Geography Optional - 2025

INFRASTRUCTURE AND INSTITUTIONAL FACTORS

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Agriculture, with its allied sectors, is unquestionably the largest livelihood provider in India, more so in the vast rural areas. It also contributes a significant figure to the Gross Domestic Product (GDP). Sustainable agriculture, in terms of food security, rural employment, and environmentally sustainable technologies such as soil conservation, sustainable natural resource management and biodiversity protection, are essential for holistic rural development. Indian agriculture and allied activities have witnessed a green revolution, a white revolution, a yellow revolution and a blue revolution. Indian Agriculture is confronted with several issues.

Small and fragmented landholdings: The average farm size in India is small, with around 85 percent of farms being less than 2 hectares in size, which can make it difficult for farmers to be profitable.

Water scarcity: India has a high population density and a large agricultural sector, which puts a strain on water resources, making it difficult for farmers to irrigate their crops.

Soil degradation: Unsustainable farming practices, such as overuse of pesticides and fertilizers, have led to soil degradation and reduced crop yields in many parts of India.

Lack of access to markets: Small farmers in India often have difficulty accessing markets to sell their products, which can limit their income and economic growth.

Food security: India has a large population and a high level of food insecurity, which requires increasing food production and ensuring that food is accessible and affordable for all.

Climate change: India is particularly vulnerable to the impacts of climate change, such as changing weather patterns and increased frequency of extreme weather events, which can reduce crop yields and make farming more difficult.

Pest and disease: Pests and diseases can have a significant impact on crop yields in India, and they are difficult to control due to the lack of effective pest management systems in place.

Labor shortage: Many farmers in India are facing labor shortages as a result of immigration policies and a lack of interest in farming as a career.

High-cost of production: The cost of production is increasing, including the cost of inputs such as seeds, fertilizer, and fuel, which can make it difficult for farmers to be profitable.

Technological gap: Not all farmers in India have access to advanced technologies, such as precision agriculture, which can limit their ability to increase productivity and efficiency.

The Task Force on Agricultural Development chose to concentrate on five major issues:

- agricultural productivity,
- remunerative prices for farmers,
- land policy,
- agrarian distress and
- Eastern states that have lagged behind the rest of the country in farming.

First, a series of essential steps are required to raise agricultural productivity. At a broad level, this issue has two aspects: low average productivity at the national level and high variation in it regionally. As explained earlier, the average productivity in rice is low relative to most of the major rice producing counties. India does better in wheat but the scope for improvement exists in this crop as well. The same goes for other crops including oilseeds, fruits and vegetables as well as activities such as animal husbandry, fisheries and poultry.

The **second** broad productivity concern relates to regional variation. It is also evident that while Punjab and Haryana exhibit high productivity nationally, states such as Madhya Pradesh, Rajasthan, Maharashtra, Chhattisgarh, Odisha, and Karnataka suffer from quite low yields per hectare. The scope for improved productivity in these latter regions is substantial.

To increase productivity, progress is required along three dimensions:

- Quality and judicious use of inputs such as water, seeds, fertilizer and pesticides;
- judicious and safe exploitation of modern technology including genetically modified (GM) seeds; and
- shift into high value commodities such as fruits, vegetables, flowers, fisheries, animal husbandry and poultry.

In the longer run, productivity enhancement requires research toward discovery of robust seed varieties and other inputs, appropriate crops and input usage for a given soil type and effective extension practices. Agricultural research and development (R&D) in India has made impressive contribution in the past. But the system is under significant stress today with lack of clarity on focus and inefficient use of financial resources. Links among sister institutions have weakened and accountability declined over time. There is need for a rethink of the R&D system. Second, farmers need to be ensured to receive remunerative prices. This issue has two aspects, one relating to the Minimum Support Price (MSP) and the other relating to the farmer's share in the price paid by the final consumer. Taking the MSP first, it effectively applies to a specified set of

commodities, predominantly rice, wheat and cotton, and is available only in a subset of producer states. In the states in which no procurement is done by the public agencies at the MSP, farmers lack the guarantee offered by the MSP .

Moreover, subsidized sales of cereals under the public distribution system (PDS) divert part of the demand thereby artificially lowering the price at which they must sell their produce. Likewise, for commodities such as fruits and vegetables, which are not subject to any procurement by official agencies, sometimes the market price can be excessively low due to perishability and localized nature of markets for them.

The inadequate cold storage facility makes matters worse by discouraging farmers from opting for these crops in the first place. Agricultural marketing has not seen any significant reforms and modernisation for decades. The supply chain remains fragmented, scale of operations is low and there is excessive presence of intermediaries. The poor state of competitiveness is more pronounced during above normal or below normal production. A small increase in production above normal level often results in price crash for farmers and a below normal production is followed by skyrocketing prices in the post-harvest period with hardly any benefit for the farmers. The second aspect of the price received by the famer concerns the small fraction of the price paid by the final consumer that the farmer receives in the marketplace.

The continued presence of regulations flowing from the Agricultural Produce Marketing Committees (APMC) Acts in most commodities in most states has meant that the farmer is compelled to sell her produce in the government-controlled marketing yards. These controls restrict transactions to the handful of local players and easy manipulations. The APMC market yards are subject to vast technical as well as marketing inefficiencies that undermine the prices that farmers receive .Only a genuine implementation of the model APMC Act of 2003, which introduces all-around marketing reform, can ensure that the farmer gets her fair share of the price paid by the final consumer .Additionally, some of the restrictive features of the Essential Commodity Act, which create an environment of uncertainty and discourage the entry of larger players into agricultural-marketing infrastructure, requires review and possibly revision.

Third, for understandable historical reasons, land leasing laws in India have taken forms that discourage formal leasing contracts between the owner and the tenant. Field studies have shown that most of tenancy in the country is concealed and, thus, unofficial. This fact has the implication that tenants are often not identified as actual cultivators in the records. The lack of identification of tenants as actual farmers has very serious implications for the conduct of public policy. Benefits intended for the tenant farmer such as disaster relief or direct benefit transfers risk being disbursed to the owner of the land who appears as the cultivator in the official records. In the absence of official records, tenants also lack access to formal credit and other benefits available to cultivators.

In many states, leasing laws can effectively result in the loss of land to the tenant leading owners to eschew leasing land altogether. Over the generations, as families have grown, land holdings have come to be divided and fragmented into small economically unviable parcels and plots.

Onerous leasing laws have prevented consolidation of these holdings. On the one hand, these smallholdings force owners to seek alternative means of livelihood and on the other their plots remain uncultivated with no prospect of being joined to other plots to produce more viable holdings. Closely related, ownership rights in India are also poorly defined. All ownership is presumptive and subject to challenge in the courts. This feature has undermined the development of a vibrant land sales market with the owner unable to get the true value of his piece of land. In turn, this discourages land sales as well when the farmer finds his piece of land too small to be a viable source of livelihood. Equally important, in the absence of ownership titles and the prospects of land disputes, banks hesitate to accept land as collateral.

Fourth, farmers are frequently affected by natural disasters such as droughts, floods, cyclones, storms, landslides, hails and earthquakes. Because most farmers lead subsistence existence, such disasters can lead to extreme distress and hardship. Though some crop insurance schemes have been tried in the past, they have not worked effectively .One critical problem is that these programs predominantly cover only farmers with outstanding bank loans. Because the poorest farmers are unable to access the banking system in the first place, they are rarely covered by the insurance. There is acute need to rectify this situation by providing for at least minimum quick relief to marginal and small farmers in case of natural calamities that destroy a large proportion of the crop.

Fifth, we need to pay special attention to the problems of farmers in eastern states. Given fertile land and abundant water resources, these states have a high potential in agriculture. Yet, their productivity in various crops lags behind the national average. Despite favorable climatic conditions and water availability crop intensity in the region is low. Therefore, concerted effort is required to bring the Green Revolution to these states

Per Drop More Crop :

The Challenges of Irrigation Water is a critical input into agriculture in nearly all its aspects. How much, at what time and how plants are watered has determining effect on the eventual yield. Good seeds and fertilizer fail to achieve their full potential if plants are not optimally watered. Adequate availability of water is important for animal husbandry as well. Fisheries are, of course, directly dependent on water resources. Increasing incomes, growing urbanization and rising prosperity are rapidly changing the composition of food basket away from cereals towards high value agricultural commodities such as fruits, vegetables, milk, poultry, fish and meat. Although per capita consumption of food grains has declined over the years, its total demand has been projected to increase due to increase in population and indirect demand from feed.

Most of the fruits, vegetables and livestock products are more water intensive as compared to cereals other than rice. Further preference to have fresh fruits and vegetables in all the seasons is resulting in increase in their cultivation in off season requiring much higher use of water. The amount of water required to produce a unit of animal origin products (chicken, mutton and eggs) is much higher than plant origin products (cereals, pulses and oilseeds). These developments point to growing demand for and therefore rising pressure on India's limited water resources. Moreover, close to 55 per cent of the current area under cultivation is not covered by irrigation. This results in low productivity and high risk to production due to erratic rainfall.

Ways and means need to be devised to expand irrigation and enable dry land agriculture to have access to water to address at least critical water shortages. India accounts for about 17 per cent of the world's population but only 4 per cent of the world fresh water resources. Distribution of these water resources across the vast expanse of the country is also uneven. Therefore, as incomes rise and the need for water rises for reasons explained in the previous paragraph, the pressure for efficient use of highly scarce water resources will rise manifold.

As per the international norms, a country is classified as Water Stressed and Water Scarce if per capita water availability goes below 1700 m3 and 1000 m3, respectively. With 1544 m3 per capita water availability, India is already a water-stressed country and moving towards turning water scarce. While the stress on limited water resources in the country is rising the scarcity is not reflected in use of water. India uses 2-4 times water to produce one unit of major food crops as compared to other major agricultural countries like China, Brazil, USA .These variations imply that if India attains water use efficiency of those countries it can save at least half of water presently used for irrigation purposes.

At present, irrigation consumes about 84 per cent of total available water. Industrial and domestic sectors consume about 12 and 4 per cent of total available water, respectively. With irrigation predicted to remain the dominant user of water, "per drop more crop" is an imperative. The efficiency of water use must improve to expand area under irrigation while also conserving water.

Irrigation infrastructure in India has seen substantial expansion over the years. The total irrigation potential created (IPC) from major, medium and minor irrigation schemes has increased from 22.6 million hectares during pre-plan period to 113 million hectares at the end of the 12th Plan. Because this irrigation potential represents 81% of India's ultimate irrigation potential estimated at 140 million hectares, the scope for further expansion of irrigation infrastructure on a large scale is limited. Therefore, priority must be given to improving the utilization of irrigation potential (IPU) of the existing irrigation potential. Currently, IPU is approximately 77 % (87 million hectares) of the IPC (113 million hectares).

- The underutilization of IPC is due to the slow pace of the Command Area Development Program (initiated in 1973–74 to bridge the gap between IPC and IPU), depletion of

professional staff in state irrigation agencies and paucity of non-plan funds available for irrigation departments. This necessitates review and restructuring of the underlying institutional setup in the irrigation sector. Over the years, there has been significant shift in the sources of irrigation.

- The share of groundwater sources has increased from 28.7 % to a whopping 62.4 %. This expansion reflects the reliability and higher irrigation efficiency of 70–80% in groundwater irrigation compared with 25–45% in canal irrigation. While proving to be a valuable source of irrigation expansion, injudicious utilization of groundwater through the explosion of tube wells has raised several sustainability issues. Although overall development of groundwater (groundwater draft as a proportion of the total availability) is 62 per cent, there exists wide regional variability. Over-dependence on groundwater beyond sustainable level use has resulted into significant decline in the groundwater table, especially in northwest India.
- The unsustainable groundwater use necessitates demand management and supply augmentation measures for improved water use efficiency in agriculture sector. On the other hand, eastern region, where groundwater utilization is on a limited scale, offer greater scope for harnessing the benefits of groundwater usage to improve crop yields.
- Several regions in the country face acute water stress chronically. These include districts of South and North Interior Karnataka; Rayalseema in Andhra Pradesh; Vidarbha and Marathwada in Maharashtra; western Rajasthan and Bundelkhand region of U.P. and M.P. Low and erratic rainfall for consecutive years in these districts have rendered water-harvesting structures devoid of water and the conservation measures almost unviable. The water storage in reservoirs has depleted leading to scarcity of drinking water.
- The moisture index in majority of these districts in the range of -85 to -50%, denoting that natural precipitation is highly inadequate to support the arable cropping.2 Neither normal agricultural practices nor the contingency measures may help the farmers. Specific attention is needed for linking these districts with some perennial source of water (linking of rivers or water grids). Furthermore, agriculture has to move from traditional crop centric farming to agri-pastoral-farm forestry systems (fruit trees, shrubs, perennial grasses and small ruminants). There is a strong case of the promotion of sources of livelihood support other than agriculture in these districts.

Cross-country comparison of water use efficiency shows that India uses 2-3 times the water used to produce one tonne of grain in countries like China, Brazil and USA. This implies that with water use efficiency of those countries India can at least double irrigation coverage or save 50 per cent water currently used in irrigation.

Achieving these gains would require the application of multiplicity of instruments. These may include:

Pradhan Mantri Krishi Sinchai Yojana (PMKSY) provides a sound framework for the expansion of as well as effective use of water in irrigation. The impact of the scheme can be

greatly enhanced , however, by restoring the original flexibility of the Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA) in asset creation. They entail the enforcement of the 40% limit on the use of material and skilled labour at the level of the district instead of panchayat and permitting the use of contractors for this component. The twin modifications would allow the flexibility necessary to undertake lasting and efficient minor irrigation projects such as irrigation tanks.

The method of irrigation followed in the country is flood irrigation, which results in a lotof water loss. Greater efficiency in irrigation can be achieved through proper designing of irrigation system for reducing water conveyance loss. Adoption of water saving technologies such as sprinkler and drip irrigation system have proven extremely effective in not just water conservation but also leading to higher yields by delivering water in a controlled manner in parts of the plant where it is most efficiently absorbed. New agronomic practices like raised bed planting, ridge-furrow method of sowing, sub-surface irrigation, precision farming offers vast scope for economizing water use.

Promotion of alternative methods of planting such as System of Rice Intensification andDirect Seeded Rice can lead to water saving and productivity increases. Water productivity can be improved by adopting the concept of multiple use of water, which is beyond the conventional sectoral barriers of the productive sectors. There is scope for increasing the income through crop diversification and integration of fish, poultry and other enterprises in the farming system. Multiple use of water approach generates more income benefits, decreases vulnerability by allowing more diversified livelihood strategies and increases sustainability of ecosystem.

Emphasis should be given on water resources conservations through **watershed development** in suitable areas and development of micro-water structures for rainwater harvesting. The promotion of water conservation efforts has direct implications for water resources availability, groundwater recharge and socio-economic conditions of the population. Specialized solution is required in chronically water stressed areas where the normal measures may not be effective.

Connecting highly water stressed areas with perennial source of water through linking of rivers or water grids is one such option. The value added agri-horti-pastoral agro-forestry systems and alternative source of livelihood are required in these districts. These districts could be ideal candidates for prioritized intervention of watershed plus activities (water conservation along with livelihood support activities) under recently launched Pradhan Mantri Krishi Sinchai Yojana (PMKSY) and convergence with MGNREGA.

Seeds, Fertilizer and Pesticides

Seeds, fertilizers and pesticides constitute the three pillars of modern agriculture and have been central to pushing agricultural-productivity frontier out. The Green Revolution in India was begun by the introduction of the high Yielding Varieties (HYV) of seeds complemented by

effective use of fertilizers and expansion of irrigation. Farmers often see a direct connect between seeds and fertilizer on the one hand and crop yield on the other.

Seed is the true carrier of technology. In India, three sets of institutions produce seeds:

- research institutions and agricultural universities;
- public sector seed producing corporations; and
- private sector firms including multinationals.

The last decade has seen two main developments in seed market. One, production of quality seed has risen at a rapid rate. And two, public sector has begun to effectively compete with the private sector. Cotton and maize have been the most favorite crops for development of hybrids both by public and the private sectors. Considering all crops together, private sector accounted for three-fourth of the total hybrids developed in the country, which is significantly lower.

While these changes have led to better availability of quality seed, **seed replacement rate** (percentage of area sown using certified quality seeds other than the farm saved seeds from the previous crop) remains low in the country. On average, it is below 20 per cent in pulses and below 30 per cent in paddy and wheat. Even now many farmers do not distinguish between common grain and seed and use common grain as seed. Another serious factor responsible for low use of quality seed is **sale of spurious seed in the market**. In order to raise productivity there is a need to supply and promote use of quality seed and also assure quality. Some important initiatives have been taken under the recently amended New Policy on Seed Development. The policy permits 100 per cent foreign direct investment under the automatic route and simplifies the procedure for inclusion of new varieties in the Organization for Economic Cooperation and Development

Seeds Scheme. The thrust is also on creating a seed bank. **Seed Rolling Plan** has been in place for all the States for identification of good seed varieties and agencies responsible for production of seeds.

Several steps need to be taken to improve the quality of seeds used by farmers:

- Sometimes prices of good quality seeds, especially hybrids, are high and farmers are unable to afford them.
- Creating community Seed Banks in producing areas can reduce dependence on market for seeds. The seed banks not only protect the existing crop varieties but also ensure supply of seeds to the farmer to meet contingency.
- Proper storage of seeds is essential to get satisfactory germination. This factor assumes particular significance in the eastern region due to humid climatic conditions. Adequate-quality storage infrastructure according to agro-climate conditions and specific seeds to be stored, needs to be created to save the seeds from damage.

- Huge demand supply gap exists in forage seed. The seed companies are not coming forward for production of forage seeds. This is a major cause of concern for development of dairy sector in the country. The seed companies and State Agricultural Universities have to take-up forage seed production on a priority basis. In parallel, the dairy cooperatives should be encouraged to grow forage seeds.
- Regulatory measures for quality seed production have to be tightened so as to discourage the sales of spurious seeds to farmers. The seed companies should be made responsible for poor performance of seed supplied by them.
- The seed companies should provide adequate compensation package for farmers in case of general failure of their seeds.

Fertilizer use has seen rapid expansion and intensification in India and in other parts of the world with the spread of the Green Revolution technology. With the scope for raising production through the expansion of cultivable land exhausted, fertilizer will continue to play a key role in meeting the future requirement of food, feed and fibre. Therefore it is important that fertiliser is used judiciously and optimally.

Fertilizers supply three critical macro elements: nitrogen (N), phosphorous (P) and potash (K). A common belief is that the ideal balance among N, P and K in India is 4: 2: 1. But these proportions represent average across different soil types, crop and water availability. Moreover, independently of the proportions, the optimal level of fertilizer use also varies according to soil type, level of yield, crop and water availability. Soil type matters because the naturally available content of the nutrients varies across soil types. Similarly, there being complementarity between water and nutrient absorption capacity, optimal levels of fertilizer use are higher in irrigated than rain-fed regions. Finally, cereals such as rice, wheat, maize and jowar, cotton and sugarcane require larger doses of nitrogen per ton of output than pulses and fruits and vegetables.

Beginning with the launch of the Green Revolution, fertilizer use in India has steadily grown but it has been **disproportionately tilted in favour of urea,** the source of nitrogen. Already in the early 1970s, the average proportions across N, P and K were 6:1.9:1, they shifted in favour of nitrogen over time reaching 10:2.9:1. There was minor shift in the reverse direction subsequently but, the proportions still stood at 8.2:3.2:1. Setting aside the suboptimal mix of different nutrients, the quantity of fertilizer use per hectare in India remains significantly low than in most countries in the world. The **average consumption of fertilizers** in India rose from. But the level remains well below what is observed in the neighbouring Pakistan (205 kg per ha) and China (396 kg per ha). There is common belief that Indian farmers use too much urea. But the observations above suggest that this is too simplistic a view. More nuanced analysis is required taking into account soil and crop type and irrigated versus rain-fed regions.

In this context, it is noteworthy that a recent National Institute of Agricultural Economics and Policy (NIAP) study reports that one third of the major states apply excess N and two thirds apply it at below optimum level.

- While six states, namely, Andhra Pradesh, Assam, Punjab, Bihar, Haryana, and Jharkhand, use proportionately more N than would be warranted by the optimal mix, 12 states use it in suboptimal proportion. The study finds similar regional imbalances in the use of P and K.
- There is clearly a need for nuanced approach to calibrating the use of fertilizers in different soils and crops and under different irrigation facilities. Farmers must be provided soil analyses through soil cards and possibly modern technology and informed of what the right mix for their crops is.
- Due to low use of organic fertilisers and increase in productivity and crop intensity micro nutrient deficiency in the soils is on increase. Thus, beside N, P and K use of micro nutrients also needs to be increased. Fertiliser sector is not getting fresh investments and the industry is pressing for decontrol of urea.
- This needs to be looked into in the long term interest of fertilizer and agriculture sector. As the domestic industry is not able to meet the rising fertilizer demand even for urea the dependence on import is rising. In an attempt to reduce dependence on imports, the Government has gone on to revive some inefficient urea plants. If imports are available at prices below the cost of these domestic plants, the wisdom of such revival is not clear.
- The fundamental principle of international trade is that we must specialize in what we can produce cheaply, let other nations specialize in what they produce cheaply, and then trade. Even then if it is an objective not to rely on imports that are viewed as uncertain, a superior alternative to reviving costly domestic plants is to set up joint venture for urea production in countries where cheap gas is available.
- Finally, a major problem with the current regime arises from canalization of urea imports. Three designated public sector agents are currently permitted to import urea upon being given an import license. Because imports are seen as the source of filling the gap between demand and domestic supply, often there are bureaucratic delays in the issuance of licenses and imports being reaching farmers resulting in shortages some time.

Allowing decanalization of urea imports and giving the subsidy to farmers and producers via **direct benefit transfer (DBT) would** solve this problem while also enforcing greater efficiency in both production and distribution of fertilizer. Under this system, fertilizer purchases and sales will take place at the import price with domestic fertilizer producers having to compete to meet that price. The farmer would pay the import price at the time of the actual transaction but would be reimbursed the difference between this price and the fixed subsidized price per-unit of purchase via a DBT deposit to her Aadhar linked bank account. Turning to fertilizer producers, domestic plants unable to cover their costs at the import price will have to be given an output subsidy equal to the transaction price and per-unit cost. In the case of the plants with per-unit cost below transaction price, it will be desirable not to tax away the profits. This will encourage the more efficient plants to strive for greater efficiency so as to generate larger profits and market share for themselves.

This system has at least three advantages over the current one.

- First and most importantly, by freeing up imports, it will alleviate shortages of fertilizer that farmers face when domestic supply falls short of the demand. Bureaucratic delays at various levels in affecting imports through public sector agents will give way to competing private and public sector retailers who would not be hamstrung by import licenses and act swiftly to take advantage of profit opportunities.
- Second, the system will help curb black market since fertilizer will be available to the farmer on demand. Eventually, once land records and tenancy reforms are in place, it will even be possible to assess the fertilizer need of each farmer and limit subsidized sale to that need.
- Finally, the system will promote transparency by making explicit the extent to which producers instead of farmers reap the subsidy. This too may motivate producers to strive for greater efficiency.

Pesticides Crop yield losses in India due to pests, which include all biotic stresses such as weeds, insect-pests, diseases, nematodes and rodents, range from 15 to 25% depending on the source of estimates. In monetary terms, the figure ranges from 0.9 to 1.4 lakh crore rupees annually. Losses due to damages caused by pests in terms of quantity are sufficiently large that if they could be avoided, India would meet its needs for the year 2025 domestically without any other change. The flip side is that indiscriminate use of chemical pesticides has an adverse effect on the environment as well as humans who end up consuming produce containing high pesticide residue. Although in per hectare terms pesticide use in India is much lower than in other countries, especially developed ones, pesticide residues in produce in India have been found to be high. ***There are at least five reasons for this phenomenon.***

- First, while pesticides are overwhelmingly used to control weeds in the developed countries, they are used to control insects that attack grains, fruits and vegetables in India.
- Second, chemicals used in India are more dangerous than those used in developed countries. In India, organochloride formulations, which are more dangerous, continue to be used whereas the developed countries have shifted to safer organophosphates and pyrethroids.
- Third, after being applied, pesticides remain in soil, water or plant for some time before they break down. Farmers often lack knowledge of waiting period of various pesticides.
- Fourth, The Central Insecticide Board and Registration Committee (CIBRC) regulate pesticide use in India. Farmers often remain unaware of pesticides recommendations of CIBRC. Farmers are also unaware of the bio-pesticides that currently constitute 4.2% of the total pesticide market in India. So far, only 12 bio-pesticides are registered in India under the Insecticides Act, 1968.
- Finally, high pesticide residues in Indian food products also result from inadequate access to latest technologies. Technologies such as low drift nozzle and spray shields need to be adopted in India to enhance the application efficiency.

It is estimated that currently only 0.1% of the applied pesticide in Indian farms hits the target with the remainder contaminating soil and water. To improve outcomes with respect to pesticide residues, we must improve the advisory services. Farmers mostly depend upon the advice of dealers, who often advise to promote their own interests that may be in conflict with the consumer interest. It is essential to provide information to and create awareness amongst farmers to discourage them from using pesticides indiscriminately. Often fruits and vegetables are subject to pesticide application after the harvest by aggregator or retailers, which needs to be curbed as well.

New Technologies In recent decades, growth in agriculture has been driven by price incentives and input subsidies. In this process, there has been injudicious exploitation of soil, water and other natural resources.

Excessive use of fertilizers has led to heavy salinization of soil in Punjab and Haryana. Ministry of Water Resources estimates that 80% blocks in Punjab have been subject to overexploitation of ground water. Haryana and Rajasthan are very close to similar situation with their water tables having declined to excessively low levels. To maintain productivity growth in a sustainable manner, there is a need to move from input intensive to technology intensive and skill intensive agriculture. Benefits of technology and skill intensive farming are beginning to be experienced albeit on a limited scale in recent years.

Genetically modified (GM) seeds for cotton production, hybrids in maize and vegetables, system of rice intensification, precision farming and farm mechanization, hi-tech cultivation of fruits and vegetables and flowers, resource conservation technologies and many off-farm activities related to mechanization, primary and secondary processing introduced in earlier part of this century offer some areas of success. In the following, some of these technologies and their potential are selectively elaborated.

Remunerative Prices for Farmers In order to facilitate productivity growth, it is important to ensure that farmers receive lucrative prices for their produce. Issues related to price fall under two categories.

- First, for some commodities and in some regions, the government has arrangement for procurement at a preannounced Minimum Support Price (MSP). By design, the MSP is available only in regions in which the government procures the commodities and only on commodities it chooses to procure. In other regions, even for commodities covered, not all farmers are able to sell their produce at the MSP.
- Second, the prevailing marketing arrangements under the conventional APMC Acts in the states have meant that the farmer receives a small fraction of the price paid by the final consumer. Marketing arrangements under these acts have undermined the interests of the farmers and benefited the intermediaries

The Minimum Support Prices India introduced price interventions in food grain market beginning in the mid-1960s as a part of its efforts to make the Green Revolution a reality. Since then, agricultural price policy has aimed to offer remunerative prices to producers through a system of minimum support prices (MSP) backed by procurement of grain, minimize short-run and year to year price fluctuations through open market operations and distribute food grains at subsidized prices through public distribution system (PDS).

While the government currently announces MSP for 23 crops, which comprise 7 cereals (paddy, wheat, maize, sorghum, pearl millet, barley and ragi), 5 pulses (gram, tur, moong, urad, lentil), 7 oilseeds (groundnut, rapeseed-mustard, soyabean, seasmum, sunflower, safflower, nigerseed), and 4 commercial crops (copra, sugarcane, cotton and raw jute).procurement is effective mainly for wheat, rice and cotton and even for these crops, it is restricted to a subset of farmers in a few States. Sugarcane is another crop where millers are under legal obligation to pay statutory minimum price fixed by various states. The result has been excessive focus on the cultivation of wheat, rice and sugarcane in the procurement states at the expense of other crops such as pulses, oilseed and coarse grains.

Intensive cultivation of these two cereals has resulted in depletion of water resources, soil degradation and deterioration in water quality in some states, especially in the north-western region. In parallel to these developments, the pricing policy has also discriminated against eastern states where procurement at the MSP is minimal or non-existent. With part of the demand in these states satisfied by subsidized PDS sales of the grain procured in other states, prices of wheat and rice in these states end up below what they would be in the absence of price interventions of the government.

The price policy has thus also created a regional bias in crop pattern as well as incomes of farmers. Therefore, there is pressing need for reorientation of price policy if it is to serve the basic goal of remunerative prices for farmers. This goal cannot be achieved through procurement backed MSP, however, because it is neither possible nor desirable for the government to buy each commodity in each market in all regions. Financial cost of such a policy would place fiscal consolidation at risk and administrative burden would put challenge the capacity of the bureaucracy.

One measure that can help check the prices received by farmers to some degree is the system of "Price Deficiency Payment". While MSP may still be used for need-based procurement, under the deficiency payments system, a subsidy would be provided on other targeted produce in case the price falls below a pre-specified assured threshold. This approach would help prevent unwanted stocks and spread price incentives to producers in all the regions and all the crops considered important for providing price support. Under the system, the government would announce a floor price for each crop. This floor may be the average of the market price in the preceding three or four years. Each farmer would register her crop and acreage sown with the nearest APMC mandi. If the market price then fell below the floor price, the farmer would be

entitled to the difference up to a maximum of, say, 10% of the assured price that could be paid via direct benefit transfer into an Aadhar linked bank account. This system would keep the quantum of the subsidy in some check and also meet the restrictions on the subsidy imposed by the World Trade Organization (WTO). The system can initially be piloted in selected districts in a few states in a crop such as cotton in which price discovery is institutionalised. Satisfactory implementation would require transparent land-leasing laws and land records so that the actual cultivator and her plot of land can be identified and given the payment due.

Agricultural Marketing and Higher Price for the Farmers Demand pattern of agricultural commodities both at consumer and industry level has been shifting towards high quality and processed products. These changes favour integrated supply chain rather than conventional marketing channels, assured market rather than open market and specific produce rather than generic one. Such supply chains also offer considerable scope for cutting the margins of middlemen. An integrated supply chain is particularly beneficial to small holders who dominate the scene in India. A well-functioning supply chain can reduce the cost of marketing by linking farmers more closely to processing firm and consumers. It can also inform them about changing consumer preferences for quantity, quality, variety, and food safety.

The major reasons for this are that agricultural markets in India are not keeping pace with the changes in production and demand and to ensure competitive prices to farmers .Agricultural marketing suffers from fragmentation resulting from large number of intermediaries and poor infrastructure, lack of vertical integration and policy distortions. A consequence of this fragmentation is that the farmer often receives a small fraction of the final price paid by the consumer. Therefore, **urgent reforms are needed in agricultural marketing** so as to enable farmers to receive a larger proportion of the final price paid by the consumers. One possible solution is to encourage contract farming under which the buyer can provide the farmer access to modern technology, quality inputs, other support and a guaranteed price. A few experiments of direct procurement backed with technical support have shown to benefit the farmers in some States. Another model is direct sales by farmer to consumers either as individuals or as an organization. Such models have been developed in some states like Apni Mandi in Punjab and Haryana, Raythu Bazaar in Andhra Pradesh and UzavaarSandhai in Tamil Nadu. Under these arrangements, farmers are allowed to sell their produce as retail to consumers in the towns on selected days and time without intermediaries. However, the scale of operation of these marketing arrangements is quite low as only farmers located in the vicinity of big towns can benefit from this form of marketing.

One way to overcome this hurdle is to encourage integrators who would buy fruits and vegetables at village level just as milk collection centres collect milk currently and supply these directly to retailers including e-retailers in towns and cities. This backend to frontend linkage will connect farm to consumers and is a win-win step for both the producer and the consumer.

Besides, a National Agricultural Market has been envisaged through Agri-Tech Infrastructure Fund (ATIF) set up by the Department of Agriculture and Cooperation This e-marketing platform is expected to help farmers in better marketing of produce, get market related information and facilitate better price discovery through efficient, transparent and competitive marketing platform with access to large number of buyers from within and outside the State through transparent auction processes. It would also increase the farmers' access to markets through warehouse based sales and thus obviating the need to transport such produce to the mandi. Implementation of this platform need to be expedited backed by adequate resources from the Government. In another important development, Government has set up a Price Stabilisation Fund for procurement and distribution of perishable agricultural and horticultural commodities. This is expected to smoothen out the price differential across seasons. While the initial focus was on potato, rice and tomato, the government has recently extended the program to pulses. This program must be carefully studied before being scaled up. Price stabilization is a tricky business and its success crucially depends on the ability of the stabilization authority to judge when the prices are high and when they are low and then quickly move to buy and sell the produce. Mistakes can easily result in destabilization of prices.

Agriculture Extension Services (AES) is to transmit latest technical knowhow to farmers. Agricultural Extension services or agricultural advisory services aim at implementing and directing the programmes and projects for change in the agricultural sector collaborating with the farmers. Extension services are carried out by extension workers or extension agents. They always pay a crucial role in promoting agricultural productivity, enhancing food security, improving rural livelihoods and promoting agriculture as an engine of pro-poor economic growth.

Objectives of Agricultural Extension services

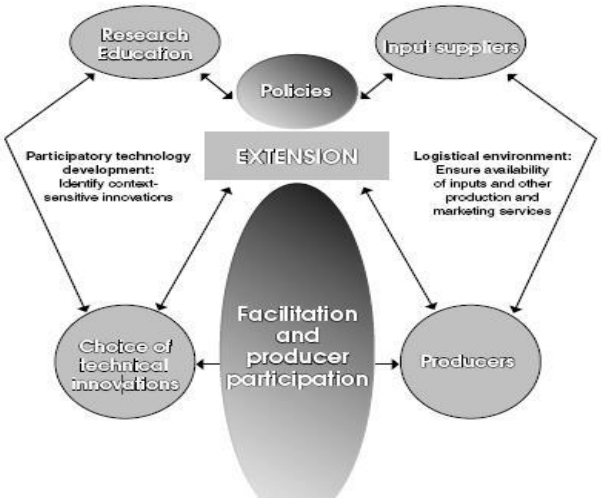
- To transmit the latest technical knowledge to farmers.
- To enhance their knowledge and make the profession more productive.
- To provide feedback from farmers to extension officers/scientists on problems and constraints in agriculture.
- To enhance professional competence of extension functionaries.
- To create healthy competition amongst farmers.
- To strengthen linkage amongst farmers, extension officers and researchers.
- To motivate farmers for overall development.

In relation to its role in rural livelihoods, agricultural extension encompasses the entire set of organizations that support and facilitate people engaged in agricultural production to solve problems and to obtain information, skills, and technologies to improve their livelihoods and well-being. Since a livelihood comprises the capabilities, assets and activities required for a means of living, it appears that agricultural extension intends not only to increase productivity and income, but also to improve multifaceted aspects of rural life. Agricultural extension is now

a common activity in most countries of the world, and it is a basic element in programmes arid projects formulated to bring about change in rural areas. Extension services are similarly a common feature of the administrative structure of rural areas and these services have the responsibility, in partnership with the farmers, of directing programmes and projects for change. An agricultural extension service offers technical advice on agriculture to farmers, and also supplies them with the necessary inputs and services to support their agricultural production. It provides information to farmers and passes to the farmers, new ideas developed by agriculture research stations. Agricultural extension programmes cover a broad area including improved crop varieties, better livestock control, improved water management, and the control of weeds, pests or plant diseases. Where appropriate, agricultural extension may also help to build up local farmers' groups and organizations so that they can benefit from extension programmes. Agricultural extension, therefore, provides the indispensable elements that farmers need to improve their agricultural productivity.

Global attention came back to agriculture due to the price hike in recent years, resulting partly from long-standing negligence on diffusion of appropriate technology that stagnated production in the face of a rising population. Increasing production is a major challenge facing present agriculture. Small holder farmers who dominate the landscape of developing world need to improve farming through acquiring adequate knowledge and information. Agricultural extension services provide critical access to the knowledge, information and technology that farmers require to improve the productivity and thus improve the quality of their lives and livelihoods. IT is hence crucial to provide farmers with the knowledge and information in a quality and timely way. Although some groundbreaking tools like the tele-centers can serve as major catalysts for information, knowledge and development opportunities, the access for farmers in remote villages is restricted due to the lack of infrastructure.

The Extension Butterfly



It is important to disseminate information about new technologies so that the farmer is able to make use the latest agricultural developments. There also exists a gap between research findings and the needs of farmers. For technology to be successful, it is important that it should serve a useful purpose to the end user. The institution that bridges the gap between farmers and agricultural research scientists is the Agricultural Extension Service. This service works through an Agricultural Research System in the States.

The National Institute of Agricultural Extension Management is an apex national institute set under the Ministry of Agriculture, Government of India. It assists the State Governments, the Government of India and other public sector organizations in effective management of their agricultural extension and other agricultural management systems.

For strengthening agricultural extension and transfer of technology to farmers, farmers clubs are being formed in most of the village. These clubs consist of innovative farmers, progressive farmers and farmers' interest groups. One innovative farmer of each club acts as the convener or contact person. These farmers work together to ensure the success of group centric farming practices such as organizing a pest control campaign. The State Agricultural Department has also established various centers for the training of extension personnel.

Scope of Agricultural Extension services

Extension services are the different programmes/projects/recommendations, which the extension service make available to their clientele through the use of extension education process. Agricultural extension service encompasses all aspects of agriculture and rural issues. It includes the provision of timely information, the linking of farmers with sources of farming inputs and credit facilities and most importantly, the provision of education services to farmers. The mistake people have been making was that of limiting agricultural extension services to helping the farmers to procure their planting inputs and other inputs needed on their farms; but people through hard experiences have come to realize the fact that for any agricultural project or programme to succeed, agricultural extensionists must be fully involved, so as to participate in all its activities from planning to execution. Modern agricultural extension work covers a wide spectrum of services, which include – improvement in production, marketing, storage, processing, fish farming, agro-forestry, input supply and distribution, man-power development, home economics/women in agriculture, irrigation, land management, farm mechanization, erosion control, livestock management, human resources/development, administration/management, programme planning and evaluation, youth development programmes etc. It is important to emphasize there that Extension is a weak instrument when it stands alone, but it becomes powerful when combined with price incentives, input supply, credit, seed multiplication and so forth. This becomes an improvement on already known relationship between Research-Extension-Farmer Linkage thus resulting in birth of Research-Extension Farmer-Input Linkages (REFILS).

Role of agricultural extension service

A role may be defined as a set of norms, values and interaction patterns associated with a given category of individuals. It is therefore, the job or function attached to a given status. It can be clarified with the economic concept of division of labour, which states that individuals work in different sectors of the economy. Agricultural extension service could be the government agency or ministry responsible for promoting the adoption and utilization of new scientific farming

practices through educational procedures. Many agricultural extension services could also be found in many non-governmental organizations (NGOs), many private firms and private organizations. Role of extension service therefore include – act as an intermediary or go between or even link between agricultural development institutions such as research institutes, universities, colleges of agriculture and target groups (which may be the farmer, women group, youth etc.) carries out the formulated agricultural extension policies, links the farmer with sources of farming inputs and credit facilities, provide the timely information on new innovations and practices meaningful agricultural development, provides educational services to farmers, and plays active role in the rural community development of any nation. This explains why it remains one of the strategies for rural development throughout the world, assist people to determine their own problems, help them find desirable solutions and encourage them to take action, foster beneficial changes in the outlook of all people, reappraise its work periodically to meet changing conditions and to modify its programs to suit the changing conditions, to provide maximum opportunity for the youth and the family to participate in attaining a better and more rewarding life, to maintain the highest level of proficiency in its workers by exposing them to relevant and continual training, to encourage and aid in the wise use and conservation of all human and natural resources, to promote the use and the development of volunteer leaders and help in the execution of extension programs, to promote efficient agricultural production and the development of institutions to ensure proper handling of the products for welfare of both the producers and consumers, it aids through educational efforts, the diffusion among people of all appropriate research and practical information relating to agriculture, home economics, health and encourage their application and above all, it promote the social and economic life of all people.

Agricultural extension services can potentially be provided by three main sources, these are the public sector, the private non-profit sector and the private for profit sector. The public sector includes ministries and departments of agriculture and agricultural research centers. The private non-profit sector includes local and international non-governmental organizations (NGOs), foundations, community boards and associations, bilateral and multilateral aid projects and other non-commercial associations. The private for-profit sector consists of commercial production and marketing firms (such as input manufacturers and distributors), commercial farmers or farmer group-operated enterprises where farmers are users and providers of agricultural information, agro-marketing and processing firms, trade associations and private consulting media companies. So, the agricultural extension services mainly concentrated on to strengthen the agricultural system by empowering farmers in terms of health, education, livelihood and income.

Major ICT interventions of Agriculture Ministry The three departments under the Union Ministry of Agriculture and Farmers' Welfare have developed several ICT based technologies. These have also evolved over the years into robust windows. Some of these are :Farmers' Portal,

Agri market, Soil Health Card Portal, e NAM, Crop Insurance etc. are some of the examples of web portals developed for farmers.

Use of Mobile Apps: Diffusing agricultural related information to farmers spread across the vast geography is made easier by proliferation of mobile phones. Today, mobile apps and services are being designed and released in different parts of the world. Mobile apps help to fulfil the larger objective of farmers' empowerment and facilitate in extension services which can address global food security, agriculture growth and farmers' welfare. Some illustrations of mobile apps developed for farmers are: Kisan Suvidha mobile app provides information on five critical parameters—weather, input dealers, market price, plant protection and expert advisories. An additional tab directly connects the farmer with the Kisan Call Centre (KCC) where agriculture experts answer their queries.

Use of basic mobile telephony: Mobile telephony has transformed the tenor of peoples' lives. In India, increased penetration of mobile handsets, large number of potential users, increased spread of communication, and low cost of usage are leading to growth of large number of mobile based information delivery models for the agricultural sector. With market information, farmers are better informed about markets status, prevailing prices in the market. Further, when this information is forecasted across seasons, the farmers can make more informed decisions to plan for the produce that is in demand, and this will help in reducing distress sales by farmers due to market supply fluctuations. KCC uses a backend data support system, which is inbuilt into the overall MIS (Management Information System). The MIS software captures callers' details and specifications of the query which helps in analysing area-wise and crop wise details within a time space framework and provides preventive, advance action solutions. The long standing demand for scaling up the KCCs to 35, so that every state/UT has its own and enable language compliant and location specific knowledge sharing with the farmers.

Use of Technology for Data Collection & Monitoring: Use of mobile apps to collect data from the field is indeed a revolutionary change. It can definitely avoids human error and increase productivity. CCE Agri is a mobile app used for data collection and data monitoring in rural areas. Data of crop cutting experiments (CCEs) is digitized using this mobile app which definitely removes chances of human error and reduces the time in data collation. This app significantly improves data speed (from harvesting to insurance loss estimation) and biggest gain is data quality. Geotagging ensures field visit, photos mitigate the manipulation risk and data transfer greatly improves data consolidation/analysis which eventually results in quick claim settlement. In rural areas, there are challenges on account of absence of or poor connectivity. Hence, this (CCE Agri) app has been designed in such a way, that data can be collected without internet connection and as and when internet is available, data can be pushed to the server.

Digital Technologies for Governance From the perspective of the government, which supports many of these individual activities, one of the desired outcomes is the equitable spread of value, knowledge and monies, to each contributor in the larger eco-system. Similarly, information that

reaches farmers can be outdated and in variance due to lack of standardisation and regular validation, resulting in confusion. Having a centralised database of farmers, cross-tabbed with minimum information of family including names, age, gender, education, land size (owned or leased), other assets (livestock, etc.), non-farm sources of income, total income, welfare coverage, etc. is required to provide specific and relevant support, where it is most needed. Mere presence of digital technologies does not make the farming system more intelligent. The agricultural value system requires the integration of the activities of independent actors and hence the need for standardisation and integration of data flow, such that the information adds value across the system. There is a plethora of data collected in digital formats, at various hierarchical and horizontal levels by different divisions &organisations, within and across departments and ministries. Integration can result in an appropriately designed Management Information System (MIS), operated via dashboard, will also serve as a monitoring and control system. A well designed Management Information System (MIS) will help in adopting outcome based implementation strategy, so that one is monitoring beyond quantitative targets of works and expenditure. It is possible to adopt key performance indicators for each of the programmes& projects and monitor their progress from a qualitative perspective.

Where & How ICT can be used effectively Technologies like precision agriculture aid farmers in tailored and effective water management, helping in production, improving economic efficiency and minimising waste and environmental impact. Recent progress in Big Data and advanced analytics capabilities and agri-robotics such as aerial imagery, sensors, and sophisticated local weather forecasts can truly transform the agri-scape and thus hold promise for increasing global agricultural productivity over the next few decades. Based on the types of calls received in Kisan Call Centre and database of the queries, Big data analytics can help in identifying flu/diseases outbreaks that could ruin a potential harvest. Sensors on fields and crops can provide granular data points on soil conditions, as well as detailed info on wind, fertilizer requirements, water availability and pest infestations. The use of granular data and analytical capability to integrate various sources of information (such as weather, soil, and market prices) can help in increasing crop yield and optimisingresource usage thereby lowering cost. Unmanned aerial vehicles (UAVs), or drones, can patrol fields and alert farmers to crop ripeness or potential problems. Farming depends on a predictable climate from one year to the next. In addition to hindering farmers, climate change is also suppressing financial investment in agriculture, ranging from small scale producers. Farmers need accurate weather forecasts. Since, climate change and extreme weather events will demand proactive measures to adapt or develop resiliency, Big Data can bring in the right information to take informed decisions. In schemes like Pradhan Mantri FasalBimaYojna (PMFBY - crop insurance scheme), use of Data Analytics can actually help in drawing inferences and making policies. Similar other factors can also be examined by putting more layers like Cadastral Maps on top of sown & insured area. The price forecasting information can help the farmer to know the price in advance, and use this input to take an appropriate decision on whether to sow that particular crop or not. Price Forecasting will

also help Government in taking decisions on fixing MSP, Import-Export duty and other policy decisions etc.

Artificial Intelligence Sensors provide the data, and can be used to automate specific tasks on the triggers provided. Artificial Intelligence (AI) takes automation to another level, by incorporating analysis and learning on the basis of past and current data. It further, adds the scope of automation even in decision making, where the integration of multiple and varied information is interpreted to balance a desired set of outcomes, which could themselves be variable. The vastness and complexity in agriculture makes it a very promising field for application of AI technology. Artificial Intelligence supports in decision making, provided through machine and digital learning processes. Human intelligence can take long to assimilate, understand and react to all the complex variables that comprise the uncertainties that agriculture is subject to. This tends to promote a word-of-mouth method of activity, promoting copy-cat decisions or dependence on more traditional decision taking. Artificial Intelligence can help make better sense of the inherent fuzzy data and rapidly put out answers from extremely complex inputs.

Agricultural Land Policy:

Leasing and Titling The need for a law that formally recognizes tenancy has been felt widely. Such a law is not only a source of consolidation of land holding and other efficiency enhancing measures in land use but is also essential for the implementation of government programs and reforms that require the identification of the actual cultivator. For example, disaster relief is meant for the actual cultivator but absent formal recognition of tenancy, the benefit may accrue to the landowner who continues to be as the cultivator in the revenue records. Similarly, fertilizer subsidy can be given through the direct benefit transfer system to the actual cultivator if the latter can be identified.

Land leasing laws in agriculture in most of the states in India were enacted during decades immediately following the independence. At the time, the abolition of Zamindari and redistribution of land to the tiller were the highest policy priorities. Tenancy and sub-tenancy were viewed as integral to the feudal system that India had inherited from the British and sought to abolish. Therefore, tenancy reform laws that various states adopted in the post-independence era sought to not only transfer ownership rights to the tenant but also prohibited or heavily discouraged leasing and sub-leasing of land.

Unfortunately, however, politically influential landowners successfully subverted the land reforms in India. Moreover, just seven states, Assam, Gujarat, Himachal Pradesh, Karnataka, Kerala, Maharashtra, and West Bengal, accounted for 97% of this transfer. In trying to force the transfer of ownership to the cultivator, many states abolished tenancy altogether. The policy resulted in minimal land transfer and had the unintended effect of ending any protection to tenants and forced them underground. Some states allowed tenancy but imposed a tight ceiling

on land rent requiring that it be no more than one-fifth to one-fourth of the produce. But since this ceiling fell well below the level acceptable to the landowner, contracts became oral in these states as well, with the rent settling closer to 50% of the produce. Today, Telangana, Bihar, Karnataka, Madhya Pradesh and Uttar Pradesh ban land leasing with exceptions granted to landowners among widows, minors, disabled and defence personnel. Kerala has for long banned tenancy entirely, permitting only recently self-help groups to lease land. Some states including Punjab, Haryana, Gujarat, Maharashtra and Assam do not ban leasing but tenancy for a specified period makes the tenant eligible to buy the leased land. This provision too has the effect of making tenancy agreements oral, leaving the tenant vulnerable. Only the states of Andhra Pradesh, Tamil Nadu, Rajasthan and West Bengal have liberal tenancy laws with the last one limiting tenancy to sharecroppers. A large number of states with otherwise liberal tenancy laws do not recognize sharecroppers as tenants.

- These restrictions have detrimental effects on not only the tenant whom they were originally designed to protect but also the landowner. The **tenant lacks the security of tenure** that she would have if laws permitted her and the landowner to freely write transparent contracts. In turn, this discourages her from making long-term investments in land and also leaves her feeling perpetually insecure about continuing to maintain cultivation rights. Furthermore, it deprives her of potential access to credit that may be available to cultivators including that under priority sector lending.
- **Landowner also feels a sense of insecurity** when leasing land encouraging many choosing to leave land fallow rather than lease it. The practice of leaving the land fallow is becoming increasingly prevalent with landowners and their children seeking non-farm employment. Over the generations, land holdings have become progressively small and fragmented. The absence of transparent land leasing laws has hampered the consolidation of these holdings. In the present-day context when many in famer families seek non-farm employment, greater potential for consolidation has opened up. The absence of transparent leasing laws also poses challenges for public policy. For example, there are calls for expanded and more effective crop insurance. Recognizing that such insurance is likely to be highly subsidized, as has been the case with the past programmes, a natural question is how to ensure that the tenant who bears the bulk of the risk of cultivation receives this benefit.
- **Absent formal records of tenancy**, it is unlikely that the actual cultivator will be able to reap this benefit. The same problem arises in the face of a natural calamity; if tenancy is informal, we cannot ensure that the actual cultivator would benefit from the disaster relief programmes. In a similar vein, fertilizer subsidy today is subject to vast leakages with fertilizer purchased at subsidized prices sold in the black market. In principle, these leakages could be sharply curtailed by the introduction of direct benefit transfer (DBT) using Aadhar seeded bank accounts along the lines of the cooking gas subsidy transfer. But in the face of the difficulty in identifying the real cultivator, DBT cannot be satisfactorily implemented.

- The introduction of transparent land leasing law that allows the potential tenant or sharecropper to engage in written contracts with the landowner is a win-win reform. In the presence of such a law, the tenant will have an incentive to make investment in improvement of land and will also be able to access credit including under priority-sector lending. Under the law, the landowner will also be able to lease land without fear of losing it to the tenant. Among other things, this will also permit the consolidation of land holding so essential in the face of declining size of and fragmented land holdings.
- Finally, with the tenant formally recognized, the government will be able to implement its policies aimed at the cultivator as the beneficiary efficiently. An argument against liberalisation of land lease market is that landowners may evict the existing tenants who had acquired rights to cultivate upon abolition of Zamindari. But giving these existing tenants the first right of refusal or even leaving them outside the purview of the new leasing law can alleviate this problem.
- Another fear is that opening of the lease market will bring private investors into agriculture. While, in principle, private investment is desirable for enhancing productivity, it may potentially hurt small and marginal farmers by restricting their access to land.

There are two answers to this argument.

- First, more productive farms would create well-paid jobs that potentially provide better living than that of a small or marginal farmer.
- And second, an overall ceiling may be imposed on the amount of land that private investors can cultivate in any region.

An important instrument for creating vibrant land lease market is land bank. Such a bank may be held by a public agency. Interested landowners may deposit their land parcels in the bank and potential cultivators may lease in land from it. The public agency would work essentially as a clearinghouse. It would transfer rent from actual cultivator to owner while charging a small fee to cover its costs. Land banks can give confidence to the owners that their land would remain safe while also earning them competitive rent. On the other hand, potential tenants would find it easier to find land parcels they wish to lease in.

Land sales market also functions inefficiently when titles are ill defined. Absence of titles can also be in the way of reform of land leasing laws. For instance, if presumptive owners fear that reformed land leasing laws that formally recognize tenancy rights would pave the way for a future populist government to transfer ownership to the tenants, they would oppose such reform. In contrast if they held indefeasible ownership titles, they would assured of their ownership rights and support the reform.

Small experiments in some states to build such register have not been successful. Existing registers suffer from problems arising from lack of up-to-date records, informal family partitions, unregistered power of attorney transactions and numerous boundary and ownership disputes. The

creation of a land-holdings register requires that land parcels be identified, with their boundaries, and ownership established. The former requires maps of individual land parcels and their location within an area's land grid, both correlated accurately with the prevailing ground conditions. The latter requires undisputed, litigation-free ownership rights. Both these records will then have to be publicly notified before the conclusive title is granted.

The National Land Records Modernization Program, initiated by the Government of India in 2008, aims to build a transparent and integrated system of real-time land records based on land surveys, updating of survey and settlement records. The high-resolution satellite imagery and ground truth data collection by electronic total station and GPS are to be used. It also envisages computerization of land records and registration, modernizing of record rooms and setting up of record management Centres. So far only four states—Gujarat, Haryana, Karnataka and Tripura—are in advanced stages of modernizing records. Another eight — Andhra Pradesh, Bihar, Delhi, Goa, Maharashtra, Odisha, Rajasthan and Uttar Pradesh—have made substantial progress. Nine other states including Chhattisgarh, Himachal Pradesh, Madhya Pradesh, Tamil Nadu and West Bengal have made some beginning towards modernizing land records, while Kerala, Arunachal Pradesh, Jammu & Kashmir, Jharkhand, Manipur, Meghalaya, Mizoram and Nagaland are very slow. It is noteworthy that states like Chhattisgarh, Orissa and Tripura has implemented Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 (popularly called as Forest Right Act 2006) under which the forest dwellers were provided 1-2 acre land for settled farming. By September 2013, titles for 2.18 million ha had been given to eligible forest dwellers. It needs to be noted that under the Indian Constitution, land is a State subject. Therefore, the changes in this area would require action by states. Given its mandate to promote cooperative and competitive federalism, the NITI Aayog is the obvious institution to assist the states in catalyzing these changes.

Land Capability Classes:

The most important aspects of land are its role in providing anchorage space to all resources, and the fact that most human activities take place on land. Land is limited in supply and there is competition for its use. In the light of increasing population, the demand is also increasing, thus optimum use of land has become a necessity. Land is also unevenly distributed in terms of itsqualities. It has its limitations for different uses. Land can be improved for a particular use by certain measures, it can also be improved by a certain kind of Land-use or at least sustained production can be assured. Land can deteriorate by its mismanagement, wrong Land-use or by certain cultivation practices, thus in order to avoid misuse and wastage of land. It should be used judiciously considering its capability and suitability for particular use.

Actually the quality of land is a complex attribute, which acts ,in a distinct fashion in its influence on the suitability of land for a specific kind of use. But in brief capability is an inherent capacity of land to perform at a given level for a general Land-use while suitability is a state of

adaptability of a given area for a specified Land-use. Land capability is by and large, ascertained by inherentsoil characteristics external land features and environmental factors that limit Land-use."Carrying capacity in a sense is a measure of farming efficiency" (Stamp L.D, 1962). The concept of carrying capacity ofland was first introduced by Stamp in his presidential address tothe International Geographical Congress at Rio de Janerio in 1951. The idea perhaps struck him while he pondered over the problem of a ever-increasing pressure of population on land resources for measuring the carrying capacity of land. The nutritive value of thefood crops instead of crop yields is taken into consideration.

Eight land capability classes are recognized and indicated by Roman numbers. (A) Class I-IV include land suited for cultivation. (B) Class-V-VIII land not suited for cultivation and should be maintained under natural vegetation of forests or grasses.

(A) Land Suited for Cultivation:

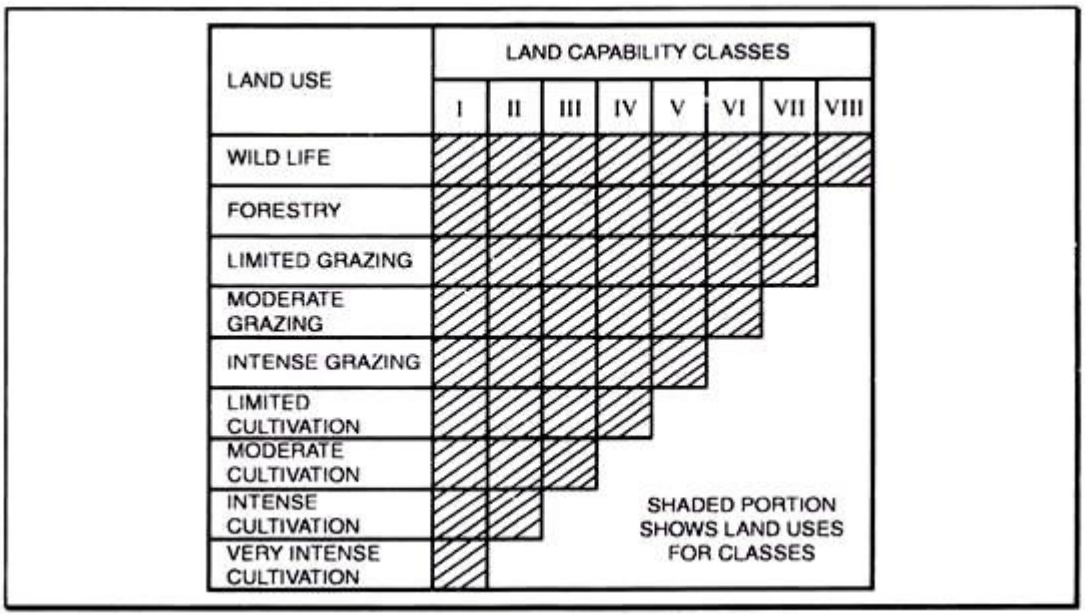
Class I. Soils in Class I are very good. The soils are deep, productive, easily worked, and nearly level. They are not subject to overflow (run-off) damage. However, they are subject to fertility and puddle erosion. Soils of this class have no or only slight risks of damage .Class I soils used for crops, need practices to maintain solid fertility and soil structure. These practices involve use of fertilizers, cover crop, green manure crop and crop rotation.

Class II: Soils of this group are good. They can be cultivated with easily applied practices. They are subject to moderate risk of damage. Soils of this group have gentle slopes, are subject to moderate erosion. They are subject to occasional overflows.These soils may require special practices such as contour tillage, crop rotation, water-control devices.

Class III: Soils in Class III are subject to severe risks. They are moderately good soils. They can be used regularly for crops, soils in this class have moderately steep slopes, are subject to more severe erosion and are inherently low in fertility. These soils require cropping systems that produce adequate plant cover. The cover is needed to protect the soil from erosion. It also helps preserve soil structure. In strip cropping, sod crops should be grown instead of cultivated row crops. Complete water-disposal system of terraces and outlets. Practices of contour tillage.

Class IV: Soils of this group have very severe permanent hazards if used for crop land. The soils are fairly good. They are frequently on steep slopes and subject to severe erosion. The soils are shallow or moderately deep, low in fertility.They should usually be kept in hay or pasture,

although a grain crop may be grown once in five or six years. Complete water-disposal system of terraces and outlets, with contour tillage. Stabilize gullies.



(B) Soils not Suited for Cultivation:

Class V: Soils in Class V should be kept in permanent vegetation. They should be used for pasture or forestry. Cultivation is not feasible, however, because of wetness, stoniness or other limitations. The land is nearly level. It is subject to only slight erosion by wind or water if properly managed. They have few permanent limitations.Grazing should be regulated.

Class VI: Soils of this class should be used for grazing and forestry. They have moderate permanent limitations and are unsuitable for cultivation. They are steep or shallow. Class VI land is either steeper or more subject to wind erosion than Class IV. Class VI land is too steep, stony, and wet for cultivation. Grazing should not be permitted.

Class VII: Soil in Class VII are subject to severe permanent limitations (or hazards). They are fair to poor for grazing or forestry. They are steep, eroded, shallow, droughty or swampy and are unsuitable for cultivation.Strict management should be applied.

Class VIII: Soils of this class are extremely rough, arid or swampy and are unsuitable for cultivation. They are not suited for forestry or grazing. They should be used for wildlife, recreation or watershed uses.

Capability Sub-Classes:

These are sub-divisions of capability classes made on the basis of four dominating limitations, namely,

- Risk of erosion
- Wetness, drainage or overflow
- Rooting zone limitations , and
- Climatic limitations .

Capability Units:

These are further sub-divisions of capability sub-classes. A capability unit consists of soils which are sufficiently uniform in their characteristics, potentialities and limitations and require fairly similar conservation treatments and management practices.

The land capability classes can change towards better classes, if the existing limitations can be permanently removed or reduced in extent by economically feasible reclamation projects or corrective measures, such as providing irrigation, installing drainage, constructing flood retarding structures or controlling large scale gullies. A further deterioration in existing conditions can similarly shift the capability to a poorer class.

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