



**Lecture 03:
SEED DEMAND FORECASTING AND PLANNING FOR CERTIFIED, FOUNDATION
AND BREEDER SEED PRODUCTION**

Demand Forecasting of seed

In adequate estimation of demand and the consequences of over production or under production can cause serious financial consequences for a seed company. Too many carryovers and stock write-offs will prove to be expensive, while lack of seed means a loss of revenue and a source of frustration for the sales force and the dealer network. This combination of special features in the seed industry makes the accurate assessment of demand even more critical. Some of these features are

- Longer period of time for the development new products from breeding programmes
- Seasonality of production
- Production subject to variables like agro climatic conditions outside the control of management
- Statutory controls and quality standards
- Existence of a generation system - where by the production in one year is the progenitor the next
- Limited shelf life and loss of germination
- Seed replacement rate: Seed Replacement Rate is the rate at which the farmers replace the seeds instead of using their own seeds

Seed Replacement Rate of Select Crops: 2005-06

Crop	SRR (%)
Paddy	17
Milletss	7
Pulses	12.5
Cottton - Rainfed /Irrigated	10/15
Groundnut	5
Gingelly	15
Sunflower	50
Castor	30
Soyabean	20

Source: Narrative notes on Plan Programme-2005-06, S.P.C., Chennai.



In demand forecasting the first step is to calculate the existing requirement multiplied by percent bought seed, which is the amount of commercial seed purchased by farmers. In calculating seed requirement, seed multiplication rates must be taken into account. Seed Multiplication Ratio is the ratio at which the seed multiplies.

In the present Indian scenario, seed production can be taken up as a small-scale industry or it can be taken up as under contract for the other seed companies. In either way, seed production has huge potential to ensure better returns.

Factors which affect demand

It is important to distinguish between actual demand, perceived demand and what the government expects the farmers to buy. The total amount of certified or labelled seed sold may be quite a small proportion of the total requirement.

Many factors have to be considered while assessing and forecasting demand. Some of these are:

- Cropping pattern and intensity
- Type of seed used
- Climate
- Demand for crop products
- Market scenario
- Disposable farm income
- Rate or level of adoption of new technology
- Government policy
- Crop cycles
- Habits and tradition
- Product performance
- Competitiveness
- Price
- Promotion

The most important factors that need to be taken into account when an individual company or organization is estimating the market share that may be gained by its own products are product performance, competitive positioning, price and promotion. This will form the basis of sales forecasting and production planning.

Demand forecasting techniques

Forecasting is the process of making projections of demand for products by examining past and present performance levels, combined with an assessment of available products and markets. This may be carried out within the government service or by individual companies in a purely commercial context. The following approaches can be used:



Target setting: This method is commonly used in developing countries where government is directly involved in planning and seed supply. In a centrally managed economy, targets are likely to be set at a national level and production plans fixed for each region.

India is an example of a more open economy where both the public and private sectors coexist in a well-developed seed industry, but where the government retains a coordinating function and has the ultimate responsibility for the security of seed supply. The Ministry of Agriculture sets the targets and organizes meetings to establish the supply situation and production plans of the various organizations involved.

Companies may opt to set a target for an ideal sales level while, at the same time, recognizing that this is unlikely to be achieved and budgeting for a more achievable situation.

Growth trends: This approach is based on the assumption that the rate of growth of seed demand as seen in past years will continue. This may give unrealistically high forecasts and will depend on the stage of market development for improved seeds. Small increases in volume in the early stages of improved seed use will represent a large increase in percentage terms, which may not be possible to sustain.

Growth rates adjusted for new technology adoption: Using this approach a given region is considered on the basis of degrees of new technology uptake and the likely speed of change. Each part of the region can then be categorized as 'low' to 'medium' or 'high' growth, better reflecting the overall situation.

Sampling: The accuracy of the above approaches can be improved if sample groups of farmers are questioned to gauge their anticipated demand for seed. This exercise is more reliable where there is a reasonable awareness of the benefits of using improved seeds.

SEED PRODUCTION

To meet the Nation's food security needs, it is important to make available to Indian farmers a wide range of seeds of superior quality, in adequate quantity on a timely basis. Public Sector Seed Institutions will be encouraged to enhance production of seed towards meeting the objective of food and nutritional security.

The Indian seed programme adheres to the limited three generation system of seed multiplication, namely, breeder, foundation and certified seed. Breeder seed is the progeny of nucleus seed.

- Nucleus seed is the seed produced by the breeder to develop the particular variety and is directly used for multiplication as breeder seed.



- Breeder seed is the seed material directly controlled by the originating or the sponsoring breeder or Institution for the initial and recurring production of foundation seed.
- Foundation seed is the progeny of breeder seed. Foundation seed may also be produced from foundation seed. Production of foundation seed stage-I and stage-II may thus be permitted, if supervised and approved by the Certification Agency and if the production process is so handled as to maintain specific genetic purity and identity.
- Certified seed is the progeny of foundation seed or the progeny of certified seed. If the certified seed is the progeny of certified seed, then this reproduction will not exceed three generations beyond foundation stage-I and it will be ascertained by the Certification Agency that genetic identity and genetic purity has not been significantly altered.

Public Sector Seed Production Agencies will continue to have free access to breeder seed under the National Agriculture Research System. The State Farms Corporation of India and National Seeds Corporation will be restructured to make productive use of these organisations in the planned growth of the Seed Sector.

Private Seed Production Agencies will also have access to breeder seed subject to terms and conditions to be decided by Government of India.

State Agriculture Universities/ICAR Institutes will have the primary responsibility for production of breeder seed as per the requirements of the respective States.

Special attention will be given to the need to upgrade the quality of farmers' saved seeds through interventions such as the Seed Village Scheme.

Seed replacement rates will be raised progressively with the objective of expanding the use of quality seeds.

DAC, in consultation with ICAR and States, will prepare a National Seed Map to identify potential, alternative and non-traditional areas for seed production of specific crops.

To put in place an effective seed production programme, each State will undertake advance planning and prepare a perspective plan for seed production and distribution over a rolling (five to six year) period. Seed Banks will be set up in nontraditional areas to meet demands for seeds during natural calamities.



The 'Seed Village Scheme' will be promoted to facilitate production and timely availability of seed of desired crops/varieties at the local level. Special emphasis will be given to seed multiplication for building adequate stocks of certified/quality seeds by providing foundation seed to farmers.

For popularizing newly developed varieties and promoting seed production of these varieties, seed minikits of pioneering seed varieties will be supplied to farmers. Seed exchange among farmers and seed producers will be encouraged to popularize new/non-traditional varieties.

Seeds of newly developed varieties must be made available to farmers with minimum time gap. Seed producing agencies will be encouraged to tie up with Research Institutions for popularization and commercialization of these varieties.

As hybrids have the potential to improve plant vigour and increase yield, support for production of hybrid seed will be provided.

Seed production will be extended to agro-climatic zones which are outside the traditional seed growing areas, in order to avoid un-remunerative seed farming in unsuitable areas.

Seed Banks will be established for stocking specified quantities of seed of required crops/varieties for ensuring timely and adequate supply of seeds to farmers during adverse situations such as natural calamities, shortfalls in production, etc. Seed Banks will be suitably strengthened with cold storage and pest control facilities.

The storage of seed at the village level will be encouraged to facilitate immediate availability of seeds in the event of natural calamities and unforeseen situations. For the storage of seeds at farm level, scientific storage structures will be popularized and techniques of scientific storage of seeds will be promoted among farmers as an extension practice.

Seed growers will be encouraged to avail of Seed Crop Insurance to cover risk factors involved in production of seeds. The Seed Crop Insurance Scheme will be reviewed so as to provide effective risk cover to seed producers and will be extended to all traditional and non-traditional areas covered under the seed production programme.

Recommended System of Breeder Seed Indent and Supply:

1. Every State shall provide 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 SRR, productivity data to ICAR, DAC and SAUs by **1st December for Kharif crops and 1st May for Rabi crops.**

2. ICAR shall prepare and circulate a list of State/area/agro-climatic zone-specific recommended varieties/hybrids of seeds particularly the newly released varieties/hybrids for cultivation along with relevant data regarding their yield potential, duration etc. to every State on or before **1st January for Kharif crops and 1st June for Rabi Crops** with copy to Seed Division, DAC.

3. SAUs shall do a similar exercise in respect of State varieties.

4. Each State in consultation with ICAR Institutes, SAUs and Seed producing Agencies shall 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.

5. State Governments shall submit the seed plan and the Breeder Seeds indent to DAC, ICAR, SAUs. The Breeder Seed Indent shall be 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.**

6. Private seed companies will 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) to Seeds Division, DAC.

7. DAC shall compile all the Breeder Seed Indents of States and private seed companies and furnish them to ICAR/ concerned PDs/PCs for production of the breeder seeds.

8. The breeder seed will be allotted to all States and private seed companies for lifting from institutes of ICAR, SAUs to produce foundation and certified seed.

9. The Lifting of Breeder Seed is to be monitored every 15 days jointly by DAC and ICAR.

10. To popularise new varieties and to induce confidence among the farmers apart from Front Line Demonstrations (FLDs), each ICAR centre, SAU and KVK shall adopt 1-2 villages in a block in an agroclimatic zone of the State for demonstration in participatory mode in the farmers fields to demonstrate the productivity/potential of the new variety with an appropriate mix of inputs and practices. State Government extension staff willfully participates in the finalisation plan of FLDs-list of farmers training etc.

11. In case of hybrids of important food crops such as paddy hybrids the State Agriculture Universities shall take the responsibility in large scale production of Pure high quality parental



lines (A Lines, R Lines) (Breeder and foundation seed). It would be ensured that NSC, SFCI, State Seeds Corporations will procure the foundation seeds on priority.

12. SAUs shall provide foundation seed to all State Seed Corporations, State Seed Farms, NSC, SFCI and Private Seed Companies for taking up large scale hybrid seed production and make it available to farmers at affordable prices. SAUs may also take up large-scale hybrid seed production in their Farms.



Lecture 04:

DETERIORATION OF CROP VARIETIES - CAUSES AND MAINTENANCE

Deterioration of Genetic Purity

The genetic purity of a variety or trueness to its type deteriorates due to several factors during the production cycles. Kadam (1942) listed the following important factors responsible for deterioration of varieties.

- Developmental variations
- Mechanical mixtures
- Mutations
- Natural crossing
- Minor genetic variations
- Selected influence of pest and diseases
- The techniques of the plant breeder

1. Developmental Variations

When seed crops are grown under environments with differing soil fertility, climate, photoperiods, or at different elevations for several consecutive generation's developmental variations may set in as differential growth responses.

It is therefore, preferred to grow the varieties of crops in the areas of their natural adaptation to minimize developmental shifts.

2. Mechanical Mixtures

Mechanical mixtures, the most important reason for varietal deterioration, often take place at the time of sowing if more than one variety is sown with the same seed drill, through volunteer plants of the same crop in the seed field, or through different varieties grown in adjacent fields. Two varieties growing next to each other field is usually mixed during harvesting and threshing operations. The threshing equipment is often contaminated with seeds of other varieties. Similarly, the gunny bags, seed bins and elevators are also often contaminate, adding to the mechanical mixtures of varieties.

Rouging the seed fields critically and using utmost care during seed production and processing are necessary to avoid such mechanical contamination.

3. Mutations

Mutations do not seriously deteriorate varieties. It is often difficult to identify or detect minor mutations occurring naturally. Mutants such as, 'fatuoids' in oats or 'rabbit ear' in peas may be removed by rouging from seed plots to purify the seeds.



4. Natural Crossing

Natural crossing can be an important source of varietal deterioration in sexually propagated crops. The extent of contamination depends upon the magnitude of natural cross-fertilization. The deterioration sets in due to natural crossing with undesirable types, diseased plants or off types. In self-fertilized crops, natural crossing is not a serious source of contamination unless variety is male sterile and is grown in close proximity with other varieties. The natural crossing, however, can be major source of contamination due to natural crossing are the breeding system of the species, isolation distance, varietal mass and pollinating agent. The direction of prevailing winds, the numbers of insects present and their activity and mass of varieties are also important considerations in contamination by natural crossing.

The isolation of seed crops is the most important factor in avoiding contamination of the cross-fertilized crops.

5. Minor Genetic Variations

Minor genetic variations can occur even in varieties appearing phenotypically uniform and homogenous when released. The variations may lost during later production cycles owing to selective elimination by the nature. The yield trials of lines propagated from plants of breeder's seed to maintain the purity of self-pollinated crop varieties can overcome these minor variations. Due care during the maintenance of nucleus and breeder's seed of cross-fertilized varieties of crop is necessary.

6. Selected Influence of Pest and Diseases

New crop varieties often are susceptible to newer races of pests and diseases caused by obligate parasites and thus selectively influence deterioration. The vegetatively propagated stock also can deteriorate quickly if infected by virus, fungi or bacteria. Seed production under strict disease free conditions is therefore essential.

7. The Techniques of the Plant Breeder:

Serious instabilities may occur in varieties owing to cytogenetic irregularities in the form of improper assessments in the release of new varieties. Premature release of varieties, still segregating for resistance and susceptibility to diseases or other factors can cause significant deterioration of varieties. This failure can be attributed to the variety testing programme. In addition to these factors, other heritable variations due to recombination's and polyploidisation may also take place in varieties during seed production, which can be avoided by periodical selection during maintenance of the seed stock.

Maintenance of Genetic Purity during seed Production

The various steps suggested, to **maintain varietal purity**, are as follows.



- Use of approved seed only in seed multiplication.
- Inspection and approval of fields prior to planting.
- Field inspection and approval of growing crops at critical stages for verification of genetic purity, detection of mixtures, weeds, and for freedom from noxious weeds and seed borne diseases etc.
- Sampling and sealing of cleaned lots
- Growing of samples of potentially approved stocks for comparison with authentic stocks.

The various steps suggested for **maintaining genetic purity** are as follows:

- a. Providing adequate isolation to prevent contamination by natural crossing or mechanical mixtures
- b. Rouging of seed fields prior to the stage at which they could contaminate the seed crop.
- c. Periodic testing of varieties for genetic purity.
- d. Avoiding genetic shifts by growing crops in areas in their adaptation only.
- e. Certification of seed crops to maintain genetic purity and quality of seed.
- f. Adopting the generation system.
- g. Grow out tests.

Genetic Purity Maintenance in Hybrid Seeds

Maintenance of the genetic purity of hybrid seeds is a complicated one requiring elaborate procedures.

Nucleus Seed of Inbred Lines

- The nucleus seed of inbred lines can be maintained by self pollination, sib-pollination, or a combination of the two procedures (hand pollination).
- Some breeders prefer 'sibbing' because it maintains vigour. "Selfing" is used to stabilize inbred lines if a change in breeding behavior is noticed.
- Some parental material is preferably maintained by alternate selfing and sibbing from one generation to other.
- Individually selfed or sibbed ears should be examined critically, discarding off types or inferior characteristics (texture, colour, seed size, chaff color and shape of earhead).
- The uniform ears are then threshed separately and planted in ear to row method to easily detect and discard off types from individual ears if any.
- Alternatively all of the ears from an individual inbred line may be composited for bulk planting in the next season.
- The hand pollination seed is sown on clean, fertile soil having no previous crop of the same kind or variety during the previous year (bearing maize).



- It is rather important to ensure that the crop is well isolated, with the requirement varying from crop to crop and depending upon the nature of the material to be protected by isolation, the nature of the contaminant, and the direction of the prevailing wind.
- The isolation can be achieved either by distance or by time (maize). The inbred line may be composited for bulk planting in the next season.
- Maintenance of genetic purity in inbred lines through hand pollination and adequate isolation alone is not enough to achieve perfection.
- The isolated fields must be critically rogued for off types and other impure types prior to the shedding of pollen.
- The nucleus seed crop is harvested after physiological maturity if artificial drying facilities exist.
- Ear to harvest lines are harvested separately and piled; These are again critically examined for ear characteristics, sorting out of all off-coloured, diseased, or otherwise undesirable ears.
- If the overall percentage of off types exceeds 0.1%, hand pollination should be repeated to produce the second year's breeders seed.
- The uniform ears are bulked, dried in a clean dry bin at temperatures not exceeding 43°C, shelled, cleaned, treated with pesticides, and stored under ideal storage conditions as breeder stock seed. This seed may be increased during the following season by paying adequate attention to isolation, roguing, etc., to maintain high genetic purity of the seed.

Nucleus Seed of Non-Inbred Lines

- To maintain in the genetic purity of the nucleus seed of non-inbred lines, the number of plants for hand pollination should be large enough to preserve genetic make up of the variety, narrowing the genetic base by sibbing only a few plants (about 5000 plants or more).
- The sibbed ears are examined critically, discarding of colour, texture, or diseased ones.
- Uniform ears are bulked, dried, shelled, cleaned, treated and stored as usual.
 - Other practices of seeding sibbed nucleus seeds are similar to those described earlier for inbred lines.
 - Roguing however, needs to be observed more critically by individuals with good knowledge of the material.
 - The breeder's stock seed thus produced from the nucleus seed can be utilized to increase the breeder's stock of non-inbred lines, paying adequate attention to



- land requirements, isolation, roguing, harvesting and handling of seed to achieve maximum genetic purity.
- The breeder's seed of the established varieties of cross-pollinated crops can be maintained by raising breeder's seed crop in isolation and roguing the crop thoroughly at various stages.
 - It is often purified by mass selection.
 - The crop is grown in isolation and rogued carefully as described earlier.
 - At maturity about 20,000 - 25000 true to type plants are selected, harvested separately, and bulked after careful examination.
 - This constitutes the breeder's stock seed. The seed may be carried over to ensure against possible failures or unforeseen shortages