

Seed selection and biodiversity maintenance by women farmers

The International Center for Wheat and Maize Improvement (CIMMYT) started a maize-breeding programme at the end of the 1970s in south-west China where 25 million poor farmers in remote upland areas depend on the crop for their staple food. An impact study of this ongoing programme was financially supported by CIMMYT and carried out by the author from 1994 to 1998.

Yiching Song and Gigi Manicad

Food security in China will continue to occupy a top position on the international food security agenda in the coming century. Sustainable production of staples such as wheat, rice and maize depend on the systematic mixing of crop varieties of various origins and genetic makeup.

Researchers are becoming more aware of the role of farmers' seed systems and their knowledge of crop development and biodiversity conservation. China has followed a modern technology-oriented approach and has relied mainly on its public seed system to ensure national food security, notably in response to the great famines of the late 1950s. The most noteworthy development was the establishment of public agricultural research and extension systems for modern varieties. Some 30% of Chinese food production can be attributed to the development and promotion of improved planting materials, especially hybrid wheat, rice and maize (Lin 1998, Fan and Pardey 1997). China was the first country in the world to plant significant areas of genetically modified crops in the early 1990s (Song 1999).

The Chinese rural economy has experienced a rapid growth since the adoption of a broad programme of rural economic reforms in 1978, and China has been widely acclaimed for its achievements in food production and poverty alleviation. However, in a rapidly changing social context and natural environment, marginalised farmers, especially women, find it difficult to adapt to change. The farmers of the remote upland areas in south-western and north-western China make up a large proportion of the 60 million Chinese who live in poverty.

Feminisation of agriculture

The feminisation of agriculture is an important phenomenon in China. Women constitute more than 80% of the agricultural work force because of the volume of

male out-migration (Song 1998). As a result, women are overburdened with agricultural activities that give little or no profit. There are fewer opportunities for women-headed households to adopt modern varieties owing to their limited access to resources and services (Jiggins 1986, Song 1998, 1999).

Furthermore, continuous agricultural exploitation since the early 1960s, guided by the state's single-minded aim of only targeting higher yields in its struggle to secure national food security, has tended to degrade natural resources and agroecology. This has negatively affected the resilience of the ecosystem and the sustainable livelihood of farmers and poor women in particular.

What has been happening in areas where natural resources are limited? How are improved plant materials meeting the needs of poor farmers and what is the role of formal and farmers' seed systems in crop development and biodiversity enhancement? The CIMMYT Collaborative Maize Breeding Programme in south-western China set out to collect information on areas with limited natural resources. The study assessed the impact of modern varieties and analysed the capabilities of public research and farmers' knowledge in dealing with food security, poverty alleviation, and agrobiodiversity conservation issues at different levels.

Impact of CIMMYT material

The impact study revealed that CIMMYT genetic material had had a significant effect both in hybrid development and in direct use. This had been achieved through the formal seed system and farmers' informal systems:

- Public breeding efforts have led to the adoption of CIMMYT-related hybrids but yield increments have been of limited benefit for resource-poor farmers in marginal rain-fed areas;
- CIMMYT's maize germplasm has had a considerable impact on household food security and poverty alleviation through the informal system which has assured the wide distribution of CIMMYT's improved populations.

Tuxpeño 1

Tuxpeño 1 (local name *Mexican 1*) is an improved population that was developed by CIMMYT from a landrace that originated from Tuxpau, Mexico. *Tuxpeño 1* was introduced in Southwest China in 1978, originally as a constituent for variety improvement and hybrid combination. However, *Tuxpeño 1* was rapidly disseminated through south-west China, mainly

through farmers' seed exchange systems. Due to its broad adaptability, stability and good stress tolerance, especially lodging resistance, *Tuxpeño 1* became particularly popular with farmers in difficult farming systems in the remote mountainous areas. Here, it has contributed significantly to household food security and poverty alleviation in the last two decades. Meanwhile, due to the poor quality of government supplied hybrid seed, *Tuxpeño 1* has increasingly been adopted by farmers in relatively favourable areas. However, since maize is an out-breeding crop, *Tuxpeño 1* has, in the absence of an improvement effort from formal breeding, degenerated greatly by out-crossing, resulting in decrease of yield, increase in plant height and loss of stress resistance characteristics. Farmers have requested the government to assist them in improving the material but in vain. This has led to efforts by local women farmers to regenerate *Tuxpeño 1*.

Women farmers' initiatives

Geographical variation is a major feature of Chinese agriculture. Regional variability in farming systems and differentiation among farmers are increasing as a result of recent reforms. Different farming systems and other ways of using maize mean different needs for, and thus interests in, technology and genetic diversity. The big gap between the breeders' limited supply and the diversity of farmers' needs has led to indigenous knowledge systems being activated and developed as farmers work on the neglected, improved Open Pollen Varieties (OPVs) and landraces to suit them to their own needs. Socioeconomic factors, including the feminisation of agriculture has meant that local seed selection and landrace maintenance is mainly done by women.

Case studies were carried out in Wenteng and Zhichen villages in south-west China where conditions were representative but contrasted sharply. Wenteng is typical of the relatively better-off communities found in the valleys and flat areas, where farmers are educated and better integrated into the market economy. Pig raising is the main source of income for most villagers and farmers now use maize as pig feed. Zhichen is representative of the poorest and most remote of mountain communities. In this harsh and rugged environment access to market is very limited. Maize is the traditional, staple food crop and there is a large variety of landraces.

Different strategies followed

The following two cases show the initiatives made by women farmers in the two villages in transforming and 'creolising' exotic varieties and in maintaining landraces.

Case 1 Wenteng

Wenteng farmers used to cultivate hybrid maize. However, most of them have recently shifted to improved OPVs mainly as a result of the limited options offered by hybrid varieties, and the decreasing quality of government-supplied hybrid seed. Due to the lack of institutional support and the popularity of *Tuxpeño 1*, women in Wenteng village have been organising themselves to maintain and improve *Tuxpeño 1* since the 1980s. An innovative woman had initiated this activity by trying to maintain *Tuxpeño 1* after it had been adopted. The crop development methods used by the women include spatial separation through the use of plots at different locations, temporal isolation and seed selection. These methods are critical for population maintenance. The women explained that due to the popularity of *Tuxpeño 1* and the women's initiative in selection, it is easy to organise women farmers to grow it in adjoining fields isolated from other varieties. The women mainly select according to mass selection both in the field and after harvesting.

The three steps in seed selection are first to select the best plants in the middle of the field: phenotypes with big ears and other desired agronomic traits. Second, select the best ears (based on cob size, length and number of seed rows) and finally the best grains are chosen from the middle part of the cob according to kernel size, shape, quality, and colour. The women farmers claimed that these techniques have been passed on for generations and they use similar techniques for the maintenance and improvement of landraces. They also added that some of their selection knowledge and skills were gained by their parents or by themselves from the so-called 'bare-footed scientists' during the time of Mao.

As a result, the varietal quality, in terms of preferred agronomic traits and yield of *Tuxpeño 1* in Wenteng village has been maintained and improved in such a way that it is better adapted to local conditions. Most villagers now consider it to be a local rather than an exotic variety. It is not surprising that the improved *Tuxpeño 1* has spread rapidly to neighbouring areas through farmers' informal seed exchange systems. Today, Wenteng is a source for quality *Tuxpeño 1* seed over a large area.

Case 2 - Zhichen

Farmers in the harsh environmental conditions of Zhichen considered improved OPVs and some landraces appropriate technologies with the capacity to meet their needs. *Tuxpeño 1* was introduced

into Zhichen at the end of the 1970s and became the dominant maize variety soon after. In contrast to Wenteng farmers, Zhichen villagers, mainly women, did not do much to improve *Tuxpeño 1* themselves. They maintained preferred landraces instead. Zhichen villagers feel that *Tuxpeño 1* has degenerated beyond their skills to improve it. While hoping that the government will improve *Tuxpeño 1* as a foreign variety, they also realise they will not receive any outside help to maintain their local varieties.

The farmers chose to maintain and improve three local varieties in accordance with their complex farming system and livelihood. *Duan 1*, an OPV improved by the county extension station in the 1960s, is maintained for its good drought resistance. Despite its low yield, farmers use this variety during the second cropping season in the autumn because no other variety will survive severe drought. The methods used by the women farmers to maintain the three local varieties include spatial isolation (growing them in isolated gardens or separate valleys) and post-harvest seed selection of the best cobs and kernels. Zhichen villagers say this knowledge has been passed down over the years. Compared with the women farmers in Wenteng, farmers in Zhichen maintain more diversity for risk management.

Fostering synergy

These farmer's adaptive strategies towards *Tuxpeño 1* show that their selection priorities and objectives reflect environmental conditions, market opportunities and institutional relations as well as socioeconomic positions and risk management. Wenteng has maintained and improved *Tuxpeño 1* while Zhichen has chosen to maintain local landraces. Given the fact that maize is their staple food crop, Zhichen farmers chose maize varieties that reflect their risk-aversion strategies. Despite the agronomic popularity of *Tuxpeño 1* other varieties were maintained and improved by Zhichen farmers for nutritional and cultural reasons and because they ensured a reliable supply in the most adverse environmental conditions. In Wenteng, on the other hand, *Tuxpeño 1* fitted the requirements for a commercial crop and a production surplus made farmers more ready to take risks. In addition, Wenteng women's greater skills in varietal improvement and seed selection reflect external influences and their better access to information and education. Zhichen women farmers, by contrast, live in isolation and are often illiterate.

Women expertise vital

These case studies also showed that the feminisation of agriculture was an important phenomenon in the remote upland areas and that women play a predominant

role in subsistence agriculture and food security. Seed maintenance and selection are entirely managed by women who draw on their indigenous knowledge and informal systems. Women farmers play significant roles in crop development and agrobiodiversity maintenance. However, their access to resources and public services is much more limited than that of men farmers.

A gender analysis and the involvement of women expertise in technology design and development is vital in meeting the specific needs and interests of women. This can substantially contribute to reducing poverty, ensuring food security and enhancing biodiversity at farmer household level (Jiggins, 1986, Quisumbing, Brown et al. 1995, Song 1998)

Better collaboration needed

The experience of *Tuxpeño 1* and the two case studies related here show the considerable impact CIMMYT's genetic material has had on household food security and poverty alleviation. However, this potential was only fully exploited because of the mediation of farmer's informal systems. This shows the need for better institutional linkage and collaboration between the farmers' and formal systems in crop improvement. In this way local dynamics and the role of farmers can be fully exploited in ensuring sustainable food security and on-farm agrobiodiversity management. ■

Yiching Song, Department of Communication and Innovation Studies, Wageningen Agricultural University, Hollandseweg 1, 6706 KN Wageningen, The Netherlands. Phone: +31-317-483297; Fax: +31-317-484791; E-mail: yiching.song@alg.vlk.wau.nl.

Gigi Manicad, Biotechnology and Development Monitor, University of Amsterdam, Department of Political Science, Oudezijds Achterburgwal 237, 1012 DL Amsterdam, The Netherlands. Phone: +31-20-5252177.

References:

- Fan S and PG Pardey 1997 **Research, productivity and output growth in Chinese agriculture** *Journal of Development Economics*.
- Jiggins J 1986 **Gender-related impacts and the work of the International Agricultural Research Centres** *CGIAR Study Paper* No. 17, World Bank, Washington, DC, USA.
- Lin JY 1998. "How did China feed itself in the past? How will China feed itself in the future?" *CIMMYT Economics Programme, Second Distinguished Economist Lecture*. CIMMYT, D.F., Mexico.
- Song Y 1993 **Rural women's participation in Chinese development strategies: patterns and sources of change in the gender division of labour**. *Unpublished MA Thesis*. Institute of Social Studies, The Hague, The Netherlands.
- Song Y 1998 'New' seed in 'old' China: impact study of CIMMYT's collaborative programme on maize breeding in Southwest China. *PhD Thesis*, Wageningen Agricultural University, The Netherlands www.cimmyt.cgiar.org/research/economics/index.htm.
- Song Y 1999. **Feminisation of maize agriculture production in south-west China**. *Biotechnology and Development Monitor* March 1999. Amsterdam University, The Netherlands.