



DRAFT VISION 2050



Directorate of Seed Research

(Indian Council of Agricultural Research)

Kushmaur, Mau 275 101 (UP), INDIA

<http://www.dsr.org.in>

Publication No. : DSR/Vision/2013/05

Printed : July 2013

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SARAD PAWAR



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MINISTER OF AGRICULTURE
& FOOD PROCESSING
INDUSTRIES GOVERNMENT
INDIA

MESSAGE

The scientific and technological inputs have been major drivers of growth and development in agriculture and allied sectors that have enabled us to achieve self-reliant food security with a reasonable degree of resilience even in times of natural calamities, in recent years. In the present times, agricultural development is faced with several challenges relating to state of natural resources, climate change, fragmentation and diversion of agricultural land to non-agricultural uses, factor productivity, global trade and IPR regime. Some of these developments are taking place at much faster pace than ever before. In order to address these changes impacting agriculture and to remain globally competent, it is essential that our R&D institutions are able to foresee the challenges and formulate prioritised research programmes so that our agriculture is not constrained for want of technological interventions.

It is a pleasure to see that Directorate of Seed Research, Kushmaur, Mau a constituent institution of the Indian Council of Agricultural Research (ICAR) has prepared VISION-2050 document. The document embodies a pragmatic assessment of the agricultural production and food demand scenario by the year 2050. Taking due cognizance of the rapidly evolving national and international agriculture, the institute, has drawn up its Strategic Framework, clearly identifying Goals and Approach.

I wish DSR, Mau all success in realization of the Vision-2050.

(SHARAD PAWAR)

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Foreword from Hon'ble DG, ICAR

Seed is *elixir* of agriculture having the potential to transmute the face of Indian agricultural scenario and for transgression of yield barriers. Seed is prime input encompassing the capacity to ensure food security i.e. seed security can play a crucial role in ensuring food security. Food security is fundamental for any sort of progress and for India with a billion plus population, is of utmost priority. A robust seed system guarantees food security needs of the country and acts as driver of growth in agriculture. Making the resource poor farmers enable with quality seed and its wholesome production technology is a challenge that needs to be tackled upon. Role of quality seed is documented and acknowledged across farming systems and ICAR duly acknowledged this fact by the launch of mile stone projects viz. AICRP- NSP (Crops) and ICAR Seed project vis-à-vis Mega Seed project, for which coordination is entrusted upon DSR. Impact of these projects in terms of quality seed production, technology development, Infrastructure development, capacity building and technology dissemination is phenomenal. However issues such as SRR and VRR need persistent emphasis which is rightly tackled with proposed VISION 2050 document.

Technological breakthroughs in field of seed science are essential to meet the demands of global seed market and at the same time for assurance of uninterrupted availability of quality seed. Even though, India is fifth in position in terms of value share in commercial world seed market (ISF, 2012), there is ample scope to amend this mentioned position and for excelling in international seed trade. Proposed VISION 2050 document addressed relevant issues in this regard towards advancement of current generation seed technological research amid renewed fervor, thereby enabling quality seed from India to find its rightful niche in domestic and international seed domains.

25th June 2013
New Delhi.

(S. Ayyappan)
Hon'ble Secretary DARE
and Director General ICAR
Krishi Bhawan, New Delhi 110114.

Preface

Seed is an essential input for crop production. Access of farmers to quality seed of superior varieties is key in increasing agricultural productivity and production. For any successful quality seed programme, it is mandatory to produce sufficient quantity of seed with appropriate research backup on various aspects of seed technology viz. production research, maintenance, quality assurance, processing, storage, seed protection, quality enhancement etc. In a bid to shoulder the responsibility, ICAR established Directorate of Seed Research during December 2004 by upgrading AICRP-NSP (Crops) which was launched during 1979-80. Directorate of Seed Research, through its flagship projects viz. AICRP – NSP (Crops) and ICAR Seed Project under the aegis of Indian Council of Agricultural Research has made significant achievements by developing appropriate technologies relevant to seed through basic, applied, strategic and anticipatory research leading to seed security which is a prerequisite for assuring food security. Apart from technology development; capacity building with focus on skill intensification, technology dissemination, model deployment (farmers participatory approach and seed village programme), employment generation, commercial orientation addressing gender outlook i.e. women entrepreneurship, expansion of seed activity in untapped areas are significant contributions of DSR.

Directorate has taken the initiative to address challenges that Indian Seed sector is facing today and may be in future. Vision 2050 document has been prepared to provide a road-map for the course of research amid major challenges like shrinking natural resources, deleterious effects of climate change etc., which are expected to affect the seed security. This document provides new priorities, adaptation of participatory models and partnership norms with different stakeholders in seed domain at national and international level to address the challenges of enhancing SRR and VRR, which are essential for total livelihood security via seed security.

I express my sincere gratitude to Dr. S. Ayyappan Secretary, DARE and Director General, Indian Council of Agricultural Research for his invaluable guidance in preparing DSR VISION 2050. I am thankful to Prof. Swapan K. Datta, Deputy Director General (Crop Science) and Dr. B.B. Singh, Assistant Director General (Seed) who has taken keen interest in preparing this document. I also appreciate the efforts made by my colleagues in bringing out this document. I am sure that DSR VISION 2050 would provide a direction to leverage the power of science for achieving high quality research in seed science and technology and quality seed production in the country

24th June 2013
Mau, UP.

(S. Rajendra Prasad)
Project Director

VISION 2050

Directorate of Seed Research

1. Context...

Seed is a bridge of hope between present and future and is inevitable for life's continuity"

Seed is the decisive input for sustained agriculture production and is paramount for realizing the potential of all other inputs without which the investment on inputs such as fertilizer, water, and pesticides will not pay desired dividends to the farmers. Use of quality seeds alone could increase productivity by 15-20 % indicate the critical role of seed in agriculture. As Indian economy is basically agrarian due to sheer number of people directly or indirectly dependent on agriculture, the role of seed in India's context is far greater significant. Food security is fundamental for any sort of progress and for India with a billion plus population, is of utmost priority. Seed is prime input having the capacity to ensure food security by means of seed security. Our nation has witnessed a momentous food grain production of 257.44 million tonnes during 2011-12 from meager 50.5 million tonnes during 1950-51, which is largely credited to the use of quality seed of improved varieties/ hybrids with improvement in seed replacement rate (SRR), improved farming practices, along with ingenuity and industry of Indian farmers, which explicitly entails for continuous and improved efforts towards quality seed accessibility to our farmers at reasonable price and at right time. Even though agricultural

Period	Quality/ Certified seed availability (Lakh q)	Food grain production (MT)	Oilseed production (MT)	Pulse production (MT)
1980-81	35	129	9.4	10.63
1990-91	57	176	18.6	14.26
2000-01	85	196	18.4	11.08
2009-10	279.72	218.1	24.9	14.70
2010-11	321.36	241.6	32.4	18.24
2011-12	353.62	257.4	30.0	17.21

Source: Directorate of Economics & Statistics, Ministry of agriculture, GOI (<http://dacnet.nic.in/eands>).

production levels are satisfying, overall contribution of agriculture to GDP and

growth per se is the Achilles' heel, which needs serious thought for meeting the future challenges.

Year-wise Seed Replacement Rates (SRR) across major crop species				
Year	2007	2008	2009	2010
Wheat	25.2	26.8	31.9	32.6
Paddy	25.9	30.0	33.6	37.5
Maize Var./ Hyd.	44.2/-	48.5/-	46.8/-	54.1/-
Jowar Var./ Hyd.	19.9/-	26.2/-	26.3/-	25.9/-
Bajra Var./ Hyd.	48.5/-	62.9/-	48.8/-	61.4/-
Gram	11.9	14.4	22.0	18.4
Urd bean	23.9	26.3	30.9	29.2
Moong bean	21.7	21.9	23.0	26.7
Arhar	16.0	16.0	27.8	17.5
Groundnut	14.3	17.0	22.9	24.5
Rapeseed & Mustard	58.6	52.7	74.8	63.6
Soyabean	33.4	35.1	38.9	35.8
Sunflower Var./ Hyd.	62.9/-	63.6/-	51.5/-	61.2/-
Cotton Var./ Hyd.	15.3/-	12.1/-	11.6/-	10.4/-

Source: Directorate of Economics & Statistics, Ministry of Agriculture, GOI (<http://dacnetnic.in/eands>)

Indian seed industry is estimated to be worth of 2 billion USD out of 45 billion USD commercial world seed market (ISF, 2012), which places it at 6th position worldwide after Canada. But this turnover is only about 30 % of the seed required for planting, as of now, which comes from the organized sector, remaining 70 % comes from the farmers as farm saved seed, which is not up to the standards recommended. There is scope to double the existing 30 % formal seed supply which in turn will increase our seed market share globally.

Realizing the importance of seed, Indian Council of Agricultural research (ICAR), apex organization for conduction and coordination of agricultural research and education, mounted serious efforts to streamline country's seed programme by launching programmes such as AICRP-NSP (Crops) in 1979-80 aimed at production of basic seed. In a bid to upgrade the mentioned project, a separate project coordination unit dedicated exclusively for nucleus and breeder seed production and to carry out conduction and coordination of seed technological research was established which in due course was elevated to directorate status paving the way for establishment of Directorate of Seed Research (DSR) in 2004. Another jewel was added to the crown of DSR by way of 'ICAR Seed Project – Seed Production in Agricultural crops' in 2005 having the aim to provide infrastructural facilities for quality seed production across cooperating centres throughout the country. Right from inception, DSR strived towards achieving excellence, which is clearly manifested in the form of surge in quality seed production and enhancement in the horizons of seed technological research. Production of breeder seed to the

tune of one lakh quintals much greater than requirement (indent) is a stupendous success, which is far beyond imagination of any other coordinated programme operated under ICAR. Achievement of ICAR seed Project, in terms of infrastructure establishment and quality seed production is of par excellence,

where more than 7 lakh quintals quality seed (breeder/ foundation/ certified/ TFL) was produced during the year 2011-12 is a phenomenal output under this project. DSR is surreal in handling coordination of mentioned projects, apart from which progress under seed technological research front is quite commendable. DSR generated valuable information and contributed significantly to seed technological research on the following mentioned fields by way of in house research as well as collaborative efforts under coordinated projects.

Summary of quality seed production under ICAR seed project "Seed Production in Agricultural Crops"			
Particulars	Production (in quintals)		
	2009-10	2010-11	2011-12
Breeder seed	95537.73	120492.55	104511.84
Foundation seed	77448.21	72817.61	92081.5
Certified seed	34712.48	55919.71	50714.26
TFL seed	104427.89	88364.35	79439.3
Participatory	234913.78	289639.77	301269.15
Planting material (Sugarcane)	84293.36	52398.69	49651.39
Total	631333.45	679632.68	677667.44
	Production (in lakh)		
Planting material (Forage root slips & sugarcane setts)	604.16	395.74	401.54
Tissue culture plants	2.01	0.38	1.69
Total	606.17	396.12	403.23

Signal achievements under seed technological research:

- Standardized seed production technology in major field crops and normalized package of practices for organic seed production of rice, wheat, groundnut, soybean and finger millet.
- Identified alternative areas for hybrid seed production of rice, sunflower, sorghum, pearl millet and pigeon pea.
- Varietal characterization of different crops viz, paddy, sunflower, guar, moth bean, cowpea, horse gram has been done for seed quality assurance (DUS guide lines).
- Standardized seed enhancement technologies like priming and pre-sowing treatments for pigeon pea, groundnut, sunflower and maize.
- Standardization of sieve sizes for processing of recently released varieties of paddy, chickpea, pigeonpea, wheat, barley, sunflower hybrids, maize

hybrids, safflower, soybean and finger millet was done and submitted for inclusion in IMSCS.

- Significant contribution was made in relation to seed treatments (vitavax 200 @ 2g/kg or Polykote TM @ 3 ml / kg + Vitavax 200 @ 2g/kg of seed) and packaging material for improving seed longevity in maize, soybean, hybrid rice and cotton.
- Newer insecticides viz. Emamectin benzoate, Spinosad and Deltamethrin and their concentrations were standardized for control of storage insects infesting wheat, pearl millet, paddy, and pulses. Significant contribution was made in the field of Modified Atmospheric Storage for complete protection against *Rhizopertha* in wheat and *Callosobruchus* in green gram.

Achievements mentioned are worth recognition for an institute, which is relatively of recent inception in ICAR system. By keeping the broader goals of increasing agricultural productivity and food security, Directorate of Seed Research is striving towards achieving excellence in seed technological research and coordination of quality seed production countrywide.

The roadmap based on the vision for seed research and seed security leading up to the year 2050 will encompass a strategy that connects the status of seed research till date based on the background information and analysis. This exercise has been done on the edifice of strategic planning setup having a defined framework, milestones and deliverables on a given time frame to address all the envisaged goals addressing the vision of providing best quality seeds and requisite practical technologies for seed industry by solidly aligning with team based network programmes on basic, strategic, applied and anticipatory research on the platform of public-private partnership.

We at DSR, through its linkages under AICRP- NSP (Crops) will forge team based network projects linking its centres at SAUs, including forging practical viable linkages with crop improvement programmes to address crop specific seed research issues both at local, regional, zonal and national levels to evolve practical solutions in seed research, quality control, seed delivery through strong formal and informal seed systems – by delivering innovation based most practical methods, processes, products and scaled-up technologies on the edifice of strong and meaningful basic and anticipatory research to support the national strategic and applied research plans.

2. Challenges

Indian agriculture has come a long way since the Green Revolution with sustained growth in GDP and food grain production to match the needs of growing population over the last 50 years. But in the recent years, the situation is becoming alarming with the agricultural production reaching the plateau in most of the crops, shrinking natural resources and effect of changing climate. Climate change is very likely to affect the frequency and intensity of weather events such as floods and drought. It is emerging as a big threat to seed production by drastically reducing seed yield and increasing biotic and abiotic stress conditions during seed production. Along with this, shortage of labour and degradation of natural resources like land and irrigation are going to be a major bottlenecks in viable seed supply to farmers' doorstep. In particular, climate change

- ✚ Climate resilient seed production technology
- ✚ Use of genomics and proteomics approaches in seed research
- ✚ Amelioration of skewed Seed Replacement Rate (SRR) & Varietal Replacement Rate (VRR)
- ✚ Development of community based seed models for different ecosystems

is expected to affect seed yield adversely by increase in temperature and CO₂ concentration and thereby affecting pollen viability, germination and stigma receptivity during flowering. Untimely rain at physiological maturity and ready to harvest stage results in discoloration, loss in vigour and low germination makes seeds unfit for sowing. Climate change not only drastically affects seed yield but seed quality as well. Hence to devise strategies to mitigate climate change and its effect on seed production is a major challenge before us.

From a long period of time, seed requirement of farmers is mainly met by farm saved seed, i.e. still 70 % of the farmers are using their own farm saved seed or seed distributed among them. Making the quality seed available at right time is greater challenge rather than production per se. Seed, being the principal input in determining productivity, seed replacement should be given utmost priority in elevating productivity levels and to match the same with international averages. Amelioration of skewed SRR, i.e. the percentage of area sown out of total area of crop planted in the season by using certified/quality seeds other than farm saved seed is the major challenge in quality seed front to be dealt with. Even though there is slight improvement recently, still a long way ahead in making the quality seed available at farmers' doorsteps, and for achieving 100% SRR, which will herald the era with improved productivity levels and quality seed driven growth in agriculture sector.

Quality seed requirement of major crops in the country (Assumption 100% SRR)						
Crops	Gross cultivated area (M.ha)	Seed Rate (Kg/ha)	Total certified seed requirement (in 000 tonnes)	SMR (ratio)	Foundation seed requirement (in 000 tonnes)	Breeder seed requirement (in tonnes)
Rice	45.60	50.00	2280.00	100.00	22.80	228.00
Wheat	27.20	125.00	3400.00	20.00	170.00	8500.00
Sorghum	7.70	15.00	115.50	160.00	0.72	4.51
Pearl millet	8.70	5.00	43.50	200.00	0.22	1.09
Maize	8.00	25.00	200.00	80.00	2.50	31.25
Pigeon pea	3.40	15.00	51.00	100.00	0.51	5.10
Chickpea	8.20	80.00	656.00	10.00	65.60	6560.00
Groundnut*	6.20	200.00	1240.00	8.00	19.30	2412.50
R&M	6.30	6.00	37.80	100.00	0.38	3.78
Soybean	8.90	75.00	667.50	16.00	41.72	2607.42
Sunflower	1.90	10.00	19.00	50.00	0.38	7.60
Cotton	9.50	3.00	28.50	50.00	0.57	11.40
Jute	0.80	3.00	2.40	100.00	0.02	0.24
Total	142.40	612.00	8741.20	994.00	324.72	20372.89

*Groundnut foundation seed requirement is has been calculated on basis of two stage c/s production

Another chronic problem of seed chain is Varietal Replacement Rate (VRR). Even though with more than 4500 varieties, which were notified and are available, indents for basic seed and its further multiplication is restricted to few varieties. Many improved varieties, which are location specific, resistant to biotic and abiotic stresses never saw the light of the day. The loophole may be attributed to below par extension activities either in NARS system or abysmal outreach activities by line agencies of agricultural departments, who ever may be the culprit but farmers are deprived of fruits of agricultural research (improved varieties). Hence special focus will be given on improvement of VRR, which will certainly pave the way for improved productivity levels manifest in the form of increased production. By addressing the mentioned challenges (SRR & VRR) broader goals of increasing agricultural productivity and food security can be attained.

Regarding seed technological research focus will be given on basic research relevant to floral biology, pollination, seed development and maturation studies in a bid to attain better seed recovery. Standardization of seed production technology in major crop species will be given highest priority, thereby enhancing viability/profitability of seed production and facilitation for envision of the same as an enterprise. Globally the contemplated research work relevant to fields of seed testing, quality assurance and seed quality enhancement is of par excellence. In order to match global requirement and to pave way for the seed from India to occupy its deserved place in international market, there is need for cutting edge infrastructure and world class laboratories accredited to international seed firms. Collaborative efforts should be mounted by formulating research projects in partnership with private seed sector to deliver desired outputs that benefit farming community of the country.

3. Operating Environment

DSR was founded by ICAR in December, 2004 in Mau district of Uttar Pradesh and entrusted with the responsibility of coordination of quality seed production and conduction & coordination of Seed Technological Research. Since DSR is having the mandate of entire country across cooperating centres, local operating environment had least significant interaction in shaping the organization activities per se. Rather than, DSR influenced significantly by way of its outreach activities, promotion & dissemination of know-how regarding seed production technology of locally demanded crops and few relevant technologies viz. seed priming and seed protection for improving productivity levels thereby socio-economic condition of farmers of this region.

Seed being the critical input in all farming systems, its influence on the system and per se being influenced by the system is rather huge. Right from farmers' choice to a particular variety, choice of seed, production technology, protection, processing, storage and marketing, at every juncture seed is playing the role of either influencing or being influenced. Hence the mandate of DSR in making available, quality seed of right variety as per local needs, dissemination of proper seed production, processing, quality control and marketing strategies, so that farmers shall reap the benefits in the form of enhanced productivity levels. Contribution made by private sector quality seed production (particularly of high value and low volume crops) and seed research (quality assurance and quality enhancement) is worth of appreciation. Private sector is playing its part in generating healthy competition, which will ultimately benefit the farmer. Consortia approach shall be pondered upon thoroughly, so that public and private sectors can cover up each of their weaknesses and can work for synergistic output, which can help in enhancing the visibility of Indian seed in international market and will solve the twin problems of meager contribution of agriculture to GDP and growth of agriculture per se.

4. Opportunities

The adoption of new means, cutting edge technologies to evolve novel processes, products and practical technologies is vital to develop seed access thresholds, accounting for the additional information the stakeholders, seed growers and seed industry needs. Our initiatives, it is hoped that, will identify the crucial role new seed technologies will play in determining seed and food security in India. The social economic benefits of the technology and policies will enable to pave the way for enhanced knowledge creation, new innovations, benefiting cost effective technologies and profitability to the farmer, seed grower and seed industry. Technological breakthroughs in relevant fields of

seed science and technology are quite commendable both at national as well as international domain. Even though there is some catching up is needed to gear to the needs of global market, the progress made is as per the vision. Seed testing and quality assurance is one area where lots of policy, infrastructure and human resource support is needed. Establishing world class facilities for seed testing, certification and to match requisites of international conventions (UPOV, ISTA etc.), so that seed from India can carve its niche in international trade. Estimated commercial world seed market is 42 billion USD out of which India's share is 2 billion USD (ISF, 2012). Even though, India is third in position in terms of value share, there is ample scope to amend the figure mentioned and for excelling in international seed trade.

- ❖ India with diverse agro-climatic zones, unlimited options for crops and probably with largest research man power, has an enormous opportunity to stamp authority on world seed front.
- ❖ Women are custodians of genetic diversity and traditional knowledge. Their expertise is only recently being attested by modern science. In many rural villages, women hold the secrets to knowledge of seeds for food, medicine, and cultural or other uses. The real need is to document the different roles played by women and men, encourage women as seed savers and breeders and mobilize them into community groups to assist to pave the way for rural development.
- ❖ Expanding the know-how of conventional seed science and technology viz. floral biology, pollination, seed development, maturation and seed production technology per se can create formidable opportunities in maximizing the productivity levels thereby food and socio-economic security of Indian farmers.
- ❖ Regarding seed quality enhancement, whole spectrums of opportunities are awaited. Second and third generation seed quality enhancement strategies can play a vital role in giving an altogether new dimension to seed.
- ❖ Seed designing will emerge as a futuristic technology, where seeds are fabricated with all necessary additives that give adequate planting value across diverse agro-climatic zones and at the same time resistant to biotic and abiotic stresses. A new era of seed designing is going to be unraveled in near future, where seeds are bought or sold on number basis making it as the most precious input of cropping system.
- ❖ The seed research initiatives on network platforms involving all the stakeholders will evolve to deliver following outcomes:
 - Seed biology in respect of seed dormancy, viability and longevity using molecular tools and techniques.

- Maximizing seed production through nutritional and agronomical manipulations
- Manipulation of source –sink relations through use of plant growth regulators to enhance the seed yield
- Technological interventions to increase ovule to seed ratio
- Identification of chemicals for synchronization of flowering between male and female parents in hybrid seed production in different crops.
- Studies on population dynamics of key storage pests in relation to climatic conditions, insecticide resistance management and integrated pest management for seed crop.
- Human Resources Development in seed sector (i) Training of young and mid carrier discipline wise scientists at national and international institutes. (ii) To impart training to seed personnel, farmers, extension personnels, NGO's, self help group.

5. Goals/ Target

Under the adept support and guidance of ICAR, DSR flourished in achieving new heights in STR and quality seed production. Being the focal point of quality seed production coordination & seed technological research, DSR will be working on following futuristic technologies as its VISION 2050, which in turn lead to seed security and food security.

Even today, seed requirement of farmers is mainly met by farm saved seed, i.e. still 65 % of the farmers are using their own farm saved seed or seed distributed among them. Making the quality seed available at right time is greater challenge rather than production per se. Future of agricultural production will largely depend upon development of improved varieties/ hybrids in various crops, supported by efficient, cost effective seed production technology. Diversification of areas of seed production, exploration of planting windows and development of climate-resilient seed production technology needs to be focused for expansion of seed production system in the country. The seed production programme of forage crops has not picked up in the country, amid renewed significance in international market, a bundle of new avenues in varied fields viz. production, processing and quality control are up for the grab. Medicinal and aromatic plant utilization and commercialization has been ignored and hold great scope for development of seed agronomic practices, seed and field standards for certification and standardization of testing protocols on the lines of international standards.

Genetic purity is the soul of seed quality. Seed which is genetically pure and possesses other desired qualities viz., high germination percentage, vigour, physical purity and sound health is essential for optimum plant stand and yield. Different seed testing protocols currently used in India need to be upgraded on the lines of international standards of seed testing such as ISTA (International Seed Testing Association), AOSA (Association of Official Seed Analysts) and OECD (Organization for Economic Cooperation and Development) for better seed quality assurance and smooth access to international seed trade. Priority need to be given for standardization of appropriate invigoration protocols as well as seed coating and pelleting technologies, for enhancing planting value and storability of high value and poor storer seeds. Molecular approach (QTLs) for enhancing seed quality is a whole new promising avenue needs to be focused upon.

Seed research programmes will address different aspects of Seed science & Technology, from inputs to final products by addressing inputs access, supply and quality assurance; seed processing and storage, seed quality enhancement, seed health, transfer of technology and extension, income generation schemes and human resource development.

Seed Production Research

- Development of seed production technologies in major crop species to improve seed yield and quality together with conservation of natural resource base
- Identification of alternative/ specific areas for quality seed production and mapping of disease free seed production zones
- Development of different models of participatory seed production and conservation of traditional varieties in seed chain through community seed systems & establishment of village seed banks
- Standardization of organic seed production techniques and seed standards
- Developing alternative methods (self incompatibility & apomixis systems) for hybrid seed production in a bid to exploit heterosis
- Focus on varietal replacement to carry improved varieties to the farmers' doorsteps
- Making availability of breeder seed to meet the ever growing demand and thereby attaining 100 % Seed Replacement Rate
- Farm mechanization towards precision seed production technologies
- Harmonization of regulatory standards (field & seed) in tune to the needs of international seed domain

- Seed Production under protected conditions particularly for vegetables, flower crops and seeds of parental lines for disease free supply of planting materials

Seed Biotechnology

- Application of QTLs/Markers in enhancing the quality of seed
- Developing certification standards for GM seeds and also cost effective kits for detection of transgenes by using microarray chips (genomics approach) and proteomic approaches
- Gene pyramiding for seed quality parameters using modern breeding and biotechnological tools
- Development of national data base for DNA profiles of crop varieties
- Development of DNA bar-coding system for tracking the breeder seed production and supply system.

Seed Quality Assurance/Varietal Maintenance and Testing

- Establishment of international standards referral laboratory to ensure uniformity in seed quality evaluation in compliance with ISTA
- Use of biochemical and molecular markers in varietal identification and genetic purity testing
- Development of user friendly molecular detection kit for fast and accurate identification of varieties, hybrids, pathogens and GMOs.
- Validation/up-gradation of field and seed standards/protocols: isolation distance, sample size, physical purity and ODV's
- Standardization of minimum weed seed standards and development of interactive software for weed seed identification
- Developing thresholds for EDVs based on morphological and molecular characters
- Facilitating / validation of standards for OECD certification to promote our hybrids/varieties in SARRC countries
- Standardization of seed testing procedures in field, vegetable, medicinal and green manure crops

Seed Processing and Storage

- Standardization of screen/ sieve sizes for different crops, revisiting processing standards in lieu of newly bred varieties and hybrids, development of ultramodern seed processing and storage technologies, low cost on-farm seed storage technologies, modified atmospheric

storage technology, development of vacuum packaging containers for high value low volume seeds.

- Development of national seed grid with modern seed storage technology as a contingent planning measure during natural calamities.

Seed Quality Enhancement

- Seed quality enhancement through second generation drying, packing and quality enhancement technologies viz. intelligent coating molecules, time & target oriented seed additives, electron treatment, magnetic treatment & MIR etc for development of designer seeds
- Use of third generation seed quality augmentation strategies viz. nanotechnology for external as well as internal designing of seeds (including seed protection and coating/infusion strategies)

Seed Health

- Development of protocols for quick detection of seed borne pathogens
- Revisiting of field and seed standards for seed-borne diseases
- Bio-management (Biopriming) of seed borne insects and diseases
- Gene mapping for seed borne disease resistance and application of serological and molecular tools (DNA chips) to identify seed-borne pathogens
- Harmonisation of national regulations on phytosanitary issues in a bid to match international norms

Seed Economics

- Development of various marketing models aimed at quality seed reach to remote localities
- Establishing e-seed knowledge centres and e-seed modules for augmenting SRR
- Policy research in quality seed sector with fine tuning of cost calculations for quality seed production
- *Ex ante* and *ex post* impact assessment of technological interventions in seed research
- Quantitative assessment of trade impacts due to seed policy reforms and price policy research in seed sector
- Founding a commercial wing for DSR technologies under a brand name

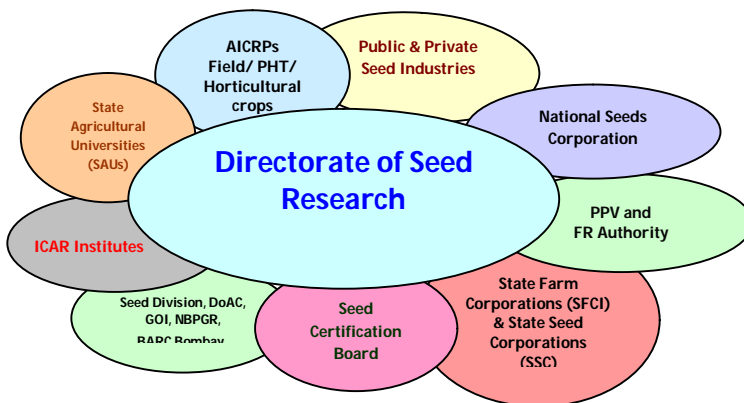
Human Resource Development & TOT (Transfer of Technology)

- Training of scientists at national and international level to impart know how about up to date seed science research
- Trainings modules on regular basis according to crop, season, need and type of beneficiary involved in seed production
- Trainings to cater the need of seed producing personnel including farmers, trainers and employees (field staff) of university/ State Seed Certification Agency/ State Seed Corporation/ Seed Producer Companies, self help groups and NGOs
- Special training programmes on quality seed production for farmers of tribal areas
- Diploma course in seed production, seed testing, seed processing and storage to cater need of trained manpower in seed sector

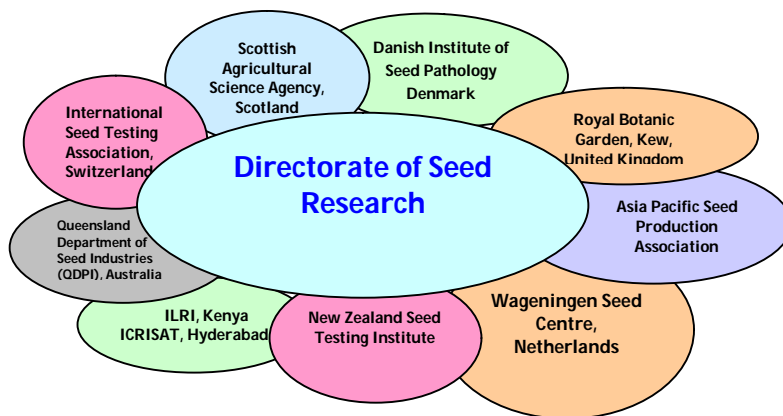
Linkages

Linkages of DSR with firms of national and international reputation in seed research both in public and private sectors address the quality seed production, availability and research issues at local, regional, zonal, national and international level, which in turn facilitate strong and meaningful basic, applied and anticipatory research to support the national strategic seed research plans.

Linkages with National Institutes / Agencies



Linkages with International Institutes / Agencies



6. Way Forward

Treading to seed security...

Directorate of Seed Research (DSR) is going to put its best foot forward in a bid to reach the specified goals set, which are decisive in attaining desired productivity levels, thereby ensuring food and nutritional security to teeming millions of population of India. DSR is envisioning itself as a vital cog in the broader system (ICAR), striving towards achieving desired levels of quality seed production and making available at farmers' door steps. Regarding Seed Technological Research, DSR as a premier institute dedicated for the cause of playing a leadership role in conduction and coordination of seed research is endeavoring to excel and match the output on par with global standards.

Because of the sheer paramountcy of 'seed' in the sphere of farming systems, DSR is envisaging itself as a national institute with a renewed outlook by expansion of its domain with creation of regional centres thereby enabling the system in attainment of goals with respect to coordination and seed technological research. DSR is envisaging to put thrust on Consortia Approach (PPP), so that better end product will reach farmers at competitive price and right time. It is also striving towards enhancement of visibility and competitiveness of Indian seed in international market.

Strategies for Seed Security

- ✚ Seed research encompassing climate resilient seed production, unraveling seed biology through molecular tools and designer seed through second and third generation technology and genomics & proteomic approaches for quality assurance

- # Adequate availability of breeder seeds of desired varieties through SAUs & other ICAR institutions and effective implementation of generation system
- # Promotion of protected cultivation for seed production in vegetable, flower crops for supply of disease free planting materials
- # Perpetuation and conservation of traditional varieties in seed chain through community seed systems and establishment of seed village banks to serve farming community in times of natural calamities like flood, drought, cyclone and disease and pest epidemics
- # Revisiting of national seed standard for seed certifications and quality control in view of OECD certification scheme, ISTA, AOSA, PPV&FRA and New Seed Bill, 2004 for promotion of seed trade
- # Harmonization among different stakeholders including private seed sector, farming communities, farmers' associations, NGOs, self help groups (SHGs), KVKs and international seed research centres to ensure seed security
- # Strengthening of human resources in seed sector through innovative training modules to acquaint with new scientific developments
- # Encouraging women and unemployed youth as a seed entrepreneur

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