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on

"Ever green and Never fading Seed Industry: Some issues"

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Ever green and Never fading Seed Industry: Some issues

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1. Introduction

India, as is known for its great culture, is also known for its vast diversity in all spheres of Agriculture from the time immemorial. The six pillars of Agriculture - soil, water, climate, seeds, peasants and tools - believed so from ancient days, are true for ever in scientific terms too. Of them, seed - the central and primary input and the carrier of the entire genetic factors over generations and ***yugas***, is basic for existence, improvement as well as for propagation of any life on this planet. The seeds have provided everything to man and animals all these years and will continue to provide for ever.

Seed is frequently cited as sacred in '***Vedas,'*** folk literature, '***Sharana Sahitya'*** and verses. The importance given to seed management in the ancient Indian agriculture was supreme! Every agricultural family had the tradition of identifying the healthiest and the most productive plants among the standing crop, taking special care of these and saving the seeds derived from these for sowing the next crop. Utmost care was given to store such elite seeds under special conditions so as to prevent any contamination, infection or deterioration in vigour, germination capacity, etc.. In fact, there were families specialized in doing such service and making available quality seeds at the time of planting in each season. It was considered as a sacred activity and seed producers commanded special respect in the society. Exchange of seeds from family to family and from village to village was considered as a noble social gesture and it was this practice that enabled them to have access to quality seeds, leading to good harvest. This traditional practice continued untill the recent past. It is getting lost in the modern culture due to commercialization. Paddocks, sacred groves, '***Pavithra vanas***,' back yards, community gardens, conservation of bio-diversity in forests have gradually lost their significance. Clonally propagated plants were identified and were cultivated and multiplied in preference to seed propagation, realizing that genetic purity is more assured in such propagation rather than multiplying through true seeds.

Seed, in fact, is the cheapest and central input in production of any crop – agricultural, horticultural, medicinal, fiber, etc. and forms the major contributing factor for high productivity. If seed is inferior or if a wrong seed is planted, nothing else can correct the shortcoming! If the seed is of high quality, production is assured despite some adversities in climate and other local practices.

2. High Volume-Low Value Crops: Structure of seed sector in India

High Volume – Low Value Crops (Food grains - Cereals, Pulses, Oilseeds, Fibres and Forages) constitute the segment of agricultural crops that is the backbone of country's food and nutritional security. A country that does not have self-reliance in food cannot save its sovereignty in the long run. Seed sector for these crops in India is of two types namely formal and informal.

Informal sector is the one where farmers produce seeds without following certification procedures and exchange it amongst themselves. The formal type of seed sector follows seed certification procedures and standards to produce a particular variety of seed.

2.1. Seed Supply Chain

Breeder seed production in the country is taken up in response to indents received from Department of Agriculture and Cooperation, Government of India (DAC, GoI) and State indents. As per the prevailing system, every state provides the agro-climatic zone-wise, district-wise and variety-wise quantity of certified/ quality seeds sold and area covered in the previous Kharif/Rabi season along with Seed Replacement Ratio (SRR), productivity data to Indian Council for Agricultural Research (ICAR), Department of Agriculture and Cooperation (DAC) and State Agricultural Universities (SAUs) by 1st December for Kharif crops and 1st May for Rabi crops. Each state in consultation with ICAR Institutes, SAUs and Seed producing Agencies is required to formulate seed plan (for Breeder, Foundation and Certified Seed) for the cropping seasons on the basis of an assessment of existing and new varieties in terms of actual or potential yield in each district/agro-climatic zone. State Governments submit—the seed plan and the Breeder Seeds indent to DAC, ICAR, and SAUs. The Breeder Seed Indent is submitted to the SAUs directly for State varieties and submitted to Seeds Division DAC/ICAR for national varieties by 15th January for Kharif crops and 15th June for Rabi crops. Private seed companies also place the breeder seed indent by 15th January for Kharif crops and 15th June for Rabi crops through National Seeds Association of India (NSAI) or directly to Seeds Division, DAC. DAC shall compile all the Breeder Seed Indents of States and private seed companies and furnish them to ICAR/ concerned Project Directors (PDs) or Project Coordinators (PCs) for production of the breeder seeds. The breeder seed will be allotted to all states and private seed companies for lifting from institutes of ICAR, and SAUs to produce foundation and certified seeds.

2.2. Public and Private Sectors: The Twin Pillars of Indian Seed Industry

The seeds play a vital role in agriculture and act as carrier of the genetic potential of varieties. Timely availability of good quality seeds at reasonable price ensures good yield and profit to the farmers. Every farmer should be able to access healthy seeds which are genetically pure, with high seed vigor and good germination percentage. Quality seed production which follows efficient certification procedures plays a major role in increasing food production in any country. To ensure this, the Government of India has prescribed standards and has brought in seed production techniques, testing, certification and marketing procedures through the Seeds Act, 1966. In the current scenario, the demand for good quality certified seeds far exceeds the availability in the market. Often, the Indian farmers also do not distinguish between grain and seed , and use common farm produce as seed. The reasons for this are as under:

i. Lack of awareness about the potential of quality seed,

ii. The non-availability of good quality seed, and

iii. High seed price.

To a greater extent, this also explains the large gap between the productivity achieved in frontline demonstration plots and the actual productivity at farm levels.

The seed scenario in India is undergoing rapid change. The Indian seed industry is one of the mature and vibrant domains in the world seed market. While the public system continues to focus on the crops needed to meet the food security challenges, the private sector has followed the business model of hybrids where the farmer has to purchase the seed every year. During the past five years, the Indian seed industry has been growing at the rate of 12 % compared to global growth of 6-7 % (NSAI). During 2003-04, the private sector produced 62.8 lakh quintals and public sector 69.5 lakh quintals of seeds which, in the next seven years, increased to 109 and 171 lakh quintals, respectively. However, it is important to point out here that the share of the private sector in total seed production does not portray

the correct picture of market share (Singh and Chand, 2011). Its share in the market value of seed is much higher than the share in volumes as the major focus of the private sector has been on selling seeds for vegetables and hybrids. These fetch higher prices (Ramaswami, 2002). Further, the private sector has a strong interest and dominance in the supply of proprietary seeds like the hybrids.

Though accurate and detailed data is not available, available information indicates that the private sector has developed and marketed much more number of crop hybrids than the public sector till 2001-02. For example, the private sector had developed 150 hybrids of cotton compared to 15 by the public sector. Similarly, the numbers of maize hybrids developed by the private and public sectors were 67 and three, respectively. In the next eight years (2002-03 to 2009-10), however, the share of the public sector increased from 8% to 19% in cotton, 4% to 40% in maize and 25% to 58% in rice (Singh and Chand, 2011). Similar changes are observed in the case of other crops too. Cotton and maize have been the favorite crops for development of hybrids by both the public and private sectors. The private sector has also shown a strong interest in pearl millet, sunflower and sorghum. Considering all crops together, the private sector accounts for three-fourths of the total hybrids developed so far in the country. The data for the last eight years, *i.e.,* after 2001-02, show that the gap between the private sector and public sector in the development of hybrids narrowed down considerably as compared to earlier time, even though the private sector continued its dominance in crops like cotton, maize, pearl millet and sorghum. These are either cross-pollinated or amenable to economic production of hybrid seeds. It is interesting to point out that even in the case of self-pollinated crops like paddy and wheat where the development of hybrids is quite cumbersome and costly, the private sector has ventured to develop and supply improved and hybrid seeds wherever it found commercial markets for these crops (like paddy in Andhra Pradesh and Haryana) (Singh and Chand, 2011).

2.3. Challenges before Indian Seed Sector

There are multiple reasons behind occasional failure of seed supply in India. One of course, is the ever-growing population needing more production. At times non-availability of seed for timely sowing and therefore planting of inferior seed poses a dire scenario. Further, negligence of the government towards agriculture sector also contributes and more so for seed sector. India is a major agrarian country in the world with a great diversity of crops and, in each crop, the varieties cultivated are very many giving scope for admixture, contamination and also mislabeling. Under distress, for want of right seed for planting, farmers at times resort to buy whatever seed that is available in government/ private sectors and those are planted quite late which brings down productivity. Artificial shortage of desired variety of seed gives scope for spiraling of seed prices leading to exploitation. Scarcity of quality seeds in India is a resultant of as much due to climatic adversities as miss-management. Therefore, if the country resorts to a planned and scientifically developed Seed Supply System (SSS), it could enhance productivity substantially.

3. Suggestions for building a sound and strong SSS

The traditional seed production and supply system should be given some emphasis for the conservation of traditional type pure line varieties of self pollinated crops like rice, wheat, millets and others. Use of Farmer Saved Seed (FSS) will work under this system.

- For modern varieties like hybrids (single cross, double cross and three way hybrids) and composites, the farmer group should be trained for making them knowledgeable about the availability and source of foundation and certified seeds for each kind of crops and crop varieties and scientific method of quality seed production besides identifying safe seed zones (SSZ) for each category of seed. In fact this is what corporate sectors are doing.

- There are university farms, state seed farms, ICAR Farms, Commodity Board Farms and KVKs numbering to 641 in the country which can participate more efficiently.
- The movement of seed from one place to another within the country should be hassle free.
- The government policy to subsidize seed sale should not be restricted for only identified crops and designate seeds like certified/ Foundation/ Notified seed etc. All seeds planted for agricultural production - be it traditional seeds or modern hybrids and high yielding variety seeds should be considered. This will also discourage sale of spurious seeds and exploitation.
- There is in practice, some unsound way of certifying the seed. The seeds of corporate sector do not come under these regulations! No notification, no multi location testing, no farm trial no minikit trials. However, thanks to this sector, but for which, the horticultural production would have suffered unbelievable loss in the last 5-6 decades! The same is true in respect of most hybrids of cereals and pulses. But for partnership with private seed companies, the advantage of modern seed would not have been realized by the farmer.

4. Factors influencing Seed Production

Like other agrarian enterprises, seed production is also vastly affected by the climatic conditions. Climate change scenario as evident from delayed and insufficient monsoon, mid-season flash floods and terminal drought, or excessive untimely rains at harvesting for the past couple of years has given a setback to seed production programme in the country. Apart from climate dependent agriculture, there are a number of other factors that determine the demand and supply of breeder seed in the country. Some of these are the inherent features of a crop species (seed rate & seed multiplication ratio) and, hence, cannot be altered beyond a certain point without a superior technological advancement; while other factors such as varietal preferences (varietal replacement rate) and use of quality seeds (seed replacement rate) may be maneuvered favorably with strong and focused efforts by various central and state government agencies.

4.1. Classes of Seeds and Varieties

4.1.1. Traditional seed: Many a times the term seed is used to mean a variety. In true sense, seed is the propagating material either true botanical or vegetative parts that can reproduce. The human selection over a period transformed into varieties which became local to each growing situations suited to different seasonal and soil conditions and they have been known as "local varieties". Improvement in selection methodology, identification of superior types and maintaining their purity through certain characteristics gave rise to "Improved varieties". In the beginning of 20th century - that is after the birth and rediscovery of Mendelian inheritance, the science of Genetics and Plant Breeding enabled scientists to understand the behavior of genes and transferring the desirable ones to the established varieties. Further advances enabled to introduce desirable genes to improve the productivity as well as resistance to biotic and abiotic stresses with substantial upgradation responding to management and better performance even under stressed situations. Even maturity period could be altered to the advantage of the growing situation. These products of crop improvement yielded what are today called "High Yielding Varieties". In all these varieties, it is possible to reuse the seeds of the previous generation if only contamination is prevented and the mutants and off types are eliminated. Quality parameters are determined for any given variety. In the fifties, hybrid varieties were evolved in some crops to exploit hybrid vigor. It is at this point that the seed production methodology made a significant deviation because of necessity to renew the seed at each planting. Because the seeds obtained from a crop

planted with hybrids will bear seeds which are genetically diverse due to segregation and hence cannot produce a crop that will be uniform. The hybrid seed (F1) will have to be produced every time by planting the parental lines with utmost care and planning starts from producing the seeds of the parental seed which is called Foundation seed.

Some of the popularly used seed titles are: Hybrid varieties, GM varieties, etc.

4.1.2. Farmer saved seed (FSS): A portion of crop saved as seed at farmer's own field for subsequent use.

4.1.3. Breeder's seed: It is produced from nucleus seed under the supervision of a qualified plant breeder in research institutes and Agricultural Universities. This provides for initial and recurring increase of foundation seed. Breeder seed is monitored by a joint inspection team of scientists and officials of certification agency, Department of Agriculture and State seed corporations/National Seed Corporation. The genetic purity of breeder seed crop should be maintained at 100 per cent.

4.1.4. Foundation seed: Foundation seed is the progeny of breeder seed and is produced by State Farm Corporation of India, National Seed Corporation, State Seed Corporation under technical control of qualified seed officer or technical officers. Its production is supervised and approved by state seed certification agency. The purity of foundation seed should be maintained as per minimum seed certification standards prescribed for each crop.

4.1.5. Certified seed: Certified seed is the progeny of foundation seed and its production is supervised and certified by state seed certification agency. The seed of this class is normally produced by the State and National Seeds Corporation and Private Seed companies on the farms of progressive growers/ registered growers. This is the commercial seed which is available to the farmers and its purity is as per minimum seed certification standards.

4.1.6. Truthfully labeled seed: Seeds produced by any organization or individuals including farmers which should meet minimum seed certification standards prescribed for certified seeds but which does not come under the purview of the Seed Certification. Like any other class of seeds the Labeling is compulsory but certification is voluntary.

5. Breeder Seed Production

Realizing the importance of seeds the ICAR has launched a flagship programme *i.e.* All India Co-ordinated Research programme- NSP (Crops) during 1979-80 with the mandate of Breeder seed production and Seed technology Research mainly for field crops. Presently there are 35 breeder seed production units to cater the needs of breeder seeds and 25 Seed Technology Research (STR) centers to develop seed production technology.

Breeder seed is produced on the basis of indents from private as well as public sector organizations placed with Department of Agriculture and Cooperation (DAC), Government of India, New Delhi which in turn consolidates the indents and forward them to the Council. The production of breeder seed is demand driven and produced mainly by different crop based Institutes of ICAR and State Agricultural Universities (SAUs). The breeder seed is supplied to indenting organizations for further multiplication to foundation and certified seeds which are made available to farmers. In augmenting seed sector, the Breeder seed project was phenomenal which led to sea change in the seed sector as witnessed by increase from a meager breeder seed production of 3914 quintals during 1981-82 to a level of about 89266 quintals during 2014-15. But still there are some constraints in achieving the perceived goals of ideal seed scenario of the country.

7. Case Studies

***Dharwad Model: Dharwad Model of Seed Production*:** University of Agricultural Sciences, Dharwad (UASD) has done exemplary work in quality seed production and distribution activities thus serving the cause of poor farmers who are usually deprived of quality seeds. Realizing the importance of quality seed in agricultural production, the then Hon'ble Vice Chancellor (1995) Dr. M.Mahadevappa established a separate independent Seed Unit at University head quarter in 1996 with Special Officer (Seeds) as administrative head and ten Agricultural Research Stations were recognized and brought under administrative control of Special Officer (Seeds) for maintenance breeding, nucleus and breeder seed production of different crops and also to undertake research activities related to seed production. This made the beginning of Dharwad model of Seed production. The modified seed village concept adopted by UAS, Dharwad in implementing the seed production programmes is being appreciated throughout the nation as Dharwad model of seed production. This model is being adopted with the following concepts.

- Wide gap exists between requirement and supply of quality seeds.
- Bridging of gap by farmers participatory seed production under modified seed village concept.
- Seed production of improved varieties under selected potential seed villages.
- Potential seed growers are identified and will be given hands on training in quality seed production.
- Providing quality basic seeds to farmers
- Regular seed plot visits and monitoring by scientists.
- The university stood first among SAU'S/ICAR institutes in breeder and total seed production at national level by contributing around 18% of the total breeder seed production and 35% of certified quality seed production during the year 2012-13.

The Dharwad model of seed production has the following benefits:

- Farmers get quality seeds of improved varieties at right time and place.
- Quality seeds of improved varieties spread quickly from farmers to farmers.
- Seed quality is improved through regular field visit and monitoring by scientists.
- Farmers get updated knowledge on seeds production and post-harvest handling through Training, Field days & Seed mela.
- Human resource development and thus enhanced employment generation
- Seed producing farmers get 10-15 per cent higher premium prices over market rates.
- Seed growers get seed production incentives by state/central governments.
- Recognized seed growers are honored during seed ***melas*** Enhanced socio-economic status of seed producing farmers Establishment of seed growers association.

Under this model, a group of potential farmers or villages around research stations were identified under "Seed Village" concept to enhance the production of quality seeds of improved varieties in different crops. This fulfills the objectives like involvement of farmers in seed production programme, demonstration and saturation of selected potential villages with improved varieties/ hybrid seeds of major crops. Under this concept, the UASD has produced around 4.47 lakh quintals of quality seeds of field crops and about 2560 quintals of seeds of horticulture crops involving 6265 farmers from 430 adopted villages since 2003.

Infrastructure developed for seed production

The required infrastructure for seed production, drying, processing, storage and quality testing have been developed over a period of time and are being upgraded to meet the future needs. These infrastructures have been developed by utilizing the funds from profit of the revolving funds, university grants and the funds from seed mega project. About 10 crores rupees has been spent for the creation of infrastructure facilities at the main station and also in other seed production centres.

Seed production partners: The university has also the partnership in seed production with the institutes like State Seed Corporations, National Seed Corporation, National Horticultural Research & Development Foundation and many farmers and private seed companies. With these partnerships the university could produce and supply large quantities of seeds to farmers.

Seed Village-Mysore Model: Under the aegis of Swarnajayanthi gram swarozgar yojana(SGSY), a Special Project was launched wherein the project aimed at inculcating entrepreneurial skills in the traditional mindsets of poor and marginal farmers to become self dependent with regard to seed requirement of both agricultural and and horticultural crops. The selected farmers were grouped into self help groups and every aspect of the project was achieved through these SHG's. The project Provided long term sustained employment to about 5000 rural poor selected from about 500 villages in 25 districts of Karnataka for improving their socio-economic status.

Implementation: The seed project was implemented in 21 districts comprising 422 seed villages and 4224 swarozgaris organized into 422 SHGs under the agricultural component. Training programs in Soft Skills and Technical Skills including Refresher Trainings in Seed Production & Processing were conducted, enabling the swarozgariis to transfer technology to the fields for earning additional income.. The harvested seeds were processed in the nearby SPUs run by them, certified, bagged and sold in the local market.

Impact: Nearly 16,500 t of seeds were produced during 2005-09. Apart from resulting in increased incomes due to seed production, majority of farmers in the project have realized the economic importance of growing seed instead of grain in increasing food production using quality seeds. In the second phase, six districts have been covered most successfully and becoming popular as Mysore model. This model clearly suggests that traditional seed production and supply system should be reestablished for the traditional and modern seeds like self-pollinated, pure line varieties (rice, wheat, millets and other self-pollinated crops) and use of Farmer Saved Seed (FSS) will surely work under this system.

IARI-Model I for Variety /Hybrid Commercialization:

1. **Advance Royalty and Commercialization:** The first IARI model was developed on rice commercialization which became "IARI-Model" where IARI worked out the likely total seed produced from Breeder Seed to Foundation Seed to Certified Seed Conversion. (The ratio of multiplication for parents of Hybrid was 1:100 for two multiplications and 10q/acre Hybrid seed production. For for variety it was 1:200). Then on a presumed rate of running hybrid/variety retail sale price as on today, the royalty on hybrid seed was kept at 4.5% and in the variety at 2%. Thus, IARI would receive at the time of signing MoU and parting of seed of parental lines, the value worked out at 4.5% of the estimated hybrid seed produced three years in advance. The company was to come back to IARI for fresh seed of parents every year for 1 hectare as per the MoU. We at that time had insisted on keeping the name PRH 10 only or Pusa Basmati 1121 only for the commercial product, which was a major negative point because, unscrupulous seed producers compromised on quality and at farmers level one was not able to find out what was the source of the seed as most farmers did not keep their receipts, as all seed

had one name only. The good quality seed producers suffered as their cost would be high. This worked well for first three years, subsequently, most companies (out of the 22 to whom the license was given) started giving reasons of no demand, etc. but we still see the seed marketed by the companies. We have already sued a few of them.

2. IARI-Model II: This model is with a license fee, structured from Rs 5.00 lakhs for breeders seed for Basmati variety (released within 3 years), Rs 3.00 lakhs for Basmati variety (between 3-5 years) and Rs 1.00 lakh beyond 5 years. In the case of wheat and mustard and others, the same is Rs. 1.00 lakh for released within five year varieties and Rs 50000 for subsequent varieties. In each case, there is a 2.5% royalty on the seed marketed after three years and the companies would come back for fresh seed each year, failing which they will be black listed.

Biotechnology

Just like the Green Revolution of the 1960s saved India from being a basket case and turned it into a bread basket, modern plant genetics and genetic engineering will be a major part of the solution to tackle hunger in the country.

India's natural resources are fast dwindling and combined with climbing temperatures, drought and a growing population, the country should really call upon science to tackle these challenges to agricultural productivity. Here are examples of great success:

A rice variety transformed with Xa21 gene using refined breeding method has created a scientific miracle in terms of warding off diseases. In 2006, the International Rice Research Institute isolated a rice gene dubbed Sub1 which allows rice plants to survive up to two weeks in flooded condition. This has been a boon for Bangladesh and other parts of Asia. Now, 3.5 million rice farmers are growing Sub1 rice in Asia. Golden Rice has been engineered to provide vitamin A to prevent weakness and blindness in children and pregnant women. India is home to the world's largest population suffering from vitamin A-deficiency (VAD), most of whom are pregnant women and children. For over 10 years, India has developed its own version of golden rice, but the authorities are unable to bring it to commerce because of the anti-technology lobby. Bt cotton developed for control of cotton bollworsm, the only genetically engineered crop approved by Government of India for commercialization since 2002, has received an overwhelming response from the farmers and revolutionized cotton cultivation in our country.

Agriculture is full of domesticated plants and animals, which means they are all genetically modified. In the mainstream scientific community, modern genetic methods are considered no more risky than conventional methods. Scientists must help navigate the fine contours of genetics, food and sound health. Ronald, a modern biotechnologist is married to Raoul Adamchak, an organic farmer. Together they are devoted to a holistic brand of sustainable agriculture by marrying modern science with the ecologically-based sustainable agriculture. They published a book, Tomorrow's Table: Organic Farming, Genetics, and the Future of Food, in which they have chronicled how to combine ecological sensitive way with modern genetics to make sustainable agriculture a reality in future. India must resist voices that oppose modern science and carve out an ecologically and economically viable path in agriculture to face the future. India has a strong army of agricultural scientists who delivered on Green Revolution, and they will also deliver on modern science provided they are given unstinted support by the government.

Future of Industry

Agriculture accounts for about 14 per cent of the GDP and provides employment to 60 per cent of the

rural population (these figures vary from source to source). The unique natural resources of India enable farmers to harvest a variety of agricultural, horticultural and forest species besides a number of species of medicinal value, and thus to emerge as a global power in agricultural production. Further, depending upon the need, the integration of technologies such as indigenous knowledge, biotechnological tools and eco-friendly practices to mitigate the challenges without any bias will augur well for our agriculture. This should account for productivity improvement under dry land conditions, maintaining soil health and market intervention.

Participatory seed generation is a powerful tool for promoting rural seed industries. For harnessing the benefit of the prevailing and forthcoming innovative technologies, it is crucial to ensure timely availability of high quality seeds and scientific agronomic practices. For this, there has to be a symbiotic partnership between the private and public sectors. Establishment of infrastructural facilities for production of basic and parental seeds in respect of self-pollinated, cross pollinated and vegetatively propagated varieties should be planned jointly by both private and public sector organizations based on domestic and export demand. Training of farmers, both men and women, and rural youth can go a long way in promoting growth of seed industry. It is important to commit a good budgetary provision for development of new varieties, hybrids and seed research. Small scale seed industries need to be promoted to minimize movement of seeds over long distances (Mahadevappa, 2005).

For a large scale F1 seed production, participatory model should be adopted. Farmers, both men and women, should be trained in emasculation – pollination techniques. They should be able to generate F1 seeds under scientific supervision. The F2 generation could be in the participatory farmers' plots and the farmers would select desirable segregants. This would provide basic understanding to scientist of farmers' methods of selection. The process can be extended to further generations till a desired adapted variety is derived. Further, farmers have their own methods of selection for seed; they also select for other desired traits, not only for grain and fodder productivity but also for cooking quality and consumer preference. Their skill could be utilized in lands race and germplasm evaluation and selection. They will also participate in sharing their knowledge and learning scientific yardsticks of seed production, maintenance, and commercialization. This would also be a sustainable and profitable avenue to improve livelihood security. Periodic internal and external reviews, workshops, participatory dialogues and training programmes could be built into the programme operation matrix so as to effect mid-course corrections and efficiently steer the programme to targeted goals.

8. Conclusion

Some of the above mentioned aspects impact India's agriculture. There area also certain constraints in the breeder seed production that range from technological to policy issues. These issues are listed below:

- Low productivity of breeder seed due to heavy dependence on climatic vagaries, declining soil fertility, elevated levels of biotic and abiotic stresses.
- Ill effects of Climate Change (example: soybean, chickpea and other pulses)
- Need for National Seed Bank or other such facility for contingency planning.
- Unrealistic indents for breeder seeds of some varieties of crops.
- Rapid fluctuations in varietal demands.
- Traceability of breeder seed source in multiplication chain.
- Need for rapid tests to establish genetic purity and seed health.
- Poor management of nucleus seeds. .

- Need for a national depository of DNA profiles of different varieties of various crops.
- Minimizing varietal mismatch in breeder seed production.
- Need for suitable seed provenance for off-season seed production.
- Issue of.....(?) non-lifting of breeder seed from production centres.

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