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Biodiversity Conservation and Crop Improvement in a Fragile Agro-Ecosystem: Insights From Guangxi, China

Yiching Song, Zhang Shihuang with Ronnie Vernooy

Farming communities around the world are facing hardship in nurturing and developing crop and animal biodiversity. Their experimentation and innovation practices are under stress. In light of recent international developments concerning innovation, trade and intellectual property (rights), there is an urgent need to develop new policies and laws that recognise and support the key contributions of rural people in the sustainable use of biodiversity. The government of China acknowledges the importance of the sustainable use of biological resources. China, the most populated country with the lowest amount of arable land per capita in the world, has no choice but to keep food security and the sustainable use of biodiversity high on its agenda. One of the most important policy tasks is to create incentives and rewards that recognise and value promising and successful, collaborative efforts to achieve these goals. Our research in China's south-west mountainous areas confirms that farmers are key players in crop improvement and conservation and that farmer-researcher collaboration can produce added value that farmers or researchers alone could never realise. We illustrate these points with an example from the field.

Figure 1: Maize plot for seed production damaged by strong winds. Photo: Ronnie Vernooy.

Guangxi: field laboratory for novel practices

The field example concerns a collaborative effort of the Center for Chinese Agricultural Policy (CCAP), national and provincial level plant breeders and local extension agents and farmers to improve maize production through a participatory innovation process. The working assumption of this initiative is that novel forms of collaboration among diverse social actors will lead to the creation of synergies required for the enhancement of sustainable crop development and in-situ/on-farm management of genetic resources (Figure 1). In this process, women and men farmers' research and management capacities to maintain agro-biodiversity in the specific Chinese context will be strengthened (Vernooy and Song 2004, Song and Vernooy, 2009).

The Chinese rural economy has experienced rapid growth since the adoption of a broad programme of rural economic reforms beginning in 1978. China is widely recognised for its achievements in reducing absolute poverty since then. Nevertheless, there are about 30 million people who still live under the absolute poverty line and they comprise the majority of the food insecure population. They mostly live in resource-constrained remote upland areas, which are agro-ecologically diverse, resource poor and risk-prone. Guangxi is one of those risk-prone mountainous regions and with an important ethnic population, the Zhuang. Our study focuses on two contrasting environmental and economic conditions of maize farming in this agro-ecological region that also covers parts of Guizhou and Yunnan provinces.

On steep mountain slopes and between rocks in a very limited number of flat fields, farmers plant maize in minute pockets of soil. Water is a serious problem due to calcareous rocks, while rains easily flood the land and wash away the crops. In these upland areas, there are no good roads and access to the market is reduced. Maize is produced for consumption as a traditional staple crop. There is still some diversity of maize landraces. For instance, waxy maize is considered to have originated from this area. Farmers work an average land size of less than 0.2 hectares. Although the poor have land use rights, in most cases the land itself is of such low quality that it is not possible to achieve subsistence levels of crop production. Some relatively better-off communities can be found in the valleys and flatter areas where maize is used mainly as pig feed. People here tend to be higher educated and their livelihood systems are more integrated in the market economy. Pigs are the main source of income for most villagers. Maize diversity has come under stress here. Since 2000, the planting area for hybrid maize varieties has been enlarged at a high speed and is now out-spacing the area planted with local varieties.

Figure 2: Waxy maize seeds drying. Photo: Ronnie Vernooy.

Research activities

Since 2000, the research team has been supporting farmers (many of them women) to carry out crop improvement experiments. We have also organised activities to strengthen their research and farm management skills; build linkages with extensionists, plant breeders and policy makers; set up farmer networks; and explore direct market involvement aimed at seed commercialisation. The research uses a participatory plant breeding methodology which facilitates close collaboration between researchers and farmers to bring about plant genetic improvements. Improvements can be made through a number of crossing techniques and/or through various variety selection processes. Trials in the Guangxi villages and on-station include both participatory plant breeding and participatory variety selection experiments. The trials build on farmers' own knowledge about crops and their environment and are "enriched" with formal plant breeders' expertise. Varieties tested include a large number of landraces, open-pollinated varieties, so-called waxy maize varieties (Figure 2) and varieties introduced from abroad (Song et al. 2006).

Some varieties have been locally improved through crossings and selections. Good potential exists to add value to these varieties through the marketing of seeds (Figure 3). Many (women) farmers are keen to explore these new economic avenues as a way to improve their households' livelihoods. However, given the particular features of these new varieties, farmers are facing several regulatory bottlenecks concerning recognition of the collaborative breeding efforts, stringent variety release procedures, non-existent certification, multiple requirements for seed production and marketing (as stipulated in the new Seed Law of 2000), and uncertain pricing (Vernooy, Song and Li 2007).

In most villages in Guangxi there is a local market once every three days. The vendors are mostly local farmers who have moved to doing off-farm work. Regular farmers go to the market to buy but not to sell produce. Direct exchange of goods does not usually happen at these markets; it might happen among neighbours or relatives. Since 2004, the research team has organised so-called Farmers' Seed Fairs which are integrated with the regular markets. These fairs were launched to encourage local people to share their seeds, knowledge, and planting experience. The Seed Fairs have become very popular and play an important function to help people value, collect and exchange local genetic resources and enhance local biodiversity. Seed Fairs have received some recognition and support from the government, but more could be done.

Challenges

Our research has made some progress in new crop variety breeding and landraces conservation and collection, but challenges have emerged. For instance, the first participatory plant breeding variety, named "New Mexico 1" (produced in 2002), is a collective achievement of farmers, breeders and extensionists in terms of efforts, knowledge and breeding materials and other inputs. Despite this collective nature of the innovation process, the variety can only be registered under a breeder or a formal breeding institution's name according to the existing new variety registration system, known as the "Protection Regulation for New Plant Varieties" and regulated by the Ministry of Agriculture since 1999. As such, it discourages farmer involvement in the innovation process.

Much remains yet to be done in China to create a more conducive enabling environment for collaborative efforts that promote the sustainable use of biodiversity. Farmers have a key role to play in crop improvement and conservation (including of medicinal plants), and farmer-researcher collaboration can produce added value that farmers or researchers alone could never realise. Acknowledging and institutionalising these two elements is important. In addition,

Farmer and professional maize breeder, hand in hand, Guangxi, China. Photo: Ronnie Vernooy.

there are other institutional issues to deal with. Farmers should be officially recognised as "co-authors" of new varieties. Plant breeders should be recognised and rewarded not only for the release of new varieties, but also for their contribution to the process leading to the final products.

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Intensified Sheep Grazing Decreases the Biodiversity of Alpine Grasslands in the Carpathians, Romania

Bruno Baur

In central and eastern Europe, alpine grasslands are unique habitats for a variety of plant and invertebrate species (Nagy et al. 2003). Seasonal pastoral activities have been practiced for many centuries on accessible areas of these natural grasslands. To increase grazing areas, semi-natural grasslands have been created in mountain areas below the tree-line by forest logging. Although vascular plant species richness of various natural and semi-natural grasslands in general increases under moderate grazing, effects of grazing on biodiversity vary considerably among ecosystems and among different taxa (Cremene et al. 2005; Baur et al. 2006). Moreover, patterns of biodiversity and their driving processes vary with spatial and temporal scale. Pasture management should be adjusted to the local conditions to identify and implement the best strategy of biodiversity conservation.

Threat to biodiversity

Alpine grasslands in the southern Carpathian mountains, Romania, harbour an extraordinarily high diversity of plants and invertebrates. Transhumant shepherding, the seasonal migration of sheep to suitable grazing grounds, is the traditional use of subalpine and alpine grasslands in the southern Carpathian mountains. Historical records document sheep grazing in the Bucegi mountains since the beginning of the sixteenth century. In these mountains, the sheep flocks have always been large, forcing the animals to graze also in adjacent forests, which were clearcut to extend the pastures in the 19th century (Coldea 2003). More recently, the size of the sheep flocks has increased further as a consequence of the altered socio-economic situation since 1989. Detrimental effects of overgrazing and trampling on plant diversity and vegetation structure, and eroded soils have been reported on the plateau of the Bucegi mountains. As a result, grazing pressure has increased on extensively used, adjacent steep mountain slopes. This is of particular concern as the southern Carpathians harbour a high number of endemic and relic plant and invertebrate species (Ioras 2003). Because of limited food resources, sheep are increasingly forced to graze on steep slopes, which were formerly not grazed by livestock and are considered as local biodiversity hotspots.

Species richness, abundance and number of endemic vascular plants and terrestrial gastropods on steep slopes that were either grazed by sheep or ungrazed by livestock in two areas of the southern Carpathians were examined (Baur et al. 2007). On calcareous soils in the Bucegi mountains, a total of 177 vascular plant and 19 gastropod species was recorded. Twelve plant species (6.8 percent) and three gastropod species (15.8 percent) were endemic to the Carpathians. Grazed sites had lower plant and gastropod species richness than ungrazed sites. Furthermore, grazed sites harboured fewer gastropod species endemic to the Carpathians than ungrazed sites. On acid soils in the Fagaras mountains, a total of 96 vascular plant and nine gastropod species was found. In this mountain area, however, grazed and ungrazed sites did not differ in species richness, abundance and number of endemic plant and gastropod species.