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A policy analysis to promote conservation and use of small millet underutilized species in India

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ABSTRACT

Despite the important role of Neglected and Underutilized Species (NUS) in diversifying agriculture, supporting traditional farming systems and improving food and nutritional security particularly in marginal lands, very little attention is being paid to their mainstreaming in national policies and institutions. Based on a detailed review of the regulatory frameworks governing the conservation, sustainable use and equitable sharing of benefits arising out of plant genetic resources and the circulation and registration of seeds and improved varieties, this paper discusses the extent to which the measures in place in India may favour or affect the conservation and use of NUS. In addition to these frameworks, in view of the major change realized by the 2013 National Food Security Act which has included coarse cereals in the country's Public Distribution System (PDS), the paper also incorporates this latest policy in its analyses. A special focus is given to small millets, a group of species with unexploited economic and nutritional potential but extremely important for marginal communities' food security and livelihoods. A set of policy recommendations and opportunities to explore are proposed to address the identified constraints with the purpose of creating a more supportive policy environment and enhancing the national capacity to promote NUS.

KEYWORDS

Neglected and underutilized species; legal framework; food and nutritional security; minor millets; India

Introduction

Often-quoted estimates of the number of plant species used worldwide suggest that approximately 30,000 are edible and that about 7000 have been cultivated or collected by humans to meet food needs (Wilson, 1992). However, only three of these – rice, wheat and maize – account for about 60% of the human energy supply (Collins & Hawtin, 1999) and receive most attention and investments in terms of research and development (Food and Agriculture Organization of the United Nations [FAO], 2010). The preference of particular major crop plants both from the demand and supply side has increased the uniformity of production systems in agriculture and favoured the establishment of global standard food supply (Hodgkin, Hunter, Wood, & Demers, 2015; Khoury et al., 2014). This process of agricultural simplification has led to the marginalization of thousands of minor species traditionally cultivated and collected by farming communities around the world, limiting livelihood options of the rural poor and the quality of their diets (Frison, Cherfas, & Hodgkin, 2011; Kahane et al., 2013). In recent years, many countries have registered a general increase of awareness about the role that these species – commonly called Neglected and Underutilized Species (NUS) – may play in sustainable farming systems and in the well-being of people living in less favourable and marginal lands (Padulosi, Thompson, & Rudebjer, 2013). Moreover, a growing amount of studies supports their importance for improving food and nutritional security, their ability to adapt to challenging environments where staple crops may fail and their potential to income generation (Cheng, Mayes, Dalle, Demissew, & Massawe, 2017; Chivenge, Mabhaudhi, Modi, & Mafongoya, 2015; Mayes et al., 2012; Nandal & Bhardwaj, 2014; Nyadanu & Lowor, 2015; Padulosi, Hoeschle-Zeledon, & Bordoni, 2008).

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Thanks to its unique bio-geographic location, its diverse climates and ecosystems, India is endowed with an astounding agricultural biodiversity, which makes the country home to a large number of NUS (Arora, 2014). Out of this portfolio, small millets are among Indian underutilized crops which show greater potential in view of their nutritional value, adaptation to harsh environments and highly regarded cultural value (DeFries et al., 2016; Finnis, 2012; Geervani & Eggum, 1989; Gopalan, Ramashastri, & Balasubramanium, 2004; Padulosi et al., 2009; Saha, Gowda, Arya, Verma, & Bansal, 2016; Yenagi, Handigol, Bala Ravi, Mal, & Padulosi, 2010). While it has to be acknowledged that research efforts on small millets are growing, their mainstreaming in the country's food system lags behind compared to other well-known cereal crops. The national policy objective of subsidizing production for achieving self-sufficiency in staple grains has focused almost exclusively on wheat and rice, thus discouraging small millets cultivation and consumption in many semi-arid regions (Fischer, Reddy, & Rao, 2016; Mal, Padulosi, & Bala Ravi, 2010). Indeed, for all species except finger millet, both area cultivated and production drastically decreased, dropping from 2177 million tonnes in 1951–1955 to 467 million tonnes in 2006–2010 (Government of India [GoI], 2011; Malathi, Appaji, Reddy, Dattatri, & Sudhakar, 2016). This decline is linked to a variety of agronomic and socio-economic aspects, ranging from the lack of improved cultivation practices and proper post-harvest processing technologies to the low awareness at decision-making levels of the underexploited economic and nutritional value of these species (Gruère, Smale, & Giuliani, 2009; Kahane et al., 2013; Padulosi et al., 2009; Padulosi, Mal, King, & Gotor, 2015).

The decline of small millets cultivation and other barriers to their greater promotion is also closely related to a number of research and policy constraints along their value chains, from identification of promising germplasm, generation of improved varieties, availability of quality seed and adequate incentives to support their cultivation, which have been found also in other NUS crops (Andersen, 2012; Padulosi et al., 2014; Will, 2008). Through a detailed review of the national legal frameworks regulating conservation and use of Plant Genetic Resources for Food and Agriculture (PGRFA) and governing the support to specific crop production and distribution, the present study explores those inadequate policy elements that may potentially hinder upscaling of small millets and other similar underutilized crops in India. For the sake of clarity it must be said that NUS, for their very nature, tend to escape from a specific mention in regulatory frameworks. However, aspects affecting their management can be inferred from broader legal provisions influencing the conservation and use of agro-biodiversity.

The state of conservation and use of NUS and small millets in India

Although collections undertaken within specific initiatives have contributed to increasing the number of NUS accessions conserved in Indian genebanks, the focus of most germplasm collection and conservation efforts has been on major food crops (Paroda & Arora, 1991; Singh, Srinivasan, Saxena, & Dhillon, 2006). As on December 2006, only 199 accessions of underutilized crops were held with medium-term storage facility at the NBPGR genebank, compared for instance to 24,000 accessions of rice or to 9000 accessions reported for oilseeds (National Bureau Plant Genetic Resources [NBPGR], 2007). Concerning small millets, about 13,300 accessions were conserved at the All India Coordinated Small Millets Improvement Project (AICSMIP) located at the University of Bangalore (NBPGR, 2007), while about 10,200 accessions were held at the ICRISAT (Bonham et al., 2010; Upadhyaya, Dronavalli, Gowda, & Singh, 2012), the second major genebank in India whose mandate includes small millets. We were not able to get more recent data on genebank holdings.

Only a portion of the genetic material collected is adequately characterized and suitable for plant breeder activities. This is all the more true for NUS germplasm, which is also hardly accessible to farmers since the usable genebank material is mainly employed by research institutes and the university sector (Bonham et al., 2010). On-farm conservation has been suggested to be particularly appropriate for conservation and continued use of NUS diversity, given the local nature of these crops and their relatively scarcer representation in *ex situ* collections (Nyadanu, Aboagye, Akromah, & Dansi, 2016; Padulosi et al., 2008, 2013); however, efforts on this front have been very limited across the country: most of the initiatives are being undertaken by NGOs and other civil society organizations, while institutional support to participatory processes for on-farm management or improvement of PGRFA is considered occasional (NBPGR, 2007).

Concerning research efforts, the All India Coordinated Research Project on underutilized and

underexploited plants started in 1982 deserves specific mention. Aimed at carrying out systematic research on newer and lesser used crops for developing and diversifying agriculture, the initiative is still operative as a Network project on underutilized crops. A crop-specific research project on small millets, the AICSMIP mentioned above, has also been operating since 1986. Despite this, India's crop research focus still appears concentrated on major species and the development of high-yielding and disease-resistant varieties within these species (GoI, 2008, 2013b). The relatively small investment in decentralized and local processes of seed improvement has had an impact on the development trends of the commercial seed market as well, which tends to make available only seeds of the most researched and improved crop species. Private seed companies also tend to invest in crops with a more consistent market share, and often in new, attractive and unique hybrids which they can brand and market more successfully. The result is that actors from the formal system end up providing limited support in terms of seed availability to those small farmers in marginal areas which are interested in new, diverse and improved seeds of NUS for maintaining and improving their production while preserving their traditions (Singh, Mathur, & Pal, 2008).

National regulatory framework affecting protection, conservation and use of PGRFA

The current legal context concerning the protection and management of PGRFA in India reflects a number of relevant international agreements regulating access and use of biological resources in general that the country has ratified over the past 20 years. This legal regime includes four key legislations – the Biological Diversity Act 2002, the Protection of Plant Variety and Farmers' Rights Act 2001, the Patents Act 1970 (amended in 1999, 2002 and 2005) and the Seeds Act 1966 – which are reviewed in the following subsections reflecting on their potential implications for NUS. Objectives, main features and implications for NUS of the regulatory framework analysed are also summarized in Table 1.

Biodiversity conservation policies – The Biological Diversity Act

With the Biological Diversity Act, India establishes a sovereign regime that regulates access to the biological resources on its territory and the granting of Intellectual Property Rights (IPRs) on varieties developed from a biological resource obtained from the country. The Act also contains clauses related to the conservation of biological resources, benefit-sharing and traditional knowledge (TK) protection. While benefit-sharing is prescribed to happen on mutually agreed terms through a process of mandatory consultations with local communities prior to granting access, the effective implementation of this process remains unclear for at least two reasons. Firstly, the designated institutional bodies at municipality level – the Biodiversity Management Committees (BMCs) – do not yet exist everywhere and where they exist the extent of farmers' involvement in the decisional process is at the discretion of the National Biodiversity Authority (Kohli & Bhutani, 2014). Secondly, it is difficult to identify individual right holders for crop genetic resources used in commercial applications, given that they are usually the result of long-standing collective breeding and selection efforts. This leads to difficulties in compensating for farmers' contribution to the development and management of the biological diversity that may be used by a third party, particularly if and when the genetic resource in question is a relatively marginal species maintained by small subsistence communities, as is the case for many NUS genetic resources. The situation described may either determine the failure of developing adequate benefit-sharing agreements in the case of commercial applications based on local PGRFA, or on the other hand, may discourage well-intentioned researchers to invest their time in trying to access the resource in question, finally excluding it from potential improvements which could benefit all the parties involved (Galluzzi & López Noriega, 2014).

Another concern relates to the preparation of People's Biodiversity Registers (PBRs), which is part of a broader project of creating a national biodiversity information system that holds great potential for conservation and protection of NUS. Each BMC is supposed to prepare PBRs involving the local communities and key individuals through a participatory process. PBRs, where documented, represent a database of traditional uses of local resources and are considered as a legal document that provides evidence of prior knowledge held by communities in case of a patent claim on any biological resource or its properties (National Biodiversity Authority [NBA], 2013). However, there are still questions on the level of access or secrecy of the information in the register and on how custodian communities may be allowed

Table 1. Main features of the legal system influencing management of PGRFA in India and their relevance to NUS.

	Biological Diversity Act, 2002	Protection of Plant Variety and Farmers' Rights Act, 2001	Patents (Amendment) Act, 2005	Seeds Act, 1966
Type of law	Biodiversity law	Intellectual property law	Intellectual property law	Seed law
Relevant international commitment	Convention on Biological Diversity	Agreement on trade-related aspects of intellectual property rights – TRIPs; (International Treaty of PGRFA – ITPGRFA)[a]	Agreement on trade-related aspects of intellectual property rights – TRIPs	–
Objective	Conservation and sustainable use of biological diversity, access and benefit-sharing, protection of Traditional Knowledge (TK)	Establishment of an effective system for protection of plant varieties, the rights of farmers and breeders and to encourage the development of new plant varieties	Regulation of the use of patents	Regulation of the quality of seeds of notified varieties for sale and for matters connected therewith
Implementing Agency	National Biodiversity Authority (NBA), Ministry of Environment & Forests (MoEF)	Protection of plant varieties and farmers' rights Authority, Ministry of Agriculture (MoA)	Patent Office, Ministry of Commerce and Industry (MoCI)	Central Seed Committee, Ministry of Agriculture (MoA)
Registration:				
Purpose	Regulate access/transfer of biological resources and applications for IPRs (except plant breeders' rights)	Grant plant breeders' rights and ensure farmers' rights	Grant patents	Commercial release
Object	Any biological material and associated knowledge obtained from India	Extant varieties,[b] new plant varieties and essentially derived varieties of the genera or species specified by Government (Art. 29(2))	Micro-organisms and non-biological processes of producing plants and animals.	Only varieties notified by Government.
Main application requirements	Details of the invention; Details of biological resources and associated knowledge used; Geographical location from where biological resources are collected Details of the identified farmer/community holding the TK.	DUS criteria (distinctness, uniformity, stability), plus novelty for new varieties; Passport data of parental lines from which the variety has been derived; Geographical location; Details of the contribution of farmer/community to evolution/breeding efforts.	Criteria of novelty, non-obviousness, usefulness; Description of the invention and scope; Disclosure of the method of performing the invention; Geographical origin of biological material when used	No application. Notified varieties require test of minimum quality standards
Recognition of farmers' contribution to conservation and use	Requirement of benefit-sharing agreements	Benefit-sharing agreements; Farmers' right on seed; Assignment Plant Genome Savior 'Farmer Reward' and 'Farmer Recognition'; Assignment of Plant Genome Savior Community (PGSC) Awards	Exclusion of an intervention which is TK from patentability (based on prior evidence)	Farmers' right on seed
Farmers' right on seed (the right to save, use, sow, re-sow, exchange, share or sell seeds to other farmers)		Applicable to all varieties, including those protected under the Act. Farmers are allowed to sell seeds of a protected variety provided that the packages do not bear its registered name	Not recognized: breeder's exemption and farmers' privilege not granted	*Notified varieties:* Partially recognized, but seed can only be sold directly to another farmer for sowing or planting purposes. *Non-notified varieties:* Not regulated by the Act
Implications for NUS	Opportunity to document and protect farmers' varieties of NUS through	Unlikeliness of NUS varieties, which are mostly bred locally by farmers to meet	Traditional seed practices forbidden for NUS varieties protected by	No legal restrictions on traditional seed practices which enables

(*Continued*)

Table 1. Continued.

	Biological Diversity Act, 2002	Protection of Plant Variety and Farmers' Rights Act, 2001	Patents (Amendment) Act, 2005	Seeds Act, 1966
	People's Biodiversity Registers; Opportunity of compensation for holders of NUS through benefit-sharing mechanism, but difficulty of identifying beneficiaries of the compensation when NUS are bred collectively; Increasing difficulties for researchers interested in a country's native NUS in getting access permits which would allow their improvement and development	the DUS criteria for protection Opportunity of compensation for holders of NUS through benefit-sharing mechanisms, but difficulty of identifying beneficiaries of the compensation when NUS are bred collectively; Opportunity to reward farmers' communities engaged in conservation/improvement of NUS through PGSC Award; Informal circulation of NUS varieties protected by IPRs allowed	patent rights; Possibility for opposition or revocation of a patent in case of non-disclosure of NUS biological material used or in case the invention is based on pre-existing TK held by communities	on-farm management of NUS; Formal transaction of NUS on commercial scale requires respect of minimum seed quality standards/truthful labelling; Difficult to devise a system for quality control which meets the mostly "informal" systems in which most NUS are conserved and used

[a]Despite that the PPV&FR Act contains provisions on farmers' rights in line with Art. 9 of the ITPGRFA, it does not constitute the "legal response" to the Treaty since the PPV&FR Act was approved before India's ratification of the latter (10 June 2002); it also does not cover other provisions of the ITPGRFA.

[b]"Extant variety" in India is considered to be: (i) notified under section 5 of the Seeds Act, 1966; or (ii) a farmers' variety; or (iii) a variety about which there is common knowledge; or (iv) any other variety which is in public domain.

to control the information managed and used at the institutional level (Kohli, Fareedi, & Bhutani, 2009).

IPRs policies – The Protection of Plant Variety and Farmers' Rights Act

The Protection of Plant Variety and Farmers' Rights Act (PPV&FR Act) constitutes the legal response to the need of introducing IPRs in the agricultural domain within the obligations undertaken in the World Trade Organization context. The law represents a *sui generis* system of protection of plant varieties that strikes a balance between farmers and public/private breeders through a legal framework that basically follows the international Union for the Protection Of new Varieties of plants (UPOV) model, but adds important provisions to support farmers' rights. As the Biological Diversity Act, the PPV&FR Act comes across several weaknesses intrinsic to IPRs systems. First of all, plant breeders' rights are unable to offer proper recognition to farmers who usually operate collectively and over time in the generation and improvement of their crops, not necessarily aiming at the production of a single ideotype. By linking the right to a specific, unique product, the recognition of farmers' contribution is limited to the genetic material used for breeding that specific commercial product, underestimating the broader role of farmers in conservation and management of agro-biodiversity. Indeed, a debate exists on the idea that the IPRs system is not the appropriate approach to protect farmers' breeding efforts (Correa, 2000; Salazar, Louwaars, & Visser, 2007). Secondly, the application requirements to obtain variety protection are inadequate for farmers' varieties, since these are unlikely to meet the mandatory DUS criteria (distinctness, uniformity, stability). Through the adoption of DUS criteria, the PPV&FR Act provides an incentive to develop varieties with the largest market potential, indirectly supporting major crops with characteristics that best meet the needs of commercial farmers and processing/marketing industries. The rigidity of the uniformity criterion is the one which raises the main criticism as it restricts genetic diversity within a plant variety and thus it negatively impacts agro-biodiversity. The criterion encourages breeders to develop varieties responsive to high-input production systems that usually serve large markets (Wolff, 2004), rather than crop varieties with greater adaptability (which often means less uniformity) and importance for low input and/or small-scale farming systems, which are those where NUS are most relevant. However, it is important to acknowledge that in its current form, which includes the breeder's exemption and farmer's privilege principles, the PPV&FR Act allows informal circulation of seed among farmers. In addition, it

introduces measures aimed at incentivizing conservation and use of local landrace seed, such as the assignment of the Plant Genome Savior 'Farmer Reward' and 'Farmer Recognition' and of the Plant Genome Savior Community Award. This last award consists of 100,000 rupees in cash, a citation and a memento and is granted to a maximum of five communities per year. Notwithstanding it represents a way to recognize the collective effort of communities engaged in the conservation of agro-biodiversity, it is not clear to what extent it can be linked to the benefit-sharing mechanism and ensure compensation overtime in case of use of local genetic resources by third parties.

IPRs policies – The Patents (Amendment) Act

In parallel to the approval of the PPV&FR Act, India revised several aspects of its patent regime through three amendments to the Patents Act of 1970, with a view to make it compliant with the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPs). Counter to the majority of other developing countries, India is considerably engaged in research in the area of biotechnology and the adjustment of the patent system has provided stronger incentives for investment and development of the domestic biotech industry (including that of seed). Biotech companies tend to prefer patents to other forms of IPRs, as they offer most robust protection for agricultural biotechnology innovation. Under the Patents (Amendment) Act, grants on intellectual property protection over new varieties may considerably affect farmers' seed practices. Patent rights forbid the use of the protected varieties for breeding activities, restricting access to genetic resources and the reproduction of IPR-protected seeds for planting or exchange purposes (Visser, 2002). Notwithstanding the patent form of protection is mainly adopted by private biotech companies which are unlikely to concentrate their breeding efforts and research on NUS (where they perceive limited market potential and profit margins), the possibility of a sudden increase of commercial interests towards non-food uses of NUS do, however, exist. In particular, biotech companies working in nutri-products, cosmetics and drug fields may identify a supposedly new nutraceutical, cosmetic or pharmaceutical use for a specific NUS and they may patent such use, restricting the possibility of using the local resource for that purpose at community level or the development of local enterprises who want to use the same resource for the same purpose. Indeed, NUS often have multiple, formally undocumented and unknown uses, which may expose them to further appropriation attempts and patent protection. Around the world, debates on the risks and opportunities of patents on derived products are increasingly getting the attention of the Media, as in the case for quinoa, a formerly underutilized crop from Andean countries becoming now a 'commoditized' crop with a range of commercial applications potentially subject to patents (Ambrozek & Zorilla, 2014; Giuliani, Hintermann, Rojas, & Padulosi, 2012).

Regulations on seed – The Seeds Act

Unlike the mentioned legislations, the Seeds Act stands independent of any legally binding international agreement and essentially represents a domestic legal device to regulate the production, marketing and utilization of seeds and propagating material. It imposes the respect of minimum quality standards for the seed transaction of all the varieties notified by the government. In terms of notified, hence regulated, varieties, major crop species largely outnumber important Indian NUS: for instance, paddy rice and wheat have 975 and 410 notified varieties respectively, while millets are represented by 119 finger millet and less than 30 other species' varieties (http://seedvariety.dacnet.nic.in/, December 2014). While notified varieties can be sold to another farmer for the purpose of sowing or planting but not formally marketed (exemption Art. 24), the law allows for farmers' traditional practices on seeds of the non-notified varieties, that is, for a large number of NUS. However, it is also true that by overseeing the quality of seed of major crops only, the Act precludes the possibility of varieties of minor species from benefiting from some standardized quality assurance schemes. These schemes may allow NUS to become attractive to more farmers or to be the basis for the development of small-scale seed cooperatives for the distribution of quality varieties on a local or regional scale. As of now, if NUS farmers are able to produce quality seeds of non-notified varieties, they will not receive recognition of their efforts on the local market, whereas if the quality of their seeds is inadequate, there is no control mechanism to prove it beyond informal relationships of trust which are hard to maintain beyond a very localized area. While labelling is mandatory for notified varieties, seed

certification through a State certification agency is a voluntary process. Certified seeds accounts for about 30% of the total seeds used in the country (GoI, 2013a), meaning that major part of seeds is sold in the formal market through truthful labels by private seed companies and farmers-seed producers able to guarantee a sufficient genetic purity of their seeds. However, rural communities may not have the means for building collective action groups that screen and value seed and that guarantee minimum quality standards for self-certification. Such a situation may be worse for NUS, for which TK and skills in seed production are being eroded together with the genetic resources themselves.

National regulatory framework on food security

The food security strategy

A comprehensive food security strategy consists not just of regulating aspects relating to the food system (food availability and price stability) but should also address problems of economic and social access to food and its utilization (FAO, 2002). Providing food in sufficient quantity to all individuals has been the most important food policy objective over time in many countries, including India. After independence, the government focused its efforts on achieving self-sufficiency in staple grains and ensuring that basic foods were available to the whole population at affordable prices, through the implementation of the world largest public network of procurement and distribution. With a share of food expenditure amounting to more than half of an average Indian household's budget (National Sample Survey Organization [NSSO], 2012), it is clear that food availability and in particular the stability of food prices have been and in part remain the main concern of the national food policy. Despite the efforts, India still accounts for a high number of undernourished and very slow progress in improving nutrition (Kadiyala, Joshi, Mahendra Dev, Nanda Kumar, & Vyas, 2011; Meenakshi, 2016). The persistence of widespread food insecurity indicates the need for more investments in an integrated policy approach for hunger elimination that takes into account the different dimensions of food security. A non-exhaustive array of the national policy measures and schemes that are being implemented in the country to tackle food insecurity is provided in Table 2.

Table 2. List of main national policy measures/schemes addressing different dimensions of food security.

Policy schemes	Food security dimension
Macro Management of Agriculture Scheme (MMA), 2000	Availability
National Horticulture Mission (NHM), 2005	Availability
National Food Security Mission (NFSM), 2007	Availability
Rashtriya Krishi Vikas Yojana, 2007	Availability
Market Intervention Scheme (MIS)	Stability
Minimum Support Price (MSP) and Public Distribution System (PDS)	Stability/Economic access
National Rural Employment Guarantee Scheme (NREGS), 2005	Economic access
National Rural Livelihood Mission (NRLM), 2010	Economic & Social access
National Mission for Empowerment of Women (NMEW), 2010	Social access
National Rural Health Mission (NRHM), 2005	Food utilization
Integrated Child Development Service (ICDS) scheme, 1975	Food utilization
Mid-Day Meal Scheme (MDMS), 1995	Food utilization

While a number of these agricultural/food security policies include schemes targeting coarse cereals (as in the case of the MMA) and millets (the RKVY), we will focus our analyses on the regulatory mechanisms at the basis of the food procurement and distribution system. The recent legislative attempt to boost an effective inclusion of coarse grains in the Public Distribution System (PDS) and in other food programmes deserves a special attention for the opportunities it offers to promote a diversified cereal composition of diets and to support small millets production and consumption in India.

The food procurement and distribution system

As part of its food security strategy, the Government has established a broad regulatory regime which pays farmers who grow selected staple crops a higher price than the market, provides them with input subsidies on fertilizers and rural power and controls for trading distribution channels, lowering the price of the end product to favour the poorest sections of the population. The dual pricing policy is undoubtedly a pro-poor and farmer-friendly measure aimed at balancing the needs of both national producers and consumers. This interconnected system of public procurement at Minimum Support Price (MSP) and food distribution at subsidized prices through the PDS finds the legal basis in two important legislations: the Essential Commodities Act (ECA) of 1955 and the National Food Security Act (NFSA) approved in 2013.

The legal basis – The Essential Commodities Act

The ECA provides the central government with the power of controlling the production, supply, trade and commerce of specified commodities with the aim of increasing or maintaining supplies and securing their equitable distribution at fair prices. The list of essential commodities object of the regulation has been reviewed from time to time in the light of the economic liberalization and currently contains seven types of commodities, including foodstuffs and seeds of food crops, fruit and vegetables. The MSP established under this Act plays a crucial role for the stability of the Indian food economy. Initially conceived as a risk-coverage instrument, the MSP soon became a sort of production incentive with the power of ensuring a reasonable profit margin to growers and influencing their production decisions regarding land allocation of crops. The grains procured from farmers by the Central Government are issued to State governments for distribution under PDS and other food-based welfare schemes, or for feeding national buffer stocks for food security purposes. Since the beginning in 1958, the PDS has been focusing on the almost exclusive public allocation of wheat and rice (Hoda & Gulati, 2013). Still in the 10th Five-Year Plan (2002–2007) document, the government was convinced that 'rice and wheat are the basic necessities for the poor and that food subsidies must be restricted to these two commodities' (GoI, 2003). Procured quantities of coarse grains and other crops have been registered on a very smaller scale, either because the related MSPs are well below market prices or because of the lack of administrative capacity to procure the commodity (Organisation for Economic Co-operation and Development [OECD], 2007). The restriction of MSP to a limited number of commodities has a significant impact on the cropping pattern. Farmers growing traditional crops may see greater opportunities in shifting from the cultivation of traditional NUS to subsidized crops, fact that would also lead to a redirection of good quality land and resources. On a broader level, the marginalization of non-subsidized crops entails a slowdown of the process of diversification in agriculture that may lead in the long run to a loss in terms of crop biodiversity. With a view to improving the efficiency of the system and extending the benefits of MSP to local farmers of non-traditional surplus States, a decentralized procurement scheme was introduced in 1997. On the one hand, this move enabled the government to save on transport and administrative costs as well as minimizing the dependence on the Food Corporation of India for PDS requirements; on the other hand, it enabled procurement of food grains more suited to the local taste, representing a great opportunity for the introduction of grains different from the major crops (Banerjee, 2011; Landy, 2016).

The legal basis – the NFSA

A legal recognition of the inclusion of coarse grains in the PDS has been achieved in 2013 as a result of years of considerable advocacy efforts. Thanks to the great mobilization for generating awareness and bringing attention on the importance of millets for improving food and nutritional security and resilience of production systems to climate change ('Consider inclusion', 2009; 'Future belongs', 2010; Nagarajan, King, Jones, Vedamoorthy, & Kumar, 2008; Padulosi et al., 2009; Sekar, 2012; Swaminathan, 2010), coarse cereals have been taken into consideration, promised by policy statements and then finally included in the definition of food grains of the NFSA. The Act brings ongoing food-based welfare schemes of the government – such as the Integrated Child Development Services and the Mid-Day Meal Scheme listed in Table 2 – under one umbrella. In particular, it pays special attention to the nutritional needs of women and children by conferring them the legal right of receiving free meals that meet prescribed nutritional standards. While the minimum nutritional standards are set at national level, various details including menu composition remain state-administered and open a room for NUS inclusion.

Given that millets consumption and production patterns vary greatly from state to state, the Planning Commission has recognized that their procurement is something that can be done better in a decentralized mode, as encouraged in Schedule III of the legislative text (GoI, 2013b). State governments are responsible for the implementation and monitoring of the system in their territories and are allowed to design state-level schemes but at their own cost without any central support. Evidence from the implementation of the decentralized scheme shows that it has been successful only in few states, while others have preferred the Central government to undertake procurement (Landy, 2016; Tanksale & Jha, 2015). This raises questions about which model may result the most effective channel for the procurement of

underutilized crops such as small millets. A key issue for the wider consumption and popularization of small millets in India is related to the need of an adequate MSP for these crops by the PDS: a too low price would in fact not motivate enough farmers to sell millet produce to the public system when private traders offer a better price.

Discussion

On the whole, a moderate degree of attention has been paid by government policies on NUS, from collecting activities to public research improvement. National efforts are remarkable compared to other countries of the Asian region; however, they remain quite scant considered the geographical size and the immense richness in agricultural biodiversity of the country.

Concerning the field of agricultural research, India may want to invest greater resources on genetic diversity studies of minor species and on the improvement of varieties which perform best under adverse environmental conditions. In this context, small millets and other 'climate smart' NUS offer many unexplored opportunities while also benefiting rural communities with their high-nutritional value (more protein and micronutrients) (Garnett et al., 2013; Padulosi et al., 2009; Padulosi, Heywood, Hunter, & Jarvis, 2011; Saha et al., 2016).

Generally, Indian NUS fall outside the regulation system set-up by the intellectual property and seed laws analysed in Section 2 and this is often the case of small millets. However, some underutilized species have acquired a relative importance at regional level, as for the case of quinoa, chia and *Moringa oleifera* (Bazile et al., 2016; Mohd Ali et al., 2012; Pandey, Pradheep, Gupta, Roshini Nayar, & Bhandari, 2011); therefore depending on the extent to which NUS will enter the formal market, provisions related to access and benefit-sharing and granting of IPRs may become more relevant in a near future for these crops, making the existing policy gaps and constraints identified an urgent issue to address. In those cases of commercial developments from NUS genetic resources held by small farmers' communities, benefit-sharing mechanisms should be devised enabling the recognition of the resource holders' contribution to its maintenance; this requires a deeper understanding of the cultural and social dynamics shaping the local context and a more inclusive approach of farmers in all the steps of the implementation process. Although the PVV&FR Authority assigns five important cash awards per year that recognize the contribution of those communities engaged in the conservation and improvement of local genetic resources, more clear guidelines containing detailed indications of the communities involvement in developing the terms and conditions of benefit-sharing should be elaborated.

Documentation of PGRFA through PBRs has a great potential for the empowerment of local communities as it might enable farmers to: (i) preserve the knowledge on genetic diversity at the village level; (ii) assert their rights to the resources and associated knowledge recorded therein; (iii) facilitate the identification of original knowledge holders for the purpose of benefit-sharing in case of NUS, (iv) guide farmers in their cultivation choices based on resiliency, nutrition and other market traits and (v) help communities to monitor both genetic and cultural erosion for preventing losses of these assets to happen (Padulosi et al., 2011). With clear-cut legal measures in place, PBRs become a mean to protect farmers' varieties of NUS and reduce the risk of misappropriation. Furthermore, considering the criticisms of the capacity of intellectual property systems for providing protection to crop innovations developed by small farmers, an alternative right system not focused on property may be a valuable option to explore, allowing NUS farmers to be a more prominent player in the country's agricultural development. Forms of protection based on the principle of declaration of origin, such as labels of geographical indication, may well be applied for the recognition of farmers' breeding and innovation efforts (Larson, 2007; Salazar et al., 2007).

It is important to recognize that in contrast with more stringent intellectual property and seed laws enacted in other countries, in India both the PPV&FR Act and the Seeds Act leave a legal space for farmers to save, use, exchange, produce and sell unbranded seeds of protected varieties or seeds of public domain varieties to other small-scale farmers, as long it takes place in informal markets and among local farmers. The presence of no legal restrictions on traditional seed practices is a fundamental condition for the on-farm conservation of agro-biodiversity and for ensuring a broad genetic basis of species to develop new varieties. Particularly in the case of local, marginalized crops such as NUS, it will be important to maintain some sort of legally recognized space for farmers' rights to their traditional seed practices, since there have already been attempts at narrowing it with the

2004 proposal of a new seeds bill at the moment still pending in the Indian Parliament.

Given that both public and private seed sector mostly focus their interests on the improvement and production of quality seeds of major crops/hybrids, a strengthening of the seed system of minor crops by devising a farmer-friendly mechanism for ensuring seed quality within such a system, may represent an important move towards promoting conservation and use of NUS. A revision of the required minimum quality standards for national distribution that allows a certain flexibility for local 'heritage' crops would be, for example, an alternative measure that enables farmers to develop and formally sell 'guaranteed' seed of improved varieties of crops in which the biotech or seed industries are scarcely interested in (Santilli, 2012). Measures to facilitate and support the utilization of truthfully labelling procedures not only for the improved varieties carried out by seed companies and producers, but also for traditional varieties coming from farmers directly, would also enable rural farmers to demonstrate the quality of their seeds and would open more commercial opportunities in which they should be able to participate. Label accuracy could be controlled by community-based participatory inspections as an alternative to state inspection standards (Lipper, Anderson, Dalton, & Keleman, 2010). Legal steps towards national implementation of the International Treaty on PGRFA (ITPGRFA) would offer an additional legal basis for the protection of farmers' rights on seed and for the conservation and sustainable use of NUS. The Treaty recognizes the role of small-scale farmers in conserving and enhancing PGRFA and recommends the elaboration of measures to protect their knowledge and to promote equal participation in the benefit-sharing mechanism. In particular, the involvement of representatives of small-scale farmers in decision-making processes related to the determination of specific criteria for the utilization, production and marketing of local seeds, would be an appropriate move towards the promotion of a parallel local seed market officially recognized.

The creation of linkages between genebanks and rural farmers could be a logical and beneficial extension of genebank activities and would provide improved material for local breeding practices and on-farm testing of germplasm with adaptive potential to climate change (Bioversity International, 2014; Bonham et al., 2010). Open days at national or regional genebanks, organization of joint farmers-genebank seed fairs, and the wider dissemination of crop catalogues produced by both genebanks and local communities, particularly of NUS, may provide for more interaction between genebanks and farmers and greater chances for participatory innovation based on crop diversity.

Policies aimed at supporting on-farm conservation and management of agro-biodiversity within communities should be strengthened and better elaborated (Padulosi et al., 2013). Participatory plant breeding (PPB) have been shown to enhance local availability of improved varieties of traditional crops (Ceccarelli, Guimarães, & Weltzien, 2009), sometimes reverting the tendency towards their abandonment in favour of commercial varieties and generally obtaining varieties with greater adaptive potential to marginal growing conditions, which is mostly where NUS are still found (Galluzzi et al., 2015). Providing economic and regulatory support to the numerous local organizations engaged in PPB and on-farm conservation programmes would represent another valuable policy measure (Padulosi et al., 2013).

The introduction of coarse grains in the NFSA undoubtedly represents an opportunity to boost production of small millets at national level and to contribute to greater food availability and access not only in terms of quantity, but also quality. The decentralized system of procurement with assured minimum support/procurement price after assessing the market price definitely appears a more suitable and logical solution to make this public mechanism effectively working with millets and involving its farmers. Nevertheless, conflicting provisions and operational and financial challenges emerge from the text of the Act. Now that small millets have greater chances to be supported and introduced in supply-focused interventions, policy issues that may hinder the conservation and use of farmers' varieties need to be addressed with a view to strengthen the supply side also through the contribution of small farmers.

On the other hand, awareness-raising activities are crucial to stimulate the demand side and to eliminate the negative connotations associated with these crops which persist in certain areas (Finnis, 2008; Fischer et al., 2016; Padulosi et al., 2009). Information on small millets nutritional values could be conveyed, for instance, through the health and nutrition education service of ICDS, or by organizing consumption promotion campaigns. Awareness raising is also needed on the supply side, to inform millet farmers of the support offered by the government. Beside

the PDS, introduction of small millets in various food-based welfare schemes should be widely promoted in order to both provide nutritionally superior meals to children and absorb millet supply coming from policy measures supporting their production. Guidelines for their inclusion into the menus of feeding programmes, such as the MDMS, should be prepared at state or district level. Promoting locally grown, nutritionally rich food items by instructing mothers on the preparation of nutritious food/feeding practices and by training SHGs on value-added millet products would also be appropriate activities (Mal et al., 2010; Yenagi et al., 2010; Yenagi, Rajaraeshwari, Sumalata, & Josna, 2013).

To ensure local availability and direct access to nutritious foods in marginal areas, alternative and/or complementary interventions should be explored for strengthening vulnerable households' food security. For example, State governments or district authorities may provide incentives to small farmers for growing vegetables and fruits for household consumption or organize local initiatives for the training of women in the management of home gardens. Considering the key role that women have in the sustainable conservation and use of agro-biodiversity, their empowerment should be integral part of every strategy aimed at improving household-level food security.

While India's main frameworks affecting access to, conservation, sustainable use of genetic resources, and on intellectual property on seeds are unique in their capacity to take the needs and peculiarities of small-scale and traditional farming systems into consideration, a gap persists when it comes to strategies for mobilizing the products of those systems within the broader agriculture and food systems of the country. This is particularly true for the vast array of species and varieties which are considered neglected and underutilized, but that hold great potential for the country's food security and sustainable development.

The recent inclusion of a broader set of species – including small millets – in large-scale security schemes, such as the PDS, is a promising opportunity to leverage the role of these crops beyond the village scale. However, the implementation of this policy on the ground will benefit from well-thought accompanying measures to ensure that the diversity held within these traditional crops is not lost in the process, thus avoiding that a policy developed to encourage improved diets ends up having negative consequences on the conservation of Indian biological heritage.

Disclosure statement

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