Plant Introduction in India During Pre- and Post-CBD Periods - An Analysis

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An analysis of the germplasm import into India before and after the adoption of Convention on Biological Diversity (CBD) was undertaken with the objective of finding the impact of signing this legally binding instrument by contracting countries. Plant Genetic Resources are at NBPGR for research purpose, quarantine examination and onward transmission to the users. The records of such imports five years prior to the signing CBD (1988-92) and five years after CBD (1997-2001), with a gap of 1993-1996 as transit phase were analysed. The impact was studied separately for CGIAR centres national gene banks in different group of crops. An overall decrease of about 14.5% in introduction of germplasm was observed during post-CBD period. This decline has, however, not affected imports from CG centres. The decrease in introduction from National Gene Banks in different countries suggest a cautious approach for sharing of germplasm. Countries like USA, Germany, Canada, UK and Italy still remain the main supplier of germplasm to India.

Key words: Convention on Biological Diversity (CBD), Plant introduction, Pre- and Post-CBD analysis

Plant Genetic Resources (PGR) are a prerequisite to any crop improvement programme. They are the heritage to be conserved for current and future generations and for the food and nutritional security of the ever-increasing world population. Crop improvement is therefore the axle of the wheel of human life. The plant breeders need diverse germplasm to develop better varieties. Hence, the acquisition of diverse and superior germplasm from exotic sources is of prime importance. Introduction of exotic germplasm has enriched Indian agriculture since times immemorial. Introduction has resulted in establishment of large number of crops and development of high yielding varieties. Not only India, almost all countries are interdependent with respect to genetic resources required for their crop improvement programs.

Enforcement of Convention on Biological Diversity (CBD), 1992 and provisions of Trade Related Aspects of Intellectual Property Rights (TRIPS) in 1990's led to the apprehension that exchange of germplasm would get restricted (Brahmi *et al.*, 2004). Developing countries have been and continue to receive large amount of germplasm from Interanational Agricultural Research Centres (IARCs) supported by Consultative Group on International Agricultural Research (CGIAR) Centres. Hence, an analysis has been carried on introduction of germplasm from CGIAR Centres hereinafter referred as CG centres and other national genebanks of different countries hereinafter referred as NGB. This is based on the records of the Germplasm Exchange Division of NBPGR, published quarterly in the form of Plant Introduction Reporters [NBPGR (1990-91, 91-92, 1997, 1998, 1999, 2000; Kumar *et al.*, 1988(a-d); Kumar *et al.*, 1989(a-d); Kazim *et al.*, 1990 (a-d); Singh *et al.*, 2001 (a-d)] The study has been categorized into two parts pre-CBD period (1988-1992) and post-CBD period of (1997-2001) to get the comparative idea on how the import was affected after CBD came into force. For this study years 1993 to 1996 were not included to avoid the effect of transit phase. The germplasm introduced in the form of international nurseries/ trials for multilocation testing from CG centres were also not included. Various cases were considered for the study- i) Crops dealt by CG centres; ii) Crops dealt by Asian Vegetable Research and Development Centre (AVRDC), Taiwan and iii) Crops not dealt by IARCs.

Crops dealt by CG Centres

India has been receiving germplasm collections of rice from International Rice Research Institute (IRRI), Philippines; maize, wheat, triticale as well as barley from International Centre for Maize and Wheat Improvement (CIMMYT), Mexico; barley, lentil, fababean, wheat, chickpea and forages from International Center for Agricultural Research in Dry Areas (ICARDA), Syria; potato, sweet potato, Andean root and tuber crops from International Potato Centre (CIP), Lima, Peru; beans, cassava, forage grasses and legumes from Central Institute for Tropical Agriculture (CIAT), Columbia; food legumes (cowpea, lima beans, soybean), root and tuber crops (sweet potato, cassava, yams), maize and rice from International Institute for Tropical Agriculture (IITA), Nigeria and sorghum, pearl millet, chickpea, pigeonpea and groundnut from International Crop

Research Institute for the Semi Arid Tropics (ICRISAT), India. The data on number of accessions introduced in different crop groups is discussed below

Cereals and Millets

In cereals and millets group, where large number of accessions have been introduced, are rice, wheat, maize, barley and sorghum. The germplasm of these crops are mainly received from IRRI, Philippines (Rice); CIMMYT, Mexico (Wheat, barley, triticale); and ICARDA, Syria (wheat, barley, triticale). During pre-CBD, the germplasm introduced from CG centres and NGB were 66.54 percent and 33.46 percent respectively. During post CBD a decline of about 1 percent was observed, 65.25 percent and 34.74 percent respectively. As regard the breeding material in the form of international nurseries/ trials introduced every year from IRRI, CIMMYT and ICARDA for multilocational testing in paddy, wheat, maize, barley, triticale, lentil, chickpea, fababean, pea, about 10,000-15,000 entries were introduced with 3-4 replications and 5-10 sets of each nurseries ranging from 1.5 lakhs to 2.5 lakhs samples. Thus, if these breeding materials are included in this study, appears to be dependence of 75 per cent on CG centres for germplasm of cereals and millets (Table 1).

Table 1. Germplasm introduced in cereals and millets from CG centres and NGB

Crop	Accessions (no.) CG centres		Accessions (no.) NGB	
	Pre-CBD	Post -CBD	Pre-CBD	Post -CBD
Rice	16,384	16,199	755	3,462
Wheat	11,968	3,492	5,209	4,546
Maize	3,939	9,584	1,332	5,414
Barley	103	83	334	69
Sorghum	2,164	2,559	3,952	1,752
Others	2,284	1,254	6,948	2,988
Total	**36,842**	**33,171**	**18,530**	**18,242**

In introductions made through CG centres, germplasm accessions contributed the largest share being 94.3 per cent and 93.4 per cent pre- and post-CBD respectively; on the other hand wild species contributed 2.7 and 2.3 per cent pre- and post-CBD respectively. The share of introduction of improved varieties from CG centres was 2.9 per cent and 4.4. per cent pre- and post-CBD respectively. In case of NGB, germplasm comprised 95.3 per cent and 96.5 per cent pre- and post-CBD respectively; wild 1.2 and 0.5per cent and varieties 3.5 and 4.4 per cent respectively. It can be concluded that during post- CBD an increase of 1.5 percent was observed in case of varieties while a decrease of 1.3 percent in is seen in case of germplasm (Table 2).

Grain legumes

Grain legumes are introduced from ICARDA, Syria; CIAT, Columbia and IITA, Nigeria. In grain legumes the ratio of germplasm introduced through CG centres and NGB is almost equal. Study exhibited that a total of 4,000 to 9,000 accessions were introduced in grain legumes and the CG centres contributed 42.2 per cent and 55.0 per cent during pre- and post-CBD respectively and NGB contributing 57.7 per cent and 45 per cent respectively. Though during post CBD the number of accessions has shown a significant increase in case of both CG centres and NGB. There is a significant increase of 12.8 per cent in post-CBD introductions from CG centres while a significant decline of 12.7 percent in post-CBD introductions from NGB (Table 3).

Oilseeds

In case of oilseeds groundnut is received from ICRISAT and import has been 41.3 percent and 64.1 percent during pre- and post-CBD respectively. From NGB of 58.7 and 35.9 per cent have been introduced pre- and post-CBD respectively (Table 4).

Table 2. Introduction of germplasm (GP), varieties (VR) and wild species from CG centres and NGB

Crop	Pre- CBD (1988-1992) No. of accessions						Post -CBD (1997-2001) No. of accessions					
	CG centres			NGB			CG centres			NGB		
	GP	VR	Wild	GP	VR	Wild	GP	VR	Wild	GP	VR	Wild
Rice	14,947	430	1,007	736	19	–	15,096	591	476	3,173	261	31
Wheat	11,932	37	–	4,907	249	62	3,033	360	99	4,369	177	–
Maize	3,805	134	–	1,015	317	–	9,062	522	–	5,408	6	–
Barley	103		–	250	12	72	83	–	–	53	16	–
Sorghum	1,682	482	–	3,891	53	10	2,559	–	–	1,686	66	–
Others	2,284		–	6,867	4	77	1,057	23	174	2,817	8	63
Total	34,753	1,083	1,007	17,666	654	221	31,817	1496	749	17,506	534	94
Percent	**94.3**	**2.9**	**2.7**	**95.3**	**3.5**	**1.2**	**93.4**	**4.4**	**2.3**	**96.5**	**2.2**	**0.5**

Table 3. Germplasm introduced in grain legumes from CG centres and NGB

Crop	Accessions (no.) CG centres		Accessions (no.) NGB	
	Pre-CBD	Post -CBD	Pre-CBD	Post- CBD
Chickpea	1,073	2,130	439	1,558
Cowpea	962	129	290	264
Lentil	509	3,882	198	102
Mungbean	114	–	238	7
Pea	117	930	1,076	1,054
Pigeonpea	64	1,596	482	264
Soybean	686	51	931	3,595
Others	506	115	1,852	337
Total	**4,028**	**8,833**	**5,506**	**7,125**

Table 4. Germplasm introduced in groundnut from CG centres and NGB

Crop	Accessions (no.) CG centres		Accessions (no.) NGB	
	Pre-CBD	Post -CBD	Pre-CBD	Post -CBD
Chickpea	1,073	2,130	439	1,558
Groundnut	508	1,582	722	887
Total	**1,581**	**3,712**	**1,161**	**2,445**

Tubers

Potato, sweet potato are introduced from CIP, Lima, Peru. This CG centre has contributed 56.8 percent and 46.2 percent of total introductions during pre- and post-CBD respectively (Table 5).

Table 5. Germplasm introduced in tubers (potato, sweet potato) from CG centres and NGB

Crop	Accessions (no.) CG centres		Accessions (no.) NGB	
	Pre-CBD	Post-CBD	Pre-CBD	Post-CBD
Tubers	381	341	290	396

Crops dealt by Asian Vegetable Research and Development Centre (AVRDC), Taiwan

The vegetable crops (*Allium* sp., tomato, pepper, eggplant, okra, cucumis, leafy brassica, cucurbits) and grain legumes (cowpea, mungbean, urdbean, pea and soybean) introduced from AVRDC, Taiwan is discussed below

Vegetables

In vegetables, NGB contributed 85.2 per cent and 97.4 per cent of introductions during pre- and post-CBD respectively. Significant increase of 12.2 per cent is observed in post-CBD introductions from NGB. This may be a result of special emphasis for procuring the vegetable germplasm by NBPGR (Table 6).

Table 6. Germplasm introduced in vegetables from AVRDC Taiwan and other countries

Crop	Accessions (no.) CG centres		Accessions (no.) NGB	
	Pre-CBD	Post -CBD	Pre-CBD	Post -CBD
Brinjal	–	–	416	106
Chilli	270	24	1,267	569
Cucumis	–	93	252	1,684
Okra	–	–	567	40
Onion	11	–	172	301
Tomato	725	–	1,899	1,068
Others	–	–	1,230	684
Total	**1,006**	**117**	**5,803**	**4,452**

Grain legumes

The germplasm introduced from AVRDC, Taiwan comprised 37.1 per cent and 13.9 per cent respectively during pre- and post- CBD respectively. From NGB 62.9 percent and 86.1 per cent germplasm of grain legumes was received during pre- and post-CBD period respectively (Table 7).

Table 7. Germplasm introduced in grain legumes from AVRDC Taiwan and NGB

Crop	Accessions (no.) CG centres		Accessions (no.) NGB	
	Pre-CBD	Post -CBD	Pre-CBD	Post -CBD
Cowpea	90	39	200	224
Mungbean	74	–	164	7
Pea	–	32	1,076	1,022
Soybean	377	613	554	2,982
Total	**541**	**684**	**1,994**	**4,235**

Crops not dealt by IARCs

The other crops not being maintained by CG centres such as oilseeds and fruit crops are introduced from NGB. The quantum of germplasm introduced from different countries is presented in Table 8.

Oilseeds

In oilseeds the introduced germplasm is mainly from NGB. During pre-CBD the total germplasm accessions introduced were 7,355, which decreased to 3,811 accessions in post-CBD.

Table 8. Germplasm introduced in Oilseeds from NGB

Crop	Accessions (no.) NGB	
	Pre-CBD	Post- CBD
Brassica sp.	1,758	892
Castor	47	16
Linseed	363	–
Others	963	518
Safflower	1,765	334
Sunflower	2,459	2,051
Total	**7,355**	**3,811**

Fruits

In fruits, the import has increased during post CBD. A significant increase of 3.6 percent is observed in post CBD introductions from NGB as a result of special efforts for procuring the fruit germplasm by NBPGR (Table 9).

Table 9. Germplasm introduced in fruits from NGB

Crop	Accessions (no.) NGB	
	Pre-CBD	Post -CBD
Apple	14	18
Citrus	128	64
Mango	7	–
Papaya	27	1
Peach	75	–
Prunus sp.	27	14
Others	405	1109
Total	**683**	**1,206**

The germplasm introduced in different crop groups viz. forages, fibers, medicinal and aromatic plants, spices and condiments, narcotics, beverages, ornamentals, under utilized crops, sugar yielding crops is presented in Table 10. The total introductions has increased to about 2.6 per cent during post-CBD from IARCs while a decline of 14.5 per cent is observed in total introductions made from NGB during post-CBD.

Table 10. Germplasm introduced in different crop groups from IARCs and NGB pre-CBD and post-CBD

Crop	Accessions (no.) CG		Accessions (no.) NGB	
	Pre-CBD	Post -CBD	Pre-CBD	Post- CBD
Chick pea	1,073	2,130	439	1,558
Cereals	36,842	33,171	18,530	18,242
Forages	13	0	3,290	1,645
Grain legumes	4,028	8,833	5,506	7,125
Oilseeds	508	1,582	7,714	4,698
Fibres	0	0	2,743	61
Vegetables	1,006	117	5,803	4,452
Tubers	381	341	290	396
Fruits	27	4	656	1,222
UUP*	106	0	398	314
Others	0	0	1720	1,750
Total	**43,984**	**46,178**	**47,089**	**41,463**

*Underutilized Plants

Overall a decline of 14.5 per cent was observed in the germplasm introduced during post-CBD. A total of 89,561 accessions in various crops were introduced during pre-CBD and the number of accessions of germplasm introduced in various crops decreased to 83,682 during post-CBD.

One of the interesting findings of the study is that 81 per cent of the total germplasm introduced was imported from countries which were not the centre of origin of that particular crop i.e. these materials were introduced from countries other than their centre of origin: whereas only 19 percent of the total germplasm introduced was received directly from the countries or the centres of origin of that particular crop. In other words, a large amount of germplasm have been collected by various nations from the place of origin and conserved at their genebanks from where regular exchange of material is taking place (Table 12).

Table 11. Total germplasm introduced during Pre and Post-CBD

Crop	Accessions (no.) NGB	
	Pre CBD	Post CBD
Cereals	55,372	51,413
Forages	3,302	1,645
Grain legumes	9,534	15,992
Oilseeds	8,222	6,280
Fibres	2,743	61
Vegetables	6,809	4,569
Tubers	671	737
Fruits	683	1,226
UUP*	106	323
Others	1,720	1,436
Total	**89,162**	**83,682**

* Underutilized Plants

Conclusions

The analysis revealed that for the food crops mainly cereals there is 75 percent dependence on CG centres introductions, while grain legumes and oilseeds are more or less equally shared from both CG and NGB. In vegetables and fruit crops the situation is reverse, the major introductions being from NGB. Results indicate an overall decline of 6.6 percent in the introduction of accessions during post-CBD period. Despite overall decrease, there was an increase in import of accessions from CG centres. This decline was confined to the supplies from NGBs, which suggest of cautious approach adopted by the different countries in sharing of germplasm. During Post-CBD there was an overall decline of 14.5 percent in introduction. The trend may however change after the International Treaty on Plant Genetic Resources for Food and Agriculture (IT-PGRFA), a legally binding treaty came into force (FAO 2002), which envisages a facilitated access to plant genetic resources for food and agriculture held by countries through multilateral system (MS) of exchange. Also, the results indicated that 81percent of the germplasm introduced from NGB or other countries did not originate there or they are not the centres of diversity of the respective crops. This

Table 12. Total germplasm introduced (origin different or same from the supplier country)

Crop group	CG centres				NGB			
	Pre-CBD		Post-CBD		Pre-CBD		Post-CBD	
	Origin different from the supplier country	Origin same from the supplier country	Origin different from the supplier country	Origin same from the country	Origin different from the country	Origin same from the country	Origin different from the supplier country	Origin same from the country country
Cereals and millets	32,880	3,962	23,510	9,625	15,395	3,135	17,216	926
Oilseeds	508	–	1,582	–	5,643	290	3148	1,550
Grain legumes	2,306	1,722	8,833	–	4,818	688	4,809	2,416
Forages	13	–	–	–	2,439	851	1,352	293
Fibres		–	–	–	915	1,364	44	17
Tubers	381	–	141	200	227	63	380	16
Vegetables	1,006	–	99	18	3,703	2,096	4,274	178
Fruits	27	–	–	–	571	92	1,043	151
UU and UEP*	106	–	–	–	398	–	175	139
M and AP		–	–	–	922	161	396	22
Ornamentals		–	–	–	70	–	47	4
Narcotics &Beverages		–	–	–	105	104	324	123
Spices and Condiments		–	–	–	114	80	163	–
Sugar yielding		–	–	–	184	–	317	40
Total	**37,227**	**5,684**	**34,165**	**9,784**	**35,504**	**8,942**	**33,688**	**5,875**

* Under utilized and underexploited Plants

might be because of early realization of the importance of plant genetic resources in these countries, leading to collection and conservation from world over. Amongst the NGB, USDA was the main supplier of germplasm to India. Significant number of accessions were also introduced from Australia, UK, Italy, Germany and Canada.

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