Journal of Intellectual Property Rights
Vol 25, September 2020, pp 131-139

# Impact of India's Plant Variety Protection Act: Analytical Examination Based on Registrations Under The Act

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*Received: 1st May 2020; accepted: 12th September 2020*

Mandated by TRIPS, India constructed a *sui generis system* for protection of plant variety, 'The Protection of Plant Variety and Farmers Right Act, 2001'. The primary objective of the study is to examine the impact of this Act in strengthening the agriculture ecosystem. The paper addresses this by analysing the different attributes of registrations under this Act i.e. types of crops registered, their registration types, applicants affiliation, etc. It further explores the implications of these registrations. The paper also examines the salient and distinctive aspects of the Act such as provisions for supporting farmer and crop diversity, incentive to breeders. The registrations undertaken under different categories show positive trends in terms of crops registered, involvement of different stakeholders, etc. New crop registration shows promise for introduction of new improved varieties. Active involvement of private entities in registering plant varieties underscores that the Act is providing incentives for them for development of new varieties. India's agriculture export exhibit linkage with new crop varieties being registered. New crops varieties can create market monopoly and help strengthen India's agriculture exports. Lack of farmers involvement and the limited role of state agriculture universities in development of new varieties is however a cause of concern.

**Keywords:** PVP&FR Act, Agriculture Ecosystem, Sui-Generis System, TRIPS Agreement, Agriculture Export

Agriculture is the primary source of livelihood in India for about 60 percent of India's population. It accounts for approximately 18 percent of India's GDP[1], with 70 percent of rural household still depending primarily on agriculture for their livelihood.[2] As per FAO,[3] India is the largest producer of pulses in the world accounting for 25 percent of global production and the second largest producer of rice, wheat, sugarcane, groundnut, vegetables, fruit and cotton. Breakup of various sectors that play a key role in the Indian economy is provided in Fig. 1. Over the years, the share of agriculture in Indian economy has decreased with service sector emerging as a key driver of Indian economy. Economic Survey further points out that share of agriculture and allied sectors in the Gross Value Added (GVA) of the country at current prices have declined from 18.2 percent in 2014-15 to 16.5 per cent in 2019-20. In spite of being the largest producer of pulses, India is major importer of pulses and vegetable oils; in 2018-19 it imported 1140.76 USD million and 9890.32 USD million pulses and vegetable oils respectively.[4]

The Indian agriculture sector is primarily an informal activity i.e. not an institutionalized or a corporate activity (Fig. 1). The key stakeholders are farmers with small land holdings and many landless labourers. The formal sector comprises public institutions like Indian Council of Agriculture Research (ICAR) that has around 100 or so institutions under it, State Agricultural Universities (SAUs), and some private enterprises. Agriculture R&D is particularly dominated by ICAR and SAUs. The private sector's research contribution has been on the margins since independence conducting about 16% of total agriculture research in India.[6] The challenges of the Indian agriculture ecosystem range from fragmented land holdings, supply chain bottlenecks, insufficient irrigation facilities, lack of

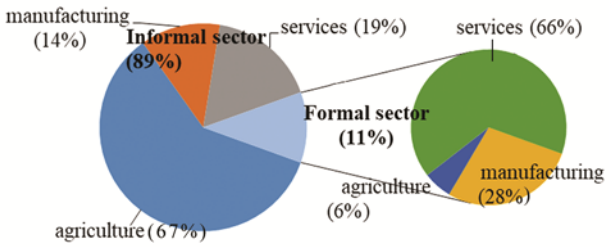


Fig. 1 — Indian Economy Driven by Informal Sector *(Stylised figure constructed from Dutz and Carl)*[5]
Note: *Authors estimation show a variation of about 3% in percentage share on an average from presented in 2006*

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storage facilities, institutional support, quality seeds, and increasing monopolization of seeds.

Farmers have been the mainstay for the protection and development of traditional varieties in India; preserving the genetic diversity of these traditional varieties as well as they enriched their diversity by human selection. The traditional varieties are passed on from generation to generation by farmers and also many of these show compatibilities to local conditions. The Green Revolution was a success primarily for increasing crop production substantially by using high yielding varieties of crops and modern methods of farming. In spite of success of green revolution, its widespread implementation created adverse impact on soil fertility, on crop diversity, and erosion of water table.[7]

The informal sector is a major contributor to seeds available to the Indian farmers. Thus, it creates a need to protect farmers rights as traditional practices by the farmers has resulted in conservation of various plant varieties. It also calls for relevant policy intervention to support the farmers who are protectors of crop diversity. Innovation and new agricultural methods should not be at the cost of destroying the agriculture diversity. India signing the TRIPS Agreement required that it develops an effective *sui generis* system for plant variety protection.[8]*Sui generis* system was constructed by India keeping in view the challenges and constraints of the Indian agriculture system. The paper argues that India's PPV&FR Act provides various mechanisms that can lead to creating an enabling environment for development of new plant varieties and can also help in protection of crop diversity. It can provide a new incentive mechanism for development of new plant varieties. Thus, it is important to assess the impact of the Act. Critical examination is also required to see the gaps that impede the proper translation of the Act. The paper is motivated by this, to examine the impact after the implementation of the Act. A question discussed in this study is whether the PPV&FR Act provides mechanism for putting farmers as an integral part of the agriculture ecosystem.

## India's *Sui Generis* System for Plant Variety Protection

> *Plant variety as per the PVP&FR Act is defined as a pant grouping within a single botanical taxon of the lowest known rank. As per this Act, variety is distinguished based on at least one expression of characteristics that is unique from another genotype. It does not include micro-organisms unlike India's Patents Act wherein, inventions covering microorganisms can be protected by patent.*

Development of new plant varieties is one of the key determinants for strengthening the agriculture ecosystem. This need motivated many countries which finally led to the establishment of the International Convention for the Protection of New Varieties of Plants (UPOV) in 1961. The main aim was to promote the development of new plant varieties by creating a suitable incentive mechanism that would motivate the development of new plant varieties. To carry forward this idea, the convention developed specific guidelines and rules to protect plant varieties under one umbrella system. The plant varieties of members of UPOV convention are protected in all the countries who are part of the convention. The UPOV 1978 provisions allowed the countries to protect varieties either with distinct breeder right or patent but not with both. The provisions were further strengthened in 1991 allowing dual protection with breeder's right and patent. The 1991 UPOV provision limited farmers rights further and on the other hand provided more incentives to breeders. However, as in the earlier draft, after the duration of protection the variety can be used freely by any person for research, breeding or propagation purposesand breeder's rights becomes non-existent.

The Trade Related aspects of Intellectual Property Rights (TRIPS) Agreement of the WTO that was implemented in 1995 as part of overall agreement mandated every member country to provide some sort of legal protection to plant varieties. As per TRIPS Agreement (Article 27.3 (b)) members have three options to provide protection for plant varieties either through patents or effective *sui generis (of its own kind)* system or their combinations. India chose to create its own *sui generis* system for protection of plant and plant varieties, PVP&FR Act in 2001. Many countries adopted UPOV type of protection by becoming member of this convention. However, countries that had not joined the convention before 1991 could only adopt the UPOV 1991. As the guidelines of UPOV amended in 1991 restricts farmers' right to sell or exchange seeds with other farmers for the purpose of propagation, this thus becomes a problematic provision in the case of India whose majority of the population (around 58%) is still

dependent on agriculture and implementing the provisions of UPOV would directly affect these farmers. Also, in the Indian context giving rights to farmers is an essential part as in India there is a very large percentage of small, marginal and subsistence farmers who are not able to buy seeds from the market each season.[6]

India, thus rightly constructed its own '*sui generis*' system of protection by drawing from UPOV 1978 and 1991 and incorporating aspects keeping in view the demands and challenges of its agriculture. Table 1 provides some salient aspects that show how India's PVP&FR Act differs and also has commonality with UPOV provisions for protection of plant varieties.

The Act, thus, largely attempted to address three key objectives: 1) protect rights of farmers and recognises the contribution of farmers towards conserving, improving, and making available the plant genetic resources for new varieties development, 2) stimulate research and private plant breeding,enhance technology transfer, foreign investment and trade, promoting conservation of agro biodiversity, and 3) sustained use of varieties and facilitating access to genetic resources and sharing benefits.[10] These objectives were met without violating the TRIPS requirements.

Only the crops notified by the Central Government in PPV&FR Authority Gazette are available for registration in India. 157 crop species so far have been notified by the Central Government for the purpose of registration. The breeder can be a person, university, private organisation, or public-funded institutions. Farmers or farmer community are eligible for applying for new, extant, EDVs or farmer's variety. Farmer's variety is very clearly defined as per this Act as variety traditionally cultivated by the farmers or is a wild relative or landrace of a variety about which the farmer possessed the common knowledge. Some important incentives are given to farmers to take advantage of this Act for protecting their interest and help preserve and create new varieties. The farmers are exempted, for example from paying the registration fees and also the fee charged for maintenance of registered variety. The Act also includes a provision for 'benefit sharing' which is not given in the UPOV Convention.[10] Benefit sharing implies that fair share of profit has to

Table 1 — India's PVP&FR Act and its distinguishing features w.r.t. UPOV 1978, 1991

| | UPOV 1978 | UPOV 1991 | PVP&FR Act |
|---|---|---|---|
| Scope of protection | Requires prior authorization of breeders for production for commercial purposes, offering for sale and marketing of reproductive material of the variety | Expands the scope of breeder's authorization to also require permission for importing, stocking, and exporting.<br>Also extends rights to harvested materials and to EDVs | Breeder has right to produce, sell, market, distribute and to import or export of the variety |
| Type of protection | Did not allow dual protection (either with distinct breeder right or patent but not with both) | Dual protection allowed | Only breeder's right<br>India does not allow patent protection to plant variety |
| Genera or Species protected | 5 Genera on joining UPOV, 24 thereafter within 8 years | 15 Genera on joining UPOV and all thereafter | 158 crop species notified under new, extant, farmer registration<br>161 crop species notified under extant, farmer registration |
| Criteria of protection | Novelty, Distinctness, Uniformity and Stability (DUS) | Novelty, DUS | Novelty along with DUS<br>Novelty criteria primarily constructed from UPOV1991 |
| Farmers' right | Farmers are allowed to sell or exchange seeds with other farmers for the purpose of propagation | Farmers are not allowed to sell or exchange seeds with other farmers for the purpose of propagation<br>Allowed to use product of harvest of protected variety for the purpose of protection on their own lands | Farmers are allowed to save seed from one's crop, use it for sowing, exchanging, sharing or selling to other farmers except selling it as branded seeds. |
| Duration of Protection | 18 years for trees and vines. 15 years for other varieties | 25 years for trees and vines. 20 years for other varieties | Same as UPOV 1978; other varieties also include same level of protection for extant varieties |

*Source: Brahmi and Chaudhary (2011)[9] and authors' own construction*

be given from commercial gains of new registered varieties by breeders from varieties developed from plant genetic resource provided by farmers (or other breeders/legal entities). Benefit sharing allows farmers to get due recognition from breeders and also get due compensation of their efforts. This provision has addressed this issue i.e. of 'benefit sharing' that has been articulated in India's National Biological Diversity Act (2002). An institutional mechanism 'National Gene Fund'[10] has been created for this purpose. Protection for innocent infringement has been given in the Act which protects farmers who were not aware of the existence of such right while infringing. This is very important in the Indian perspective to avoid harassment of farmers by the seed companies. The unique features of India's PVP&FR Act thus show promise for protection of diversity, stimulating agriculture innovation and support to farmers who are involved in various ways in protecting the plant genetic resource of the country.

The criteria of distinctiveness (distinguishable by at least one essential characteristic), uniformity (if variety is subject to the variation expected from particular features of its propagation it remains sufficiently uniform in its essential characteristics) and stability (if after repeated propagation its essential characteristics remain unchanged) (DUS) must be fulfilled by extant and farmers' variety within 3 years from the date of its notification. *An additional criteria of novelty* [(not been sold or otherwise disposed of in India, earlier than one year and outside India (for trees and vines earlier than six years, and in any other case, earlier than four years)]*must be fulfilled by new and essentially derived variety to be considered for registration* (PPV&FR Act). [10]Testing of varieties would involve field and multi-location trials according to DUS guidelines as prescribed and notified by PPV&FR Authority. These tests are to be conducted for at least two seasons and on a minimum of two locations.[10]The farmer privilege of save, exchange, re-sow seeds are the major differentiator of the PPV&FR Act. The Act included elements of Farmer's rights from UPOV 1978 of farmers' right and testing criteria of UPOV 1991. India is not able to share any other DUS testing procedure undertaken in other countries for registration which makes it very cost intensive.[9] India has to develop its own testing procedure for crops not notified in UPOV. Table 2 highlights the categories under which protection is available and other salient aspects.

Other countries member of convention of which India is also a part or has some bilateral agreement with India is also entitled to register plant variety in India provided the application was made within 12 months from the date of filing in the convention country.

The above salient aspects of the act are useful to understand the trends we observe from the analysis of registration data which are addressed in subsequent sections. In this context it is also useful to examine

Table 2 — Categories of plant variety protection in the PVP&FR Act

| | New variety | Extant variety | Farmer's variety | Essentially derived variety |
|---|---|---|---|---|
| Definition | A variety whose propagating or harvested material has not been sold or otherwise disposed of by or with the consent of its breeder or his successor for the purposes of exploitation of such variety at the date of filing of application (Chapter 3 PPV & FR Act) | • All varieties already available in India.<br>• Either notified under Section 5 of the Seeds Act, 1996; a farmers' variety; a variety about which there is common knowledge or any other variety that is in the public domain.<br>• There is no condition of novelty. | Variety traditionally cultivated by the farmers or is a wild relative or landrace of a variety about which the farmer possessed the common knowledge (Chapter 1 PPV&FR Act) | Predominantly derived from initial variety, while retaining the expression of the essential characteristics that results from the genotype or combination of genotype of such initial variety and is clearly distinguishable from such initial variety. (Chapter 1 PPV&FR Act) |
| Criteria for registration | • Registration requirements are very similar with the UPOV Convention guidelines<br>• A new variety must conform to the criteria of commercial novelty, distinctiveness, uniformity and stability (DUS). (Chapter 3 PPV&FR Act) | • Conditions for registration are limited to DUS.<br>• After notification of the species a three-year moratorium is provided within which extant varieties can be registered. | DUS criteria need to be fulfilled for registration. | Commercial novelty and DUS criteria need to be fulfilled for registration. |

*Constructed from PVP&FR Act, [10] Rangnekar, 2016, [11] Nagarajan et al. [12]*

some previous studies that have analysed the trends. Brahmi and Choudhury[9] examined the plant protection mechanisms in different countries including India. This study was useful insituating this research. More specific studies that were based on examination of PPV&FR registration and related statistics are highlighted below. These studies along with showing insights of the trends, also provided us with useful comparator set for the present study. Kocchar[13] examined a total of 1654 applications in the PVP&FR Act covering the period May 2007 to September 2009. The study found that application was maximum in the extant variety (73%), followed by new (26%) and farmer's variety (1%). The applications were dominated by cotton crop followed by rice and maize in extant as well as new variety. Thus, one can see two aspects of this study namely a positive trend of registration in new varieties. On the other hand, the study highlighted farmer's lack of inclination for protecting their variety. Nagarjun *et al.*[12] drew attention to various provisions of the PVP&FR Act and the mechanisms for implementing these provisions. Some of the useful insights drawn by the authors by close reading of the Act is discussed later in the study. The study also provided statistics on application and registration of 19 notified crops covering the period 2007 to 31st May 2010. Rice, wheat, maize, and green gram were crops that received registration. Inspite of cotton having the maximum application (325), there were only 5 cotton varieties that were approved for registration. It is difficult to interpret from these statistics as out of 1708 applications, only 415 applications were put up to the recommendation committee for registration examination during this period. Later study bySrivastava *et al.*[14] Analysed 7506 applications and 1432 registrations covering the period May 2007 to July 2014. The study found new, extant, farmers and essentially derived varieties (EDVs) applications were 1595, 2140, 3634 and 137 respectively. The registrations were maximum for extant (884), followed by farmer's variety (395), new variety (152) and EDVs (1). Thus their study found that unlike the earlier study by Kocchar,[13] farmers were getting actively involved in filling applications under this Act. Public sector was the most active organization with 768 registrations with 395 and 269 registrations from farmers and private organization, respectively. The study also pointed out that most registrations in farmers' variety are for rice registrations. Applications had upward trend with high peaks in 2011 and 2013 with 1361 and 1677 applications, respectively. Rangnekar[11] analysed 4094 applications till May 2013 which constituted extant variety (37.8%), farmers' variety (33.2%), and new varieties (28.9%). The studies found that majority of applications in farmers' varieties were in rice. The study raised the issue that farmers' variety is not protected in the same way as a new variety.

## Registration Trends under the PVP&FR Act

An analysis of the registrations under the PVP&FR is carried out in this section. The data for registrations was collected from the Plant Authority of India's website. Various variables in the data such as year of registration, type of variety (extant, new or farmers'), crop type, and organization type were chosen to carry out the analysis. Figure 2 shows the trends in plant variety registration from 2009 onwards i.e. from the year when the registration started to February 2019.

A total of 3534 varieties were registered during the period 2009 to February 2019. Fig. 2 shows that the registration per year has generally followed an upward trend (deviating from a strictly exponential trend). Applications for plant variety registration started from May 2007; the 2007-2011 period saw 3568 applications which almost tripled in the period of 2012-2016 with 9810 applications[15]. Thus, over the period both applications as well as registration showed strong positive trend broadly implying the Act contributing to create new opportunities for stakeholders that includes farmers and private enterprises.

Applications for extant, farmer, and new varieties were 1537, 1077, 870 respectively during 2007-2011 and 1232, 7078, 1404, respectively during 2012-2016 (Fig. 3).[15] One can observe applications by framers have now become very significant. The same trend can be observed in registration where farmer variety is leading in overall variety registrations. However, the application to registration conversion of farmers' variety is very low about 12% as compared to about 46% and 18% of extant and new varieties respectively.

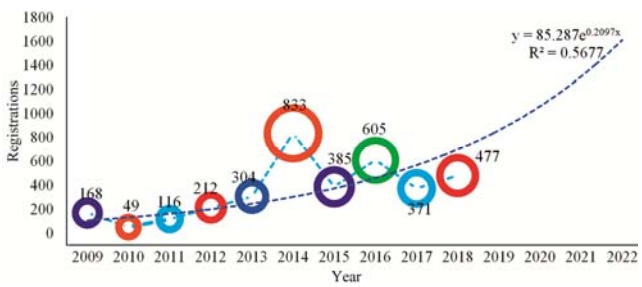
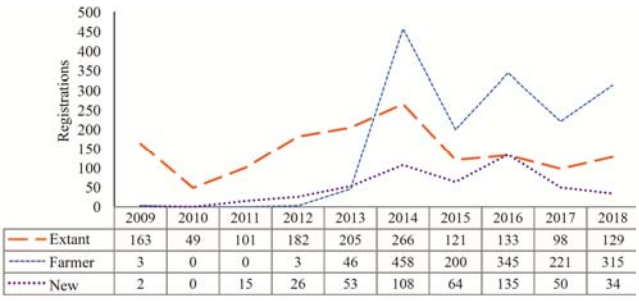



Fig. 2 — Trends in plant varieties registrations (2009-2018)




| | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|---|---|
| Extant | 163 | 49 | 101 | 182 | 205 | 266 | 121 | 133 | 98 | 129 |
| Farmer | 3 | 0 | 0 | 3 | 46 | 458 | 200 | 345 | 221 | 315 |
| New | 2 | 0 | 15 | 26 | 53 | 108 | 64 | 135 | 50 | 34 |

Fig. 3 — Trends in registration of different plant variety category namely extant, farmer and new varieties (2009-2018)


| | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|---|---|
| Public | 144 | 44 | 55 | 122 | 123 | 154 | 57 | 105 | 50 | 27 |
| Private | 16 | 0 | 21 | 54 | 104 | 124 | 122 | 147 | 93 | 94 |
| SOU | 5 | 5 | 40 | 31 | 31 | 96 | 7 | 6 | 5 | 41 |
| Farmer | 3 | 0 | 0 | 3 | 46 | 458 | 200 | 345 | 221 | 315 |

Fig. 4 — Registration by organization type (2009-2018)

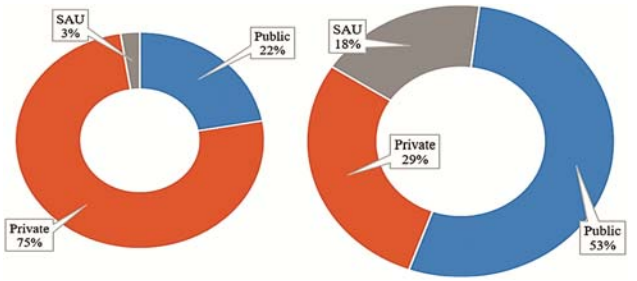



Fig. 5 — Share of various organizations in new and extant variety registrations

As pointed out by Kocchar[13], applications for farmer category were a cause of concern during the initial period of registration. Hanchinal *et al.*[16] suggested that the reason for this slow registration was that the departments like National Agriculture Research System (NARS), Non-Governmental Organizations (NGOs) and Krishi Vigyan Kendras (KVKs) were not very conversant with the Act and also the farmers were largely unaware of the provisions of the Act. One can observe from that varied types of activities are being conducted by Plant Authority of India to increase awareness of this Act.[17] The plant authority started three programs: (i) *Plant Genome Savior Community Award* which is conferred to farmers, community of farmers especially tribal and rural communities. It recognizes engagement in improvement, conservation, and preservation of genetic resources of economic plants and their wild relatives in identified agro bio-diversity hotspots. Five awards are given each year, constituting ten lakhs cash each, a citation, and a memento[18]. (ii) *Plant Genome Savior Farmer Reward* which given to farmers involved in conserving genetic resources of landraces and wild relatives of economic plants. It also recognizes improvement through selection and preservation. The selected and preserved material "has been used as donors of gene in varieties registerable under the PPV&FR Act, 2001". Maximum ten awards per year are given comprising one lakh fifty thousand cash each, a citation and a memento.[19] (iii) *Plant Genome Savior Farmer Recognition* which recognizes farmers following the same criteria of *Plant Genome Savior Farmer Reward.* Maximum twenty recognitions per year are given comprising one lakh cash each, a citation and a memento[20]. The increasing application and registration under the Act can be seen as a positive outcome of these initiatives.

The private sector is now taking the lead over governmental organizations in terms of the number of varieties registered (Fig. 4). Kochupillai[6] citing experts commented that the strong research base of public sector is the reason behind the success of private sector research in agriculture. Public sector research sector has been the prime source of inbred lines for the seed industry of private sector. This may not be the complete picture as hybrid seeds and genetically modified seeds provide new instruments of monopoly and control over seed industry. This has motivated private sector research and one can see large agro-chemical companies globally as well in India now actively involved in seed production of various crops.

It can be observed that two thirds of the share of new variety registrations has been done by the private sector whereas in extant variety public organizations are registering most of the extant varieties (Fig. 5). This similar trend was also observed by Kochupillai[6] in the study undertaken covering upto 2010. They are however earlier trends. The present study covers a longer period and brings the new registrations under this Act thus providing a more informed assessment of the contemporary trends and their implications. Their study also highlighted that most varieties registered in the extant category have a very brief period of exclusivity in the market; the plausible reason they cited was that the varieties are either copied or replaced by other varieties. Thus, they argued that it reduces the scope of profit making in the extant varieties and hence protection is not sought for them by the private organizations. The firm

Table 3 — Major crops registered under the PVP&FR Act

| Crop | Registrations | Variety | | | Organisation | | |
|---|---|---|---|---|---|---|---|
| | | Extant | Framer | New | Public | Private | SAU's |
| Rice | 1850 | 226 | 1535 | 89 | 124 | 132 | 59 |
| Maize | 238 | 127 | 6 | 105 | 104 | 126 | 2 |
| Tetraploid Cotton | 226 | 165 | 1 | 59 | 9 | 182 | 34 |
| Wheat | 155 | 126 | 9 | 20 | 124 | 7 | 15 |
| Sorghum | 133 | 72 | 4 | 57 | 59 | 47 | 23 |
| Pearl millet | 122 | 79 | - | 43 | 34 | 88 | - |
| Indian Mustard | 72 | 63 | 6 | 3 | 25 | 9 | 25 |
| Sunflower | 55 | 27 | - | 28 | 3 | 45 | 7 |
| Chickpea | 50 | 46 | 2 | 2 | 40 | - | 8 |
| Sugarcane | 48 | 43 | - | - | 42 | 1 | 5 |

*Note: Indian Mustard and Indian Mustard (Sarso) registration data have been merged*

behavior is motivated by profit and this plausibly can be a valid reason for this trend. Protecting existing varieties through this Act can be on the other hand be motivation of public sector which is also supported to some extent by Kochupillai.[6] However, the reason for lack of registration of EDV is not clear. Private sector's active involvement in registration of new varieties is not surprising. New varieties can disrupt the market and create monopoly which is discussed later in the study. Thus, it can give return to investment and profit which is prime motivator for private firms. The registration of new varieties also demonstrates the quality of research and innovation capabilities of private sector.

The major volume of rice registrations belongs to the farmers' variety. It is not possible to come to any firm conclusion behind this trend (Table 3). Rice is a low value high volume crop which can self-pollinate and it can be resowed again in the next season without affecting the yield. This self-pollinating and high yield from the resowed seeds may be one of the reasons for the private organizations to not invest in the staple crops. The private sector interests lie in cash crops i.e. high value low volume crops like cotton and crops where hybrids can be effectively developed. Hybrid crops do not give the same yield when the last season seeds are resowed in the next season. The hybrid seeds thus provide the scope of profit unlike crops like rice. This argument can further be verified by looking at the registrations of wheat varieties where the public sector is leading. The reason being attributed for rice also shown by wheat. Private sector is leading in tetraploid cotton registrations. It is a high value and low volume crop, also as it is a hybrid crop wherein seeds are to be purchased each season for sowing as resowing the old seeds will hamper the yield. High yield in the hybrid varieties (*Heterosis*) is the reason for the R&D efforts by private sector in these hybrid varieties.

Table 4 — Major crops registered in new variety

| Crop | Registrations | Public | Private | SAU'S |
|---|---|---|---|---|
| Maize | 105 | 39 | 66 | - |
| Rice | 89 | 10 | 74 | 5 |
| Tetraploid Cotton | 59 | 2 | 56 | 1 |
| Sorghum | 57 | 20 | 35 | 2 |
| Pearl millet | 43 | - | 43 | - |
| Sunflower | 28 | - | 28 | - |
| Wheat | 20 | 14 | 4 | 1 |
| Tomato* | 12 | - | 12 | - |
| Potato* | 10 | 2 | 8 | - |
| Okra/Lady's Finger* | 8 | - | 8 | - |
| Chickpea | 2 | 1 | - | 1 |
| Sugarcane | - | - | - | - |
| Indian Mustard | 3 | 1 | 2 | - |

*Note: Crop* denotes crops not in the top 10 registered crops*

The private sector is leading in tertraploid cotton registrations in both new and extant variety (Table 4 and 5). A reverse trend is seen in rice registrations as the private sector is developing more new varieties of rice and the public sector is interested in registering the extant variety of rice. New varieties of rice being registered by private entities show that new opportunities are being seen in creating branded rice. New varieties can have disruptive effect on the domestic market and also export. Indian rice particularly good quality rice like basmati has high volume international trade which can be exploited by new improved varieties. This can be observed from analyzing export statistics of agriculture crops.[17] As per the latest statistics of agriculture commodities that

Table 5 — Major crops registered in extant variety

| Crop | Registrations | Public | Private | SAU'S |
|---|---|---|---|---|
| Rice | 226 | 114 | 58 | 54 |
| Tetraploid Cotton | 165 | 7 | 125 | 33 |
| Maize | 127 | 65 | 60 | 2 |
| Wheat | 126 | 109 | 3 | 14 |
| Pearl millet | 79 | 34 | 45 | - |
| Sorghum | 72 | 39 | 12 | 21 |
| Indian Mustard | 63 | 25 | 13 | 25 |
| Chickpea | 46 | - | 39 | 7 |
| Sugarcane | 43 | 37 | 1 | 5 |
| Okra/Lady's Finger* | 35 | 9 | 24 | 2 |
| Groundnut* | 34 | 20 | - | 14 |
| Soybean* | 32 | 28 | 2 | 2 |
| Sunflower | 27 | 3 | 17 | 7 |

*Note: Crop* denotes crops not in the top 10 registered crops*

were exported; 4.414.61 tonnes of basmati rice of value 4,712.44 USD million was exported in 2018-19. This was the highest agriculture export commodity in that year. Rice other than basmati export was 7,599.75 tonnes with value of 3,040.22 USD million.[21] This was the third highest value agriculture commodity exported in that year followed by spices. The same trend can also be seen in earlier years. One can also see the importance of cotton in overall agriculture export. Cotton raw including waste export was 1,143.07 tonnes with value of 2,104.41 USD million. Thus, examining export statistics gives some indications of India's plant variety registration.

## Policy Implications

The study undertook a detailed investigation of registrations under the PVP&FR Act to uncover to what extent this Act has helped in strengthening the agriculture ecosystem. Protection of crop diversity, farmer's access to quality seed, mechanism for protecting variety developed by farmers, involvement of entrepreneurs (breeders) and industry at large in plant variety development were some of the issues that the study examined in this context. Trends based on registrations by different stakeholders, types of registrations, crops registered over the years, and various types of linkages among these variables were undertaken to examine these aspects. An important outcome of this exercise was also a database that was constructed from registration data under this Act to capture the above aspects properly. Key aspects of India's agriculture ecosystem and the salient aspects of India's PVP&FR Act was examined to situate the study properly and draw the implications. Export statistics was also examined to see whether plant registration provides new opportunities.

The PPV&FR Act is beginning to show a tangible impact on the agriculture innovation system. Involvements of farmers, private breeders and various types of crops that are being registered have important bearing on our agriculture ecosystem. Farmer variety registration shows a new mechanism for protecting crop diversity. Many farmers are filing application and also getting registration. The public funded research organizations and State Agriculture Universities played a key role in giving initial momentum as can be seen from application filed and registrations at the early stages of the implementation of this Act. Subsequently, there has been significant increase in applications by farmers and breeders (primarily private entities including firms). Active role of plant variety authority can be seen in promoting this Act among farmers and public at large. Dissemination workshops with plant breeders are also being frequently held. These can be seen as creating awareness and contributing to the increased application filing and registration.

New crop registration shows promise for introduction of new improved varieties in Indian agriculture. Active involvement of private entities shows that private firms are investing money in agriculture research. A close examination of India's agriculture export, agriculture commodities that have high export volume and value shows linkage with new varieties of crops being registered. Thus, this may help to strengthen our agriculture exports as new improved variety can create niche and market monopoly. However, farmer's absence and the limited role of state agriculture universities in development of new varieties need to be addressed.

The close reading of India's PVP&FR Act, looking at the salient aspects of the Act and the application and registration trends gives a positive outlook of India's *sui generis Plant Variety Protection Act*. Benefit sharing is one of the unique features that this Act has addressed. It has also given flexibility to farmers in registering their variety. There is thus hope that these features will be more aggressively exploited by farmers in protecting their variety. This will also help in crop diversity and provide more choice for farmers in buying new seeds. The study is limited as it has not examined the registrations done by different countries in India. This can be a very important domain to be explored in future studies. Also, future

study intends to examine legal provisions for plant variety protection in other major agriculture dominated countries. This can help to draw key insights and plausibly can highlight further enabling aspects that can be suitably incorporated in India's Act and implementation framework.

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