DEVELOPING AN AGRICULTURAL BIODIVERSITY POLICY FOR CHINA

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Abstract

China does not have an agricultural biodiversity policy. Given the significant size and importance of the country's agricultural resource base, the elaboration of a specific institutional framework for agricultural biodiversity could be instrumental to harmonize the

many different and sometimes overlapping or conflicting policies and laws that at present impinge on it. Based on three field experiences, recommendations are made to elaborate a more supportive institutional framework, covering, in particular, recognition, rights, roles, responsibilities, mechanisms, and incentives for community-based and collaborative efforts and innovations concerning in situ conservation of agricultural biodiversity as well as crop improvement.

Key words

Agrobiodiversity, China, food security, genetic erosion, participatory plant breeding, policy development

Background: food security and genetic erosion

China's agricultural development in recent decades has been very successful when considering its contributions to achieving national food security and reducing national poverty. However, despite these successes, the country faces several challenges: persistent and widespread rural poverty in most of the fragile agro-ecological regions, increasing socio-economic inequality at the national level and within many regions, feminization and ageing of agriculture, severe environmental degradation, unsustainable intensification of agricultural production, and erosion of agricultural biodiversity. Smallholder farmers are rapidly losing agricultural biodiversity, related traditional knowledge and local practices (Song 1998; Song and Vernooy 2010a, b; Vernooy 2012).

This process of genetic erosion is threatening both the livelihoods and security of the poor and the national agricultural sustainability and food security in the long run both

nationally and internationally. It also weakens the future capacity to adapt to new and unforeseen circumstances including climate change related stresses. Recent research in the south-west, for example, concerning trends in levels of maize diversity, very clearly points to a reduction in on-farm diversity both concerning the number of varieties as well as the area under cultivation. Landraces in particular are in decline although with some variety among the three provinces surveyed, Guangxi, Yunnan and Guizhou (Li et al. 2011). Maize cultivation nation-wide, which has expanded rapidly in recent years, relies heavily on a hybrid breeding strategy based on a very small number of varieties with a very narrow genetic base (Zhang S. et al. 2010).

Rapid and large-scale privatization of seed production has led to a focus on hybrids and other modern varieties, and an almost total neglect of other types of crops including traditional varieties and under-utilized crops. Most hybrid varieties, however, are unable to adapt to the conditions in remote mountainous areas including to variable weather conditions and longer term climate change dynamics. In parallel to the privatization of seed production, the government agricultural extension system became paralyzed and obsolete. In the 1990s, the whole system almost collapsed: no real service delivery took place, few or no innovations reached farmers, connections with other rural development agencies were ineffective or nonexistent and most staff dedicated time and energy to tasks other than serving farmers and contributing to sustainable rural development (Zhang L. et al. 2010). Many local extension stations became seed, fertilizer and pesticide shops. Farmers often did not even realize that they were government-run enterprises. Concern over farmers' own seed systems was mostly absent.

The Chinese government, partially inspired and guided by international processes (e.g., the Convention on Biological Diversity [CBD] to which China is a signatory, and the International Treaty on Plant Genetic Resources for Food and Agriculture [ITPGRFA], of which China is not yet a signatory), has started to pay attention to these issues through gradual policy and legal reforms in the field of rural development broadly and the conservation of biodiversity specifically (Wang 2012; Zhang 2011; Song et al. 2012). Progress has been made, but many challenges remain. To date, the lessons learned from promising (project) field experiences to sustainably manage agricultural biodiversity have only been partially integrated in policy and legal development. This article presents the lessons learned and policy recommendations generated from three field research initiatives dealing simultaneously with novel agricultural biodiversity management practices and relevant policies and laws. The cases demonstrate that through strong collaborative and sound participatory methodologies involving researchers, farmers, extension agents and government staff both local practices and national policies can be enhanced at the same time. Such an approach is still very new in China. Of particular importance is to elaborate a more supportive institutional framework, covering recognition, rights, roles, responsibilities, mechanisms and incentives for community-based and collaborative efforts and innovations concerning in situ conservation of agricultural biodiversity (including wild relatives) as well as crop improvement.

Following this introduction, a brief review of China's agricultural policy and legal development is presented. Then the experiences and lessons from the three field initiatives are summarized. A concluding section presents policy recommendations. Initial ideas for the article were developed during a workshop held in December 2011 in Beijing attended by

national and international researchers and policy advisors working on agricultural biodiversity management including core team members from the three initiatives highlighted here (for a detailed account of the workshop, Vernooy et al. 2012).

China's agricultural biodiversity policy and legal development

Lewis-Lettington et al. (2006) present three principles for developing policies and laws for access and benefit sharing of genetic resources. Building on this, a sound agricultural biodiversity policy should have: 1) clear and coherent purpose concerning conservation and sustainable use, access, and benefit sharing; complemented by clear and coherent specific objectives, concerning the characterization of genetic resources, prevention of genetic erosion, promotion of domestic use and development, enhancement of national capacities related to conservation and use, inter-state cooperation, and harmonization with international agreements and treaties; 2) identification of the institutional capacities and human behaviors that are prerequisite conditions for achieving the purpose and specific objectives (and in case of insufficiency, a plan to fill the gaps); 3) a prioritization of policy interventions required to achieve purpose and specific objectives, such as restrictive measures, promotional measures, administrative measures, monitoring and enforcement.

To date, limited progress has been made to apply these three principles to the development of agricultural biodiversity policy. China's first National Biodiversity Strategy and Action Plan elaborated in 2010, has a very broad scope. This plan covers in general terms both in situ and ex situ conservation as well as bio-safety and offers some guidelines for implementation. It also proposes a number of programs and projects, only some of which are being implemented at this moment, such as, for example, the conservation of

wild crop relatives. One of the most important aspects that require further elaboration in terms of policy purpose concerns the definitions of ownership and stewardship of genetic resources. At present, the State exercises sovereignty over genetic resources (according to Article 10 of the Seed Law). Plant breeders, either belonging to institutes, companies or as so-called hobby breeders, can apply intellectual property rights over improved varieties; while farmers and farmer communities do not hold individual or collective rights over local varieties. For collaborative breeding, the ownership of new varieties can be based on a formal contractual agreement between the parties involved. Farmers' rights over local genetic resources can be strengthened through such agreements, but to our knowledge, to date, only two of such agreements have been developed and signed in the country. Much remains to be done to clarify the relationships that govern genetic resources, in terms of access and use, and concerning the creation of synergies among stakeholders (Song and Vernooy 2010b).

In terms of institutions responsible for conservation and use of agrobiodiversity, there are three at this moment: the Ministry of Agriculture (MoA), the Ministry of Environmental Protection (MEP), and the State Forestry Administration. The MEP has been assigned the role of national coordination and chairs important bodies, such as the Coordinating Committee to implement the Convention on Biological Diversity, and the Joint meeting to develop coherent access and benefit sharing (ABS) regulations. In 2011, the government set up China's National Biodiversity Commission led by vice-premier Li Keqiang and involving 30 vice-ministers and governors of key regions. The Commission has started to draft national ABS regulations. The Chinese government will most likely be signing the Nagoya Protocol on ABS adopted at the 10th Conference of the Parties (October 2010) which

defines the broad terms for ABS regulation.[i] Similar coordination bodies not exist at lower administrative levels.

In practice, there are several, partially connected, sometimes overlapping, sometimes conflicting, policies and laws affecting agricultural biodiversity in various ways and to varying degrees influenced by international agreements (see, for selected country studies of [agricultural] biodiversity policy/law development, Chiarolla 2011; GIZ 2011a; Santilli 2011; Ruiz and Vernooy 2012).[ii] As the three case studies presented here reveal, several institutional and related capacity gaps have been observed: lack of harmonization of institutional (governance) mechanisms (e.g., conflicts between sectoral authorities and territorial authorities), weak public participation (poor information provision, absence of platforms for interactions and joint decision-making), lack of or sometimes perverse incentives, and weak enforcement. These gaps are compounded by a disjuncture between policies at national on the one hand and provincial and county levels on the other hand including the absence of feedback mechanisms between these levels (Qin 2010). National policies and international agreements could be better harmonized as well (Zhang 2011).

Experiences from the field

Approach and methodology

In-depth research about agricultural biodiversity in China has a relatively short history and there are only a few longer-term studies that have focused on the dynamic linkages between practice and policies related to the conservation and sustainable use of agro-biodiversity. Two of such cases are major, longer terms initiatives, a Sino-German technical cooperation project of the Ministry of Agriculture of China and the Deutsche Gesellschaft

für Internationale Zusammenarbeit (GIZ) GmbH on behalf of the German Federal Ministry for Economic Cooperation and Development, BMZ, and the Center for Chinese Agricultural Policies (CCAP) with the support of the International Development Research Centre of Canada (IDRC), respectively. Both these cases link local level efforts in multiple locations with policy processes at the national level. The third case is a smaller, shorter-term one, executed in Yunnan province by Yunnan University with the support of Bioversity International. Together they address, without pretending to be representative in terms of agro-ecological systems in China, many of the key aspects or components of sustainable use and conservation of agrobiodiversity. Table 1 summarizes some of the main characteristics of the three initiatives. The sites of the local level efforts are visualized in figure 1.

Table 1: Main characteristics of the three study cases

Figure 1: Map of research sites of the three study cases

The theoretical approach that informs the three initiatives is social constructivism (Vernooy and Song 2004). This approach assumes that important features of the external world are uncertain and disputed, and that people actively construct their understanding of it. Joint discovery and the active building of linkages between various stakeholders are essential parts of the research process. Researchers and development workers often assume roles as facilitators, rather than instructors, in the process of building a more dynamic and holistic view of change as well as in the actual implementation of the change process. When it comes to influencing policy processes, this approach can be translated in

three possible impact pathways described by Carden (2009) as expanding policy capacities, broadening policy horizons, and affecting decision regimes. The first focuses on strengthening a policy community's capacity to identify, assess and communicate new ideas and cultivate the talent to analyze and apply incoming research advice. The second refers to improving the intellectual framework surrounding policy development by introducing new ideas on the agenda, by ensuring that research results reach policymakers in a usable format and understandable language, and by fostering dialogue between researchers and policymakers. The third leads to changes in the decision making regime not only in terms of content but also concerning procedures of legislative, administrative and evaluative deliberation. The three initiatives have each tried one or more of these pathways in a variety of forms.

In terms of methodology, the three cases share commonalities. All three are based on and built on everyday local practices of farmer communities concerning agricultural biodiversity management and conservation. They make use of a participatory approach (use of participatory rural appraisal tools, participatory plant breeding methods, participatory village planning, farmer seed fairs), combine the use of natural and social sciences, and engage in policy and legal analysis and advising government planning from the start. They work on agricultural biodiversity management and conservation through strategies that include multiple but complementary activities. In the case of the Sino-German initiative: awareness raising, integrated surveys, *in situ* conservation, Farmer Field Schools (FFS), adding value to agrobiodiversity products, and mainstreaming (Seib 2011). In the case of the Guangxi initiative: socio-economic surveys, crop improvement, in situ conservation, conversion to green/organic agriculture, extension reform, strengthening of farmer

organizations, and advocacy (Song and Vernooy 2010b). The Yunnan initiative uses awareness raising, ethno-botanical surveys, in situ conservation, farmer seed fairs, and policy analysis (Bioversity International 2010).

Hainan, Hunan, Hubei, Anhui, Chongqing: farmer-led conservation and sustainable use

Perhaps the single largest agrobiodiversity initiative carried out in China to date has been the Sino-German *Sustainable Management of Agrobiodiversity in the Provinces of Hainan and Hunan* project, carried out between 2005-2011. Three year EU co-funding under the EU-China Biodiversity Programme allowed extension to other mountain areas in Southern China, in Anhui, Hubei, Chongqing. The multi-level approach adopted – activities at village, county, provincial and national level – as well as a large number of intervention areas focusing on various target groups proved to be very successful. The internet, posters, exhibitions, documentaries, publications and other mass media showed to be effective means to introduce agrobiodiversity conservation and management, disseminate relevant scientific knowledge, and create agrobiodiversity conservation awareness (Breiholz et al. 2011, GIZ 2011a, b; Seib 2011; Martins 2012). The village surveys, carried out by local researchers, together with government staff and farmers, played a central role and served as the basis for village planning including measures to conserve agricultural biodiversity in situ. Surveys covered resource assessments (e.g., identification of local cultivars, species at risk), interviews about traditional knowledge, and socio-economic aspects (e.g., economic potential of certain plants). The surveys also allowed developing a set of indicators for the monitoring of changes over time (Waldmueller 2011).

A variety of *in situ* measures were identified adapted to local context. Among them were village code of conduct, small habitat protection, notably to protect key wild plants (over the project time frame, 81% of species identified as indicator species remained stable while 17% increased in number of cultivars or in area covered); some "lost" cultivars were reintroduced; biodiversity friendly farming methods (reduced use of chemical fertilizers and pesticides ranging from 10 to 40 percent); improved seed maintenance; and seed fairs (Seib 2011: 17-18). Payments for environmental services were introduced on a pilot basis (in kind, infrastructure measures) and proved to be effective measures for the conservation of agricultural biodiversity. Farmer Field Schools in which many women played key roles were set up to carry out small agronomic experiments and at a later stage to develop value adding activities, such as the processing and marketing of certain plants. Active women's participation, however, was often hindered by gender-based inequities. Some of the FFS evolved to formal cooperatives, a process that is not automatic, but requiring guidance and support. Farmers were trained in value chain analysis and development. A number of products from underutilized varieties and species have been marketed generating additional income through ecologically sound management. Examples include wild raspberry (*Rubus rosifolius*) and a red rice variety (Seib 2011: 30). Only if an economic benefit can actually be demonstrated will farmers be willing to grow the traditional varieties, which often have a lower yield. This is why farmers have been supported in translating local agrobiodiversity into an economic advantage (Martins 2012).

Current policies and laws that impact agricultural biodiversity were reviewed in the light of the experiences gained at local level, and recommendations for improvement formulated and presented to policy makers. Workshops and conferences were conducted

for mainstreaming agrobiodiversity into Chinese government strategies, and important aspects of sustainable management of agrobiodiversity were included in the development plans of the project areas (e.g., 12th five-year development plans at province and county level). Collaboration with higher education centers led to the establishment of a new course on agrobiodiversity management (at Hainan University) and three new research units dedicated to agrobiodiversity in south China. Training for government staff was also set up. The project led to six policy recommendations (see, GIZ 2011b).

Guangxi: participatory plant breeding and in situ conservation

Participatory plant breeding (PPB) represents a promising approach through which farmers and farmer groups and communities are able to strengthen agricultural biodiversity in close cooperation with formal sector breeders and other scientists. PPB was piloted in China in Guangxi province in 2000 by a research team led by the Center for Chinese Agricultural Policy (Vernooy 2003). Over time, the PPB efforts broadened to cover sustainable rural development broadly and expanded to neighboring provinces of Guizhou and Yunnan. The main aim of the PPB initiative is to establish cooperative and complementary relations between the formal seed system and farmers' systems. Cooperation is necessary to provide opportunities for the empowerment of farmers, mainly women farmers, as most men have migrated to the cities (Song and Vernooy 2010a). The farmers become active partners in plant breeding, on-farm biodiversity management and seed marketing (Song and Vernooy 2010b). Through the use and active experimentation with a broader range of crop diversity, PPB can strengthen on-farm biodiversity management and contribute to both formal breeding and farmers' crop improvement. The PPB research draws the attention to the

importance of supporting local seed systems including production, certification and marketing of PPB varieties, which right now under the current policy and legal framework, is very difficult given that PPB varieties are not recognized by the formal system.

Crop improvements are made through a number of crossing techniques and various variety selection processes, which involve detasseling, mass selection and line selection by farmers with support from breeders. Breeders use more complex methods in the fields of the Guangxi Maize Research Institute (GMRI) in Nanning. The work has covered a range of parallel activities over a number of years using various methods to identify parental materials (through participatory variety selection), improve populations (involving local and formal-system genetic materials) and select further to obtain individual varieties. Trials in six villages and at GMRI include both PPB and participatory variety selection. These trials are evaluated by both breeders and farmers after each cycle and subsequently, new designs are discussed and agreed to jointly. The trials allow for comparisons in terms of locality, approach, objectives and the types of varieties tested (Song et al. 2012).

Based on 10 years of experimentation, five farmer-preferred varieties have been selected and released in the research villages: four open-pollinated varieties (OPVs) and one hybrid variety. They have also spread beyond these villages. In addition, five varieties from the International Maize and Wheat Improvement Center that were showing increasingly poor results have been adapted locally. Another five landraces from the trial villages have been improved thanks to the joint efforts of farmers and formal breeders. Agronomic traits, yields and palatability of all these varieties are satisfactory and they are better adapted to the local environment (Zhang S. et al. 2010). A women-farmer-improved variety, known locally as New Mexico 1 (i.e., Xin Mo 1) has been tested over a number of cycles and

certified by the formal breeding institution. Its robustness and taste make it very popular, and it is now widely used locally. Farmers from neighbouring areas, who have heard about this variety, are coming to learn more and to ask for seeds. In the research area, varietal diversity is increasing. Meanwhile, formal breeders have identified in farmers' fields a number of useful breeding materials with a valuable, broad genetic base.

The CCAP led efforts include two novel access and benefit sharing agreements between farmers from 12 communities and scientists from two public breeding institutes. These agreements are concrete examples of how the access and benefit sharing component of the national agrobiodiversity policy could be implemented at local level. They are the result of a long and arduous process of discussion and negotiation between the key stakeholders involved. The parties to the agreement are now advocating that a national landrace conservation and improvement program should also be set up as part of the working agenda of all plant breeding institutes in the country. Efforts of breeders in this area should also be recognized and evaluated in institutes' annual performance reviews. Another idea that aim pursuing is to set up a national registration system for open-pollinated varieties (OPVs), including landraces, traditional varieties and farmer-improved OPVs, in parallel with the 'new varieties' protected by law. Within this system, the diversity of plant genetic resources can be captured and the contribution of breeders (both farmer breeders and formal-sector breeders) can be recognized (Song et al. 2012). Given their significance, nationally and even internationally (very few of such examples exist), we present the details of one of the agreements (translated from the Chinese, Song et al. 2012).

[box]

Example . ABS agreement on conservation and improvement of maize and rice landraces in Guangxi

With the rapid loss of biodiversity, agricultural genetic resources have been challenged. The mountainous area of southwest China is one of the biodiversity hotspots in the world. Farmers living here are relatively far from the global market and industrialized farming systems. To maintain genetic resources and improve the livelihood of smallholder farmers in the southwest, the Participatory Action Research (PAR) Program of the CCAP under the Chinese Academy of Science (CAS), initiates this agreement for supporting farmers' in situ landrace conservation and improvement.

The following items have been agreed to:

1. Each household is free to participate.
2. The program emphasizes landrace conservation and improvement with no exclusion of hybrid selection and adoption.
3. The program will provide technology and information support for participating farmers in collaboration with Guangxi Maize Research Institute and Guangxi Rice Research Institute.
4. To reduce the possible varietal and technical risks, the program will compensate according to the average yield of the local popular variety in the same season/year, at a similar location.
5. The program will provide incentives for pioneer practitioners who agree to evaluate the process and outputs of landrace conservation and improvement.
6. The costs of the program will be borne by the PAR Program, to set a Development Fund

for interested communities. Compensation will jointly come from the Development Fund and the PAR Program; for communities without a Development Fund, compensation will be covered by the program.

7. Research institutes ought to subsidize farmers when collecting their landraces from project villages and provide source of collection when applying for national and provincial registration.
8. The particular institution to be set up for benefit sharing within the community is beyond the scope of this agreement, but the program will provide suggestions about developing concrete activities and setting up a benefits sharing system in the community.
9. This agreement will be renewed every three years; it will enter into force after all parties have signed.

Contractors

Party A (institute representatives)

3 representatives from the Center for Chinese Agricultural Policy, Chinese Academy of Science, GMRI and GRRI

Party B (farmer representatives)

10 farmer representatives from 10 PPB trial villages in eight counties of Guangxi

Date and place agreed and signed

June 21, 2010

Nanning, Guangxi Province

[end box]

The PPB research also highlights the need for redefining the public roles of Chinese plant breeders, which in recent years, have become too much intertwined with private roles. It is time for a redefinition based on farmers' needs and interests, in particular of women farmers, and to pay much more attention and support to improving farmer varieties (in the case of maize including open-pollinated and waxy maize varieties, which are drought tolerant and culturally preferred) as a key response to climate change.

Guizhou, Sichuan, Yunnan: fostering community-based conservation efforts

The Biotechnology and Genetic Germplasm Institute, Yunnan Academy of Agricultural Sciences, Kunming, is coordinating an initiative to develop a methodology to document and register traditional biodiversity knowledge, develop a formal register for farmers' varieties, educate scientists about respecting and protecting traditional knowledge, access and benefit sharing, and design new mechanisms for the participation of farmers and communities in decision-making concerning agricultural biodiversity management. These efforts are part of the project supported by Bioversity International, *The role of agrobiodiversity to adapt to a changing world: the case of pests and diseases*. The initiative is carried out in Guizhou, Sichuan and Yunnan provinces, among which Yunnan is the province in China with the largest number of plant species, about 17,000 of a total of about 30,000 in all of the country.

In 2010, the initiative carried out a provincial level survey in Yunnan among collectors, conservers and users of genetic resources related to eight major institutions

holding genebanks. The survey provided important findings about genebank rules, regulations and practices, including about recognition, access and benefit sharing in relation to agricultural biodiversity. Survey findings were complemented by selected interviews and by observations in the field. Several important facts came to light (Bioversity International 2010). Follow up assessments in Guizhuo and Sichuan resulted in similar findings.

Most of the gene-bank curators in Yunnan developed a database of their ex situ collections and documented some traditional knowledge related to use and conservation of the materials collected. However, only parts of the database are made public. The collected genetic resources themselves are mostly used in academic research, but hardly for the purpose of development (programs and projects). Specific decision-making mechanisms and procedures to access and exchange the ex situ materials are lacking.

Most of the provincial breeders developed their own crop databases, but prefer not to share the information they possess. Breeders stated that they often use local materials, determine their breeding goals in conformity with local needs and cooperate with farmers during field days and demonstration field stages. They usually do not invite farmers to take part in decision-making about their activities in the field or on-station. Some breeders receive monetary rewards for new varieties developed; some of them share benefits with farmers through small payments; they make improved varieties available to farmers and others through market channels. Formal mechanisms for benefit sharing of genetic resources have not been developed yet.

Local communities in Yunnan have limited awareness that they have certain rights related to genetic resources, and lack the knowledge about how to protect these rights. Through some project interventions, this situation has started to change gradually. Although

some local governments and media are active in supporting the conversation of biodiversity, this is not yet a widespread process. Farmers' varieties or improved farmer varieties can be exchanged and sold locally but there is as yet no system in place to register or recognize these varieties.

Recommendations

The three examples presented above offer valuable lessons about agricultural biodiversity management in practice in an integrative and people-focused way. They indicate that there is a growing recognition of farmers' (and local communities') historical, current, and potential future contributions to the maintenance and improvement of genetic resources and of their rights in terms of research, policy and law. We recommend that the recognition of this role of custodians of biodiversity stands at the heart of China's agricultural biodiversity policy. Such policy recognizes the value of both formal and informal knowledge and practice systems. For example, OPV improvement, practiced by Chinese farmers since domestication of their crops, could be strengthened through PPB in which professional breeder's expertise plays an important role. Adding value to special varieties developed by farmers and breeders together by means of a carefully developed value chain, is another example. We recommend further to develop a strategy to integrate the current national policy and legislative elements related to agricultural biodiversity in one institutional governance framework including the creation of a single coordinating unit and linking this integrated institutional framework to international agreements concerning agricultural biodiversity, in particular the CBD and the ITPGRFA.

There is a need at all levels to strengthen capacities and processes in policy and law development involving communities and farmers through participatory mechanisms, programs and projects; and to build new linkages to communicate local experiences to the national level. This could be done through the creation of open and dynamic platforms allowing all relevant stakeholders to have a voice concerning agricultural biodiversity conservation policy and practice. The policy should define the roles and responsibilities of stakeholders in halting and reversing agrobiodiversity loss and assign key roles to farmer communities.

In terms of interventions, priority should be given to experimental, practical initiatives of access and benefit sharing, incentives for in situ and on farm conservation (e.g., through fiscal reform) and farmer participation in policy implementation,monitoring and compliance. This includes changing the incentive and reward mechanisms for public plant breeders so that they not only focus on hybrid production. A national program could be set up to support innovative incentive mechanisms and supporting institutions such as the ABS agreements developed in Guangxi, PPB projects, or payments for agrobiodiversity conservation services. Implementation practices should be guided by the precautionary principle. Such a program could be strengthened through regular agrobiodiversity surveys to identify and monitor trends concerning (loss of) biodiversity, livelihood improvements, technology adoption and adaptation and the evolution of traditional customs and knowledge. Of particular importance are initiatives to add value to agrobiodiversity resources through the exploration of their economic potential based on product quality, nutritional value and its origin and associated cultural background.

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References

Bioversity International (2010). Report on the policy workshop of farmers' rights and communal agrobiodiversity in Xishuangbanna. The role of agrobiodiversity to adapt to a changing world: the case of pests and diseases. Rome: Bioversity International. Unpublished project document.

Breiholz, J., Plötz, T., & Amend, T. (Eds.) (2011). Mountain Gods and Wild Rice. Agriobiodiversity as a basis for human existence. Contributions from China. Beijing: GIZ. Available: http://www.conservation-development.net/index.php?L=2&ds=365 (Accessed March 5, 2013).

Carden, F. (2009). *Knowledge to policy: making the most of development research.* New York: Sage & Ottawa: International Development Research Centre.

Chiarolla, C. (2011). *Intellectual property, agriculture and global food security: the privatization of crop diversity.* Cheltenham: Edward Elgar.

GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit) (ed.) (2011a). Implementing international agreements to conserve agrobiodiversity - Lessons from five countries. "People, Food and Biodiversity" issue paper series, Eschborn: GIZ. Can be found on the following webpage: http://www.giz.de/Themen/en/22063.htm (Accessed March 7, 2013).

GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit) (2011b). Concept note on Strengthening Sustainable Agrobiodiversity Management. Beijing: GIZ. Unpublished project document.

Lewis-Lettington, R.J., Ruiz Muller, M., Young, T.R., Nnadozie, K.A., Halewood, M., Cabrera Medaglia, J. (2006). *Methodology for developing policies and laws for access to genetic resources and benefit sharing.* Rome: International Plant Genetic Resources Institute.

Li, J., Lammerts van Bueren, E., Jiggins, J., & Leeuwis, C. (2011). Farmers' adoption of maiz (*Zea mays* L.) hybrids and the persistence of landraces in Southwest China: implications for policy and breeding. *Genetic Resources and Crop Evolution* DOI 10.1007/s10722-011-9750-1. Available: http://www.springerlink.com/content/n52185j453727n55/ (Accessed March 5, 2013).

Martins, C (2012). Use it or lose it - Agrobiodiversity conservation in China. *Rural 21* 01/2012, 30-32. Available: http://www.rural21.com/uploads/media/rural2012_01-S30-32.pdf (Accessed March 5, 2013).

Qin, T. (2010). Agro-biodiversity law and policy in China. Powerpoint presentation for the International Conference on Conservation and Sustainable Use of Agro-biodiversity. September 9-10, 2010. Beijing.

Ruiz, M., & Vernooy, R. (Eds.) (2012). *The custodians of biodiversity: Sharing access to and benefits of genetic resources.* Abingdon: Earthscan & Ottawa: International Development Research Centre.

Santilli, J. (2011). *Agrobiodiversity and the law: regulating genetic resources, food security and cultural diversity. Abingdon:* Earthscan.

Seib, N. (Ed.) (2011). *Best practices: Sino-German Project on Sustainable Management of Agrobiodiversity.* Beijing: GIZ. Available: http://star-www.giz.de/dokumente/bib-2011/giz2011-0500en-agrobiodiv-china.pdf (Accessed March 7, 2013).

Song, Y. (1998). *"New" seeds in "old" China: impact study of CIMMYT's collaborative programme on maize breeding in South-west China.* Published PhD thesis. Wageningen Agricultural University, Wageningen.

Song, Y., Li, J., & Vernooy, R. (2012). China: designing policies and laws to ensure fair access and benefit sharing of genetic resources and participatory plant breeding products. In M. Ruiz & R. Vernooy (Eds.), *The custodians of biodiversity: sharing access to and benefits of genetic resources* (pp. 94-120). Abingdon: Earthscan & Ottawa: International Development Research Centre.

Song, Y., & Vernooy, R. (2010a). Seeds of empowerment: action research in the context of feminization of agriculture in Southwest China. *Gender, Technology and Development* 14(1), 25-44.

Song, Y., & Vernooy, R. (Eds.) (2010b). *Seeds and synergies: innovation in rural development in China.* Bourton on Dunsmore: Practical Action Publishing & Ottawa: International Development Research Centre.

Vernooy, R. (2003). *Seeds that give: participatory plant breeding.* Ottawa: International Development Research Centre.

Vernooy, R. (2012). For food security, China tries an alternative to industrial agriculture. *The Solutions* January-February 3(1): 62-69. Available: http://www.thesolutionsjournal.com/node/1058 (Accessed March 5, 2013).

Vernooy, R., & Song, Y. (2004). New approaches to conserve agricultural biodiversity. *Journal of International Agricultural Sustainability* 2(1): 55-66.

Vernooy, R., Song, Y., & Zhang, Z. (2012). Policies of plant genetic resources for food and agriculture: China and the world. Workshop report. Rome: Bioversity International. Available: http://www.bioversityinternational.org/nc/publications/publication/issue/policies_of_plant_genetic_resources_for_food_and_agriculture_china_and_the_world (Accessed March 5, 2013).

Waldmueller, L. (Ed.) (2011). *Training of Trainers Sourcebook on Conservation and Management of Agrobiodiversity in the People's Republic of China.* Beijing: GIZ. Available: http://www.giz.de/Themen/de/dokumente/giz2011-en-agrobiodiv-training-of-trainers-part1.pdf, http://www.giz.de/Themen/de/dokumente/giz2011-en-agrobiodiv-training-of-trainers-part2.pdf, and http://www.giz.de/Themen/de/dokumente/giz2011-en-agrobiodiv-training-of-trainers-part3.pdf (Accessed March 8, 2013).

Wang, F. (2012). Flow of crop germplasm resources into and out of China. In M. Halewood, I. López-Noriega & S. Louafi (Eds.), *Crop genetic resources as global commons: challenges in international law and governance* (pp. 62-78). London: Earthscan.

Xue, D. (2011). China and the Convention on Biological Diversity. Powerpoint presentation for the workshop Policies of plant genetic resources for food and agriculture: China and the world. December 1, 2012. Beijing: Center for Chinese Agricultural Policy.

Zhang, L., Luo, H., Huang B. Pan Q. (2010) Opening our eyes: renewing the Chinese agricultural extension system. In Y. Song & R. Vernooy (Eds.) *Seeds and synergies: innovation in rural development in China* (pp. 85-111). Bourton on Dunsmore: Practical Action Publishing & Ottawa: International Development Research Centre.

Zhang, S., Huang K., & Song Y. (2010). Maize and the formal agricultural research and development system: evolution, challenges and alternatives. In Y. Song & R. Vernooy (Eds.) *Seeds and synergies: innovation in rural development in China* (pp. 13-28). Bourton on Dunsmore: Practical Action Publishing & Ottawa: International Development Research Centre.

Zhang, X. (2011). Access to plant genetic resources for food and agriculture and benefit sharing in China: legal framework, current practices, and future development. Rome: Bioversity International. Unpublished paper.

[i] China has strict regulations concerning the collection of plant genetic resources both for nationals and foreigners. For the import of germplasm, Material Transfer Agreements (MTAs) are used. Access regulations are spelled out clearly, but compliance is not always very rigorous. In addition, provisions about benefit sharing are lacking, for example about how breeders collecting local varieties ought to share benefits with

individual farmers or farmer communities holding these materials. The country has not yet signed the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). According to Zhang (2011), the Chinese government is waiting to see what other countries are doing, in particular the USA, Russia, and Japan (all three non-signatories as yet). The government is also studying what benefits the ITPRGFA has produced to date for countries that signed the Treaty. China, as the second largest holder of accessions in the world, is concerned about how exactly benefit sharing will take place once it has signed on to the multilateral system of germplasm exchange (Zhang 2011). China is a member of International Union for Plant Variety Protection (UPOV) and ratified the 1978 act. China is under a lot of international pressure to "upgrade" to the 1991 act, but has resisted so far because it aims to balance plant variety protection (and breeders' rights) and farmers' rights. There is a growing concern among policy makers and scientists as well, about registration and recognition of farmers' varieties as well as about domestic seed production, and the roles both play in sustainable agricultural development. The MoA, as part of the development of a national Strategy for Intellectual Property Rights in Agriculture, is drafting the Regulation on Agricultural Genetic Resources Ownership Registration which is waiting to be reviewed. The envisaged Regulation (for which no implementation date has been set yet) aims to clarify ownership concerning crop improvement processes including with regards to farmers' varieties. This Regulation recognizes the important roles played by farmers and local communities and offers them more protection than was previous the case.

[ii] Policies and laws include the 1982 Constitution, the agricultural development policy, the 2009 National Biodiversity Protection Strategy and Action Plan, the 2007 Outline of a National Program on Conservation and Use of Biological Species, the Environmental

protection law of 1989, the Grassland law of 1985, amended in 2002, the Agriculture law of 1993, amended in 2002, the Seed law of 2000, amended in 2004, the 2003 Rules for Management of Genetic Resources of Agricultural Crops, the Patent law amended in 2009 now including an important article [26] on Disclosure of Origin of Plant Genetic Resources in line with the CBD), and the 2011 law of Cultural Heritage. These laws are complemented by a series of regulations on the Protection of Wild Plants (approved in 1996), New Plant Varieties Protection (approved in 1997), Multiplication of main Food Crops (approved 2001), Agricultural GMOs (approved in 2002), Approval of Import and Export of Livestock Genetic Resources and International Collaborative Research Using Livestock Genetic Resources (approved in 2008). For more details, see, Qin 2010; Xue 2011; Wang 2012; Zhang 2011; Song et al. 2012.