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### **Promotion of Quality Protein Maize as a strategic solution to Addressing Food and Nutrition Security: The legacy of Dr. Wayne Haag**



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## **Introduction**

**Quality protein maize (QPM)** contains nearly twice as much usable protein as other maize varieties and yields 10% more grain than traditional varieties of maize. It was developed by Dr. Surinder Vasal and Dr. Evangelina Villegas at the International Maize and Wheat Improvement Centre (CIMMYT) in the late 1990s. For their achievement, they won the 2000 World Food Prize.

Conventional maize is a poor-quality food staple unless consumed as part of a varied diet – which is beyond the means of most people in the developing world. QPM produces 70-100% more of lysine and tryptophan than the most modern varieties of maize. These two amino acids allow the body to manufacture complete proteins, thereby eliminating wet-malnutrition. In addition, tryptophan can be converted in the body to niacin, which theoretically reduces the incidence of pellagra.

Modified maize with higher protein content dates back to the 1920s, and the "opaque-2" variety had been developed in 1963. While its lysine and tryptophan levels were better than those of conventional maize, opaque-2 had lower yields and a soft, chalky kernel, which made it more susceptible to ear rot and insect damage. Moreover, the taste and kernel appearance dissatisfied consumers, who ultimately rejected the enhanced-protein varieties in the market.

Integrating cereal chemistry and plant breeding techniques, Drs. Vasal and Villegas collaborated to combine the existing opaque-2 maize with genetic modifiers. Through the 1970s, they produced and analyzed germplasms at an astonishing rate, sometimes processing up to 25,000 samples a year. By the mid-1980s, they had produced a QPM germplasm with hard kernel characteristics and good taste similar to the traditional grain and with much higher quality levels of lysine and tryptophan.

However, their discovery remained unexploited for years because many nutritionists felt that protein could be added to the diets of the most poor in other ways. In the early 1990s, CIMMYT gained the international support and funding to begin promoting QPM, in Ghana and several other African countries.

QPM hybrids have been developed and tested for varying climatic and growing conditions; QPM varieties are grown on roughly 9 million acres (36,000 km<sup>2</sup>) worldwide. Meanwhile, QPM research and development have spread from Mexico to throughout Latin America and Africa, Europe, and Asia. In Guizhou, the poorest province in China, QPM hybrid yields are 10% higher than those of other hybrids, and the crop has enabled new pig production enterprises, bringing increased food security and disposable income. In total, the QPM germplasm has grown to contribute over \$1 billion annually to the economies of developing countries.

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### **Concerted efforts of Dr. Wayne Haag**

The Sasakawa Global (SG) 2000-Mozambique program led by Dr. Wayne Haag tested quality protein maize (QPM) varieties for local release. Obatanpa, the popular QPM variety from Ghana, was released by the national maize program for commercial use, under the local name of Sussuma. A national multi-location yield trial conducted by National Agricultural Institute, recorded an average 4.6 t/ha yield performance for Sussuma, compared to 4.2-4.4 t/ha for the three most popular improved varieties grown at the time.

The Sasakawa Africa Association (SAA) QPM regional program worked with maize breeders at the National Agricultural Institute to develop new varieties and hybrids, and to strengthen seed production. A special emphasis was placed on sustaining an effective QPM seed quality laboratory to ensure that protein quality was maintained in breeding materials and in seed production.

QPM spread to neighbouring SAA operational countries, including Malawi, where farmers considered quality protein maize (QPM) an important crop due to its high nutritional value. The Ministry of Agriculture in Malawi initiated studies on human and animal nutrition with the objective of establishing QPM's superiority over "normal" maize. In 2003 SG 2000 donated two tons of QPM to be used in the studies, and in 2004 a total of 37 tons of QPM seed were produced for distribution to farmers. The QPM cultivar, Denbanyuman, introduced in 1997 by SG 2000, made great progress in Mali, where it flourished in all maize growing areas. To reduce dependency on seed imported from Ghana, the National Maize Research Program in Mali produced QPM breeder's seed for the first time in 2004. The SAA Regional QPM programme headed by Wayne Haag, collaborated by sponsoring a course on QPM seed production for regional scientists in Kumasi, Ghana.

### **Impact of SG 2000**

In Nigeria the QPM variety Obatanpa was released with the cooperation of Ahmadu Bello University and the Central and West Africa Maize Network. Six hectares were planted to satisfy the demand for seed of the new variety. The United Nations Children's Fund (UNICEF), the National Animal Production Research Institute, and Helen Keller International joined SG 2000 in promoting QPM for feeding infants and fattening livestock.

In 2004 SG 2000 and the Tanzania Food and Nutrition Centre (NFNC) co-produced a QPM promotional video designed to help increase the demand for the highly nutritious grain all over the country. Farmers, researchers, and government officials were interviewed to gather testimonials on the advantages of QPM over normal maize both as food and as feed.

In 2004, the SG 2000 Regional Program sponsored seed production activities in Malawi by Pedro Chauque of INIA/Mozambique, and by Dr. Peter Sallah, of Ghana's Crops Research Institute (CRI), in Senegal. The vast majority of seed produced is Obatanpa,

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or a reselection of it. Ghana retained the lead in terms of annual QPM production, but Uganda's production also expanded rapidly. Burkina Faso, Mali, Mozambique, and South Africa produced significant amounts of QPM, while production in Ethiopia, Kenya, Malawi, Nigeria, Tanzania, and Zimbabwe also increased.

Dr. Twumasi used CIMMYT germplasm during the early 1990s to develop Obatanpa, which by 2005 was sown on more than half of Ghana's maize area. With support from Sasakawa Global 2000, the International Institute of Tropical Agriculture (IITA), and CIDA, Obatanpa was released in numerous countries of Africa, including Uganda where "Nalongo" is among the most popular maize varieties.

CIDA-funded research in Ethiopia beginning in 2003, to develop a QPM version of the hybrid BH660, which accounts for some 60% of seed sales in Ethiopia. These and other superior varieties developed are being promoted through the new "Nutritious Maize for Ethiopia.

Dr. Wayne Haag's mentorship and tutelage helped several maize researchers from the Africa develop as strong breeders in their own right.

### **Quality Protein maize in East and Central Africa**

Maize is an important crop in East and Central Africa as source of food, feed and household income for most smallholder families. Increasing maize productivity remains one of the most effective ways to combat hunger and poverty in the region. The potential contribution of QPM for improving human nutritional status in developing countries where maize is the staple food has been accorded worldwide attention, as highlighted by the award of the World Food Prize for 2000 to the scientists who researched on QPM more than 30 years ago. QPM varieties contain 70-100% more lysine and tryptophan (building blocks of proteins) than normal maize varieties; hence, the nutritional quality of the protein in QPM grain approaches that of protein derived from cow's milk (Vasal, 1994). This essential aspect of enhanced protein quality has been combined with high yield potential, good agronomic characteristics as well as tolerance to major diseases and pests. Quality Protein Maize looks and tastes like any maize variety capturing the interests of many farmers and consumers.

Maize is generally grown in maize-livestock farming systems where it makes a contribution to livestock feeding (Thorne, 2002) in the context of mixed farming systems. Livestock rearing can provide a pathway out of poverty through improvements to household nutrition, cash income, asset building and employment (De Haan, 2004).

Poultry and piggery are fast growing animal enterprises in many areas in Africa for income. These two animal industries benefit from low cost value of QPM with potential to reduce feed costs.

Findings from pilot QPM projects (Lyimo, 2007) showed clear evidence of demand by farmers, processors and consumers for QPM seed, grain and products. QPM has been

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used in school feeding programs where QPM is promoted because of its nutritive value and potential for improved livelihood. There is also potential for improved and cheap nutritional source for vulnerable groups such as children in orphanages, prisons and feeding programmes in health centres. Experiences and lessons learnt from dissemination of proven and emerging technologies in quality protein maize in east and central Africa show successful results.

### **Introduction of QPM in Uganda**

A variety technically named Longe 5 and locally called “Nalongo”, which means “mother of twins”, was released by National Agricultural Research Organization (NARO) in the year 2000 and widely disseminated with support from Sasakawa Global 2000. At the farmers’ level, the name “Nalongo” is derived from the fact that the variety bears two cobs per mature stem. At a scientific level, Longe 5 derives its “Nalongo” name from its double benefit of high yields and high nutritious value. Nalongo was tested scientifically, and found to display superior agronomic performance as well as nutritional values compared to normal maize varieties

### **Chronology of Quality Protein Maize introduction in Uganda**

<b>1998-2000 first season</b>	<ul style="list-style-type: none"> <li>• Adaptation and release of variety Obantapa as Longe 5 QPM or Nalongo.</li> </ul>
<b>2000 first season</b>	<ul style="list-style-type: none"> <li>• Received breeder seed from Ghana and multiplication with private seed company began.</li> </ul>
<b>2001 first season</b>	<ul style="list-style-type: none"> <li>• Commercialization through contractual agreement with NASECO and East African Seed Companies. A total of 500 MT was produced in the first cycle, 150 MT sold 2002A. And 300 MT was being produced by NASECO alone in 2nd cycle 2002A. Nalongo was now commercially available throughout Uganda as a preferred brand/ variety.</li> </ul>
<b>2002 first season</b>	<ul style="list-style-type: none"> <li>• QPM officially launched for commercial production in Uganda on 22nd February at Bugiri District in Eastern Uganda.</li> <li>• Feeding trials for demonstration of feed Efficiency of QPM conducted.</li> <li>• Area planted to QPM on farmer’s fields is 2089 acres.</li> <li>• Hybrid seed production (3-way cross) entered National Seed Certification release trials.</li> </ul>
<b>2003 first season</b>	<ul style="list-style-type: none"> <li>• Available Seed for sale was 350 MT.</li> <li>• Began feeding trials for demonstration of feed efficiency of QPM on farm in rural communities in collaboration with Makerere University, Animal Science Dept, led by Prof. Mutetika.</li> </ul>

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	<ul style="list-style-type: none"> <li>• Intensification of seed increase OPV + Hybrids (3-way cross NASECO) plans underway for test production in Tanzania in August.</li> <li>• Request for opening up the gate way to access regional Markets</li> </ul>
<b>2004</b>	<ul style="list-style-type: none"> <li>• Local capacity for QPM screening started being built with support from the SG2000 QPM regional coordinator Dr Wayne Haag.</li> <li>• Upgrading of the Crop Science lab of Faculty of Agriculture Makerere University and the National Agricultural Research Organization (NARO)'s live stock lab at Namulonge to meet different levels of accuracy in QPM analysis, CIMMYT QPMD released \$6000 to help implement the recommended improvements that needed to be done.</li> <li>• Capacity of two lab technicians was built at the IITA campus in Nigeria on QPM analysis in October 2004, supported by Dr. Wayne Haag.</li> <li>• SG 2000 with support from Dr. Wayne Haag continued to support the labs with necessary requirements.</li> <li>• The National Quality Protein Maize working group was formed</li> </ul>

**In Uganda Institutions that were involved in QPM activities included:**

- Sasakawa Global 2000
- Public- National Agricultural Research Organization (NARO), National Agricultural Advisory Services (NAADS), World Food Program (WFP), United Nations High Commission for Refugee (UNHCR)

Private- Nkoola Institutional Development Associates Limited (NIDA), East African Seeds, Farm input care centre (FICA) Seeds, Nalweyo seed company (N ASECO), Uganda Seed Project, and Harvest farm Seeds.

**The efforts of Dr. Wayne Haag in promoting QPM in Uganda resulted into formation of the Quality protein maize working groups, in the SAA operational Countries of Ghana, Tanzania, Malawi, Uganda, Mozambique, the membership of the Uganda chapter is shown below:**

**QPM working group Uganda -2004**

1. Hannington Kamuhanda ICE-MARK AFRICA/ Chairman of the WG
2. Hilary Rugema SG2000/ Secretary of the National Working Group

**Members**

3. Rose Omaria NARO
4. Barbara Tembo Min of Health
5. Josephine Okot Victoria Seed Co.
6. Sara Seruwagi Makerere University Crop Science Lab

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7. Dr. BOA Ministry of Agriculture Animal industry and Fisheries  
(MAAIF)National seed certification services (NSCS)
8. Richard Masagazi NASECO
9. Mr. Mubagazi Emmanuel FICA Seeds

**Promoters of QPM in Uganda 1999- 2008**

NARO/NAARI	<ul style="list-style-type: none"> <li>• Maize germplasm evaluation &amp; breeding</li> <li>• Breeders seed production</li> <li>• Farmer participatory eval'n</li> <li>• Agronomic practices</li> </ul>	Dennis Kyetere George Bigirwa (Pathologist/Head, Cereals Research Prgm.) Joseph Kikafunda (Agronomist) Justus Imanyoha
SG2000	<ul style="list-style-type: none"> <li>• Technology dissemination</li> <li>• QPM promotion</li> <li>• Agribusiness development</li> </ul>	Mike Foster Wayne Haag Hilary Rugema Semaana Robert Anyang
Makerere University, Crop Science Dept.	<ul style="list-style-type: none"> <li>• QPM germplasm development; MAS</li> <li>• QPM quality control</li> </ul>	Richard Edema (biotechnologist)
Makerere University, Agric. Economics & Agribusiness Dept.	<ul style="list-style-type: none"> <li>• QPMD baseline &amp; performance indicator studies</li> </ul>	Dick Sserunkuuma (Ag. Economist)
Ministry of agriculture/NAADS	<ul style="list-style-type: none"> <li>• Agricultural extension</li> <li>• Seed certification</li> </ul>	Dr. Silim Nandi Mr. Bazale
Ministry of Health	<ul style="list-style-type: none"> <li>• Human health &amp; nutrition</li> </ul>	Barbara Tembo (Senior Nutritionist)
FICA Seed Co	<ul style="list-style-type: none"> <li>• Variety evaluation &amp; development</li> <li>• Seed production &amp; marketing</li> </ul>	Chris Kaijuka (Managing Director) Emmanuel Mubangizi (General Manager) Justus Imanywoha (Breeder)
NASECO Ltd	<ul style="list-style-type: none"> <li>• Variety evaluation &amp; development</li> <li>• Seed production &amp; marketing</li> </ul>	Nicolai and Robert Anyang
East African Seed Co	<ul style="list-style-type: none"> <li>• Seed production &amp; marketing</li> </ul>	Hannington Kamuhanda (Sales Manager)
Harvest Farm Seed Co	<ul style="list-style-type: none"> <li>• Seed production &amp; marketing</li> </ul>	Mukiri wa Githendu (General Manager)
Victoria Seed Co	<ul style="list-style-type: none"> <li>• Seed production &amp; marketing</li> </ul>	Josephine Okot (Manager/Breeder)
ASARECA	<ul style="list-style-type: none"> <li>• Sub-regional organization</li> <li>• Regional agricultural research coordination</li> </ul>	Seyfu Ketema (Exec. Secretary)

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Bakusekamajja Women's Dev. Farmers Association	<ul style="list-style-type: none"> <li>• Community based org.</li> <li>• Seed production</li> </ul>	Grace Bakaira (Chairperson)
Africa 2000 Network	<ul style="list-style-type: none"> <li>• Agricultural development</li> </ul>	Mary Jo Kakinda
WFP	<ul style="list-style-type: none"> <li>• Food relief agency</li> </ul>	Dorothy Kanyomozi, Elivis Odeke
UNHCR	<ul style="list-style-type: none"> <li>• Food for refugees</li> </ul>	
Chemiphar	<ul style="list-style-type: none"> <li>• Lab analysis</li> </ul>	Kephar Kitau

### **Work of CIMMYT's Dr. Dag Turner, Dr. Denis Frisen and Dr. Wayne Haag in promotion through the Quality protein maize Development project (QPMD)**

The Quality Protein Maize Development (QPMD) Project was designed to build upon the successes of the East Africa Cereals Project (EACP), supported by the Canadian International Development Agency (CIDA) and implemented by the International Maize and Wheat Improvement Centre (CIMMYT) over a sixteen-year period. Maize research in Ethiopia, Kenya, Tanzania and Uganda (The Horn and Eastern Africa region), was also coordinated through the Eastern and Central African Maize and Wheat (ECAMAW) Research Network, a sub-structure of the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), one of the three founding members of the Forum for Agricultural Research in Africa (FARA), related to the New Partnership for African Development (NEPAD) and the African Union (AU).

The QPMD Project was designed as a five-year project, involving participation by governmental organizations, NGOs and private sector stakeholders in Ethiopia, Kenya, Tanzania and Uganda. The total CIDA contribution was CAD\$4.5 million. The Project formally began in January 2003 and was terminated in June 2007.

The goal of the Project was to improve the food security, nutrition (and thus health), and farm income of resource-poor farming families by developing and facilitating adoption of stress-tolerant QPM cultivars adapted to the major ecologies of The Horn and East Africa. The purpose was to improve the availability, production and utilization of protein quality-enhanced open-pollinated and hybrid maize varieties, and to facilitate transfer of the technology package to farmers in the four target countries of the region: Ethiopia, Kenya, Tanzania and Uganda.

The QPMD Project aimed at promoting widespread adoption of QPM in the region among those who rely on maize as their dietary staple. It focused on producing nutritionally dense, stress tolerant maize varieties and disseminating them to rural families, employing gender-sensitive approaches.

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