td>11</td>
<td>14</td>
</tr>
</tbody>
</table>

3.3 Seed Prices

In 1997, small local private companies sold maize OPV seeds for about 20 baht/kg ($USD 0.77/kg). Double cross hybrid seeds averaged at about 45 baht/kg ($USD 1.73/kg); three-way cross hybrids seeds, about 60 baht/kg ($USD 2.3/ kg); and single cross hybrids seeds at about 80 baht/kg ($USD 3.08/kg). At that time, ordinary maize grain prices averaged at about 4.0 baht/kg ($USD 0.15/kg). Seed-to-grain price ratios thus averaged about 5:1 for OPVs, 11:1 for double cross hybrids, 15:1 for three way cross hybrids, and 20:1 for single cross hybrids. A comparison of seed-to-grain price ratio in 16-17 countries by Krull, Prescott and Crum (1998) showed that OPV seed-to-grain price ratio ranged from 3.0-7.6 while that for private hybrid ranged from 6.4-26.7. They pointed out that in mature markets, extensive use of improved seed is frequently associated with high seed prices. Experience has shown that farmers quickly appreciate that using improved maize seed does not cost more, it pays more. In a particular country,

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4 These prices were calculated at $US = 26 baht at rate in June 1997 but the baht currency devalued to $US = 45 baht by Dec 1997)
whether hybrid seeds pay for its higher prices depend on the level of incremental yield they can result. For example, using Thailand case, an increase of 0.4 t/ha yield (at 4 baht/kg) will already pay for the single cross hybrid seed costs per ha (at 80 baht/kg and 18 kg/ha seed rate), provided that other costs are the same.

3.4 Varietal Adoption and Diffusion

In the 1970s and 1980s, maize farmers extensively adopted improved OPVs; during the 1990s, more and more farmers switched to hybrid maize. Its adoption has since increased from 20 percent of total maize area in 1990, to 49 percent in 1993, to 60 percent in 1995 (Kriangsak, 1997). In 1997, it was estimated that 81 percent of the national maize area was planted to private-sector hybrid seeds; 4.7 percent to public-sector hybrids; 13.9 percent, to OPVs; and a tiny 0.3 percent was planted to traditional varieties (Office of Agricultural Economics, 1997).

A 1994 study of 200 maize farmers in Nakorn Sawan found that, despite an 85 and 13 percent increase in material and labor costs respectively, farmers who adopted hybrids enjoyed a 32 percent yield increase, 36 percent increase in net return, 29 percent increase in profit per kg and a 69 percent increase in profit per ha (Benjavan, 1996). It also reported that yield advantage is the most important reason why farmers select hybrids. Those farmers who were still using OPV were concerned about higher seed prices and poor pest resistance quality. Those farmers who were still using OPV reported that the OPV seeds were lower in prices and better in pest resistance quality compared to hybrid seeds.

Despite widespread adoption of hybrid varieties however, a meaningful increase in the national average yield is yet to be achieved. Given the potential of the new hybrids, many experts feel that the national average yield should at least be 5.0 t/ha. To date, the national average is only 3.4 t/ha, with some areas posting significantly lower levels than this. Drought, and inadequate use of chemical fertilizers, are probably major causes of such low yield. At the same time, some studies suggested that the trend in yield lags behind those for costs (Office of Agricultural Economics, 1998).

3.5 Profitability of Adopting Improved Varieties

In experimental trials, hybrid maize, has substantial yield advantage over the OPVs. The value of incremental yield offset the incremental cost of higher seed prices and fertilizer costs. Chokechai (1997, 1997a) reported that in the Cooperative Hybrid Yield Trials during 1994-1996. Superior single cross hybrids had an average yield of 9.5-9.9 t/ha, compared to 5.9-7.0 t/ha for Suwa 1 OPV and 2.9-3.3 t/ha for national average.

Estimating yields in farmers’ fields, Narong et al (1993) found that maize yields in export zone, special promotion zones and all other zones were 3.87 t/ha, 2.85 t/ha and 2.5 t/ha respectively. Sanit and Saran (1993) conducted during the 1992-1993 crop year in Sa Kaew province of the central plain found that the average yield for single-cross hybrids reached 4.85 t/ha with a profit of 8,063 baht/ha (about US$ 322/ha). Other hybrids yielded an average of 4.4 t/ha for an average profit of 7,330 baht/ha (US$ 293/ha). Meanwhile, the OPV Suwan 3 yielded, on average, about 3.58 t/ha and a profit of 5,654 baht/ha (US$ 226/ha). Differences in seed costs explain these differences in profits because the costs of other production inputs did not vary much (Sanit and Saran, 1993). Similarly, Tipatorn et al. (1994) found that,

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5 Export zone = areas where production is made for exporting, usually areas with good infrastructure. Special promotion zone = areas with special government projects. All other zones = areas apart from export and special promotion zones.

6 These prices were calculated using $USD 1= 25 baht
in three Northern Thailand provinces, the average yield of OPVs was 3.2 t/ha with a profit of 255 baht/ha (US$ 10.2/ha) while that of hybrid maize was 4.2 t/ha with a profit of 2,556 baht/ha (US$ 102.2/ha). Again, hybrid yields were found to be statistically higher while variable costs or grain prices were not statistically different between hybrids and OPVs.

Despite however the proven yield superiority of hybrid maize over improved OPVs as mentioned above, relatively few studies in Thailand confirm the broad-level impact of hybrid maize cultivation, particularly in relation to profitability and farmers’ income. While there are many studies showing farm-level benefits of hybrid maize, many of them are now outdated. In the last 5 years, the types, as well as seed prices, of hybrids used by farmers have substantially changed. Although there is a sense that hybrid maize is probably improving the lives of maize farmers, there is particular concern about inadequate information on the extent of such impact, problems associated with difficult areas and less than optimal agronomic and environmental conditions, and continuing yield gaps.

4. PUBLIC-PRIVATE SECTOR LINKAGES

Thailand’s success in widespread adoption of new maize technology, i.e. improved OPVs and hybrid maize, can be attributed to the effective collaboration between the public and private sectors. The public sector has laid a foundation in improved OPVs and quality inbred lines followed by the private sector’s intensive research on hybrids, successful production and marketing of seeds. The public sector also provides strong promotion and extension activities as well as a supportive policy environment.

4.1 Germplasm Exchange

The first important linkage between the private and public sector (including international public organizations) involved flows of improved germplasm. The private sector can obtain breeding materials from the public sector, especially from CIMMYT whose maize germplasm bank house some 13,000 accessions collected from around the world. Private companies can also directly access CIMMYT germplasm materials, which they evaluate regularly. CIMMYT has been very open and helpful in distributing germplasm materials free of charge. CIMMYT materials are also accessible to national public agencies like the KU and DOA, whose strong breeding programs, in turn, provide research support to multinational and domestic private companies.

The impact of CIMMYT germplasm is more pronounced among national research organization and small domestic companies than among large multinational companies, national companies and their partnerships. These latter groups of companies have access to germplasm developed by their own mother or overseas branch companies. They reportedly use a small proportion of CIMMYT materials for breeding work (around 16 percent of total germplasm used) while obtaining the bulk of their breeding materials from elsewhere. Approximately 56 percent of the germplasm used in breeding were in-country selections made by the company; 10 percent from their foreign offices; and 18 percent from other public sources both within and outside Thailand.

Interviews conducted with seven private companies revealed that Suwan 1 is still used extensively for breeding work. Often, it was reported that CIMMYT materials were not well adapted to local conditions. On the other hand, private companies extensively use the inbred lines, OPVs and hybrid varieties from Suwan Farm for further breeding.
4.2 Inbred Line Development

In the past, the private sector has benefited from inbred line development work that is conveniently done by public sector research. Suwan Farm, for example, has successfully developed 46 inbred lines that are extensively used by both public organizations and private companies to develop hybrid maize. Suwan Farm sells its inbred lines at reasonable prices, occasionally with instructions on how to develop hybrids from the inbred lines. These have encouraged good business for small and medium scale seed producers. Large private companies buy those inbred lines for further development or to weed out competition. These inbred lines thus benefit both small and large private seed businesses.

4.3 Varietal Testing and Evaluation

Suwan Farm, DOA and the private sector join together for regular varietal testing and evaluation. The Department of Agricultural Extension (DOAE) has also established a seed quality testing program. The varietal testing and evaluation program provides a mechanism for comparing and contrasting materials produced by the private sector and materials produced by the public sector. Private companies use the results as reference points for working with farmers and with government agencies. At the international level, CIMMYT and FAO established the Tropical Asian Maize Network (TAMNET) to provide a venue for varietal testing and evaluation across countries of South and Southeast Asia. Trials conducted through this network show that the yield potentials of many new hybrids are around 8-9 t/ha (Yosaporn et al., 1998; Vasal, 1998; Chokechai, 1997).

4.4 Human Capital Development

Another important public-private linkage is evident in the area of human capital development. Universities provide degree and short-term training for private sector personnel. CIMMYT also regularly trains both public and private sector researchers, both of whom have their background one way or another in public universities. They relate with each other on a personal basis, either as friends, alumni of the same institutions, or through friends of friends, junior-senior, ex-students and teachers, etc. As such, the human capital in Thailand’s public and private sector maize research are well functioning, highly qualified and motivated people committed to their work. Frequent personal contact between public and private sector researchers also makes maize research more interesting yet competitive, and has clearly contributed to the success of the maize research system in Thailand.

4.5 Information Exchange

There are several important venues for information exchange between the public and private maize sectors in Thailand. There are regular workshops and conferences on maize research, focusing either on plant breeding, agronomic work, biotechnology, or maize farming systems, among other topics. There is an annual conference on National Corn and Sorghum Research, where delegates from both the public and private sectors actively participate. CIMMYT and other international organizations like the Bangkok-based Asia-Pacific Seed Association (APSA) also conduct regular regional and international conferences attended by national maize scientists and researchers.

Another important means of public-private sector linkage are the national and international publications. Although the channels of information are relatively closed in the private sector, public organizations regularly publish research papers, journal articles, books, etc. Knowledge is abundant in the private sector, but issues of confidentiality, patents and trade secrets gave them no choice but to remain inaccessible to the public. However, as more knowledge is accumulated in the private sector, there is a danger that public knowledge will become more limited and that learning will be inhibited. It is the role
of the public sector to diffuse and disseminate knowledge, to counteract the private sector’s “closed” form of knowledge.

4.6 Policy-Related Matters

The Thai government has been very supportive of the research and development work carried out in the private sector. It provided appropriate policies that support and expand the work of private companies, thus making possible the rapid expansion in terms of adoption and variety development of hybrid maize. Maize farmers also benefit from public and private sector expenditures on research, extension and infrastructure development. The Ministry of Agriculture and Agricultural Cooperatives (MOAC), for example, actively promotes maize production especially with increased demand in both domestic and foreign markets. Apart from providing seed subsidies, the government has pledged to continuously promote public and private collaboration in maize production. Plant breeders’ rights are also high in the agenda although the particular form of implementation will not concentrate only on plant breeders’ rights per se, but also cover plant varietal protection by community and farmers’ rights.

During 1994-98, a DOAE program subsidized hybrid seed costs for 128,000 ha or around 10 percent of the total maize area at that time. Under this program, farmers paid only 10 percent of the hybrid seed cost. (Farmers only paid 8 baht/kg of the actual cost of 70-80 baht/kg.) By rotating areas covered by this program, farmers in at least 640,000 hectares (45 percent of maize areas in the country) would have had some hybrid seeds introduced to them within five years. After one year, farmers must purchase their own seeds at market prices. In 1999, DOAE plans to subsidize 50 percent of the seed cost on 240,000 ha. The subsidized seed program is jointly administered with private seed companies who see the opportunity of introducing their seeds to maize farmers. Thailand’s Bank of Agriculture and Agricultural Cooperatives (BAAC) also promote hybrid seed adoption by granting farmers agricultural loans that partly include in-kind credit of seeds and fertilizers.

5. LOOKING AHEAD

5.1 Emerging Technologies

It is foreseen that production technology advances, particularly on maize biotechnology, will be substantial in the near future. These advances will set a new stage for the maize seed industry, both for the public and the private sector. Issues relating to bio-safety, health hazards, costs and competitiveness of the industry will have to be addressed. Genetically modified seeds being pushed by the private sector, for example, is a technology too advanced for the public sector, especially in developing countries, to catch up. Human capital development needs and the role of public (including international centers like CIMMYT) and private sectors amidst these technological advances will have to be seriously re-evaluated. There should also be substantial impact studies of these emerging technologies.

5.2 The Evolving Legal Environment

On the legal side, emerging technologies will require a shift in paradigm concerning plant breeders’ rights and variety protection. In the past when new varieties were not protected by law, private companies used forms of breeders’ “secrets” to protect their varieties while relying on “contract laws” to enforce business deals. Because secrets were sometimes revealed and/or “stolen,” private companies see the need to protect their varieties through legal means. In the next few years, new forms of plant varietal protection, together with the technical means to enforce these rights (e.g. DNA fingerprinting) will be in order.
5.3 Changes in the Organization of Research and the Role of the Public Sector

Maize research in Thailand, like research on other crops, will not be the same in the future. As patents and/or plant variety protection laws increasingly protect private research, public sector researchers and even farmers will be less willing to share information, research results, and germplasm. Remuneration will be demanded in many cases. In the context of more private funding for future public research, research results can be sold for profit, and some products of public sector research will need to be patented. Beginning in the year 2000, more universities in Thailand will be financed by the government through block grants, forcing them to substantially revise how research is conducted. Public research institutions will be pushed to be more income-oriented and cost-effective than in the past. It is possible that public research will increasingly be financed by the private sector, patented, more privately owned and eventually more expensive to farmers. If this trend does not look agreeable, institutional innovations in public policies and management and legal framework will have to be formulated, both at the national and international levels.

6. CONCLUSIONS

The current success of the Thai maize seed industry can be traced back to the 1970s and 1980s, when public breeding of open-pollinated varieties laid a firm foundation for private breeding of hybrids in the 1990s. Contrary to expectations however, gains in average productivity per unit area have not been realized in farmers’ fields. While some measure of gains in farmers’ incomes have been observed, additional data are needed to fully assess the aggregate impacts of hybrids and thus of maize research in Thailand. With substantial yield gaps between experimental stations and farmers’ fields, more research is needed to determine farm-level production constraints, especially for resource-poor farmers in marginal environments.

In the next decade, maize research will follow a different approach and provide a new set of impacts, due to rapid changes in technology as well as legal and political environments. As research becomes increasingly privatized and concentrated, it is time to rethink the roles of the public and private sectors to identify future gaps of knowledge. In the end, public sector research organizations, both national and international, will have to fill in these knowledge gaps.

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