Review Article

INNOVATIVE INITIATIVES FOR ENHANCING ACCESS OF QUALITY SEEDS TO FARMERS UNDER EVOLVING IPR REGIME - INSIGHTS AND IMPLICATIONS

P.A. Lakshmi Prasanna
ICAR-Indian Institute of Rice Research, Rajendranagar, Hyderabad- 500030, INDIA
**Corresponding author's E-mail: prasannaparaiveedu@yahoo.com*

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ABSTRACT
In order to comply with obligation under WTO and also to provide incentives for private sector participation in plant varietal development research, several countries brought plant varieties under Intellectual Property Rights (IPR) regime. This together with increasing consolidation and concentration of Agro-biochemical companies at global level under expanding frontier technologies for plant varietal development has raised concern regarding quality seed accessibility to farmers at affordable price. For achieving sustainable development goal of zero hunger by meeting food and nutritional security requirements, accessibility to quality seed at affordable price is prerequisite. To address this issue of accessibility of quality seed at affordable price, several market and non-market based innovative approaches are identified and are being experimented across different countries and regions of the World by different agencies focussing on different stakeholders. Some of these approaches are of voluntary nature involving partnership or contracts. Some approaches are governed by legislations but some are not governed by any legislation. Some approaches are complying with prevalent "Individualistic" IPR regimes but some approaches are based on "protected commons" IPR concept. This study attempts to documents and examine these approaches, so as to get useful insights for effective adaptation of these mechanisms in Indian context.

INTRODUCTION

In order to comply with obligation under WTO's TRIPS agreement several countries brought plant varieties under Intellectual Property Rights (IPR) regime. Some researchers argued that IPR (more specifically patents) in the case of plant varieties is necessary for innovation i.e. development of new varieties (Smith *et al*., 2016; CIOPORA, 2017) and thereby increasing biodiversity. But some researchers argued that IPR by leading to concentration of property (plant genetic recourses) in hands of few firms (Halpert and Chappel, 2017) which offer limited choice to farmers, destroy plant diversity. Some more researchers argued that IPRs are not at all necessary for innovation in plant varieties, on the other hand IPRs serve as rent seeking tools (Heald and Chapman, 2011; Halpert and Chappel, 2017). In the context of prevalence of different types of IPRs like Plant Variety Rights (PVR), Plant Patent, Utility patent and Trade secret, Lence *et al*. (2016) observed that different types of IPRs are suitable for providing incentives in different types of research (in terms of period, extent of risk in research and nature of genetic material used in research etc) in plant varietal development. Some researchers are viewing, recent agro-biotech firms mergers, as a strategy to leverage access to IPRs of other firms by changing market structure.

In the backdrop of this intensive debate regarding effect of IPR on control over plant germplasm, seed market structure, innovation and seed prices in agriculture, there have been some initiatives to address/prevent some of negative effects. These initiatives at global level are described in the following section of this paper. In subsequent sections, IPR status for plant varieties in India, local initiatives to accelerate varietal spread and conserve biodiversity are discussed. In penultimate section, drawing on insights from global level initiatives, possible additional initiatives and needed policy interventions in India are discussed. In final section conclusions are presented.

Initiatives across countries

Open Source Seed Initiative: IPR regime is leading to restriction on access to plant varieties/genetic material for research by breeders and farmers in several countries. To address this concern a non-profit organization consisting of a group of plant breeders, farmers, non-profit agencies, policy makers etc was launched with the name "Open Source Seed Initiative" (OSSI) in 2014 in USA. This initiative is aimed at creating and ensuring access to

"protected common genetic resources" for fostering development of new plant varieties (Luby and Goldman, 2016). This initiative is based on insights drawn from "open source" development in software industry, "copy left licence" in the area of copy rights and management of commons (Ostrom, 1990). For accessing seeds under OSSI, one has to sign a pledge, which reads "**You have the freedom to use these OSSI - pledged seeds in any way you choose. In return, you pledge not to restrict other's use of these seeds or their derivatives by patents or other means and to include this pledge with any transfer of these seeds or their derivatives**". Breeders who want to contribute their cultivars under OSSI-Pledged varieties are able to submit their varieties to OSSI. OSSI is partnering with seed companies for selling seeds of OSSI-Pledged varieties. Thus OSSI is using a hybrid approach having market and non-market components. Under OSSI, developer of a OSSI pledged variety retains the right to distribute or not distribute seeds as per his choice. But once the seeds are distributed, OSSI pledge becomes binding on both donor and recipient. OSSI accepts varieties that have been released previously on a case by case basis after evaluation of extent of spread of the variety.

F1 Hybrids also can be OSSI Pledged; however a contributor has to disclose the details of parents used in producing his hybrid. The contributor also needs to describe the genetically controlled traits expressed or carried by the parents or the hybrid that can make the hybrid valuable in future breeding program. It is not necessary that parents themselves be OSSI Pledged. Further the breeder has to assure OSSI that to the best of his/her knowledge there are no intellectual property protection claims associated with the hybrid's parents which may restrict freedom in future use of hybrid or its progeny. OSSI as of now is not accepting material containing transgenic component.

Currently OSSI has 382 cultivars of 58 crops (most of them are horticultural crops) , contributed by 38 plant breeders and sold by 51 companies from different countries. Out of these 382 varieties, 347 varieties are bred for organic system, 341 varieties are available for commercialization and 363 varieties are finished varieties. Under OSSI initiative, breeders contributing their variety as OSSI-Pledged varieties can enter into royalty like agreements with seed companies for selling their varieties, there is no restriction on it. Only thing is that the agreement should not impose any restriction on ultimate recipient of the seed in any way. Thus OSSI is focusing on fostering a decentralised and innovative plant breeding system, respecting the rights and sovereignty of indigenous communities over their seeds and genetic resources (Kloppenburg, 2014). Under United Nations Environment program initiative "Sustainable consumption and production" there is a call for Worldwide alliance for open source seeds.

Open Source Seed Licence (OSSL): This initiative is taken up by AGRECOL (Association for Agriculture Ecology) a non-profit entity in Germany. Under this, licensee will be granted the right to use seeds for any purpose (propagation, enhancement) and pass on the seeds to others, disseminate propagated or enhanced seeds. OSSI is initiative is relying on "pledge" mechanism i.e. an ethical approach, on the contrary OSSL is initiative based on enforceable "Licence" mechanism. Abridged version of Licence reads

"By acquiring or opening the packet of these plant seeds you accept, by way of an agreement, the provisions of a licence agreement where no costs shall be incurred to you. You especially undertake not to limit the use of these seeds and their enhancements, for instance by making a claim to plant variety rights or patent rights on the seed's components. You shall pass on the seeds, and propagations obtained there from, to third parties only on the terms and conditions of this licence. You will find the exact licensing provisions inside the packet and at www.opensourceseeds.de/licence. If you do not wish to accept these provisions, you need to refrain from acquiring and using these seeds".

For a variety to get OSSL the variety must be new, not distributed prior to getting OSSL and also may not have any characteristic and gene sequences that have been patented. If any licensee infringes any of the licensing provisions his/her rights of use of the seeds or their enhancement will lapse immediately. The expiry of rights of use of infringer shall not have any influence upon the rights of other users, as long as the other users do not infringe the licensing provisions. As of now one tomato variety (Sunviva) and one wheat variety (Convento C) are available under OSSL.

Farmers seed networks: It is estimated that at global level 80-90% of seed and plant material flow is through farmers seed network (Coomes *et al*., 2015). Farmers seed networks are being considered important also for transmission of seeds of non-core crops and plant species ignored by formal seed systems thereby contributing to agro-biodiversity. This biodiversity can be form basis for future varietal improvements and adaptation to climate change and other biotic and abiotic stresses. Farmers seed networks aid in faster movement of seeds across ecosystems and geographic locations unattractive to formal seed systems because of thin markets. National and international agricultural agencies are attempting to harness the potentials and efficiency of farmers seed networks in seed transfer, and building seed systems for bio-fortified crops. In Nigeria and DR Cango farmers who received free planting material of pro-vitamin Yellow Cassava, were required to provide an equal amount of planting material to two additional farmers in subsequent season (Bouis and Saltzman, 2017). Similar arrangement was observed in case of spread of Zinc rich rice variety BRRI dhan 64 in Bangladesh.

In several countries farmers are involved in seed production also. Quality maintenance with respect to seeds produced by farmers can become an issue in countries with limited

capacity for seed inspection and certification. For instance Tielens (2017) reported that in Uganda there were only three Government field inspectors to control tens of thousands of seed producers. In this context, Integrated Seed Sector Development (ISSD) program (a project of four years duration started in 2012 in Uganda), besides setting up local seed business (comprising of farmers groups), also made effort to formalize a decentralized seed quality assurance system. Under this scheme a new a class of seeds namely Quality Declared Seed (QDS) category was developed. These seeds are also produced following same production procedures as in the case of certified seeds, except the seed control is done by District Agricultural officers, trained by seed inspectors of the National Seed Certification Services (NSCS). Further number of inspection visits to a field were reduced to two in case of QDS seeds compared to six in the case of certified seeds. The farmers paid 15 dollars per visit as a group. This mechanism of quality control is complemented by quality control by "quality committee" of a seed producing farmers groups. These steps resulted in reduction in cost of seed quality control. This in turn has led to increased small farmer's access to quality seeds at affordable price. QDS was accepted in Uganda national seed policy in 2014. The local seed business farmers groups received financial support for investment up to the extent of 75 percent only, thereby insisting on 25 percent contribution by farmers group.

Access to seed index: Access to seeds Foundation (ASF) is an independent, non-profit organization based in Netherlands. This foundation publishes "Access to Seed Index" every two years. The index aims to monitor progress and encourage seed industry participation in creating enabling environment for smallholder farmers by focusing on different dimensions of access viz ;(i) availability (ii) affordability (iii) suitability (iv) capability (v) profitability and (vi)autonomy.

The index is a relative ranking comparing seed companies with each other. In other words the exercise attempts to use positive reinforcement approach for encouraging participation of seed industry in small holders development. Accordingly to arrive at ranking of the seed companies in 2016, seven activity areas were chosen. The seven areas were (i) Governance and Strategy (ii) Public policy and stakeholder engagement (iii) Genetic resource and Intellectual property (iv) Research and Development (v) Marketing and Sales (vi) capacity building and (vii) Local seed sector development. In each area four indicators were used viz.; (i) Commitment (ii) Performance (iii) transparency and (iv) innovation. The index was build following weighted score approach. Separate indices were built for assessing seed companies role at global level and regional level and also for two different crop groups i.e. field crops and vegetable crops. The index focused on companies with an integrated seed business model covering the full seed value chain starting from Research and Development to seed distribution. Accordingly in 2016 access to seed index assessment at global level, seven leading seed companies of field crops and ten leading seed companies of vegetable crops were covered. The methodology for measuring access to seed index is flexible and is being revised/refined in every round taking into consideration of views from different stakeholders. The index is compatible with multiple seed system, marketing, and Intellectual Property Rights (IPR) principles.

DuPont Pioneer topped in 2016 access to seed index at global level with respect to field crops (ASF, 2016). It was followed by Syngenta and Bayer. With respect to vegetable crop seeds, East-West Seed Company ranked first, followed by Syngenta and Bayer. At global level, it was observed that more companies supported breeders exemption in plant variety protection than in Patent law. Further the companies expressed conditional support for farmer's exemption (limiting to certain crops or certain geographic area or certain category of farmers for specific uses). Only few companies reported activities related to patents and humanitarian licensing. Regarding patenting of native traits, only one company expressed its support and one company clearly expressed its opposition, rest 5 companies did not disclose their position. Access to seed foundation initially assessed access to seed index at regional level only in one region, but is slowly increasing the number of regions.

AgAccord: AgAccord is a private sector led voluntary contractual framework and intends to address marketability, regulatory and stewardship issues resulting from patent expiration related to biotechnological events. In US the last patent governing Roundup Ready (RR1) in Soyabean expired on April 28, in 2015 (Jefferson *et al*., 2015). In this case as adhoc measure, Monsanto made a commitment to maintain all regulatory approvals until 2021 (Jefferson *et al*., 2015).To handle the transition process in subsequent such cases, AgAccord can serve as a mechanism facilitating generic seed development (Agbiogenerics) in USA.

The trait which enters into public domain because of patent expiration, will be available for incorporating into other varieties of same crop or other crops without any license fee. However at present regulatory regimes for biotech crops in several countries including US is based on events (not based on traits). Hence the regulatory system approval of a trait is on a species to species basis. Thus there will be regulatory costs in developing generic seeds. Further there are wide differences between countries in terms of regulating Genetically Modified (GM) crops in terms of approval as well as periodicity of renewal of approval. Thus these differences in regulatory regime will lead to heavy regulatory costs in growing and marketing of agbiogeneric crops. The original owner may not have incentives to bear this regulatory cost when patents expire. New entrants in agbiogeneric market also may not have incentive or may not

have capacity to bear this regulatory cost. To tide over this problematic situation, and for facilitating transition of regulatory and stewardship responsibilities AgAccord was the mechanism identified through negotiation in private sector. The negotiations were led by American Seed Trade Association (ASTA) and the Biotechnology Industry Organization.

AgAccord consists of two agreements (i) Generic Event Marketability and Access Agreement (GEMAA) and (ii) Data Use and Compensation Agreement (DUCA). An Signatory can choose to sign GEMAA or DUCA or both. Both GEMAA and DUCA have some common basic elements (i) Notice of patent expiration three years prior to that expiration (ii) an obligation to provide access to the biotechnology event in a "usable" form at patent expiration (germplasm free from intellectual property like patents and plant variety rights) (iii) mechanism for sharing or transitioning of regulatory responsibilities through negotiation with binding arbitration if necessary (iv) a predictable process for signatories or groups of signatories to become "verified" that they are able to share or take over regulatory responsibilities and (v) stewardship requirement for signatories. A process for signatories to enter into negotiations for data compensation is optional under GEMAA , mandatory under DUCA. Signatories signing both GEMAA and DUCA, will have access to events covered by both agreements, but they would be bound to follow DUCA process. If a signatory to both the agreements wants to follow GEMAA process, it has to withdraw from DUCA.

As of now there are 10 signatories to GEMAA (including four multinational companies which are involved in recent merger proposals, and some crop growers/seed trade associations) and it became operational from 15th November 2012. Under GEMAA, "Proprietary Regulatory Property" (PRP) Holders i.e. biotechnology companies developing information to gain authorization in an importing country" must provide access to the generic event at patent expiration. Further while giving notice regarding patent expiration, a GEMAA PRP holder has a choice to (i) independently maintain regulatory responsibility for the event at no cost to users of the generic event (ii) seek to share regulatory responsibility or (iii) discontinue regulatory responsibility. PRP holder choice regarding regulatory cost sharing determines its obligation to provide access to PRP to interested GEMAA signatories. In addition if a PRP holder decides to discontinue regulatory responsibility for a biotechnology event, the PRP holder has to bear full regulatory cost for that event for seven years after notice of discontinuation. Till date under GEMAA Monsanto has given notice of patent expirations covering one in Soyabean and one in Corn, in both the cases the company has opted to independently maintain and obtain covered authorization.

DUCA opened for signature in December 2013. DUCA will become operational once it gets signed by (i) 3 parties that are currently PRP holders or those who have petitioned for non-regulatory status of their events (ii) 3 non PRP holders. Under DUCA in order to be able to join in negotiations each signatory must become "verified" (must establish their ability to steward events and establish a verification fund). Further under DUCA each signatory who gains access to an event through a comprehensive agreement must pay a share of basic regulatory cost and continuing maintenance costs.

The scope of AgAccord is limited to events patented and commercially cultivated in US and regulatory authorization in US export markets. Though AgAccord is private sector led solution, it is open for public sector organizations. Costs associated with signing the AgAccord are limited to the annual operating costs of the GEMAA/DUCA. Small business entities and non-profit corporations are exempt from paying operational cost. Companies with more than 100 employees but less than 250 employees have to pay discounted operating costs. Signing AgAccord, does not imply that the signatory has to pay the cost of global regulatory authorization. Only when a signatory enters into negotiation and executes an agreement resulting from negotiation or arbitration it has to pay regulatory cost. Under GEMAA a signatory will commit to steward responsibility only if the signatory is using seed products containing biological events. GEMAA is more flexible as it provides a choice to PRP holders in providing access to its PRP with respect to off patent event to others, but under DUCA access to PRP and data compensation is mandatory.

Allred (2013) argued that the GEMAA agreement will maintain consolidation in transgenic seed market as it will be difficult for public sector universities and small private entities to become "verified" members. Non members will not receive copies of patented events for developing generic alternatives (Lawson, 2015). Further both members and non-members will not be able to test and engage in regulatory review of generic products before the expiry of patent term for a event. This results in delay in release of generic seeds. In the mean time the original innovator company can engage in 'product hopping' and reduce the market for generic competition (Allred, 2013; Schonenberg, 2014; Lawson, 2015; Johnson, 2016). Hence it is opined that US Government intervention through a provision exempting generic transgenic seed development from patent infringement during final years of patent term (similar to Hatch-Waxman Act in the case of research for generic drugs in pharmaceutical industry) will facilitate smooth transition to generic seed markets and maintain competition in generic seed markets.

Public Private Partnerships (PPP): PPP for plant varietal development and seed commercialization can be leveraged through several mechanisms like funding/subsidized credit, tax exemption, licensing, benefit sharing etc. Several evidences are available in literature for this. In Brazil,

private companies like Monsanto, BASF, Syngenta, Dupont etc are carrying out research working with Embrapa (state-owned research corporation affiliated with the Brazilian Ministry of Agriculture) and contracts with non-profit organizations for seed production (Moreddu, 2016). Syngenta company is partnering with International Rice Research Institute to develop more genetic markers for rice breeding (Moreddu, 2016).

In recent year some donor organizations wanted to explore effectiveness of "pull" mechanism (where in donors stimulate demand for new technologies in contrast to "push" mechanism where in donors directly fund the supply of agricultural inputs) for incentivizing private sector participation in agriculture and empowering smallholder farmers. For this, a group of countries including Australia, Canada, the United Kingdom, and the United States, in partnership with the Bill and Melinda Gates Foundation, launched AgResults multilateral initiative in June 2012 G20 summit. AgResults incentivizes private sector innovation in the field of smallholder agriculture through prizes that promote the uptake of innovative technologies. As of now Ag Results is a 118 million USD project with seven pilot projects, in two pilot projects focus is on seed market development.

Under AgResults program, in Zambia a pilot project (of 5 years duration staring with 2015) for introduction bio-fortified (Pro-vitamin A) maize (PVA maize) was launched with 7 million USD. This project was redesigned and re-launched in December 2016, after addressing deficiencies/limitations in initial design. The project targets both seed companies and maize millers in value chain mode. Under this pull approach based project, different ranges of sales quantity thresholds (a total of 6 threshold ranges) were established for different periods. The amount of money a seed company/corn miller can win is calculated as (i) a base threshold payment based on the total sale threshold reached and (ii) an additional per unit payment (fixed for the relevant threshold) for each metric ton of PVA maize seed or corn sold. The mechanism design is such that both base payment and per unit payment increases with increase in total sales (a sliding scale threshold structure). The project is managed by a pilot manager and a pilot verifier. As of now two seed companies joined the project and reported seed sales surpassing initial threshold levels. Eight millers have joined in this pilot project. The project is also supported by Zambian Government input subsidy program and Harvest plus program of CGIAR research program.

Under AgResults another pilot project focussing on seed sector is a six years legume seeds project in Uganda. The project was initially launched in 2014. But after noticing several problems in the program, the project was redesigned and re-launched in February 2017. The project intends to incentivize seed companies to produce and sell quality verified bean and soyabean seed varieties to smallholder farmers of Uganda. This project also consists of two parts in its redesigned form (i) an annualized prize that provides a premium on seed sales growth and (ii) access to cold storage to allow companies to carry over unsold seeds from one season to the next. The annual prize is 20% of the sale price up to a maximum of 20% growth relative to the prior year. Further the seed companies participating in the project must adhere to seed certification scheme created by AgVerify, a private sector seed quality verification scheme. To this effect AgVerify and AgResults entered into formal partnership in December 2016. Till date seven seed companies have joined the project. Thus AgResults is implementing "pull" mechanism based on principles of "participatory constraint" and "incentive compatibility" of contract theory. The pilot projects are designed in such a way that the "risk-reward" payoff to market players are altered so as to encourage their participation. Further the pilot projects are focussed on "single problem" to address under given "value chain" and "political economy" background.

IPR for plant varieties in India

In India Protection of Plant varieties and Farmers Rights (PPVFR) Act was enacted in 2001. Under this Act besides research exemption provision, there are provisions for protecting farmer's rights as consumer, conservator and researchers. Accordingly there is provision for registration of farmers varieties and benefit sharing. Till November 6th, 2017, totally 15467 applications for plant varieties registration are received by PPVFR Act Authority, spreading across 106 crop species. In these applications 66% applications are with respect to farmers varieties spreading across 97 crops. Applications from private sector constitute 23 % of total applications spreading across 40 crops. 2 applications are from individual breeder. Rest of the applications are from public sector spreading across 78 crops. This indicates that private sector is seeking IPR protection more compared to public sector. Highest share of farmers application, though is a good sign, how many farmers really understand the meaning of and utility of registering with PPVFRA need to be assessed.

Till Dec 2016, 2672 varieties are registered with PPVFRA, out of which 1056 (40%) varieties are farmers varieties, 1026 (38%) varieties are public varieties and rest (22%) are private varieties. Private sector is leading in number of hybrids registered. Public sector plant varieties are spread over 45 crops as against 22 crops in the case of private sector and 12 crops in the case of farmers varieties. 96 % of farmers varieties are rice varieties. 69 % of rice varieties of farmers are from Odisha and another 18% of farmers rice varieties are from Chhattisgarh. As on 31-12-2016, out of 2672 varieties registered with PPVFRA, for 276 varieties (10%) statutory period of protection is over.

PPVFRA is being claimed as effective sui-generis system with distinct/ unique features compared to IPR regime

under UPOV convention (Ranjan, 2009; Shil, 2017). The special features are (i) registration of extant varieties (ii) right to farmers as breeders, conservators and consumers (iii) compulsory licensing provision and (iv) obligatory disclosure requirement on the part of breeder. Compulsory licensing provision serves as check on anticompetitive behaviour of breeder. Mandatory disclosure requirement not only helps in effective implementation of benefit sharing and but also acts a check on anticompetitive behaviour of breeders. Notably both these provisions are not there in the Indian Seeds Bill -2004 (with amendments in 2011) proposed for regulating quality of seeds . It is being argued that introduction of seed bill in the present form is an indirect way of diluting provisions of PPVFRA and making new Indian seed law compatible with provisions of UPOV with more rights to breeders (Ranjan, 2009). Parliamentary standing committee recommended that a price regulatory provision should be made in the seeds bill (by constituting a sub- committee) to control prices of seeds to ensure that the farmers are not charged exaggerated price by seed suppliers. But some researchers (Singh and Chand, 2011) suggest regulation of competition rather than direct price regulation. Manjunatha *et al.* (2016) based on field study reported that seed sale price regulation mechanism through seed legislation constituted one among top 4 priorities in the case of farmers, NGOs, and seed dealers. In the case of private seed companies deregulation of sale price of seeds constituted the top most priority with regard to seed legislation. In PPVFRA some reference is there regarding "reasonable price" under compulsory licensing provision, but there is no clear-cut definition of what constitutes a reasonable price. Amidst this backdrop on 7th December 2015 Cotton Seeds price (control) order-2015 was promulgated under Essential Commodities Act. This order is in conjunction with the seeds Act, 1966 and Seeds (control) order, 1983. Subsequently, under this Cotton Seeds price (control) order, on 18th May 2016, a Gazette notification on 'Licensing and Formats for GM Technology Agreement Guidelines, 2016' was issued by Ministry of Agriculture and Farmers welfare, but later it was rescinded on 24-05-2016, kept as a draft under public domain for comments for a period of 90 days.

In the context of seeds bill, Parliamentary standing committee recommended that compensation to farmers if the seeds does not conform to the minimum standards fixed by the committee, needs to be based on the expected performance as mentioned by the seed producer on the label of the seed package. Further the committee recommends that seed certification agency should be held responsible for the quality of the seeds and should invariably be made a party to the compensation process, along with the seed producer/ supplier in case the seed fails to give the desired yield. In PPVFRA also a provision is there for compensating farmers in case of failure of seed.

Initiatives in India to enhance quality seed access

In the context of pending seed bill enactment with provisions diluting PPVFRA, as precautionary measures some initiatives have been taken up in India too to address the issues of control over germplasm/seeds, seed quality and seed price. Centre for Sustainable Agriculture, Hyderabad by organizing an open source network bred and shared eight varieties of rice, wheat and pulses (Lucas, 2017).

Archana *et al*. (2017) investigating various practices of the repossession of seeds in order to conserve agro-biodiversity and ecosystem, reported two cases of NGO led control and conservation of seeds of land races in the state of Odisha in India. Loka Samabaya Pratisthan (LSP) and Sambhav are the two NGOs, having their own seed banks and practicing organic farming. High chemical input usage in modern varieties cultivation leading to ecological damage motivated the initiation of seed bank program of LSP. Sambhav seed bank program was started with the objective of protecting environment by conserving agro-biodiversity. On farm crop (agro) biodiversity conservation is essential for developing new varieties under changing climatic conditions (Priyadarshini *et al*., 2016). LSP conserves rice germplasm only, on the other hand Sambhav conserves germplasm of rice, millets, pigeon pea and fruits. Seed banks are managed by organizations but not by communities both in the case of LSP and Sambhav. But under Sambhav seed bank program, seed conservation takes place at organizational level as well as at farmers group level. Both the NGOs do not support farmers financially but only provides them training for cultivating the land race varieties. Both LSP and Sambhav, followed a strategy of collecting and expanding their germplasm collection using informal networks. Under Sambhav an initiative has been taken up in which farmers are encouraged to 'adopt a seed' by signing a two page document containing vow to take care of seeds of a particular variety. Both LSP and Sambhav are sharing the conserved varieties with interested farmers for cultivation.

Issues and implications

Both OSSI and OSSL varieties, may not be attractive to profit oriented big private companies with high and improved Research and Development capacity because of their pledge/licence conditions. This may lead to lower use of these varieties in improved varietal research. Hence there is need to be cautious about this issue. Proper threat mechanisms should be there to check sale of spurious seeds. In this direction, recently Telangana State Government has decided to bring those found guilty of manufacturing and selling spurious seeds under the purview of the Preventive Detection Act (The Hindu, 2017).

In NGO led initiatives reviewed in the study, and some OSSI/OSSL initiatives there is emphasis on natural or organic cultivation. This is in line with Government of India (GOI) policy of encouraging organic cultivation. Hence these seed sector initiatives can be linked with ongoing GOI programs like National Mission on Sustainable Agriculture,

Paramparagat Krishi Vikas Yojana. In US, Organic Seed Alliance (OSA) is monitoring organic seed system, publishing "state of organic seeds" once in 5 years(OSA,2016) . Similar initiatives can be taken up in India also. Further there is need for comprehensive policy on organic product for domestic markets and imports (Mukherjee *et al.,* 2017). These policy initiatives can support organic agriculture under OSSI and NGO led initiatives for conserving biodiversity.

In India also significant progress is there in development of bio-fortified cereals (Neeraja *et al*., 2017). Drawing insights from AgResults projects, In India also such projects can be experimented with selected high priority cereals. India can also think of some incentive program similar to "access to seed index" kind at national level to complement with program of checking anti-competitive behaviour though Competitive Commission of India.

CONCLUSIONS

There are several different innovative initiatives across globe for enhancing quality seed access to farmers by addressing restriction on access to seed in short term and long term (by way of arresting biodiversity loss). Some initiatives are there in India also on this line. These initiatives need to be strengthening by linking with GOI program. Some more initiatives can be taken up in India drawing from global level initiatives.

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