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ABSTRACT

The core objectives of the Convention on Biological Diversity and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) are the conservation and sustainable use of plant genetic resources. The ITPGRFA links these goals explicitly to farmers' rights. Although farmers' rights have been debated intensely at international level, their effective implementation at national level remains a major challenge. Community seed banks are good examples of effective implementation of those rights, but have received little attention in scientific literature and policy circles. Case studies in this article from Bangladesh, Côte d'Ivoire, India and Zimbabwe illustrate how this knowledge gap can be filled.

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Introduction

Community seed banks (CSBs) are locally governed and managed, collective-action institutions, whose core function is to maintain seeds for local use (Development Fund 2011). They have been designed to conserve, restore, revitalise, strengthen and improve plant genetic resources for food and agriculture, especially, but not solely, focusing on local varieties of crops. CSBs handle major and minor crops as well as neglected and underused species. Around the world, CSBs are helping farmers and communities regain, maintain and increase their control over the seeds they use. Many of them have led to stronger cooperation among and between farmers and with others, such as plant breeders, other agricultural researchers, and gene bank managers, who are involved in the conservation and sustainable use of agricultural biodiversity (Vernoooy, Shrestha, and Sthapit 2015). However, the recognition of CSBs in policies and laws has lagged behind. An important reason for this lack of attention is that CSBs operate under diverse political regimes and in varied policy and legal contexts. In some countries, CSBs operate in the margins and are not (legally) recognised.

Among the main functions of CSBs are the conservation and sustainable use of plant genetic resources. These are also core objectives of two international agreements: the Convention on Biological Diversity (CBD) and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). The latter links these roles to the concept of farmers' rights, recognising that farmers and local and indigenous communities around the world are at the heart of the conservation and development of plant genetic resources and, thus, of world food production (Article 9.1). The concept of farmers' rights has made some inroads in the policies or laws of some countries (e.g. Ethiopia, India, Nepal, Peru and the Philippines), but it remains a challenge to incorporate the four basic rights referred to in Article 9 of the ITPGRFA in national policies and laws and effectively implement them. In resolution 5/2015, the ITPGRFA governing body encouraged signatories to undertake a

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series of concrete actions to implement farmers' rights. To follow up on this resolution, the ITPGRFA Secretariat organised an international consultation in Indonesia in September 2016 to present examples from around the world of the practical implementation of farmers' rights. CSBs were identified as one example, and a plenary presentation on their roles and functions was part of the consultation (Sabran and Batta Torheim 2016).

This article addresses the question of how CSBs contribute to the establishment of the farmers' rights defined by the ITPGRFA. This issue is important given the demand for good examples of how to implement such rights (Andersen 2016; Secretariat of the ITPGRFA 2018). The answer not only has scientific merit in fields such as political science and international law, but can also be used to achieve more recognition and mobilise more support for CSBs at the national, regional and international levels (Chaves Posada 2015).

In the following sections, we briefly review the origin, main definitions and implementation modalities of farmers' rights; introduce research methods and empirical data; and discuss the findings. We present four case studies, from Côte d'Ivoire, India, Zimbabwe and Bangladesh. The multiple co-authorship of this article reflects both the individual contributions in the form of case studies and the collective efforts to compare case studies and generate valuable insights for theory and practice.

Farmers' rights: concept and implementation

The concept of farmers' rights arose in international agricultural circles following a series of debates at the Food and Agricultural Organization (FAO) of the United Nations in 1979 over the unequal distribution of benefits from the sharing of plant genetic resources. Plant breeders enjoy breeders' rights or other intellectual property rights and, thus, may receive some monetary benefit; however, the farmers and indigenous communities who provided the original germplasm used by breeders do not have such opportunities (Esquinas-Alcázar 1996). This led to the adoption of three FAO resolutions (4/89, 5/89, 3/91) recognising plant breeders' and farmers' rights, simultaneously and in parallel. Of note, farmers' rights were stated to be "*vested in the International Community, as trustees for present and future generations of farmers, for the purpose of ensuring full benefits of farmers and supporting the continuation of their contributions*" (Resolution 5/89). In this view, farmers' rights are collective rights, belonging to the community, as opposed to breeders' rights, which are individual.

The concept of farmers' rights was then included in the FAO's International Undertaking on Plant Genetic Resources and later in the ITPGRFA. However, according to Moore and Tymowski (2005), there was a "sea change" in the concept between the two agreements. In the ITPGRFA, the focus is on rights that farmers may enjoy at the national level. The key elements of farmers' rights, as defined in Articles 9.2 (a) to (c) and 9.3 of the ITPGRFA, include the right to save, use, exchange and sell farm-saved seed and propagating material; the right to protect traditional knowledge relevant to plant genetic resources for food and agriculture; the right to an equitable share of benefits arising from the use of these resources; and the right to participate in decisions, at the national level, on matters related to the conservation and sustainable use of such resources. As a practical starting point, we therefore use this description of farmers' rights in our analysis of the roles of selected CSBs around the world. These rights relate directly to the main functions of CSBs.

Methods

In November 2015, Bioversity International organised a three-day international workshop in India to document the variety of ways in which CSBs around the world implement farmers' rights. Participants from international and national, government and non-government research and development organisations directly involved in or working with CSBs presented 16 case studies from Bangladesh, Bhutan, China, Costa Rica, Côte d'Ivoire, India, Nepal, Rwanda, South Africa, Sri Lanka, Uganda, Vietnam and Zimbabwe. They included detailed documentation of the activities, achievements and challenges of CSBs based on interviews with CSB members, field observations and a review of (grey) literature. The studies

presented a wide diversity of CSBs in terms of history, functions, size, and scale of operations; governance and management; years of existence; support received; and policy and legal environment. In China, Rwanda, Uganda, South Africa and Vietnam, CSBs are in their infancy (although seed clubs have existed for some time in Vietnam). In Bangladesh, Ethiopia, India, Nepal and Zimbabwe, seed banks have a track record extending for more than 20 years. Nepal has more than 40 well-functioning CSBs, while Bhutan has four, South Africa and Uganda three each, and Rwanda two. Eight of the case studies built on information included in a book about CSBs (Vernooy, Shrestha, and Sthapit 2015): Bangladesh, Bhutan, Costa Rica, Nepal, Rwanda, Uganda, South Africa and Zimbabwe.

Each of the 16 case studies addressed the question: in what practical ways do CSBs contribute to the effective implementation of the four major farmers' rights as recognised by the ITPGRFA? The cases also allow two complementary comparisons: how each CSB is doing in terms of the four farmers' rights, and how each of the four farmers' rights is doing across the CSBs. Given space limitations, here we present four of the case studies in detail while offering some elements of the others. The CSBs in these studies vary from nascent and small in scope (Côte d'Ivoire), nascent and larger in scope (India), more mature and smaller in scope (Zimbabwe), to more mature and larger in scope (Bangladesh). History and scope are two important aspects that influence how CSBs function (Vernooy, Shrestha, and Sthapit 2015).

Case studies

Côte d'Ivoire

Although not called CSBs, farmer-led organisations that deal with conservation and management of seeds can be found in most regions of Côte d'Ivoire. One of these, the Agricultural Simplified Cooperative Society Man-Eyo of Yapi-Kouamékro, was established in 2013 in east-central Côte d'Ivoire, about 500 km from the capital, Abidjan. It emerged from a group of farmers who, since 2001, had been producing rice seeds on an individual basis for the government-supported national rice programme. Currently, about 70 farmers are members of the cooperative and continue to produce rice seeds on demand for the national programme (Koffi 2015). Thus, the cooperative operates as a formally recognised group of rice seed producers and sellers. Such groups also exist for maize seed production and marketing. In addition, the groups aim to safeguard and promote local varieties and associated traditional knowledge. These groups receive some technical support from the government research sector, but they operate independently in terms of their financial operations.

The right to save, use, exchange and sell farm-saved seed and propagating material

No existing regulation deals specifically with the protection of farmers' rights in Côte d'Ivoire. CSBs and individual farmers are free to save, use, exchange and sell farm-saved seeds and propagating material provided they respect the oversight of government agencies with regard to quality control and marketing. The cooperative maintains three hectares of community fields for seed multiplication. The seeds farmers produce include both traditional and improved varieties of rice, and the group sell seeds either to the government's Office National de Développement de la Riziculture (ONDR; National Rice Production Development Office) or to private buyers.

The right to protect traditional knowledge

Recognition by the ONDR may be considered as an implicit form of protection of traditional knowledge and an endorsement of farmers' rights in that farmers' skills and knowledge are formally recognised and their organisation is acknowledged as a producer and distributor of seeds.

The right to an equitable share of benefits

ONDR support allows farmers to maintain and conserve plant genetic resources as the seeds of traditional varieties come from the producers themselves, who have maintained them over time. Faced

with the possible disappearance of traditional seeds, cooperative members would like to specialise in their production and are motivated to expand their work, filling a potential market niche. However, currently, there are no other mechanisms for receiving or sharing benefits arising from conservation and sustainable use efforts, and production is often driven by consumer demand; for example, for CB-1 rice, which is recommended for people with diabetes or high blood pressure. Cooperative members benefit in a non-monetary way from collaboration with ONDR, in terms of capacity development and technology transfer, and are happy with this support.

The right to participate in decisions at the national level

Although Côte d'Ivoire is a signatory of the ITPGRFA, its implementation has not been easy. A draft law on access and benefit-sharing (yet to be approved by parliament) may be an opportunity to directly or indirectly recognise and support the establishment of CSBs in the country. But awareness of the role of CSBs is not widespread among policymakers or the public. The cooperative is sometimes invited by the ONDR to take part in workshops on seeds. This is an opportunity for farmers to participate in national consultations on plant genetic resources and advocate CSB support and implementation of their rights as an approach to conservation and sustainable use of plant genetic resources.

India

CSBs have been operating in various parts of India for about 20 years. They have been initiated and supported by a number of NGOs, such as the Bharatiya Agro-Industries Foundation, the Centre for Sustainable Agriculture, the Green Foundation, Seva Mandir-Udaipur and the M.S. Swaminathan Research Foundation. More recently, Bioversity International has begun to support a novel type of CSB as part of its Seeds for Needs programme in many countries. This initiative aims to give farmers better access to crop diversity to strengthen their capacity to adapt to climate change. Researchers from the national agricultural research system, extension agents, NGO staff and Bioversity International work together with farmers to supply and test a number of major varieties – of rice and wheat and, more recently, pulses and vegetables – through various types of on-farm experiments. Together they assess how the selected materials perform at test sites in various agro-climatic zones. After several cycles of on-farm evaluation, farmers' groups have initiated seed production and conservation of the best-performing rice and wheat varieties. The methods used in these experiments include crowdsourcing: data collection by large numbers of volunteers instead of a few researchers. Over time, thousands of farmers carry out small trials, and researchers collect and analyse the data (van Etten 2011). Since its start in 2011 with about 30 farmers in one district, the Seeds for Needs project in India has involved more than 15,000 active farmers in 24 districts in four states (Bihar, Chhattisgarh, Madhya Pradesh and Uttar Pradesh).

To complement the participatory variety selection work, more than 20 new CSBs have been established with technical and some financial support of the research team. The core function of these seed banks is to ensure access and availability of good quality seeds. In particular, they provide locally adapted seed at a low cost, foster seed exchanges at local and supra-local levels, acquire novel varieties not available locally and access seeds from areas where plants have adapted to extreme weather conditions or that that have unique characteristics. Farmers also envision selling some of the multiplied seed at the local level as a way to generate additional income.

The right to save, use, exchange and sell farm-saved seed and propagating material

The seed exchanges facilitated by CSBs are regulated, to a large extent, by the Seeds Act of 1966, allowing the free flow of seeds without a brand name among farmers through both non-commercial and commercial transactions. This means that, in practice, most CSB operations are legal. However, CSBs have limited potential to enter the formal seed market as the free flow rule does not apply to branded seeds.

India is among the foremost countries in the world in terms of farmers' rights legislation with its Protection of Plant Varieties and Farmers' Rights Act, 2001 (PPVFR). The law aims to protect both breeders' and farmers' rights. It not only supports farmers' privileges to save, use and exchange protected seeds and propagating material, but also makes efforts to allow farmers to claim some unique forms of intellectual property rights over their varieties (Ramanna 2006). Nine farmers' rights are included in the act: the rights to save, exchange, sell (non-branded) seeds and propagating material; to register varieties; to be recognised and rewarded for conservation of varieties; to take part in benefit-sharing; to receive information about the expected performance of a variety; to receive compensation for failure of a variety to perform; to receive free services for registration and conducting tests on varieties; to make legal claims under the act; and to be protected from innocent infringement.

In Chapter VI (Section 41), special rights are given to communities that are instrumental in conserving local varieties, provided documentation exists to validate such a claim. If a community registers a variety under its name, it will enjoy the same rights as an individual or breeder. It has the right to demand royalties if the variety is used by any organisation for downstream research or a commercial purpose. This section grants communities the right to own and maintain a variety and receive certain monetary benefits as well. Thus, it opens the door to formal contribution of CSBs to the conservation of plant genetic resources. Given that a CSB is maintained by a community and has facilities for the conservation and evaluation of traditional varieties, it can register local and unique varieties under this act. Section 44 of the act exempts farmers and communities from registration fees and associated legal costs.

The right to protect traditional knowledge

Although the PPVFR act does not specifically mention "traditional knowledge", it does refer to the important roles of traditional varieties and landraces. For medicinal plants (including crops that have medicinal use) and medicinal formulae, India has a searchable, public database – the Traditional Knowledge Digital Library (TKDL) – that has legal status and can be cited as evidence in cases of infringement during patent filing. Thus, the TKDL serves as a defensive mechanism against biopiracy. CSBs make use of a variety of seed registers that contain basic information about stored seeds. However, these registers do not have the institutional endorsement of the TKDL. Another example of protection is the support Seva Mandir-Udaipur has given to farmers to revive and register two maize and two pigeon pea varieties under the PPVFR act.

The right to an equitable share of benefits

Sections 24, 26, 35 of the PPVFR act describe various aspects of benefit-sharing, but there has been very limited implementation of any of them. Farmers managing CSBs mainly receive non-monetary benefits, such as capacity development and technology transfer. For example, together with local partner organisations, the research team is training CSB members, both men and women, in seed selection, treatment, multiplication, storage and marketing techniques. An innovative technology, zeolite bead desiccant, is being used to dry seeds to a low moisture level before they are sealed in airtight containers for storage.

The right to participate in decisions at the national level

Research partners are experimenting with the use of information and communications technology (ICT) to collect data from farmers, transmit the results of their experiments and provide useful information, such as weather forecasts, crop management recommendations and the names of seed suppliers. The Indian government has become a strong supporter of these efforts, including for the establishment of CSBs, both technically and financially, and several national agricultural research organisations have been directed to provide support and facilitate scaling out of the approach.

Zimbabwe

The 1991/92 drought that ravaged southern Africa and was declared a national disaster in Zimbabwe was instrumental in the establishment of CSBs in the country. Most farmers lost their traditional plant varieties during the drought. In 1998, the Community Technology Development Trust (CTDT), a local NGO, in consultation with government agencies and farming communities, established three CSBs as a pilot project in Uzumba-Maramba-Pfungwe, Tsholotsho and Chiredzi districts (Mushita, Kasasa, and Mbozi 2015). Their broad objective is to promote knowledge and seed exchange, local experimentation by farmers and community conservation of germplasm. To increase awareness of the importance of conservation and management of agricultural biodiversity, diversity within crop species and the role of the exchange of germplasm, seed fairs have been held annually at each CSB and every second year at the national level. The CSBs continue to receive technical support from CTDT, while some financial support has been provided by international organisations. More recently, the CSBs have started to produce and market some seed as a way to generate income for members and support the sustainability of the seed banks.

The right to save, use, exchange and sell farm-saved seed and propagating material

The Seeds Act of Zimbabwe (Chapter 19: 13) allows farmers to save, use, exchange and sell farm-saved seeds locally in their communities, but not beyond. Storing seeds in the CSB creates a reserve in case of drought, flood or other catastrophe. All community members who deposit seeds have equal access to them, free of charge. Seeds may be sold locally to anyone else. However, the CSB has also made a commitment to give seeds to non-members in need, especially the most vulnerable groups, such as elders and orphan young farmers, if approved by the management committee, indicating the potential of CSBs as local solutions to emergencies.

The right to protect traditional knowledge

The three CSBs maintain a community biodiversity register and passport data for local crops and varieties and associated traditional knowledge, thus directly contributing to the protection of this knowledge. The registers are monitored by CTDT staff and the agricultural extension service. Seed and food fairs are another mechanism for maintaining and sharing local knowledge related to plant genetic resources. Currently, there is no legal framework to protect and support CSBs, the seeds they safeguard, or the related traditional knowledge; however, a draft bill on plant genetic resources is being circulated within the Ministry of Agriculture for comments before it is tabled in parliament. It calls for a fund to be created to support CSB activities and also stipulates that farmers who conserve and maintain plant genetic resources will receive incentives.

The right to an equitable share of benefits

The agricultural extension service of the Ministry of Agriculture supports seed collection by the three CSBs, which not only conserve, but also produce and sell seeds. Community-based seed production is playing an important role in the seed supply system of smallholder farmers, as CSBs offer them access to local varieties, including seeds improved through participatory variety selection and plant breeding. Farmers also have access to improved material from national and international research organisations that also offer technical training to CSB members. Farmers benefit from learning advanced seed conservation technologies and are able to generate income from the sales of seeds, although with certain restrictions. Through field schools, farmers work closely with researchers and extension officers to further develop and improve their seeds by participatory action research. This work is being done in collaboration with the government's crop breeding institute and international research centres.

The right to participate in decisions at the national level

Local members of parliament, traditional leaders, government ministries and farmers' organisations, such as the Zimbabwe Farmers' Union, all interact with CSB committees. The Southern African Development Community (SADC) Plant Genetic Resources Centre in Zimbabwe has highlighted the success and relevance of CSBs and is considering how the Zimbabwean model can be replicated in the 14 SADC member states. CSBs receive support from the government extension service, the national gene bank, the national crop breeding institute and CTDT. With the support of CTDT, farmers are campaigning for national recognition of farmers' rights as part of implementation of the ITPGRFA. CSBs are represented in national decision-making processes through the Zimbabwe Farmers' Union, but do not have direct involvement.

Bangladesh

Nayakrishi Andolon (meaning new agricultural movement) is community-based, biodiverse ecological agriculture practised by thousands of farmers in Bangladesh. Nayakrishi is guided by 10 simple rules and obligations between members, such as conserving crop diversity at the household and community level, promoting multicropping and intercropping to maintain diversity and enhance soil fertility, promoting production, use and management of both cultivated and uncultivated (growing in the wild) species and learning how to calculate the total yield of a farming household and a community (Akther 2015). The aim is to ensure optimal yields under local conditions and contribute to seed sovereignty and food security.

The Nayakrishi Seed Network is an independent initiative created by a few interested households in the Andolon movement. These farmers have taken the responsibility to ensure that other farmers in the community will continue to plant, regenerate and conserve all common species and varieties. They then became nodal farmers in the network, which has grown and includes now more than 300,000 farming households in 19 districts. The movement received technical and some financial support from UBINIG (Policy Research for Policy Alternative), a non-government action research organisation. The households that have taken on this role have established a number of Nayakrishi seed huts (NSHs), a type of CSB, which conserve seeds of local varieties suited to the needs of the community. NSHs are legally registered as farmers' cooperatives and receive technical support from the Department of Agricultural Extension. Although they operate independently, they sometimes collaborate with government programmes.

The work of Nayakrishi Andolon and the various CSBs has contributed to the increased use of local varieties of crops in many districts of the country. The NSHs are producing and making available a large diversity of good-quality seeds to farmers. By growing a variety of vegetables and pulses in their fields and homesteads, many farmers have ensured a good supply of nutritious food for their families and improved their income by selling produce.

The right to save, use, exchange and sell farm-saved seed and propagating material.

The draft Plant Variety and Farmers' Rights Protection Act, 2016 (PVFRPA) recognises the rights of farmers and sharecroppers to collect, save, conserve, propagate and use the propagation material of any protected variety for personal and non-commercial use. It prohibits the exchange of seeds for commercial purposes. Although the act recognises breeders' rights, there is no provision for the protection of farmers' varieties and related knowledge. The draft PVFRPA has not yet been approved.

NSHs distribute seeds to Nayakrishi farmers on demand in exchange for the commitment to deposit or pay back seeds after the harvest. Through NSH activities, farmers collect, regenerate, and maintain neglected and underused crop species and rare plant varieties. Nayakrishi women farmers have enhanced their experience and wisdom in seed conservation techniques and maintain home gardens rich in biodiversity. Some of the NSHs, such as the one in Mamudpur, have a

specialised women's seed network formed by Unnayan Bikalper Nitinirdharoni Gobeshona (UBINIG) in consultation with the community. UBINIG is a local NGO engaged in a community-led and community-based policy and action research (Sobhan et al. 2015). The women's seed network is engaged in such activities as collecting, drying and storing seeds in clean and dry containers to ensure seed viability. The group meets weekly to review and approve the cropping plan for the season, including seed distribution and exchanges. In various ecological zones of Bangladesh, Nayakrishi farmers have established community seed wealth centres (CSWCs), another kind of CSB, usually in the Biddaghors or farmer training centres. In general, the expansion of NSHs and CSWCs in Bangladesh has promoted farmers' rights to save, use, exchange and sell farm-saved seed by strengthening the local seed system (UBINIG 2018).

The right to protect traditional knowledge

Although the NSHs collect, maintain, distribute and enhance seed circulation through active participation of community farmers, traditional knowledge is documented by CSWCs with the support of UBINIG. However, legal protection of this knowledge has yet to be obtained. At the national level, UBINIG and other organisations collaborated in the drafting of the Biodiversity and Community Knowledge Protection Act to provide legal protection for the holders of traditional knowledge. This act aims to create the necessary framework through which new innovations related to plants, animals, fish and other life forms can be addressed. Its main objective is to protect the sovereign rights of the communities that have knowledge of biodiversity and have managed, maintained, conserved, reproduced, and enhanced biodiversity, genetic resources and traditional knowledge, culture, and various forms of practice related to these resources. Although the act was well received by relevant authorities, it still awaits government approval.

The right to an equitable share of benefits

Members of the CSBs receive mainly non-monetary benefits, such as capacity development, technology transfer, and access to seeds stored in the national gene banks. Farmers also carry out joint participatory research on seed conservation and crop improvement along with the Bangladesh Rice Research Institute, the Bangladesh Jute Research Institute and the Department of Agricultural Extension (DAE). As a result, farmers have strengthened their technical and organisational skills. NSH and CSWC members have benefited directly from participatory variety selection of Aus rice, varieties cultivated during the July–August cropping season. To date, nine improved varieties have been developed through these collaborations. Two have been submitted to the National Seed Board, but their formal release is still pending. In the meantime, farmers have received seeds of both varieties, which are drought resistant, a characteristic that breeders and farmers are increasingly looking for. This experience shows that farmers' right to register and release a variety is possible, although this has not been recognised in the draft PVFRPA. Based on interactions with NSH and CSWC members the DAE is now promoting the use of local crops at the community level.

The right to participate in decisions at the national level

Some participation by farmers' representatives in national decision-making occurs through an agreement with the Department of Agriculture. Government agencies have recognised and rewarded some of the farmers in the Nayakrishi movement.

Discussion

Table 1 summarises the main features of each case study.

The evolution of CSBs has varied depending on national political and socio-economic conditions; policies and laws related to agricultural, rural development and the conservation of biodiversity; the history and roles of civil society organisations in agricultural development; and the availability of support from and approaches used by international development and research organisations. As a

Table 1. Main features of the four case studies.

Case study	Farmers' rights				
	Legal recognition of CSB as a farmers' organisation for conservation, use, and distribution of seeds	De facto protection of traditional knowledge	Effective, equitable benefit-sharing	Meaningful participation in national decision-making	Other rights/remarks
Côte d'Ivoire	Recognised cooperative manages CSB operations.	Indirectly, through appreciation by researchers of farmers' efforts to maintain local varieties.	Profits shared among cooperative members. Access to improved varieties from public breeding institutions. Access to quality seed.	No formal representation.	CSBs could be included in the new access and benefit-sharing law, directly or indirectly, but awareness at national level about the importance of conservation is not widespread.
India	Seeds Act of 1966 allows the free flow of seeds without a brand name among farmers through both non-commercial and commercial transactions. A CSB maintained by a community and with facilities for the conservation and evaluation of traditional varieties, can register local and unique varieties under the PVRFR. No legal registration of CSBs.	Documentation, characterisation, and cataloguing of varieties. The traditional knowledge digital library serves as a defensive mechanism against biopiracy (for plants with medicinal value).	Improved varieties developed through participatory variety selection (crowdsourcing). Farmers receive training and capacity building in seed management. Registration of farmers' varieties possible. Some possible income from seed production and sale.	No CSB participation in state and national level decision-making.	Under the PPVFR, in addition to farmers' rights to save, use, sow, re-sow, exchange, share, or sell seed of a protected variety, farmers also have rights as breeders, rights to compensation, and entitlement to benefit from the gene fund. Technical and financial support from national and some state governments.
Bangladesh	Legal bodies are farmers' cooperatives called seed huts, recognised and supported by the Department of Agricultural Extension. Networking and information exchange with government programmes.	Documentation of farmers' knowledge and practices. Biodiversity and Community Knowledge Protection Act submitted to government.	Increased access to quality seeds; income generation by marketing. Recognition and rewards to farmers. Technical support from national organisations resulting in safer food.	Some participation of farmers' representatives through a memorandum of understanding with the Department of Agriculture. Two rice varieties developed through PVS have been released.	CSBs are producing and making available to farmers a wide diversity of seeds.

(Continued)

Table 1. Continued.

Case study	Farmers' rights				
	Legal recognition of CSB as a farmers' organisation for conservation, use, and distribution of seeds	De facto protection of traditional knowledge	Effective, equitable benefit-sharing	Meaningful participation in national decision-making	Other rights/remarks
Zimbabwe	No formal recognition, but farmer groups and CSBs are supported by the government extension service, a local NGO (Community Technology Development Trust [CTDT]), the national gene bank, and the national crop breeding institute.	Community biodiversity register and passport data on local PGRFAs and associated traditional knowledge maintained by CSBs and monitored by CTDT and the extension service. Seed and food fairs.	Access to seeds of improved varieties through PPB/PVS. Access to stable inbred lines from research institutes, such as CIMMYT, ICRISAT, and crop breeding institute. CSBs benefit from advanced seed conservation technologies. Income generation through sale of seed. Capacity building provided by ICRISAT and crop breeding institute. Seed collections are backed up by the extension service.	Participation through Farmers' Union of Zimbabwe.	Farmers can sell seeds within a 40 km area only. To overcome this limitation, they collaborate with seed houses that have the right to sell seeds more widely. CTDT is campaigning for national recognition of farmers' rights as part of the domestication of the ITPGRFA.

Notes: CIMMYT = International Maize and Wheat Improvement Center; CSB = community seed bank; FAO = Food and Agriculture Organisation; ICRISAT = International Crops Research Institute for the Semi-Arid Tropics; ITPGRFA = International Treaty on Plant Genetic Resources for Food and Agriculture; PVPFR = Protection of Plant Varieties and Farmers' Rights Act (2001); PGRFA = plant genetic resources for food and agriculture; PPB = participatory plant breeding; PVS = participatory varietal selection.

result, some CSBs have a narrow range of functions and limited capacity to express farmers' rights (Côte d'Ivoire), while others have multiple functions and broader capacity (Bangladesh, India, Zimbabwe). Scope matters, but our findings reveal that CSBs can provide multiple practical opportunities for governments to implement farmers' rights.

In most countries, the activities of CSBs reflect the ITPGRFA's definition of farmers' rights in the broad sense. The Nayakrishi Andolon movement in Bangladesh and the associated CSBs are guided by the aims of seed and food security and by strict ecological principles and behavioural rules. This goes beyond the interpretation of farmers' rights as contained in the ITPGRFA; however, it has taken much time and effort to reach that stage. The movement is now trying to consolidate its achievements. In Uganda in 2017, CSBs attained legal recognition in the recent national policy formulation processes; they are now recognised and registered as community-based organisations.

Farmers' rights are expressed in terms of the right to save, use and exchange farm-saved seeds. However, the right to sell seeds is restricted in many cases: limits on types of seed (Bangladesh, Bhutan, India, Nepal, South Africa); rules concerning the packing and labelling of seeds for sale (India); and geographic limits on distribution of CSB materials (Bhutan, China, Vietnam, Zimbabwe). The only country that is working on a law without restrictions is Rwanda. The country's draft law on seeds and varieties (2015) and the new seed strategy (2016–2020) aim to fully support farmers in local seed production as a strategy to reduce imports and sustain productivity and food security in local

communities. In Bhutan, the Biodiversity Act of 2003 allows farmers to propagate protected seed that they have harvested on their holdings and to exchange that seed with others on a non-commercial basis. In China, the 2015 revised seed law (Article 37) and the plant variety protection law (Article 10 (ii)), based on the International Convention for the Protection of New Varieties of Plants (1978), allow farmers to save and sell or exchange their own seeds, including protected varieties, but the venue of such sale and exchange is limited to local rural fairs.

CSB activities also reflect the protection of traditional knowledge to varying degrees. In Bangladesh, India and Zimbabwe, governments have elaborated and implemented measures to respect, protect and promote traditional knowledge relevant to plant genetic resources and farmers' seed systems and recognise the validity of farmers' seed certification systems. Vietnam's national biodiversity strategy and vision includes a mechanism for managing access to genetic resources, sharing benefits and protecting traditional knowledge, although CSBs are not mentioned.

Bhutan, Costa Rica, Nepal and Uganda have a supportive policy and legal framework in place regarding CSBs. In other countries organisations that are supporting CSBs have developed such practical measures as seed or diversity registers, to help farming communities protect their traditional knowledge. Unfortunately, the value and utility of community biodiversity or seed registers has not been documented, although some positive experiences have been noted in Nepal. Another example of farmers' rights, the requirement for prior informed consent to obtain access to plant genetic resources, has been established by most CSBs, but to varying degrees of formality. There is considerable scope for improvement if governments work with CSBs, in particular in terms of implementation of the ITPGRFA's multilateral system of access and benefit-sharing and the CBD's Nagoya Protocol, which make prior informed consent a legal requirement.

The cases provide numerous examples of direct benefit-sharing (mainly non-monetary), such as material benefits from taking part in participatory research (variety selection in particular) and better access to genetic resources and related knowledge for farmers (e.g. through links with national gene banks). In Nepal, both the national agrobiodiversity policy and the biodiversity strategy of Nepal include mechanisms for equitable sharing of benefits. In Costa Rica, in harmony with the biodiversity law, the "*general rules for the access to the genetic and biochemical elements and resources of the biodiversity*" regulate:

the fair and equitable distribution of the social, environmental and economic benefits derived from the use of the elements and biochemical and genetic resources of the biodiversity for all the sectors of society, with special attention to local communities and indigenous people. (Article 1b)

Certification of good-quality seed for local marketing was also evident in a number of the case studies, for example, Côte d'Ivoire, Ethiopia, India and Zimbabwe.

However, in one striking aspect, practice does not meet the ITPGRFA definition: in most countries, CSBs (and smallholder farmers in general) have little or no opportunity to participate in decision-making at the national level. In Nepal, there is some recognition and involvement of farmers in national decision-making; for example, the chair of the national network of CSBs participates in policy fora. In some countries, NGOs also voice farmers concerns at the national level (Bangladesh, China, India, South Africa, Sri Lanka, Zimbabwe).

The role of women farmers in CSBs remains poorly documented except in the case of Bangladesh. Although we know from other studies that women play important roles in most CSBs (Vernooy, Shrestha, and Sthapit 2015), the case studies do not offer proof of the active development of good governance measures that allow women's participation in decision-making; offer them access to technology, natural resources, finance and markets; create an institutional environment to support women community organisations; or build their capacities.

Conclusions

The evidence presented here differs from other research on farmers' rights, as it is based on action research carried out by both researchers and practitioners, who are linking their field experience

directly to national and international policy development. As far as we know, this is the first time this issue has been researched in such detail. The results go beyond the more common desk analyses of farmers' rights and policy instruments that aim to promote conservation and sustainable use of plant genetic resources for food and agriculture. Desk studies usually call for more capacity building about key issues, but do not offer concrete examples based on practical experience for designing and implementing policies and regulations.

Based on the case studies and analysis of their relevance, we conclude that CSBs can be an effective platform for realising farmers' rights as defined by the ITPGRFA and, in some cases, in broader terms. They can be instrumental in establishing comprehensive farmers' rights, although the degree and depth may vary according to the national context. Such an achievement cannot come overnight: it takes time and effort to build a CSB, achieve legal recognition, obtain technical and financial support, connect with other farmers and establish supportive relations with other agricultural stakeholders. The four cases indicate that mainstreaming CSBs in national policies is a viable option for countries that have ratified the ITPGRFA and want to live up to their obligation by implementing farmers' rights. Inspiration can be drawn from the few governments that have started to formally support CSBs: Bhutan, Ethiopia, Nepal, Mexico, Uganda and South Africa. We argue that the use of selected case studies, which to date have received little attention, can stimulate decision-makers to create policy and legal space for CSBs and design practical measures that provide financial, organisational and technical support.

Our findings not only advance the science of plant genetic resources management and seed systems, political science and international law, but also have merit in relation to national policy and legal development. The multiple functions that CSBs already fulfil (or could fulfil with additional support and growth) – conservation, exchange, crop improvement, seed production and marketing, a platform for farmer empowerment – suggest that they are instrumental in safeguarding agricultural biodiversity and sharing the benefits derived from its use.

The activities underway in Bangladesh, India and Zimbabwe show what can be achieved on a large scale. The Bangladesh ecological farmers' movement, and the Nayakrishi Seed Huts in particular, provides evidence of an impact on a scale beyond small pilot projects. Nevertheless, more effort, technical and financial support and research are still required to consolidate the gains as well as address gaps and weaknesses. The work of UBINIG, together with farmers, has created an excellent opportunity to learn from practical experience, identify lessons learned and influence policy to some degree. UBINIG, as the source of inspiration of the movement, is now focusing on further developing the research capabilities of farmers at both individual and group levels. The practice of ecological farming contributes to food security, food safety and income for the farming communities. It is time that the world at large acknowledges that farmers in Bangladesh and other countries are producers of valid and authentic knowledge that can show the way to a more sustainable planet.

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