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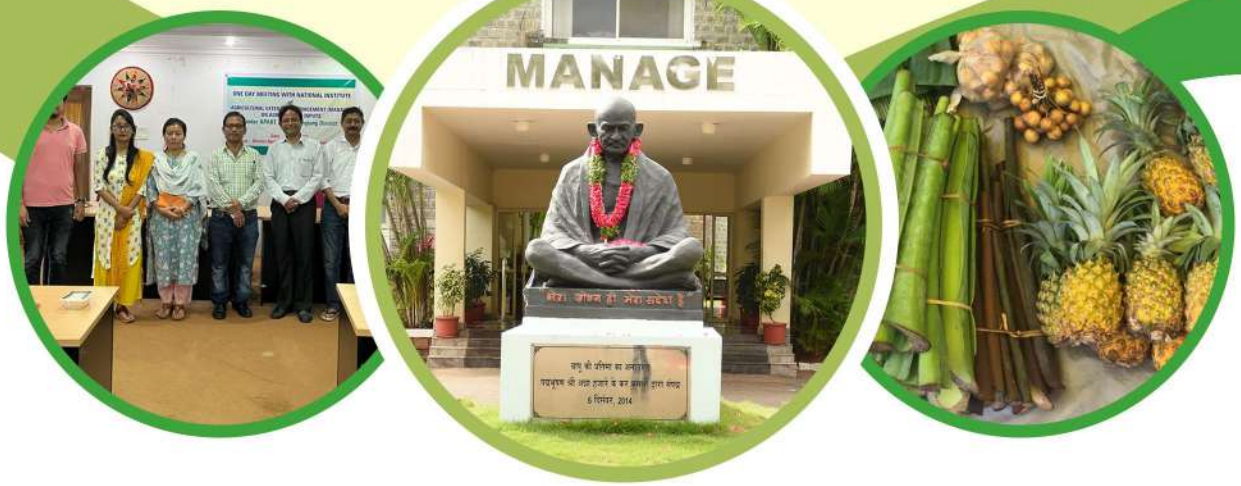
Review and Analysis of
Farm Input Supply Systems in Assam



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MANAGE

National Institute of Agricultural Extension Management (MANAGE)
(An Autonomous Organisation of Ministry of Agriculture and Farmers Welfare, Govt. Of India)
Rajendra Nagar Hyderabad – 500 030, Telangana, India

Study on

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By

National Institute of Agricultural Extension Management (MANAGE), Hyderabad

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Team associated with the Study

Shalendra, Coordinator, MANAGE, Hyderabad

Soumitra Das, Team Leader & Agri Input system Expert

Vijay Bhaskar Reddy, Seed System Expert

Ajay Bhartiya, Fertilizer System Expert

Ansuman Maity, Agro-chemical System Expert

B Venkata Rao, Assistant Director (Marketing)

Sangamesh Angre, Consultant (Skill Development)

Acronyms & Abbreviations

AAU – Assam Agricultural University
ADO – Agricultural Development Officer
ASAMB – Assam State Agricultural Marketing Board
ASC – Assam Seed Corporation
ASOCA – Assam Seed & Organic Certification Agency
ATMA – Agricultural Technology Management Agency
C&F – Clearing and Forwarding
CIB&RC – Central Insecticides Board and Registration Committee
DoA – Department of Agriculture
DOH – Department of Horticulture
ePoS – Electronic Point of Sale Machine
ETL – Economic Threshold Level
F/S – Foundation Seed
F1 – Hybrid
FAO – Food and Agriculture Organization
FBO – Food Business Operators
FCO – Fertilizer Control Order
FFS – Farmer Field School
FPO – Farmer Producer Organization
FY – Financial Year
GoA – Government of Assam
GoI – Government of India
ha – Hectare
HRS – Horticultural Research Station
HYV – High Yielding Variety
ICAR – Indian Council of Agricultural Research
ICT – Information and Communication Technology
IPM – Integrated Pest Management
KVK – Krishi Vigyan Kendra
MNC – Multinational Company
MRP – Maximum Retail Price
MSP – Minimum Support Price
MT – Metric Tonnes
NBS – Nutrient Based Subsidy
NGO – Non-Governmental Organization
OP – Open Pollinated
PPC – Plant Protection Chemicals
RARS – Regional Agricultural Research Station
RPS – Retention Price Scheme
RTI – Right to Information
SAU – State Agricultural University
SHG – Self Help Group
SRR – Seed Replacement Ratio
TCB – Tissue Culture Banana
TL – Truthfully Labelled
TSSCL – Telangana State Seed Corporation Ltd
VRR – Varietal Replacement Ratio

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Executive Summary

Seeds

Seed in agriculture is the starting point. It is a source of continuity and change and therefore, may be considered as most important agri-product. It is estimated that the direct contribution of quality seed alone to the total production is about 40 - 50 percent facilitated by efficient management of other inputs. It is important to formulate agricultural development policies involving seeds for its role in agricultural production. The process of making seed available to the producers as an industry is a comprehensive process covering research and development, seed production, certification process to ensure quality and marketing and distribution. The size of global seed industry at present is USD 52 BN and growing at CAGR of 5 percent. Though, India is occupying 5th position in global market but its share is just 6 percent which mainly is due to presence of mix of large, medium and small companies.

While certain large companies have competencies in all the industry functions such as R&D, production, processing, marketing and distribution; small companies on the other hand may specialize only in one or more functions. The foundation for Indian seed sector development was laid down by public sector institutions during 1960s and 1970s. The public sector is represented by the National Seed Corporation (NSC) and the State Seed Corporations (SSCs). Currently there are nearly 700+ seed companies in India both in private and public sectors. The Indian seed industry is regulated by Seed Act, 1966 which regulates the quality of seeds sold to farmers. The Seed Control Order, 1983 oversees the process of licensing for conducting seed business. In general, private sector specializes in high value hybrid seeds and varietal seeds and offers them to farmers as Truthfully Labelled (TL) seeds, whereas public sector specializes in high volume OPV seeds and offers them to farmers as Certified Seeds. The Indian hybrid seed industry is estimated at Rs 10,000 Crores or USD 1.33 BN. The entire hybrid Cotton Seed Market is GM Cotton Seed and, therefore, GM Seed Market is nearly 16 percent of the total seed market and 35 percent of the hybrid seed market. Cotton and vegetables account for more than 60 percent share of hybrid seeds market in India.

Assam has to depend on other states for its seed requirement and will have to go a long way before achieving self-sufficiency in seed production. Though, the

State has the capacity to produce almost entire quantity of seeds of rice, oilseeds, various pulses and different kinds of vegetable crops with active involvement of the Assam Agricultural University, Assam Seed Corporation and also the Department of Agriculture. However, the state at present will have to rely on procuring seeds from other states mainly seeds of wheat, maize, some pulses and seeds of hybrid varieties of rice and other crops due to limited capacity of the state to produce quality seeds. The weak formal seed system in Assam indicates the dependence of farmers on informal seed system which may have a contribution of anything between 30-40 percent highlighting the importance of informal seed system in Assam. It may also be important for maintaining traditional seed system mainly for crops having geographic importance like black rice, joha rice, scented rice and Assam local ginger and turmeric.

The assessment of seed and planting material for major crops in Assam suggests a huge requirement of paddy seed in the state. Total paddy seed requirement is 3,02,242 qts, in all three seasons put together. Assam state is more or less self-sufficient in seed production of varietal and high yielding varieties of paddy and rapeseed and mustard. Regarding pulses, seed production is done in the state but with limited success in obtaining the required quantities due to various reasons like availability of breeder seed and adverse climatic conditions which are not favourable for seed production in the state. Not much success has been achieved in vegetable seed production though there are some OP Vegetable seed production trials in progress. Multiplication of Breeder seed in low cost net houses is in progress for OP vegetable seeds. OP Vegetable seed lines of Pumpkin & Tomato are in progress under APART. Most of the vegetable seeds are sourced from other states and a major role is played by private seed companies in vegetable seed supplies in the state. Regarding Banana crop, most of the farmers are observed to be growing local varieties with own planting material though the tissue culture concept is slowly gaining ground. The state government is not focusing much on developing planting material. In case of potato also, though the State is making efforts through APART but most of the planting material (tubers) comes from other states like Punjab, Haryana, Uttar Pradesh and West Bengal. Same is the case with Turmeric and Ginger planting material where farmers are using their own produce for multiplication.

Observations on production of seed and planting material based on secondary information and interaction with different stakeholders to help develop better seed supply chain in the state suggest that seed production should be planned during dry season and districts selected for seed production should not be flood effected. Farmers should be trained on seed production techniques and drying facilities should be provided to the seed producing farmers so that seed can be dried to optimum moisture levels and stored. Seed testing facilities should be made available to the seed producing farmers for testing various seed quality parameters. There is also need for having proper seed storage infrastructure and government should encourage involvement of FPOs in seed production by providing common seed production facilities.

It is observed that the Seed Replacement Ratio (SRR) and Varietal Replacement Ratio (VRR) in the state is very low when compared to other states. There is a need to improve SRR and introduce new seed varieties which are more yielding and disease tolerant in comparison to the existing seed varieties. A comprehensive list of verities of major crops suitable for cultivation in Assam needs to be developed by involving different agencies mainly the regional research stations and University. A tentative list has also been compiled under the study.

In the state of Assam, Assam Seed & Organic Certification Agency (ASOCA) takes care of all the activities related to certification of seeds sown by the farmers for the purpose of seed production. ASOCA is putting a lot of efforts on certification to ensure availability of quality seeds of various crops in the state. There is need to strengthen the seed certification system with provision for buy back at premium price from the farmers and encourage participation of private players.

Seed processing is a vital part of the seed production. Seed processing and the infrastructure to support the same has an important role to play in making the seed supply system effective. Assam is lagging behind in making the seed processing facilities available. There are only two seed processing units in the entire state. Even ASC Seed Processing Plant is not fully functional. There is an immediate need to establish at least one seed processing plant in each district. Lack of sufficient seed processing plants in the State is one of the major reasons for supply of inferior quality seeds effecting seed supply chain in the state.

There are 52 farms operating under Assam Seed Corporation (12 farms of ASC and 40 farms of Directorate of Agriculture handed over to ASC). In most of the ASC farms, area is not being utilized completely. In order to utilize these farms optimally for seed development and production, possibilities may be explored under PPP model so that resources can be utilized jointly by public and private companies. Another important issue to be addressed is to have a sound seed licensing system. More than two-third of the retailers are selling seed without any seed license.

Seed village program should be strengthened in the State. In order to develop an efficient seed supply system and have sound monitoring mechanism in the state, there is a need to have 'Seed Traceability System'. There is also need for a seed consortium to encourage strong network between the seed supply chain stakeholders leading to efficient delivery of inputs.

There is need to develop a comprehensive capacity building strategy covering all the relevant stakeholders and different aspects of inputs supply system. All the institutes and agencies involved in development, production and distribution of seeds to be involved in capacity building programs and focus to be given on involving players like company and their team of distributors and retailers. Farmer awareness and training to be made an integral part of the distribution network so as to ensure proper use of seeds and other inputs. The Assam has great potential in seed production but a sound seed production and supply system involving both public and private players is required to be developed with participation of other states as well.

Agro-chemicals

The Green Revolution leading to increased productivity has allowed world food production to increase significantly in the past 50 years. Much of the increase in yield per unit of area can be attributed to more efficient control of (biotic) stress rather than an increase in yield potential. The reduction of current yield losses caused by pests, pathogens and weeds is a major challenge to agricultural production. Thus, the intensity of crop protection has increased considerably, a 15 – 20 fold increase in the quantum of pesticides used worldwide with India and Assam being no exception. During the past few decades, India and Assam both have witnessed a substantial increase in the use of pesticides in terms of both volume and value. Despite huge growth experienced in per hectare consumption of pesticides in Assam, the

application is still quite low in comparison to other states like Tamil Nadu, Punjab and Telangana. Though, the per unit application of chemicals in low in Assam, the problem of indiscriminate use of chemical pesticides without considering scientific recommendations has been witnessed in areas mainly cultivating paddy and vegetables. The excessive indiscriminate use of pesticides not only increases the cost of production but also results in many other issues related to environment and human health. Judicious application of pesticides, therefore, is the concern of all stakeholders in view of low productivity in the state compared to that in other states like Punjab, Telangana, Tamil Nadu, etc. There is need to strengthen the delivery system of pesticides in Assam by improving the infrastructure and building capacity of different stakeholders for long-term cost-effective and sustainable growth in the agricultural sector.

After land, the provision of farm inputs such as seeds, machinery and equipment; fertilizer and agro-chemicals are probably the most important factor influencing the productivity of farms. The farmers require the right inputs at the right time in correct quantities at affordable prices. The effectiveness of the input supplying system in fulfilling these requirements is largely influenced by the structure, conduct and regulatory environment defining the system. It also enables farmers to receive inputs in a transparent and corruption-free market environment which minimizes administrative costs of delivery of farm-inputs.

Broadly, the plant protection chemical delivery system in Assam can be divided into three major sub-sectors. Marketing Channel which consists of the traditional channel through which a pesticide formulation finds its way from the primary manufacturer to the end users i.e. the farmers. The regulatory body, mainly the Government of Assam through the Ministry of Agriculture plays an important role in the seamless delivery of pesticides in the state. Major roles of the State Government are issuing licenses to the pesticide manufacturing and marketing companies, dealers, distributors and cooperatives, checking the quality of the materials which are being sold to the farmers and checking the presence of spurious and substandard materials in the marketplace, imparting training to different stakeholders and sometimes purchase and free distribution of pesticides to farmers. Lastly, the knowledge sector which consists of Assam Agricultural University and Research & Development and marketing department of the primary manufacturer

and formulators of pesticides. The university through its extensive network of Krishi Vigyan Kendra (KVK), the Directorate of Extension and the Directorate of Research plays an important role in the dissemination of knowledge related to pests and pesticides to the stakeholders of the entire system.

Apparently, there is no short supply of pesticides in Assam and no data is available on crop failure due to the non-availability of pesticides. But, this may be an understatement as there is hardly any study done to make any estimation on the actual requirement of the different segments of the pesticides. Moreover, the density of sale points that cater to delivery of pesticides is less compared to the agriculturally developed states like Punjab, Haryana & Tamil Nadu. Distribution of sale points across different districts of the state is also skewed. Although, district-wise data on the number of sale points are not available, it is very likely that Barpeta, Tinsukia, Dibrugarh, Sonitpur, Darang, Udalguri and Nagaon might have the major share of the sales points in the state indicating the urgent need for the Government to start its own sale counters, particularly in the geographically challenged territories.

Assam traditionally is a market (except tea plantation segment) of generic pesticides and is less adaptive to newer technologies as far as plant protection is concerned. This may be a result of gap in the extension and the educational background of the different stakeholders involved in the supply system. Again, as the pesticide is a decontrolled sector, the interventions of the Government agencies are somewhat less as compared to the fertilizer and seed sector. Coming to bio-pesticides, Assam has considerable potential for bio-pesticides as some parts of the state are traditionally organic. But, there is a considerable gap between the potential and actual use because of many reasons like lack of availability, short life span, lack of efficacy, etc. Most of the stakeholders have a negative impression of bio-pesticides. The private sector may be provided with requisite support to start small and medium level enterprises with an assurance to buyback, which may be restricted to a certain percentage of the production, by the Department of Agriculture for requirements under various schemes and programs.

The state is also facing the problem of presence of the non-genuine / illegal pesticides. The problem is more complicated as the sole State Pesticide Testing Laboratory is not functional. The number of samples collected by the pesticide inspectors is also very less due to the lengthy operational procedure for sending the

samples to Central Pesticide Testing Laboratory, Faridabad. There is an urgent need to take steps to operationalize the State Pesticide Testing Laboratory and increase the number of samples collected and analysed for quality inspection for the best interest of the farmers and the state.

There is need for an effective strategy to be adopted involving both the public and private agencies to create awareness among different stakeholders for efficient use of pesticides. Most of the farmers are aware only about old generic molecules with limited understanding of new technologies. Retailers and distributors are also observed to suffer from lack of awareness on issues related to legally authorised pesticides marketing companies, importance of verifying the authenticity of companies before distributing/ selling their products and issues related to safe disposal of expired stocks. A comprehensive plan covering production, awareness, training, certification, infrastructure creation and diversification toward new products mainly bio-pesticides is required to ensure smooth delivery of chemicals to farmers.

Fertilizers

Availability of inputs including seeds, agro-chemicals, machineries and fertilizers needs lots of attention of policy makers in Assam. The level of awareness and availability of fertilizers is observed to be less than the all India average. There is need to have a sound distribution network with participation of public agencies to ensure timely supply of inputs mainly fertilizers. Most of the states have at least one public or cooperative organisation to ensure smooth delivery of fertilizers rather than replying completely on private channels for smooth distribution of fertilisers. However, the Assam Government is observed to lack the same. The fertilizers in the state of Assam are distributed primarily through private channels making the performance of fertilizer distribution in terms of availability (quality and price) solely influenced by the convenience and objectives of the private players. Private sector is driven by commercial interests without any concern for farmers. There is a need to have a public agency playing the guiding role in the distribution of fertilizers in the state to monitor the performance of private trade and to safeguard the conflicting interests of different stakeholders. The presence of such institute based on strong rural network can also help in efficient implementation of various schemes and projects of the state and central government related with agriculture development. In

many states, government wing responsible for distribution of fertilizers is also the agency facilitating successful implementation of various state and central government schemes.

The Government of Assam has recently introduced a comprehensive Standard Operating Procedure (SOP) for Fertilizer (Urea). The proper implementation of SOP ensuring regulated supply by safeguarding the interest of all the stakeholders mainly famers looking for regular supply at reasonable price may actually be the game-changer. Though, the government was compelled to reverse the decision to restore the previous market situation by extending the implementation from 1st November 2022. All cancelled licenses, around 1200, were restored to maintain the network of retailers back to 3650. Wholesalers were converted to retailers with lots of limitation in sales. July is peak month of fertilizer consumption and fertilizers were not available to farmers even if the stocks were there in the warehouses. Assam State Agricultural Marketing Board (ASAMB) is required to be prepared properly and state government to have a sound system to ensure regular monitoring of the activities of the Board and other stakeholder in the revised system to ensure smooth delivery of fertilizer. Strengthening of the Board and building capacity of the officers will be important as they don't have experience of fertilizers trade and distribution and private players may again set their tune.

Some of the common fertilizers observed to be popular in Assam fertilizer markets are Urea, Di Ammonium Phosphate (DAP), Muriate of Potash (MOP), NPK Mixtures, Single Super Phosphate (SSP), Organic Fertilizers and Micro-Nutrients. Supply chain and marketing of Urea is different from all other fertilizers due to heavy subsidy and government regulations. Urea becomes the most sought after fertilizer for its significance for plant growth, cheap price and control of government on its distribution and marketing. There is a permanent urea shortage for the last few years all over the state. The BVFCL, IFFCO & IPL have failed to supply urea to all the districts regularly based on a plan. No dealer knows when the next lot of urea would be available. This shortfall of fertilisers mainly Urea is to be addressed at different levels including proper allocation which will depend on appropriate estimation of demand in the state. Another component of the strategy can be diversification towards secondary and micro-nutrients. State government needs to promote

secondary and micro-nutrients. Nano-fertilisers also offer great potential if policy environment is created to provide support infrastructure.

Farmers in the state are unaware about nutritional requirement of plant and purpose of different fertilizers. There is need to guide different departments to have proper plans to introduce and encourage the consumption of speciality fertilizers, secondary & micro-nutrients and the concept of balanced nutrition. The level of application of chemical fertilizer is low in the state at 72 kg/ha against the national average of 162 kg/ha. This can be taken as an opportunity and follow a modest approach which is blends of organic or natural fertilizers with speciality fertilizers to provide required nutrition, sustainability and efficacy. At the same time, government should help in promoting public or private companies to capitalise on being “more organic”. A balanced nutrition and better source of nutrients should be promoted to take the advantage of sustainable productivity mainly in horticulture crops. There is need to encourage involvement of agencies like KVKs. At present, there are 23 KVKs in Assam. KVKs are having experts in horticulture, agronomy, plant protection, animal-husbandry, fisheries and extension support staff. These KVKs require support, empowerment and motivation to become the vehicle for change in Assam agriculture. There is lack of awareness amongst the farmers, distribution channel partners and even government officials on various aspects of balanced use of fertilisers. It is important to encourage balanced use of fertilisers to achieve optimal production with minimum impact on environment and also to reduce cost of production. The use of fertilisers in Assam is very less compared to national average, let it be Urea, DAP, MOP or SSP. Farmers are many times observed to be using organic fertilisers not by choice but out of compulsion of not getting regular fertilizers at fair prices. The issue of pricing of fertilisers mainly Urea has also been highlighted by different stakeholders during various interactions conducted under the study. In some of the cases observed in Cachar district, there were instances where Urea was procured at almost double the prescribed priced.

It is very difficult to ensure delivery of fertilizer to the farmers at fair price with the existing channel of fertilizer distribution having dominance of private or corporate channels. There is need to improve it by encouraging participation of both public and private agencies and have sufficient retailers to get the product delivered even in difficult area. Induction of new Urea SOP and entry of government agency (ASAMB)

in the distribution of urea has opened the gate for cost-effective delivery of fertilizers and dissemination of new technologies, which are many times ignored by private sector because of difficulties in launching new products.

ASAMB has to be strengthened and empowered, young blood is required in the organisation to make it happen. The capacity of staff and officers available at ASAMB is required to be built appropriately. After the announcement of Urea SOP, there is no formal organisation structure to handle urea trade and deal with issues related to duties and responsibilities of officers, mapping of warehouses, new rake-points, creating network and issuing Form-O & PoS machines and so on. ASAMB needs all the support and attention from state government to turnaround agriculture is Assam.

Methods to assess the requirement of different fertilizers including demand of urea by DoA has to be revisited. It appears that Assam government is demanding lesser urea than actual requirement of the state leading to shortage in supply and making price uncontrollable. Government of Assam has to focus on new generation of fertilizers to compensate shortage of other fertilizers, at least nutritional requirement of the plant can be fulfilled for optimum production. It is worth mentioning that Speciality Fertilizers are required in smaller quantities, hence the component of transportation cost is less. Fertilizer use efficiency of specialty fertilizers is very high and has minimal effect on carbon footprint. Private and cooperative sectors need to be encouraged to participate better through increased density and coverage of retailers to have a sound fertilizer system in the state.

PESTLE Analysis

PESTLE Analysis

Seeds

Political factors impacting seed supply system in Assam

Political factors play a significant role in defining the seed supply system in the state. Following analysis has been done on political factors of Assam which are influencing the seed supply system in the state –

- The political environment is favourable in the state for development of seed system. However, there is need for having a legal framework for better participation of private players in supply of seeds. In order to have a balanced participation of different stakeholders and deliver the seed at best possible price to the farmers, there is need to have a seed price policy for private companies.
- Taxation – There is no tax for seed production or marketing which is a favourable condition in the state for seed system.
- Week regulations in seed system – In seed sector, the old Seed Act of 1966 & 1983 are still followed. In the present situation, the Seed Act should be updated and seed regulations in the state should be strictly enforced to stop sale of unauthorized seed by private seed companies.
- Seed traceability system – Seed traceability is not there in the present system. There is need to implement a proper traceability system by introducing technology like barcode system for all seed supplies made in the state to provide complete details on the movement of seed in the state.

Economic factors

- The ability of the farmers to purchase good quality seed is affected by factors like low income and poor productivity due to uncertain climatic conditions and week distribution network.
- Absence of proper buyback arrangement with fixed price is the major constraint expressed by the farmers. The fluctuation in the selling price of farmer produced seeds results in low income for the seed producing farmers.
- Government spending on seed subsidy – Limited funds allotted in comparison to other states for implementing seed subsidy programs in the state.
- Infrastructure – No proper infrastructure developed in the state for seed sector development. There is need for seed processing, seed drying and seed packaging infrastructure.

Social factors

- Attitude towards savings – The culture of income saving by the farmers in the state of Assam is relatively low.
- Lack of proper knowledge in the farming community is having impact on selection and use of quality seeds for farming.
- Migration – Participation of youth in agriculture in the state is declining due to migration.
- Entrepreneurial orientation – Farmers lack entrepreneurial spirit towards agriculture.
- Attitude towards leisure – The rural society of the state is having leisure attitude and therefore, fail to take agriculture as business.

Technological factors

- Application of agriculture technology in seed sector is very low in the state of Assam.
- Seed traceability technology need to be introduced in the state.
- Limited use of latest machinery in Assam Seed Sector has been observed. There is need to upgrade seed processing plants.

Environmental factors

- Weather – Assam has got very humid and heavy rainfall conditions which influences seed production process negatively.
- Climate change – Assam state faces both extreme flood to drought. Unseasonal rains affect the seed production and supply system in the state.

Legal factors

- The seed regulation system is week and not properly implemented in the Assam.
- There is also need to implement laws to protect farmers from crop failure due to sub-standard seed supplies.
- Seed Act which is being implemented in the state is very old. There is need to formulated new laws to protect the seed trade and interest of different stakeholders.

Agro-chemicals

Factors	Status	Strength	Limitation
Political	Pesticide is deregulated sector and government policies are in line with the interest of the private sector players.	▪ Willingness of the state government to promote new technology related to plant protection through different public sector scheme. ▪ Effective implementation of PM-KISAN Samman Nidhi Yojana (a Central Sector scheme with 100% funding from Government of India) ▪ Implementation of Pradhan Mantri Fasal Bima Yojana (PMFBY) which is the central government sponsored crop insurance scheme	▪ Goods and Service Tax (GST) on synthetic pesticides is 18% which makes speciality chemicals costlier and put a cap on their use by the farmers. Although, GST is not a state subject ▪ Lack of interest in running public sector sale points in geographically challenged areas of the state. ▪ Slow response in controlling the proliferation of inferior quality pesticides and pesticide spiked bio products in the states.
Economic	▪ Assam is the largest economy in the northeast region. Owing to its relative proximity to the rest of the country and availability of relatively better	▪ Economy is agriculture based, with 69 percent of the population engaged in it. ▪ Diversified agriculture and almost year-round	▪ Almost 100 percent dependency on the import of pesticides from other states or countries. ▪ Small and marginal land holdings

	infrastructure, the state offers a favourable environment for the industry. ▪ Assam has the largest tea-growing area in the world, constituting around one-seventh of the global tea production. In 2020-21, tea production in the state stood at 503.46 thousand tonnes, which was 39.12% of the total tea production in India. It also has 20 industrial estates, three industrial growth centres, 11 Integrated Infrastructure Development Depots, 17 industrial areas, 12 growth centres, eight mini industrial estates, one export promotion park and one food processing industrial park. ▪ At current prices, the Gross State Domestic Product (GSDP) of Assam in 2020-21 is estimated Rs. 4.09 trillion (US$ 55.14 billion).	activities related to agriculture provide huge scope ▪ A deregulated market for pesticides.	▪ Lack of credit facilities for the small and medium agri-input related businesses ▪ Prone to natural calamities like flood ▪ Agriculture is practiced mainly under rainfed condition

	The GSDP of the state grew at a CAGR of 12.38 percent between 2015-16 and 2020-21.		
Social	Assam has a heterogeneous population with socio-cultural and ethnic diversity. According to the Census of India, 2011; the population of Assam stands at 312.05 lakh out of which 159.39 lakh are male and 152.66 lakh are female. The decadal growth of the state's population works out at 17.07 per cent during the decade 2001-2011 as against 17.68 per cent for the country as a whole. Out of the total 312.05 lakh population, 86 percent population live in rural areas and 14 percent population live in urban areas of the State.	▪ 86 percent of the total population lives in rural areas and is mostly dependent on agriculture ▪ Assam is a young state and has a huge young workforce available for the development of agriculture and agribusiness.	▪ Lack of entrepreneurial spirit ▪ Lack of interest in agri-related business ▪ Migration of rural youth to other states for employment. ▪ Level of technical knowledge or education related to plant protection is poor.
Technological	Application and innovation of new technologies related to pesticide is very poor	Assam has 23.62 million wireless telephone user out of which 13.88 million resides in rural areas. This can be used for effective delivery of information.	▪ Overall Tele-density (Circle/ State-wise) is among the lowest in the country (TRAI, Press release on 28th January 2021)

			▪ Both public and private investment in the use of new technology or innovations related to pesticide is less.
Legal	Pesticides are regulated in India through the Insecticides Act, 1968 and Insecticides Rules, 1971. The Draft Pesticide Management Bill 2017 was released by the Union Ministry of Agriculture and Farmers Welfare (MoAFW) for stakeholder comments on February 19, 2018.	The existing legal system covers all the stakeholders and a guiding force in smooth functioning of the pesticide delivery system in state.	▪ Enforcement of the law is not stringent ▪ Lack of manpower to ensure proper implementation of the laws
Environmental	Assam is blessed with abundant natural resources and a favourable climate for agriculture. Barring a few incidences, people are less concerned about environmental pollution related to pesticide use and agriculture only in a few areas of the state is cultivated as naturally organic in nature.	▪ Fertile soil ▪ Natural water resources ▪ Huge potential for the organic and bio-pesticide sector	▪ Problem of residue in the finished products ▪ Problem of disposal of empty container of used pesticide ▪ Development of resistance to pesticides due to improper use ▪ Climate change related issues

Fertilizers

Political

Agriculture in Assam has immense potential and visible results can be obtained with little efforts. The Government of Assam should adopt “Development of Agriculture” as its top most agenda for overall development of the state and increase in per capita income. There is need to follow a multi-faceted approach for overall development of agriculture in the state covering rural infrastructure, food processing units and strong marketing channels for national and international markets.

Economic

The provision of additional funds of Rs 20 Crore has been made for effective implementation of Urea SOP. However, there may be requirement for more funds mainly to support transportation in a state like Assam with difficult geography. The Government can take huge advantage by effective implementation of various Central Government schemes like Kissan Credit Card, Soil Health Card, making LPG connections available, etc. The State Government is also required to make all possible efforts to get more Urea from the GoI as it is underfed. Fertilizer consumption in Assam is 72 kg/ha while the average consumption of fertiliser at national level is 162 kg/ha.

Social

The Assam agriculture can broadly be defined as limited input use agriculture. Many of the difficult areas with practically no supply of fertilizers are practicing organic farming. Neither public sector nor private sector have made sufficient efforts to promote new fertilizers with better fertilizer use efficiency and better cost-benefit to farmers. Emphasis has to be given to promote –

- Balance use of fertilizers
- Effectiveness of secondary and micro-nutrients. Good fertilizers should be promoted by the state government
- Soil Health Cards should be issued to farmers which, basically, is the first step of precision agriculture.
- In name of organic fertilizers, farmers are generally aware of city compost, vermi-compost and farmyard manure. There are various effective organic fertilizers being used in other states which need to be promoted in Assam as well.

Technological

Fertilizers in Assam mainly focus on Urea, DAP, MOP & SSP. There is lack of awareness about secondary and micro-nutrients. The application of technologies and use of fertilizers in the state is lacking in comparison to other states. On the question of organic fertilizers, there is no practice of using globally acclaimed fertilizers. Assam is low in productivity and extension agencies have to be strengthened for dissemination of technologies. The interactions with staff and officers of KVKs during field survey suggest that they are well qualified and quite capable but need infrastructure and support. Private players can also support extension efforts of the Government.

Legal

Implementation of FCO in Assam is weak, for example take the case of cancellation of license after the announcement of Urea SOP. Around 1200 licenses were annulled because either retailers were not eligible or they were not having ePoS. At present, the entire supply-chain of fertilizer is disrupted in Assam. ASAMB has to act fast to take the charge of urea distribution and state government has to be vigilant in ensuring implementation of FCO. The Government has to ensure that only good quality fertilizers are available in the market. Companies with sub-standard products should be blacklisted. GoA in collaboration with Agriculture Universities should come out with recommendations on secondary and micro-nutrients for horticulture crops to produce more exportable quality output.

Environmental

Consumption of chemical fertilizers in Assam is low and therefore, has resulted in limited pollution of soils and ground water. GoA has an opportunity to develop good agricultural practices so that Assam can produce more exportable horticultural crops with minimum possible damage to the environment. The state government should adopt approach of mixed fertilizers covering both chemical and organic fertilizers. Growing national and international demand for organic food should be capitalized through participation of public and private sectors.

Section – I

Background & Methodology


TRICHOSTAR

Section I
Introduction

The present study on agri-input supply system in Assam aims at coming up with suggestions and recommendations to enhance the production and productivity of the farmers by establishing an efficient and effective agri-input & service delivery system in the state for ensuring adequate and timely availability of essential inputs like seeds, fertilizers and agro-chemicals. The final report is mainly built on the structure defined for mid-term report. The findings are primarily based on secondary information available with different departments and agencies and interactions held with different stakeholders during the field survey visits to different districts considered under the study.

Approach

The approach adopted for the study is to develop a strategy that is suitable and feasible for the agricultural inputs supply system in Assam. The observations made on the agri-inputs system prevailing in Assam based on the interactions with all the relevant stakeholders during Inception Workshop, field visits made to different districts and online interactions arranged by APART, production trends in the state, status of use of agri-inputs and relevant developments in other states were used to come up with suggestions to guide the formulation of strategy for establishing an efficient agri-input delivery system in the state. The consultation with stakeholders was held at local, district and state levels through a combination of fieldwork, key informant interviews, focus group discussions and online meetings. The information was collected from all the relevant stakeholders of the agri-input sectors mainly seed, fertilizer and agro-chemical represented by the distributors, dealers, retailers, C&F agents and the end beneficiary, the farmer.

The interactions for ground level assessment of agri-input system with identified stakeholders were conducted in the selected districts of Assam namely Jorhat, Sonitpur, Nagaon, Karbi Anglong, Kamrup, Cachar and Barpeta. The field survey meetings were facilitated by the officers from APART and different state departments in each selected district. The team of experts identified by MANAGE interacted with the stakeholders and filled in the Questionnaires prepared for seed, fertilizer and agro-chemical. The team also met and discussed with the district officials, Assam Agricultural University (AAU) scientists, KVK scientists and others.

Timing

The timeline of the study on input supply system in Assam is as given below –

Sr No	Deliverable	Timeline for contract effectiveness
1	Signing of MoU	26th May 2022
2	Inception Report	30 days
3	Mid Term Report	100 days
4	Draft final Report	150 days
5	Final Report	180 days

Team of experts

The study is being implemented by MANAGE for APART. Considering the importance of the study, MANAGE has identified a team of experts to work exclusively on the study. The team structure is as given below –

Name	Position	Location
MANAGE, Hyderabad		
Dr Shalendra	MANAGE Coordinator	MANAGE
Experts		
Dr Soumitra Das	Team Leader & Agri Input System Expert	New Delhi
Shri Vijay Bhaskar Reddy	Seed System Expert	Bangalore
Shri Ajay Bharatiya	Fertilizer System Expert	Hyderabad
Dr Ansuman Maity	Agro-chemical System Expert	Kolkata

Relevance of the objectives

Agriculture is important for state like Assam but most of the crops are not being cultivated to their full potential. In such an environment, it become important not only to deliver the right kind of inputs but also to deliver the associated knowledge through a robust extension system. This makes it pertinent to study different aspects related to delivery of inputs and facilitate (i) developing an action plan for improving access to farm inputs (ii) strengthening private sector activities in farm input market and (iii) designing capacity building programs for agri-input supply chain stakeholders based on the findings. The objectives and all the expected outcome are confirmed to remain achievable and relevant at the state, district and local levels.

Focus of the study

The study mainly revolves around developing an action plan for improving access of farmers to different farm-inputs mainly seeds, fertilizers and agro-chemicals. Accordingly, the report focuses on findings and suggestions based on the interactions with stakeholders to help strengthen farm-input delivery system and improve private sector activities in farm input markets. The focus will also be on assessment of gaps in capacity building for stakeholders operating at different levels of agri-input supply chain.

Methodology

A comprehensive methodology was developed to achieve the objectives of the study which relied on both the primary and secondary information. Secondary information was collected from different departments. The information on various aspects of area and production was collected from relevant departments of Assam Government. However, the primary information was collected from all relevant stakeholders of the agri-input sectors like seeds, fertilizers and agro-chemicals in the identified districts namely Jorhat, Sonitpur, Nagaon, Karbi Anglong, Kamrup, Cachar and Barpeta. The interactions held with different stakeholders focused on understanding the system prevailing in the state for delivery of key inputs like seeds, fertilizers and agro-chemicals. The report mainly focuses on presenting the existing status of farm-inputs supply system prevailing in the state as captured through interactions with different stakeholders. Though, the findings have also been seen in the light of secondary information collected from different departments.

Data collection

The study depends on both primary as well as secondary information. The secondary information is collected from various relevant documents published by the different departments like agriculture, horticulture, statistics, State Agricultural University and Research Organizations, Assam Seeds Corporation, ASAMB, Seeds Portals of Assam Government and various other published reports and articles. Whereas, the primary information is collected from all relevant stakeholders through interactions and FGDs. All relevant stakeholders of the supply chain of Seed, Fertilizer and Agro-chemical sectors are included in the study from the selected districts. A total of 180 stakeholders from seven districts were considered under the study (Table-1).

Table 1. Sample considered under the study

Sr No	Districts	Date	Farmers	Retailers	Dealers	Distributors	State Govt Officials	APART Officials	SAU / KVK	Total
1	Jorhat	20.07.22	4	5	2	1	11	3	1	27
2	Sonitpur	21.07.22	6	6	1	1	12	2	1	29
3	Nagaon	22.07.22	6	8	2	3	11	4	1	35
4	Karbi Anglong	25.07.22	6	3	3	2	7	4	1	26
5	Kamrup	26.07.22	5	9	2	2	4	3		25
6	Cachar	17.10.22	4	5	-	3	6	1	1	20
7	Barpeta	18.10.22	7	3	-	-	5	1	2	18
8	**Total**	**--**	38	39	10	12	56	18	7	180

Data collection instruments

In order to collect information from all the relevant stakeholders, questionnaires were prepared for each of the agri-input sector considered under the study like seed, fertilizer and agro-chemical. Separate questionnaires were prepared to capture the perception of different stakeholders like distributors, dealers, retailers and end beneficiary, the farmers (the questionnaires are shared at Annexure-1).

Districts considered

The primary information was collected from all relevant stakeholders of the supply chains of key agri-input sectors like seed, fertilizer and agro-chemical identified from the selected districts. One district from each agro-climatic zone was identified in consultation with APART team taking into consideration the overall objectives of the study and crops important for the agricultural development of the state. Though, two districts namely Kamrup and Barpeta were considered from Lower Assam. The reasonable number of stakeholders from each level of supply chain were considered for interaction and collection of information covering manufacturers, formulators, distributors, sub-distributors, retailers, farmers, government officials, academia and extension workers.

The districts considered under the study are as given below –

Zone Name	Districts
Upper Brahmaputra Valley	Jorhat
North Bank plains	Sonitpur
Central Brahmaputra Valley	Nagaon
Hill Zone	Karbi Anglong
Barak Valley	Cachar
Lower Brahmaputra Valley	Kamrup & Berpeta

Evaluation limitations

The short-term study is planned to be completed in a limited timeframe of six month. The findings of the study are based on representative stakeholders selected from identified districts only. Given the diversity in population in terms of religion, ethnicity, agro-ecological climate, diversified crops cultivated and enterprise practices, the findings based on limited sample may not represent the true picture but provide only indicative framework. Though, all possible efforts have been made to depict the true situation by following a scientific and comprehensive methodology. Limited availability of literature on the subject in the local context is another limitation. Some of the figures are based on the assessment made after various round of interactions with the stakeholders in the absence of secondary information, for instance, in case of agro-chemicals.

Key deliverables of the study

The key deliverable at this stage of the study is the preparation and submission of Final Report. The results of the study on the agri-input supply system in Assam are expected to facilitate identification of key stakeholders involved at different level in the agri-input & service delivery supply chain for the smooth functioning of the system. In addition, it will also help in identifying the policies related issues which influences effectiveness of delivery of agri-inputs in the state and suggest corrective measures to benefit all important stakeholders mainly end-user, the farmer. The findings of the study are also expected to provide guidelines to the policymakers concerned with the policy planning and implementation of agri-input and service delivery system in the state.

Section – II

Agriculture in Assam


KRISHI
BHAW
KARBI ANGLONG

Section II
Brief on Agriculture in Assam

Agriculture in Assam

Agriculture is important for economic development of Assam. Activities under agriculture and allied sector provide employment directly or indirectly to more than half of the workforce in the state. Agriculture, industry and services are estimated to contribute 17%, 39%, and 44%, respectively to the state economy in 2019-20. The industry and services sector have seen a decline in growth in recent years whereas the agriculture sector continues to grow, though, at a low rate. The Gross State Domestic Products (GSDP) of agricultural and allied sector at current prices during 2020-21 was Rs 8502335 lakhs with crops contributing nearly 55 percent, followed by fishing and aquaculture (18.74%), forestry and logging (16.16%) and livestock (10.19%). The agriculture census data for the year 2015-16 suggests that 37.95 percent of the total geographical land area in the state is under cultivation. During 2019-20, the cropping intensity in the state was 147.84 percent with net area sown of 27.09 lakhs hectares and 12.96 lakhs hectares area sown more than once. The state has great potential for agriculture due to its conducive climatic condition but there is need to create enabling environment. Only 26 percent of the net sown area is under irrigation. As per the budget for the year 2020-21, the state has allocated only five percent of its total budget towards agriculture and allied activities which is lower than the average allocations by other states (7.1%).

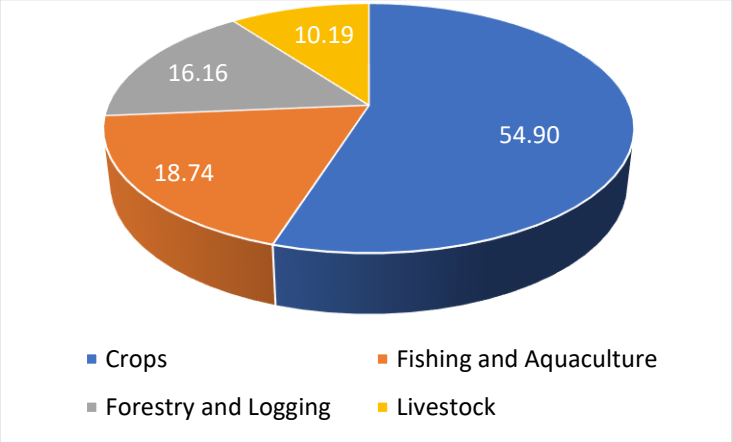


Figure 1. Contribution of sectors in GSDP in Agriculture and Allied Activities (Source: DES, Assam)

The information on area and production of principle crops in Assam during 2020-21 is presented in Table-2. The information compiled in the table highlights the dominance of Paddy in the agriculture of the state. More than 92 percent of the total area under foodgrains in the state is under Paddy cultivation contributing more than 95 percent of the foodgrains production. Again, about two-third of the gross cropped

area in the state is under cultivation of foodgrains, about eight percent area is under oilseeds followed by 20 percent under fruits and vegetables and less than one percent under sugarcane. The state government needs to take the importance of paddy into consideration while formulating any plan and policies mainly with respect to supply of inputs like seeds and fertilisers.

Table 2. Area and production of principle crops in Assam during 2020-21

Crops	Area (in 000 ha)	Production (in 000 tonnes)
Paddy	2360 (92.26)	5214 (95.02)
Wheat	9.34 (0.37)	12.88 (0.23)
Course Cereals	46.13 (1.80)	151.17 (2.75)
Pulses	142.30 (5.55)	108.70 (1.99)
Foodgrains	2558 (63.87)	5488
Oilseeds	309.65 (7.73)	199.93
Sugarcane	30.50 (0.76)	1093
Fruits & Vegetables	797 (19.90)	9996

Source: https://des.assam.gov.in/
Note – Figures in parenthesis represents percent of foodgrains/ area as percent of gross cropped area

Horticulture is also emerging as an important component for ability of the state to produce wide range of products including fruits, vegetables, flowers, spices, nuts, tubers, medicinal and aromatic plants. Horticulture crops occupied about 20 percent of the gross cultivated area of the state during 2020-21 with an annual production of 99.96 lakhs MT of various horticultural produces.

Bringing farmers together is another important aspect of Assam agriculture as is the case with any other state in India. More than 86 percent of the farmers are operating on small and marginal land holdings. These 86 percent of the smallholders cultivate about half of the area (Table-3). There is need for the state government to promote aggregation by availing benefits available under different schemes like the Central Sector Scheme on “Formation and Promotion of 10,000 Farmer Producer

Organizations (FPOs)" with focus on formulation and promotion of 10,000 new FPOs till 2027-28. Assam can also avail the benefits under the scheme to bring farmers in group and take advantage of scale mainly related to diversification, adoption of investment intensive technology and marketing.

Table 3. Operational holdings by size group (2015-16)

Category	Number of Operational Landholdings			Area of Operational Landholdings			Average Size (ha)
	Number	(%)	Cumulative (%)	Area (Ha)	(%)	Cumulative (%)	
Marginal	1868020	68.13	68.13	784971	26.37	26.37	0.42
Small	495313	18.07	86.20	696107	23.39	49.76	1.41
Semi-Medium	295286	10.77	96.97	806250	27.09	76.85	2.73
Medium	79262	2.89	99.86	410091	13.78	90.63	5.17
Large	3830	0.14	100.00	278836	9.37	100.00	72.8
All Holdings	2741711	100.00	--	2976255	100.00	--	1.09

Source: Directorate of Economics and Statistics, Assam

The state government has also identified the importance of credit for investment in and development of agriculture sector. Same has also been reflected by the efforts made by the Government to improve access of farmers to institutional credit. The Assam Government through Directorate of Agriculture has issued 37 lakhs Kisan Credit Cards (KCC) and sanctioned Rs 15437 crores as credit during the period 2001-02 to 2020-21. The Government has also introduced 'Zero-Interest-Crop-Loans' by providing 100 percent interest subventions on agricultural loan taken by the farmers of Assam to the limit of Rs 1.00 lakh.

Supply of inputs has also been identified as an important strategy to ensure development of agriculture in the state. The consumption of fertilisers in Assam has increased during last few years (Table-4). The per unit consumption of fertilisers during TE 2020-21 was observed to be 63.47 kg/ha in Assam.

Table 4. Consumption of fertilisers in Assam (in 000 MT)

Fertiliser/ Year	TE 2018-19	TE 2019-20	TE 2020-21
Nitrogen	152.80	162.32	173.42
Phosphorus	43.29	45.70	46.17
Potash	41.22	41.52	42.44
Consumption	57.03	60.97	63.47
(kg/Ha)	57.03	60.97	63.47

Source: Directorate of Agriculture, Assam

Though, an increase has been observed in per unit consumption of fertilisers during last few years, it still is much less than the national average of 137.15 kg per hectare. The fertiliser consumption is also skewed towards Nitrogen (Figure-2). The consumption of pesticides, similar to consumption of fertilizers, has also shown increasing trends as suggested by the consumption of 465.10 MT of pesticides during 2020-21 which is more than 13 percent higher to the chemicals consumed during 2019-20 (Table-5). However, the diversification towards bio-pesticides with consumption of 259.50 MT during the same year is important to note. This diversification is a result of the efforts made by the state government by organising trainings and demonstrations.

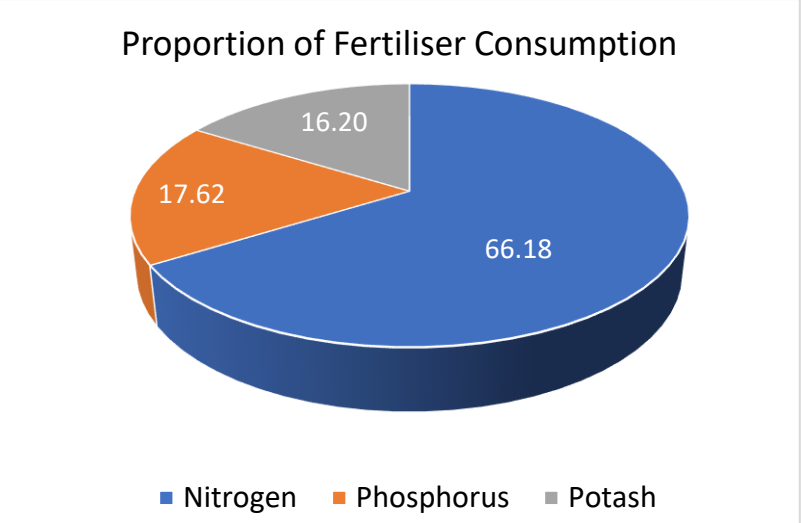


Figure 2. Proportion of fertiliser consumption

Table 5. Consumption of pesticides in Assam (in MT)

Pesticide Consumption	2018-19	2019-20	2020-21
Chemical Pesticide	439.95	410.39	465.10
Bio-Pesticide	233.50	242.35	259.50

Source: Directorate of Agriculture, Assam

In addition to encouraged use of fertilisers and pesticides, efforts have also been made by the state government to bring more area under improved varieties as suggested by the increase in seed replacement rate of various leading crops like paddy, blackgram, rapeseed and mustard and greengram in recent past. Though, seed replacement rate has improved in recent years but marginally and therefore, the seed sector seeks more concentrated efforts by the government. There is need on one hand to bring more area under use of improved seeds and on the other hand, to create awareness among farmers to use good quality seeds as only a little more than 50 percent farmers are using certified/ improved/ hybrid seeds (Table-6). Rest of the farmers are still relying on local seeds or seeds procured from unknown source which may compromise on the quality of the seeds leading to reduced production and higher cost of production.

Table 6. Type of seeds used by the farmers in Assam

Sr No	Type of Seeds	Percent (%)
1	Certified	28
2	Hybrid	16
3	Improved	12
4	Local	16
5	Others/ unknown source	28

Source – Field survey

Availability of inputs mainly seeds, fertilisers and chemicals have an important role to play in helping farmers realise full production potential of different crops. The state Government has also identified the same and is making all possible efforts to ensure timely availability of these inputs. The introduction of SOP for distribution of fertiliser is a step in that direction only. However, it is equally important to understand the major constraints limiting famers from effective and efficient use of inputs. The information compiled in Table-7 suggests that 36 percent of the respondent farmers perceive that poor understanding of knowhow of input use limit them from using the inputs efficiently. Other important factors limiting proper use of inputs as perceived by the farmers considered under the study are poor purchasing power (36%), availability of spurious inputs (24%), higher then specified rates (20%), unavailability of inputs on time (8%), distance to nearest source of procurement (8%) and poor exposure to training and extension (4%).

Table 7. Major factors limiting effective use of inputs as perceived by farmers

Sr No	Constraints	Percent (%)
1	Lack of knowhow of inputs use	36
2	Lack of purchasing power	36
3	Supply of spurious inputs	24
4	Higher than specified price	20
5	Unavailability of inputs on time	08
6	Limited physical access due to lack of retail outlets	08
7	Poor extension/ training exposure	04

Agriculture and allied activities are important for socio-economic development of Assam. Government of Assam is also putting in efforts covering areas like institutional credit, ensuring availability of quality inputs, bringing more area under high yielding varieties and irrigation, focus on efficient use of nutrients by encouraging Integrated Nutrient Management and management of soil health by adopting natural farming and organic farming. Crop insurance has also been identified as an important tool to safeguard the interest of farmers mainly in flood prone area. The Assam Government is moving in right direction but may have to put in more focussed efforts to help the state realize its full agricultural potential.

Section – III

Seeds

Section III
Seeds

Introduction

Seeds in agriculture is the starting point. It is the source of continuity, change and restoration, making it one of the most important agri-product. Although, seed is vital and multi-dimensional, still it is often taken for granted or worse neglected. However, a sound understanding of the primary and catalytic role of seed is important for the formulation of effective strategy and policies for agricultural development. It is the time to take stock and make assessment of changes experienced in agriculture sector because of availability of improved seed. Seed is the basic unit facilitating distribution and maintenance of plant populations over space and time making it one of the most important inputs of crop based agriculture. Seeds carry the genetic potential of crop plant, determining the upper limit on yield and therefore, the ultimate productivity of other inputs like fertilizers, agro-chemicals and management. It is estimated that the direct contribution of quality seed alone to the total production is about 40-45 percent which depends on the crop and is facilitated by efficient management of other inputs.

As a production input, improved seeds have several advantages over other inputs. Seeds are required in relatively small quantities, multiplied rather than consumed in the production process, familiar to all cultivators and their use does not require substantial changes in farming practices. On the other hand, seeds have two major disadvantages, i.e., it is required to be maintained in living condition to fulfill their propagative function and their production must be planned well in advance so as to ensure the availability.

Seeds of identified best varieties are evaluated for their suitability for specific agro-climatic conditions before commercialization and then multiplied through standard seed production process, tested for genetic purity and seed quality standards, processed and then marketed to farmers across various distribution channels. This makes overall production of seeds as industry a comprehensive process covering research and development, seed production, quality assurance and marketing and distribution (Figure-3). Another important dimension of seed is its self-replicating nature based on their ability to reproduce which is a natural life process.

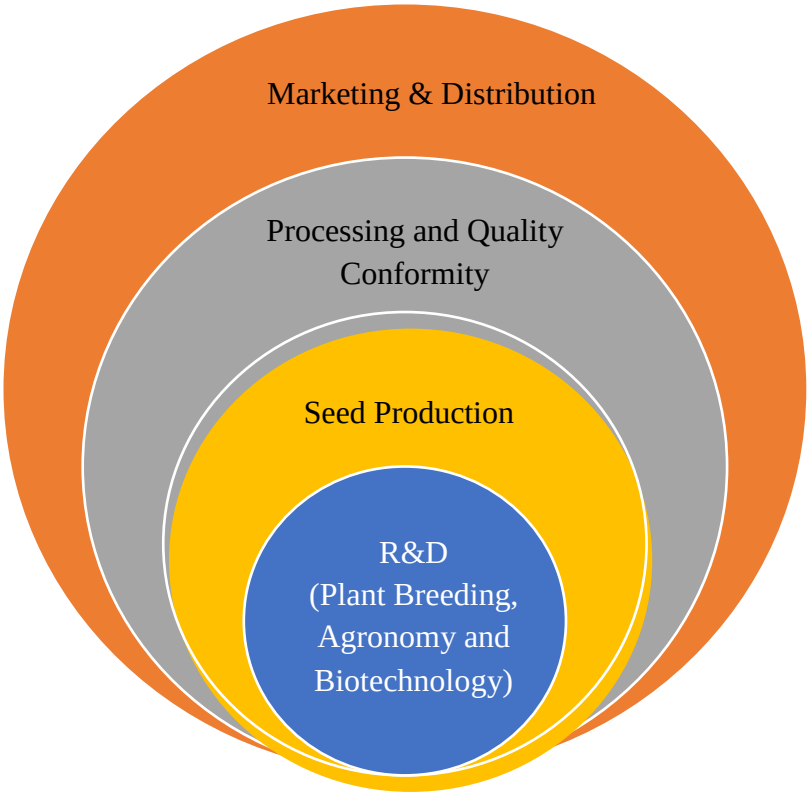


Figure 3. Different functions as part of overall seed production process

Global Seed Industry

The global seed industry market size as per OECD report, 2018 is estimated at USD 45 BN and presently at USD 52 BN. The market is growing at a CAGR of 5 percent. India stood at sixth position as per the statistics published in 2012. However, present position of India in Global Market is 5th with market size of USD 3.1 Billion (Table-8).

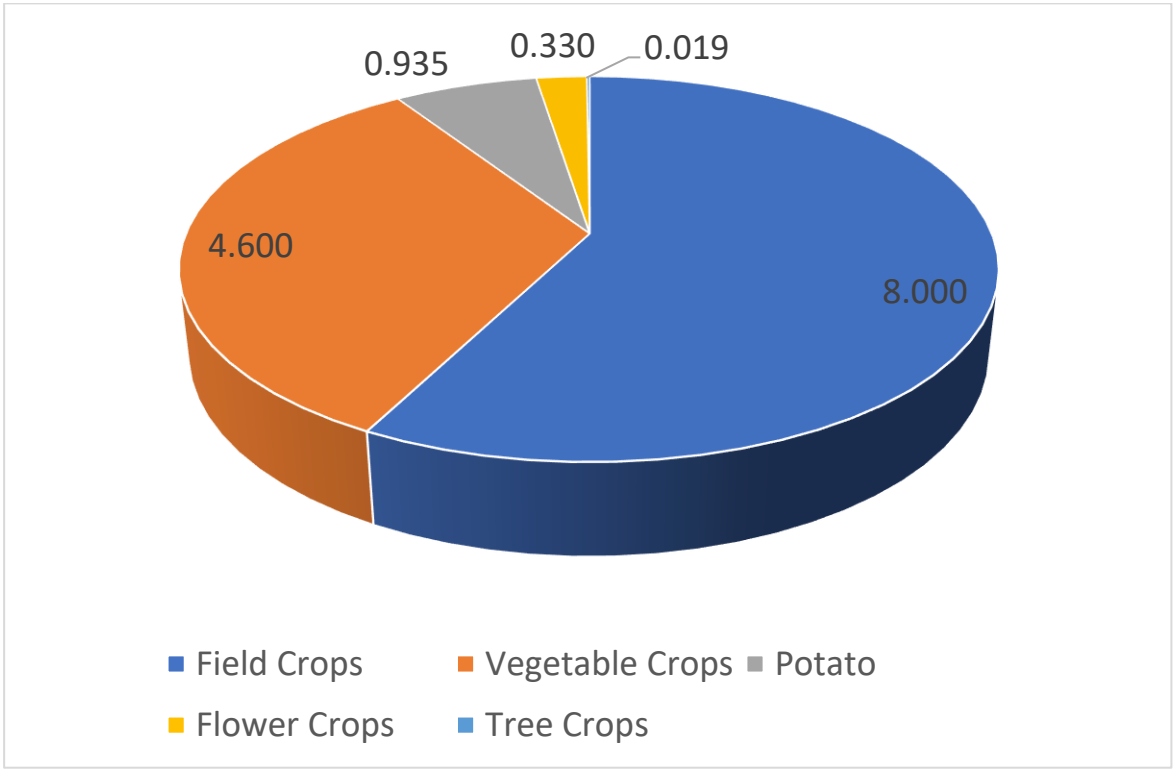
Table 8.Global seed industry market size (in USD Billion)

Sr No	Country	Mkt Size in USD BN 2018 ISF data	Global Share (%)	Mkt Size in USD BN 2019-20	Global Share (%)
1.	USA	12	27	13	25
2.	China	10	22	11	21
3.	France	2.8	6	3.5	7
4.	Brazil	2.6	6	3.2	6
5.	India	2	4	3.1	6
6.	Canada	2.1	5	2.8	5
7.	Japan	1.4	3	1.7	3
8.	Germany	1.2	3	1.4	3
9.	Argentina	1	2	1.1	2
10.	Italy	0.8	2	1.0	2

11.	Turkey	0.8	2	0.8	2
12.	Spain	0.7	2	0.85	2
13.	Netherlands	0.6	1	0.6	1
14.	Russia	0.5	1	0.6	1
15.	UK	0.4	1	0.5	1
16.	South Africa	0.4	1	0.5	1
17.	Australia	0.4	1	0.5	1
18.	South Korea	0.4	1	0.5	1
19.	Mexico	0.4	1	0.5	1
20.	Czech Republic	0.3	1	0.4	1
21.	RoW	4.4	10	4.8	9
	Total	**45.2**	**100%**	**52.25**	**100**

While India is the fifth largest seed industry globally, it has a miniscule share in global seed trade. The size of total global seed exports are valued at USD 13.8 BN covering seeds of field crops, tree crops, potato, flower crops and vegetable crops as per ISF data 2018 (Figure-4). Netherlands leads the market with 21 percent share followed by countries like France (14 percent), USA (14 percent) and Germany (7 percent) (Figure-5).

Figure 4. Global seed exports crop-category-wise (in USD BN)



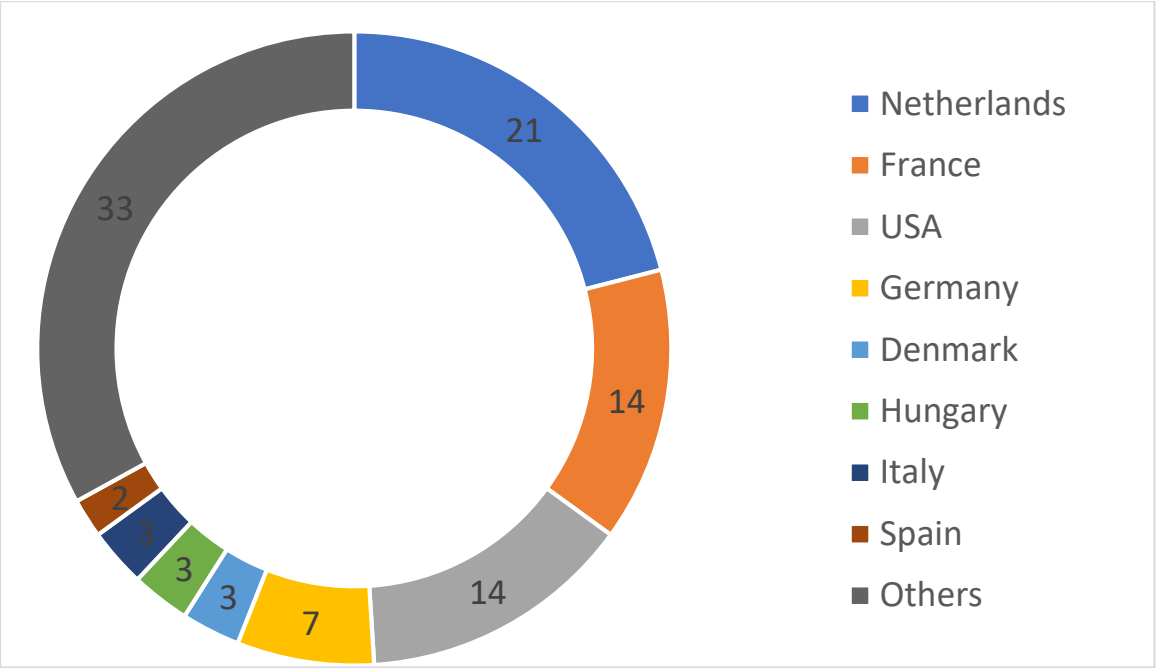


Figure 5. Global seed exports market

Indian Seed Industry

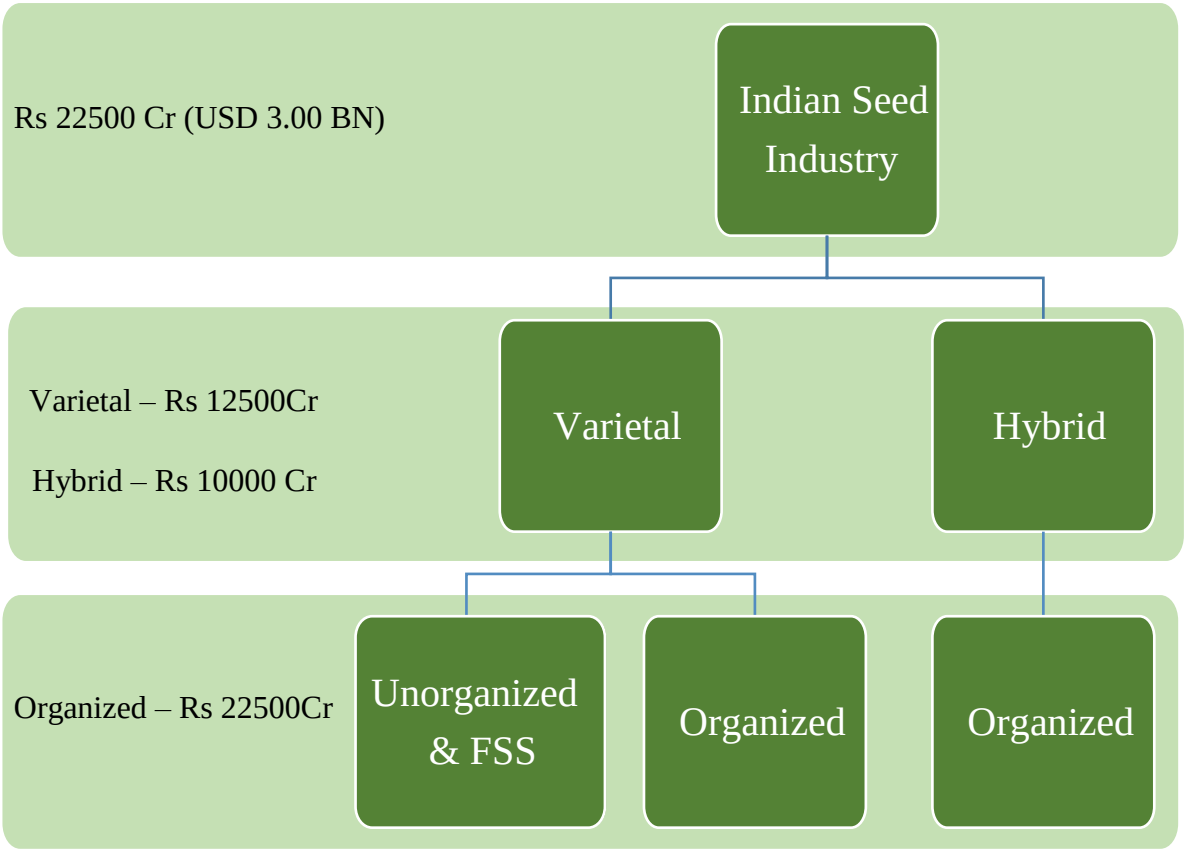
Indian seed industry is a sub-sector within agri-input sector of agriculture and allied industry. Seed is the primary input in agriculture, which encapsulates the genetics of plant variety. At the core of Indian Seed Industry is plant variety development through conventional plant breeding in the process of genetic improvement of crops. Plant variety, therefore, is the key product of seed industry with each new variety showing incremental advantage over the existing varieties.

The seed industry in India is a mix of large, medium and small seed companies in public and private sector. While certain large companies have competencies in all the industry functions such as R&D, production, processing, marketing and distribution; the small companies on the other hand may specialize only in one or more functions. It is to be noted that the Indian seed sector has developed on the strong foundation laid down by public sector research institutions in 1960s and 1970s during green revolution era.

The public sector is represented by the National Seed Corporation (NSC) and the State Seed Corporations (SSCs). Currently there are nearly 700+ seed companies in India both in private and public sectors. The public sector research of State Agricultural Universities (SAUs) and Indian Council of Agricultural Research (ICAR) has not only fuelled the development of Indian seed industry, but also continues to drive the industry with continuous delivery of new improved plant varieties to both public and private sectors.

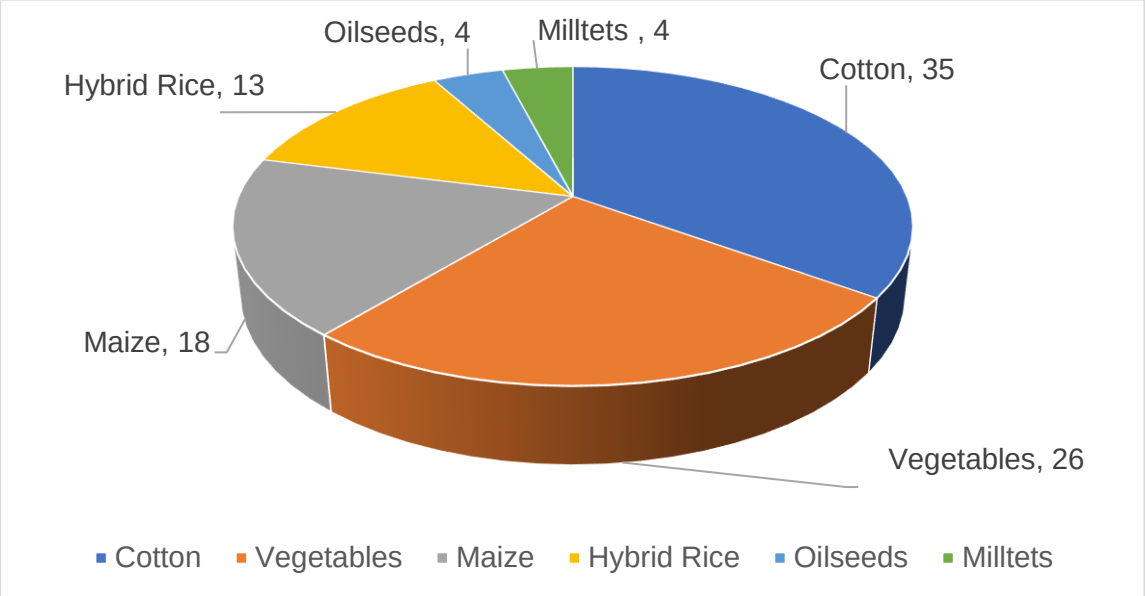
The Indian seed industry is regulated by Seed Act, 1966 which regulates the quality of seeds sold to farmers. The Seed Control Order, 1983 oversees the process of licensing for conducting seed business. In general, private sector specializes in high value hybrid seeds and varietal seeds and offers them to farmers as Truthfully Labelled (TL) seeds, whereas public sector specializes in high volume OPV seeds and offers them to farmers as Certified Seeds. The Indian seed sector is valued at about USD 3.0 BN and is the 5th largest market globally as per NSAI estimates. The farm saved seeds and used by farmers and exchanged between farmers is not included in market size. However, with respect to exports, India has a miniscule share and has a huge opportunity to become a global seed hub. The seed industry landscape is depicted in Figure-6.

Figure 6. Seed industry landscape



The Indian hybrid seed industry is estimated at Rs 10,000 Crores or USD 1.33 BN. The entire hybrid Cotton Seed Market is GM Cotton Seed and, therefore, GM Seed Market is nearly 16 percent of the total seed market and 35 percent of the hybrid seed market. The crop-wise share of Indian seed industry for hybrid seeds is presented in (Figure-7).

Figure 7. Crop-wise share of Indian seed industry for hybrid seeds



The Indian OPV seed industry is estimated at Rs 12,500 Crores including nurseries and crops where vegetative planting material is utilized as seed or propagating material. The commercial OPV seed industry falls under both organized and unorganized sectors. The estimates for unorganized seed sector and FSS are not available and may be valued at about 20 – 25 percent more than estimated value of the industry which pegs the market size at USD 3.6 BN to USD 3.75 BN. The unorganized sector also includes seed, propagating materials and nurseries. The unorganized sector sells both branded and unbranded seed, however, the estimates of revenue of branded seeds are not available as it is sold in informal channels out of seed quality regulation. The FSS comprises farmer's seed which is part of farm produce used for sowing and also exchanged between farmers in unbranded manner.

The interaction with different stakeholders mainly the distributors and retailers also suggests that more than one-third of the seeds distributed to the farmers are hybrids, followed by local (24 percent), certified (24 percent) and truthful (17 percent). This information is based on a small sample and may have limitation in reflecting the true picture but provides an overview of the situation prevailing in Assam (Table-9).

Table 9. Seed distribution in Assam

Sr No.	Type of Seeds	Percent Share
1	Hybrid	34.8
2	Local	23.9
3	Certified	23.9
4	Truthful	17.4

The increasing trend of Seed Replacement Rate (SRR) by farmers in various crops expands the size of commercial seed industry. Over the period of time, the SRR of various crops has been increasing from 10 percent to more than 50 percent in many of the crops where Open Pollinated Varieties (OPV) seeds are used. This leads to a large section of farmers using FSS and being out of purview of the commercial seed industry. It should be noted that in case of crops where hybrid seeds are used, the SRR is 100 percent as the farmers cannot re-use the seed for the next generation as re-use of hybrid seed leads to dilution of genetic purity due to genetic segregation of characters in the next generations.

Assam Seed Sector

The economy of Assam is mainly agrarian with agriculture and allied activities contributing about 20 percent to the net domestic product of the state and providing livelihood support to about 75 per cent of the population. However, the productivity of the major crops like rice, pulses and oilseeds is still much lower in Assam compared to the national average. Agriculture in Assam in macro sense is characterized by mono-cropping, largely small holders with low input-low output condition and subsistence farming systems practised primarily under rain-fed condition. These limitations now can be overcome and converted into opportunities by capitalizing on the hidden strengths in the form of maximizing production through input optimization, especially when green revolution belt is experiencing fatigue. Utilizing the existing technology and anticipated R & D support, the state has to gear up itself to increase foodgrains production and productivity of all the important crops and help farmers realise enhanced income.

The state has the capacity to produce almost entire quantity of seeds of rice, oilseeds, several pulses and different kinds of vegetable crops with active involvement of the Assam Agricultural University, Assam Seed Corporation and also the Department of Agriculture. However, the state has a long way to go before achieving self-sufficiency in seed production and trade. The Assam Agricultural University has already demonstrated its capability to produce huge quantity of seeds of different crops, particularly rice, toria and pulses on its own farms as well as in the farmers' field adopting participatory seed production program. In order to achieve self-sufficiency, the seed farms of the Government of Assam and ASC will have to be adequately strengthened and University capacity will also have to be further built on required facilities for storage and processing (both on-farm and mobile). Though,

the seeds of wheat, maize, some pulses and entire seeds of the hybrid varieties of rice and other crops will have to be procured from outside due to limited capacity of the state and the kind of quantity required. Developing improved seeds is a complex research and development process. Seeds should be accessible and available at right time, affordable and meet the true needs of farmers and markets.

Seed Replacement Ratio (SRR) in Assam is very less when compared to other states. In case of Paddy, SRR is 52% when compared to Telangana (91%), Andhra Pradesh (87%), Tamil Nadu (71%) and 58 percent in Kerala (Sourced from *Seednet*). There is need to increase SRR for better quality seeds as farmers are still using their own seed in the State. It is same in case of pulses and oilseed, SRR of Assam is less when compared to other states like Punjab, Telangana and Andhra Pradesh. Varietal Replacement Ration (VRR) is also low in the state. In Assam, very old varieties of paddy, pulses and oilseeds are being grown though a number of new varieties developed by various government research institutions are available. Such varieties are required to be introduced in the state and replace old varieties in most of the crops.

Seed Supply Chain

Importance of Seed Supply Chain

Assam was once completely dependent on supply from outside for meeting its requirement of seed till Assam State Seed Certification Agency (ASSCA) was established in the year 1985. The situation has improved but state has not so far been able to achieve self-sufficiency in production of its own seeds except for paddy and mustard due to infrastructural inadequacy. It is essential that the seeds required for various state government programs be produced within the State to ensure timely supply of seeds in required quality and quantity to the farmers. Experience suggests that the Assam Seeds Corporation Ltd. may not be able to produce the required quantities of certified seeds of various crop which otherwise can be produced in the State due to inadequate infrastructure and issues related to finance. The Assam agriculture is characterized by traditional rainfed farming and low productive techniques of production and therefore, is prone to various natural factors like floods & drought. There is an immediate need to improve agricultural productivity and production through adoption of improved agricultural technologies and techniques. With this background, it is important to understand the seed supply system in general and in particular to the state of Assam.

An efficient seed supply system has a major role to play in the development of agriculture and well-being of farming community. Some of the factors making seed system important are listed below –

- Seed is an important input in the production of crop
- Disrupted seed availability lead to reduced agriculture productivity
- Prevent damage of seed due to the poor availability of storage
- Prevent fake & substandard seed in the market
- Ensure price control of seeds
- Improves quality of seeds
- Ensure minimal seed distribution channels and timely seed supply to farmers
- Help in improving processing and storage capacity
- Prevent black marketing of seeds
- Improve financial position of farmers
- Lowering of cost and margins and improving benefits of different stakeholders present all along the supply chain

Structure of seed supply system

A typical seed supply system is depicted in Figure 8 & 9. The figures suggest that the seed system consists of both formal and informal distribution. The informal system mainly revolves around farmers maintaining their own stock or seed exchange between them. Informal system will also include components like local market and other local system with limited monitoring and assurance for quality seeds. The formal system on the other hand is more organized having participation of agro-dealers, government seed program and a properly defined system for complete chain of activities require to multiply and deliver seeds to the farmer. The complete chain of processes are better monitored to ensure delivery of good quality seeds to the farmers.

Figure 8. Seed Supply System

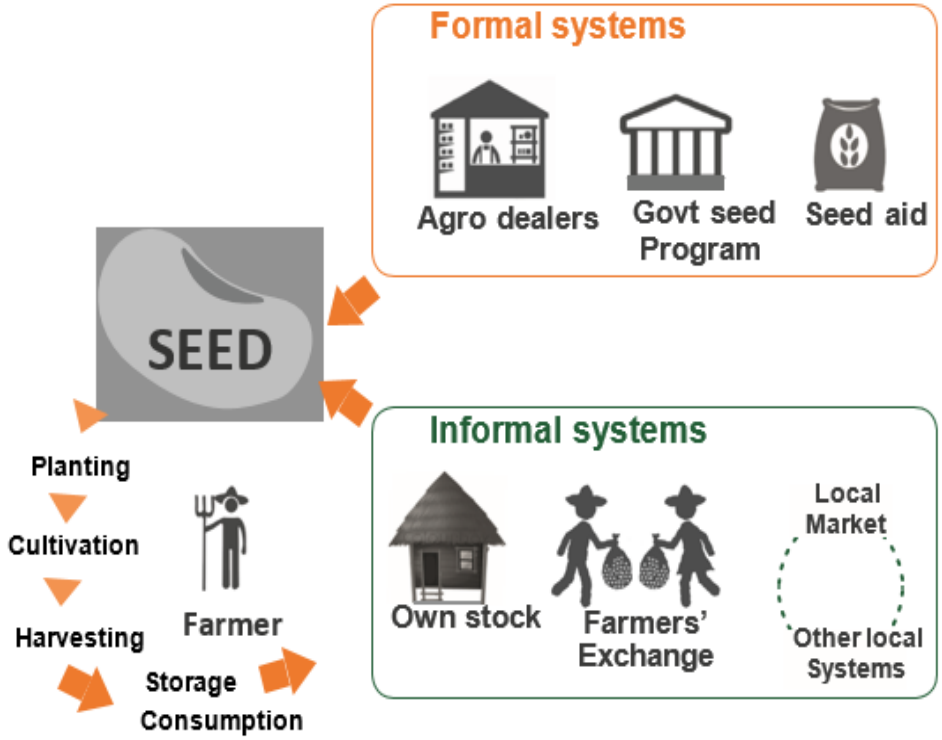
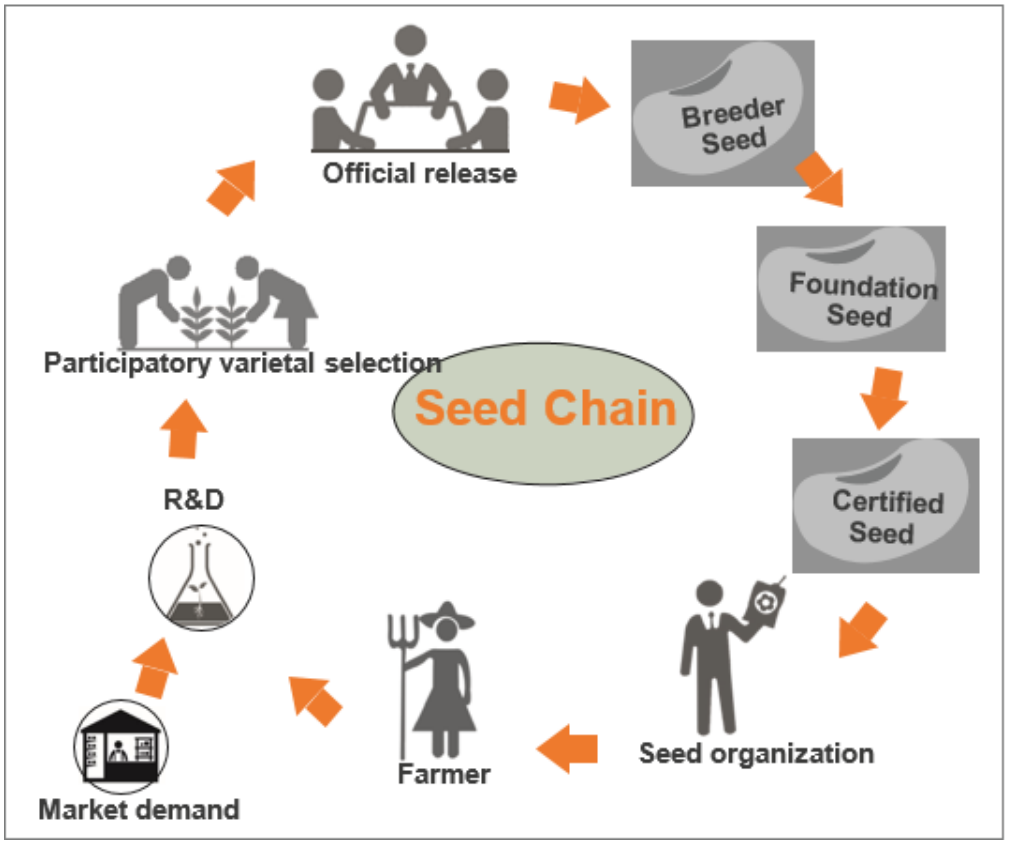


Figure 9. Schematic diagram of Seed Supply System



It is important to have an understanding on the contribution made by formal and informal seed systems. A well-functional seed system uses the appropriate combination of formal and informal supply channels, market and non-market transactions to stimulate and meet efficiently the evolving demand of farmers for quality seed. The weak formal seed system in Assam indicate the dependence of farmers on informal seed system which may have a contribution of anything between 30-40 percent. The information compiled based on the interaction with retailers and distributors suggests the dependence of the seed system on local producers and other sources (Table-10). Only 28 percent of the seed is procured from public and private agencies whereas 32 percent seed is procured from local private seed companies and 40 percent from other informal sources.

Table 10. Source of seed procurement for retailers and distributors

Sr No	Source	%
1	Government agency	12
2	State private seed company	16
3	Local private seed company	32
4	Others informal sources	40

This highlights the importance of informal seed system in Assam. It may also be important in maintaining traditional seed system mainly for various crops having geographic importance like black rice, joha rice, scented rice and Assam local ginger and turmeric. In case of Assam, public sector seed production and distribution needs to be strengthened, private sector participation required to be encouraged and capacity of farmers to be built appropriately to improve quality of seed.

Stakeholders of Assam Seed Supply Chain & their role

Seed supply chain is influenced by the involvement of different stakeholders and the contribution made by them. Stakeholders in seed supply chain in Assam and their role in development of seed system is depicted in Table-11.

Table 11. Stakeholders and their role in seed system

S.No	Stakeholder	Role in Seed system
1	Assam Agricultural University, RARS	▪ Research & development of new seed varieties of various field crops with value addition (flood tolerant, drought tolerant, disease resistance, more nutritional value, etc.) suitable for Assam state. ▪ Collection and maintenance of seed bank. ▪ Multiplication of breeder seed of OP seed varieties. ▪ Trails for suitability of new varieties in various zones of Assam. ▪ Selection & sourcing of varieties developed by other national & state research institutions suitable for cultivating in the state of Assam. ▪ Testing and evaluating private seed company hybrids/ varieties and assessing suitability for growing in the state of Assam.
2	Horticultural Research Station, AAU	▪ Research & development of horticulture & plantation crops in the state of Assam.
3	KVKs	▪ Breeder seed production. ▪ Conducting varietal performance trials. ▪ New varieties mini-kits distribution to the farmers. ▪ Conducting training programs for farmers on seed production and supply chain.
4	Assam Seed & Organic Certification Agency (ASOCA)	▪ Production of foundation & certified seed involving farmers mainly of OP varieties of field crops. ▪ Arranging buy back agreement to seed production with assured price. ▪ Seed testing & certification as per standards.
5	Assam Seed Corporation Ltd. (ASCL)	▪ Production of foundation seed in ASCL seed farms located at different locations. ▪ Procurement of certified seeds, packing and distribution to farmers. ▪ Procurement of seeds of various crops from private companies and supply to farmers under various subsidy schemes through department of agriculture.
6	Department of Agriculture	▪ Seed distribution system implementation at the level of farmers. ▪ Planning on seed requirement season-wise and crop-wise. ▪ Issuing seed licenses to private seed companies and seed dealers. ▪ Sampling of seeds from seed dealers for quality test. ▪ Controlling entry of un-authorized seed in the state.

		▪ Identifying beneficiary farmers and supply seeds under subsidy schemes.
7	Department of Horticulture	▪ Tissue culture banana plants development & distribution to farmers. ▪ Fruit & plantation crops development and distribution to the farmers. ▪ Potato tubers seed production and distribution. ▪ Development of tissue culture labs. ▪ Supporting vegetable seed companies for promotion of hybrid vegetable seeds in the state. ▪ Development of food processing industries.
8	FPOs	▪ Seed production, processing and distribution.
9	Private seed processing units	▪ Seed cleaning and processing for field crops.
10	Private seed companies	▪ Research, production, packing and distribution of quality seeds in the state of Assam
11	Seed dealers/ retailers	▪ Supply seeds to farmer
12	Farmers	▪ Involved with seed production ▪ End user of seeds for farming
13	APART	▪ Implementation of project

Seed marketing (supply to farmers)

Seed reaches farmers in Assam through a seed distribution system having participation of public sectors and private players. Major stakeholders involved in seed distribution network in the state are given below –

1) ASC distributes certified seeds to farmers under various subsidy schemes and government programs. ASC sources seed from various approved private seed companies and distribute to the farmers.
2) Directorate of Agriculture distributes seed to farmers through ADO and staff under various seed subsidy schemes.
3) KVKs distributes seed mini-kits of new varieties to the farmers under various seed promotional schemes.
4) Private seed companies supplies seed to farmers in the state through their seed distributors and dealers.

5) Seed distributors supply seed to their dealers and retailers, intern they supply seeds to the farmers.

6) Seed dealers/ retailers also play a vital role in seed distribution channel for being the final point of seed supplies done to the farmers.

The seed distribution system in Assam is observed to have participation of large number of players. There is need to strengthen these stakeholders to ensure improved seed supply chain in the state.

Crops & varieties suitable for cultivating in Assam

Selection of variety is vital in seed sector. It is important to consider various parameters like adoptability to agro-climatic conditions, growing seasons and yield parameters while recommending a variety to farmers. The crop-wise varieties suitable for cultivation in Assam are given in Table-12.

Table 12. Information on varieties suitable for cultivation in Assam

Crop	Variety recommended	Salient Features
Paddy	Ranjith	Long duration 15-155 days, medium tall with medium slender grain, tolerant to blast, average yield 5-5.5 MT/Ha.
	Ranjith Sub 1	A variety with submergence tolerance, can withstand 12 days of complete submergence, duration 145-150 days, medium slender grain quality, average yield 5-5.5 MT/ha
	Bahadur	Long duration 150-155 days, medium tall with medium bold grain, average yield 5-5.5 MT/ha
	Bhadur Sub 1	A variety with submergence tolerance, can withstand 12 days of complete submergence, duration 140-145 days, medium bold grain quality, average yield 5-5.5 MT/ha
	Gitesh	Long duration variety having staggering ability, can be transplanted up to 60 days old seedlings without significant reduction in yield. Medium slender grain with average yield of 5.0-5.5 Mt/ha
	Mahsuri	Duration 140-145 days, medium tall with medium slender grain.
	Aghoni	Aghoni is high yielding glutinous rice variety with average yield 4.5 MT/ha

	Ketekijoha	Aromatic high yield rice variety with yield 3.5 – 4.0 MT/ha
Green Gram	SGC 16	High yielding, short duration and resistance to YMV & CLS
	SGC 20	High yielding, short duration and resistance to YMV & CLS
	Pratap	High yielding and resistance to CLS
	Sonia	High yielding, resistance to YMV & CLS
	K 851	High yielding, resistance to CLS
Black Gram	SBC 40	High yielding, short duration and resistance to YMV & CLS
	SBC 47	High yielding, short duration and resistance to YMV & CLS
	Manas	High yielding and resistance to YMV & CLS
	KU-301	High yielding and resistance to YMV & CLS
	PU-31	High yielding, short duration, resistance to YMV (Yellow mosic virus) & CLS(sercospora leaf spot)
Arhar	T 21	Semi spreading and medium tall with good yield
Lentil	HUL 57	Small seeded and resistance to rust
	KLS 218	Medium seeded and resistance to rust
	PL 406	Medium seeded and semi spreading
	Axom marur 1 & 2	Moderately resistant to wilt
Pea	Rachana	Tall, tolerant to powdery mildew
	SPC 101	High yielding, short duration and resistance to PM
	FB 255	Moderately resistant to rust
Rapeseed	M-27	High yielding
	Ts-38	High yielding, notified in 2021 (new variety)
	Ts-67	High yielding, suitable for late season
Banana (TC)	G-9	AAA genotype, medium height, large fruit with yield 25-35 kg. Height of plant around 8 feet
	Jahaji	Dwarf Cavendish group AAA genotype, parthenocarpic, susceptible to bacterial wilt and fusarium wilt. Av bunch weight 20 kg
	Malbhog	AAA genotype, it has sweet aroma, taste and higher post-harvest life, severely affected by pananma wilt
	Amrit Sagar	AAA genotype Cavendish group

Potato	Kufri Chandramukhi	White cream coloured tubers, excellent flavour and taste, yield 15-20 MT/ha, susceptible to all major diseases
	Kurfi Khyati	White cream coloured tubers, resistant to early blight, moderately susceptible to late blight. Early bulker, suitable for high cropping intensity with yield 25-30 MT/ha
	Kufri Pokhraj	Yellow flesh, resistant to early blight, suitable for low input cropping Yield 25-30 MT/ha
	Kufri Surya	White cream coloured, heat tolerant, suitable for early planting Yield 20-25 MT/ha
	Kufri Jyoti	White cream coloured and suitable for processing Yield 25-30 MT/ha
	Rangpuria (Local)	Small tubers, deep eye, high keeping quality and susceptible to late blight

Source: Directorate of Research (Agri), Assam Agriculture University

New Hi-Zn Paddy variety

IET 23832 is a bio fortified semi-dwarf, medium duration (125 days) variety with non-lodging plant type and long slender grains for irrigated conditions. It is the first high zinc rice variety notified at national level with overall mean zinc content of 22.6 ppm (24.0 ppm in AP, KA & TN) in polished rice, developed through conventional breeding without compromising yield using the material from Harvest Plus. Based on high zinc content and yield performance over 5 MT/ha, it has good cooking quality with desirable amylose content (20.7%). It is moderately resistant to blast, sheath rot and rice tungro virus. The variety is a proof of concept for Biofortification and can address the hidden hunger or mineral malnutrition, thus targeting nutritional security of the nation.

An assessment of crop wise seed requirement

A wide range of public and private players are participating in seed supply system of the state. It is important to make an assessment of crop wise seed requirement, equally important is to identify the agency having capacity to facilitate production and supply the same. The assessment of seed and planting material requirement of major crops in Assam is presented in Table-13.

Table 13. Crop-wise seed & planting materials required in Assam

Crops	Varieties Recommended	Major Growing Districts	Crop Area (Ha)	Seed & Planting Material Required	Source of Supply
Cereals					
Paddy (Varietal & High Yielding Varieties)	Ranjeeth Ranjit sub 1 Bahadur Bahdur sub 1 Mahsuri Gitesh Swarna Sub 1 Aghoni Ketekijoha	Nagaon Dhubri Barpeta Morigoan Darrang Sonitpur K.Along	755605	302242 qts	Farmer own seed ASC, NSC, DOA, FPOs Private seed companies
Hybrid Paddy		Nagaon Dhubri, Barpeta Sonitpur Morigoan Golpara	274300	41145 qts	Private seed companies
Maize Hybrid		Darrang K.Anglong Kamrup-R Nagoan Golpara	32847	7391 qts	Private seed companies
Pulses					
Lentil	HUL 57 PI-406 KLS-218 AxomMasur 1 & 2	Dhubei Barpeta Kamrup – R Sonitpur	23792	7138 qts	Farmers own seed, ASC, NSC, DOA, FPOs, Private seed companies
Black gram	SBC-40 SBC-47 PU-31 Manas KU-301	Dhubri Sonitpur Barpeta	21607	5402 qts	Farmers ASC, NSC, DOA, FPOs, private seed companies
Peas	Rachana SPC 101 FB 255	Kamrup – R Nagaon Golaghat Sonitpur	34503	17251 qts	Private seed companies NSC, ASC

Oilseeds and Rapeseed & Mustard	JD-6 TS-36 TS-38 PM-25	Lakhimpur Nagaon Dhubri Kokrajhar	288921	28892 qts	ASC, DOA, FPOs, NSC, private seed companies
Tuber crop and Potato	Kufrichandramukhi Kufrikhyati Kufripokhraj KufriJyothi Rangpurai (Local)	Barpeta Darrang Kamrup Sonitpur Nagoan	103041	185473 MT	Farmers own, West Bengal suppliers, DOA trial seed production
Spices & condiments and Ginger	Nadia Aizol	Karbi Anglong NC Hills Cachar	17986	28778 MT	Farmers own produce
Turmeric	Megha -1 Lakadong, LakashainLadaw Lashein	Kamrup Darrang Nagaon Sonitpur	16492	42230 MT	Farmers own produce
Fruit crops **Banana**	G-9 (TC) Jahaji (TC) Malbhog (TC) AmrithSagar (TC)	Barpeta Kamrup Nagaon Cachar Nalbari Golalpara Golaghat	48778	975.56 lac plants	Farmers own, Tissue culture nursery
Pineapple	Queen Kew Mauritius	Kamrup Nagaon NC Hills Karbi Anglong	16607	7224 lacs suckers/ crowns	Farmers own production
Vegetables covering **Tomato** **Brinjal** **Cabbage** **Carrot** **Chilli** **Gourds**	Sonitpur Nagoan Golaghat Kamrup Nagoan	Rocky Navkiran Green express Early nantis Tejeswani	292515	--	Private seed companies,

Source: Compiled based on the information available at Department of Agriculture, Govt of Assam, Seednet, Agri vision 2025 and Agriculture Statistics of Assam

The table suggests that paddy is the major crop cultivated in the state and therefore, there is a huge requirement of paddy seed in the state. Total paddy seed requirement is 3,02,242 qts, in all three seasons put together. Out of the total paddy seed requirements, 16 percent in autumn, 40 percent winter and 44 percent is during summer. The interaction with the stakeholders reveals that most of the farmers use their own farm produce which is retained as seed for next season. It is required to be replaced by quality certified seeds. Majority of the paddy seed required by the state is produced within the state regarding varietal and high yielding varieties. Presently, the hybrid seed is mainly supplied by private seed companies and the seed is produced outside Assam. This needs to be addressed immediately by building capacity of various public and private institutions as hybrid paddy cultivation in the state is increasing.

Assam state is more or less self-sufficient in seed production of varietal and high yielding varieties of paddy and rapeseed and mustard. Regarding pulses, seed production is done in the state but with limited success in obtaining the required quantities due to various reasons like availability of breeder seed and adverse climatic conditions which are not favourable for seed production in the state. Not much success has been achieved in vegetable seed production though there are some OP Vegetable seed production trials in progress. Multiplication of Breeder seed in low cost net houses is in progress for OP vegetable seeds. OP Vegetable seed lines of Pumpkin & Tomato are in progress under APART. Most of the vegetable seeds are sourced from other states and a major role is played by private seed companies in vegetable seed supplies in the state.

Regarding Banana crop, tissue culture concept is slowly developing in the state with various government department extending support to the farmers. However, it has been observed that most of the farmers grow local varieties with own planting material. Regarding pineapple, farmers will generally have their own production for planting material using special variety of Assam. The state government is not focusing much on developing planting material.

In case of potato seed development, most of the potato planting material (tubers) comes from other states majorly from Punjab, Haryana, Uttar Pradesh and West Bengal. However, the State Government with the support of APART has started production of potato mini tubers. Regarding Turmeric and Ginger planting material, not much have been done by the departments in developing the seed material and farmers use their own produce for multiplication.

It is also observed that during foundation seed production of blackgram which has been taken up by the ASC farmers, there was only vegetative growth and no flowering during May sowing due to high rainfall. It is advised not to take seed production of pulses mainly blackgram and greengram in high rainfall areas.

Seed and planting material production system

The state is involved with research, development and production of seeds of various crops. State is successful in producing seeds of paddy, rapeseed & mustard, pulses (lentil, blackgram and greengram) and peas. Trial seed production of vegetable seeds has been also initiated in the state. Pilot project on potato seed (mini tubers) production is also in progress. State is promoting tissue culture banana and appropriate initiatives have already been taken for developing tissue culture banana nurseries in the state.

Observations on seed and planting material production based on secondary information and interaction with different stakeholders held to help develop better seed supply chain in the state suggest that a lot of efforts are going on in the state to achieve self-sufficiency in seed production. However, there are some setbacks observed in quality seed production in the state for different crops. Based on interactions with officials and other stakeholders and secondary information available with different departments, following are some of the setbacks observed in the state in seed production mainly with respect to paddy, blackgram, lentil, rapeseed and mustard.

Area	Observations	Factors Responsible
Low seed yields	The yield of paddy seed is low in the state in comparison to the traditional seed producing states like Telangana. It is same in case of oilseeds & pulses, yields are lower when compared to other traditional seed producing states	▪ Climatic conditions of the region ▪ Crop damage due to uncertain rainfall ▪ Lack of farmer training on seed production ▪ Poor crop management ▪ Foundation seed source ▪ No proper nutritional management during different stages of crop production.
Poor physical appearance & seed uniformity	Paddy seed produced in the state is not shinny and colour is dull, more towards brownish appearance when compared to seeds produced in the traditional seed production areas where the seed colour is golden yellow. In case of pulses &	▪ Mainly due to high humidity ▪ Rain effect during drying ▪ Poor drying methods adopted ▪ Poor storage system ▪ More moisture in the seed ▪ Lack of proper processing facilities

	oilseeds, seed size is smaller when compared to traditional seed producing areas like Karnataka.	
Low seed viability	Seeds produced in the state loose germination very fast	▪ More moisture in the seed ▪ Lack of proper drying facilities ▪ Optimum seed moisture not maintained while storage
More processing loss	More chaffy and unmatured seeds observed, processing loss is more than 25 percent in paddy when compared to 10-15 percent in the seed produced in Telangana.	▪ Rains during seed pollination time ▪ Dry spell during seed setting stage ▪ Improper harvesting time ▪ Seed damage is more due to moisture
Low storability of seeds	Seed produced in Assam cannot be stored for longer duration.	▪ More moisture in the seed ▪ Farmers do not maintain optimum seed moisture levels i.e., 8 to 10 percent ▪ Lack of knowledge among farmers on seed moisture management ▪ Lack of proper testing facilities ▪ Lack of proper storage facilities for the seeds produced

Paddy Seed Assam

Paddy Seed Telangana

Suggestions and Recommendations

Some of the suggestions based on the field observations are as listed below –

- Seed production should be planned during dry season and districts selected for seed production should not be flood effected
- Farmers should be trained on seed production techniques
- Seed drying facilities should be provided to the seed producing farmers
- Seed should be dried to optimum moisture levels and stored
- Proper seed storage infrastructure should be developed – Mini storage units to be provided to farmers through FPOs
- Seed testing facilities should be made available to the seed producing farmers for testing various seed quality parameters
- Proper seed storage infrastructure should be developed and made available to farmers mainly the portable storage for rice with ability to retain aroma in aromatic rice
- Involve FPOs in seed production by providing common seed production facilities to FPOs where farmers can use these facilities
- Proper nutrition management required to be followed at different stages of crop production as recommended for seed production.

Contract seed production in other traditional seed producing states

The climatic conditions of Assam are not highly suitable for producing quality seeds of wide range of crops when compared to other traditional seed producing states like Telangana, Karnataka, Maharashtra and Gujarat. Hence it is recommended to take seed production of concerned crops in other states which are more suitable for quality seed production following the model of MSSCL (Maharashtra State Seed Corporation Ltd). In MSSCL seed production model, the Corporation will depute their production staff in other traditional seed producing states under contract seed production of particular variety which are required for distribution in their own state.

ASC can explore possibilities of seed production in other states, as given below –

- High yielding paddy – Telangana
- Pulses – Karnataka
- Oilseeds – Madhya Pradesh, Uttar Pradesh & Gujarat
- Vegetables – Karnataka

Seed Certification

In the state of Assam, Assam Seed & Organic Certification Agency (ASOCA) takes care of all the activities related to certification of seeds sown by the farmers for the purpose of seed production. ASOCA is putting a lot of efforts on certification to ensure availability of quality seeds of various crops in the state. The statement showing the progress on seed certification of different crops for the year 2020-21 is presented in Table-14.

Table 14. Progress on seed certification of various crops (2020-21)

Sr No	Name of Crops	Area Registered	Qty Produced/ Anticipated	Qty Certified	Percentage of Certification
		(Ha)	(In Qt)	(In Qt)	(%)
1	Winter Paddy	5560.8	155700	25450	17
2	Mustard	2037	24530	550	2.24
3	Winter Black Gram	3502	42100	1560	4
4	Summer Black Gram	485	5800	Nil	-
5	Winter Green Gram	1570.5	18850	1227	7
6	Summer Green Gram	222	2550	Nil	-
7	Lentil	837	8400	70	8.3
8	Pea	1000	10000	323	3
9	Jute	800	4000	Nil	-
10	Groundnut	1045	23000	1800	9
11	Potato	224	49000	1000	2
12	Rajmah	90	1480	Nil	-
13	Summer Paddy	537.1	16000	6500	40.6

Source: Assam Seed & Organic Certification Agency – Guwahati

Though, ASOCA is putting lot of efforts for certification of seed, farmers are not showing much interest in getting certification of their seeds. The information presented in the table shows that there is huge gap between seed registered by the farmers for certification while participating in seed production program and actual seed certified once the seed is ready. In case of paddy only, the percentage of seed certified against seed registered for certification is relatively satisfactory. In case of other crops, it is less than 10 percent or even nil in some crops.

The interaction was held with the seed producing farmers, ASOCA State and District Certification Officials, to find out the reasons for low rate of seed certification in comparison to seed registered for certification. The reasons as perceived by the stakeholders along with some suggestions for improving seed certification ratio are given below –

Reasons	Suggestions & recommendations
The farmers are not interested in getting their seed certified as there is no proper procurement arrangements.	ASC should make a buy back agreement with farmers for procuring certified seed before commencement of seed production process. Involve private seed companies who are selling their seed in the state for making buy back agreement with seed producing farmers
No proper premium price paid for certified seeds. Most of the farmers do not get any extra price for certified seed as there is no proper buy back agreement. They sell their seed either to private seed companies as TL seed or sell as gain in the market at lower price	At least 20 to 30 percent premium price to be fixed for certified seeds when compared to grain price so that the farmers get interested in certifying their seed production
Farmers buy TL seeds from various private seed companies and do not have knowledge on importance of using certified seeds	Create awareness among farmers on the authenticity of quality of certified seeds when compared to TL seeds
No export of seed to other states	Need to tie-up with other State Seed Corporations where similar crop variety seeds are used for cultivation
Individual farmers are not interested in certifying their seeds due to lack of knowledge on the importance of seed certification	FPOs should be involved in certified seed production program

Suggestions and Recommendations

Some of the suggestions based on the field observations are as listed below –

- Proper policies to encourage private seed companies to go for certified seed sales in the state which at present are selling TL seeds
- Attract private seed companies by providing incentives for taking up certified seed production in the state with buy back agreement with the seed producing farmers
- Focus has to be given on distribution of seed certified by ASOCA in various seed supply programs of the government.

Seed Processing

Seed processing is a vital part of the seed production required to move the improved genetic materials of the plant breeder into commercial channels for feeding the rapidly expanding world population. The farmer must get the quality seed that is free from all undesired materials to ensure good production. Seed can seldom be planted in the condition in which it comes from the growers. In fact, many seed lots contain weed or other crop seed or inert material that makes them unfit for sale without processing. Crop seeds also frequently have stems, awns, clusters or other structures which prevent them from flowing freely through the drill. Seed processing is that segment of the seed industry which is responsible for upgrading seed, improving planting condition of seed and applying chemical protectants to the seed. Seed processing and the infrastructure to support the same has an important role to play in making the seed supply system effective in the state.

It is observed that Assam state is lagging behind in seed processing facilities. There are only two seed processing units in the entire state. Even ASC Seed Processing Plant is not in fully functional condition. There is an immediate need to establish at least one seed processing plant in each district. Lack of sufficient seed processing plants in the State is one of the major reasons for supply of inferior quality seeds effecting seed supply chain in the state. Most of the farmers during the group discussions organised under the study expressed the unavailability of seed processing facility limiting their seed production ability and also influencing the quality of the seed.

Seed Processing Plant - Nagaon

Suggestions for improving seed processing in the State

Some of the suggestions based on the field observations to improve seed processing in the state are given below –

- ASC Seed Processing Plant to be re-started with latest seed processing machinery and improved processing capacity
- Encourage private seed companies to establish seed processing units in the state by providing incentives and linking them with different subsidy schemes of the government
- Involve FPOs in establishing seed processing units
- Provide mini seed processing units to farmers under subsidy schemes, so that the seed processing at primary level can be performed at the farmer field level

Seed Quality Control

Maintaining quality seed production is very important in seed supply chain. It has been observed that there are only four seed testing labs in the states which is not sufficient for a state like Assam for ensuring seed quality analysis. Due to inadequate seed testing facilities the number of seed samples tested at the level of dealers are very low when compared to other states. Seed testing is not done properly in the state due to which sub-standard seeds are floating in the market.

Suggestions for Seed quality control

- Increase number of seed testing facilities in public sector.
- Encourage establishment of private seed testing labs operated by qualified technical team.
- Every lot of seed supplied under subsidy program should be passed through seed quality standards.
- Number of seed samples collected from retailers should be increased to have control on quality seed supply to the farmers.

Seed Village Program

Establishment of seed village

Despite implementation of the organized seed program since the mid-60s, the seed replacement rate is low and most of the farmers still use farm saved seeds. It is therefore, necessary to improve stock of farm saved seeds for enhancing crop production/ productivity. Seed village concept focuses on the same by promoting the quality seed production of foundation and certified seed classes. Under the program, a suitable area for seed production will be identified by the scientists. The foundation/ certified seeds or university labelled seeds will be supplied by the University through KVK and Research Stations at 50 percent subsidy cost to the identified farmers in the area. The farmers will use these quality seeds and take up their own seed production in a small area (1 acre) for their own use mainly for crops like rice, pulses and oilseeds. The area for seed production under the program will be identified by taking various factors into consideration, like –

- Irrigation facilities.
- Suitability of climatic conditions to raise the crop for more than one season.
- Labour availability and knowledge of local farmers on that particular crop.
- Occurrence or outbreak of pest and diseases.
- Past history of the area for suitability to raise seed crop.
- Average rainfall and distribution.
- Closeness to an urban area for easy movement of seed and other inputs.

Capacity building is another important component under the seed village concept. Training on seed production and seed technology to the identified farmers for the seed crops grown in the seed villages will be given for technology empowerment of farmers. The seed village program provides a total of 3 days of training to the farmers on seed production. The first one-day training is provided at the time of sowing covering issues like isolation distance, seed treatment and other agronomic practices. The second one-day training is provided during flowering stage which covers identifying off types and their removal, maintenance of seed plots, plant protection measures, maturity status and harvesting methods. The third one-day training is provided after harvesting covering seed cleaning, grading, seed treating, bagging and storage, seed sampling and sending to seed testing laboratory for analysis. The structure of the program is depicted in Figure-10. Tamil Nadu, Telangana, Gujarat and Jharkhand are some of the states having implemented the program successfully. Though, the Seed Village Program in the State of Assam is in the budding stage at present. The state Government along with the implementing agencies is putting all possible efforts to ensure successful implementation of seed village program in the state.

Seed Village Program scheme by Central Government

Central government has issued guidelines to state government for implementation of seed village program. Following aspects are covered under seed village program:

1. Provide financial assistance for distribution of foundation/ certified seed at 50% cost of the seed of crops for production of certified/quality seeds only.
2. The number of farmers may be more than 50 subject to a maximum of 150.
3. Supply of storage bin under the program. There is provision for assistance @ 33% subject to a maximum of Rs. 3000/- for SC/ST farmers and @ 25% subject to maximum of Rs. 2000 for other farmers for procuring seeds storage bin of 20 qt. capacity.
4. The implementing agencies will be State Department of Agriculture, State Agricultural Universities, Krishi Vigyan Kendras, State Seed Corporation, National Seeds Corporation, State Farms Corporation of India (SFCI), State Seeds Certification Agencies and Department of Seed Certification. One

implementing agency will be identified for the area/ locality and to be authorized by the State Government.

5. The crop varieties normally grown in the seed villages will be decided in consultation with the farmers, preferably the same crop for all the farmers.
6. If the implementing agency feels that farmers are showing more interest they can form self-help-group (SHG) and take the assistance for setting up of seed processing unit under 25% back ended credit linked subsidy scheme.

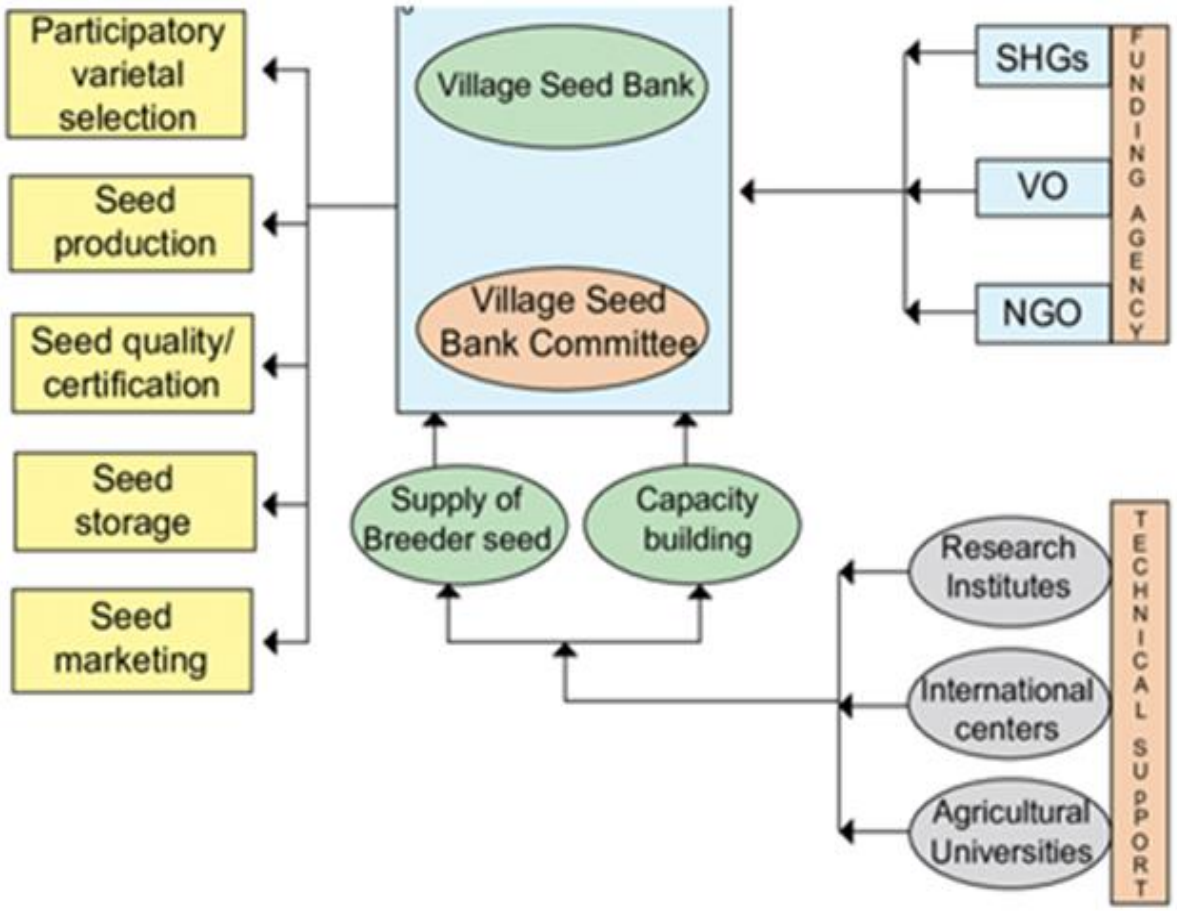


Figure 10. Seed Village System

Seed farms utilization

There are 52 seeds farms operating under ASC. ASC has 12 farms whereas additional 40 farms have been handed over by Department of Agriculture, Government of Assam. The status of utilisation of seed farms owned by Assam Seed Cooperation Limited is presented in Table-15.

Table 15. Different seed farms operating under Assam Seed Corporation Ltd

Sr No	Name of Farm	Location	Total Area (ha)	Cultivable Area (ha)
1	Dalgaon Seeds farm	Dalgaon, Darrang	118	65
2	Darigaji Seeds farm	Darigaji, Nagaon	65	55
3	Golakganj Seeds farm	Golakganj, Dhuburi	37	22
4	Dhekiajuli Seeds farm	Dhekiajuli, Sonitpur	20	17
5	Dimoru Seed Farm	Dimoru, Nagaon	12	11
6	Tingtingia Seeds farm	Tingtingia, Jorhat	36	11
7	Rohdoi Seeds farm	Rohdoi, Sivasagar	16	14
8	Cherelipathar Seeds farm	Titabor, Jorhat	13	8
9	Moniarkhal Seeds farm	Monierkhal, Cachar	26	8
10	Fallangoni Seeds farm	Fallangoni, Golaghat	28	10
11	Senchowa Seeds farm	Senchowa, Nagaon	3.8	3
12	Moran Big Nursery-cum-Seeds farm	Moran, Dibrugarh	3	3

ASC – Farm

The table reveals that out of the 12 farms owned by Assam Seed Corporation, only four farms are being used for foundation seed production of field crops mainly paddy, pulses and oilseeds. In most of the ASC farms, area is not being utilized completely. In order to utilize these farms optimally for seed development and production, possibilities of involving private players may be explored under PPP model so that resources can be utilized jointly by public and private companies.

Suggestions and recommendations for better utilization of 52 seed farms operating under ASC –

- Model farms to be developed for seed production and trail on crops (eg. One farm exclusively for paddy varieties demonstration and production).
- Lease out the unutlised area to private seed companies for developing crops and varieties suitable for production in Assam.
- Seed production of certified seeds of various crops.
- Developing vegetable seed production and multiplication program.
- Developing tuber crop seed production.
- Banana tissue culture nurseries.
- Some of farms can be utilized for varietal evaluation trials on payment basis by private seed companies for obtaining sales permission in the state.
- Development of PPP model for research and developmental activities related to seed technology.
- Establishment of seed testing labs under PPP model.
- Setup common seed processing facilities with involvement of FPOs and private seed companies.

Seed & planting material distribution

Seed and planting material in Assam is distributed through Government Agencies like ASC and Department of Agriculture, farmers organisations like co-operative societies and FPOs and, private agencies distributing seed through their dealers & distributors and private nurseries.

Government Agencies – Seed is distributed to farmers under various subsidy schemes by ASC and DOA. Seeds are procured from private seed companies by ASC through price empanelment and is then distributed to farmers under various

subsidy schemes like RKVY, NFSM and Disaster Management Programs which are funded by Central Government, State Government and World Bank implemented by APART.

Table 16. Seed & planting material distributed by ASC under various subsidy schemes in the State of Assam

Sr No	Year/ Crops	Quantity in Qtls			Difference
		2019-20	2020-21	2021-22	2021-22 over 2020-21
1	HYV Paddy Seeds	40601.9	37893.4	25712.6	-12181
2	Hybrid Paddy	6446.2	4883.95	3231.94	-1652
3	Traditional Paddy Seeds	6786.8	7176.6		-7176.6
4	Hybrid Maize Seeds	4450.9	6116.06	7124.67	1008.61
5	Jute seeds	4973.43	2714.43	1494.77	-1219.7
6	Hy. Jute seeds	--	--	381.57	381.57
7	Mustard seeds	13894.5	5828.64	927	-4901.6
8	Pea seeds	11879	2946.5	610.5	-2336
9	Black Gram	10929.4	3605.42	7234.26	3628.84
10	Green Gram	5504.82	440	2667.81	2227.81
11	Lentil seeds	7164.6	1999.5	--	-1999.5
12	Ground nut seeds	13377.8	15760.5	2949.4	-12811
13	Dhaincha seeds	4948.25	--	7987	7987
14	Arhar seeds	2657	240	--	-240
15	Onion seeds	206.06	225.5	401.3	175.8
16	Hybrid Sunflower seeds	466	953.38	--	-953.38
17	Hybrid Vegetable seeds	204.41	107.62	80.5968	-27.023
18	Niger seeds	3064	--	--	0
19	Soyabean seeds	5448.7	3715.8	2893.5	-822.3
20	Potato Seeds	10944	--	1263	1263
21	Lin Seeds	2011.45	--	--	0
22	Rajmah Seeds	4850.95	4738.8	--	-4738.8
23	Garlic seeds	--	1973.25	--	-1973.3
24	Sweet corn	--	144.82	7	-137.82
25	Millet	--	--	27.36	27.36
26	Red Rice	--	--	900	900
27	Sugar cane sets	--	--	34278	34278
28	Wheat	--	--	3600	3600
29	**TOTAL**	**160810**	**101464**	**103772**	--

Source: Assam Seed Corporation

The information compiled in the table suggests that ASC supplies only a minor share of the total demand of seed & planting material in the state. Crops like Banana, Turmeric & Ginger should be focused for arranging quality planting material as they are important crops grown in the state. Distribution of millet seeds should be increased in the state as there is much scope of cultivating these crops in the state. There is need to increase cultivation of special Assam crop varieties of Black Rice, Red Rice and Joha Rice for export potential of these varieties. Focus should be there on horticultural crops and improved distribution of planting materials to the farmers.

Farmers Organizations – Farmer organizations play a major role in seed & planting material distribution in the state. Farmer organizations who are having input supply outlet, supply seeds directly to the farmers. It has been observed that most of the FPOs do have retail outlets for seed. There is need for each FPO to have retail outlet for supplying quality inputs to the farmers.

Private Agencies

- Seed Companies – Private seed companies play a major role in seed distribution in the state. Private seed companies supply mainly truthfully labelled varieties and hybrid seed through their distributors and dealers in the state. Total state requirements of major crops like Hybrid Paddy, Hybrid Maize, OP & Hybrid vegetables are distributed by private seed companies. There is need to strengthen private seed companies in the state. It has also been observed that many unauthorized seed companies from other states & countries (mainly Bangladesh) are selling seeds in the state which needs to be controlled.
- Seed distributors & dealers – They are the final point for supply of seeds to the farmers and therefore, play major role in supplying quality seed timely to the farmers. It has been observed that lot of unauthorized dealers sell seeds to the farmers in the state which need to be controlled for better quality seed distribution.
- Plant nurseries – Nursery suppliers play an important role in supplying quality plantation crops to the farmers. It has been observed that there are not many private nurseries in the state. Govt need to take steps to promote more private nurseries in the state to fulfil the demand for the plants. There is also need to increase Tissue Culture Banana nurseries in the state.

Recommendations & suggestions for improving seed & planting material distribution in the State of Assam

ASC	▪ ASC should develop its own brand of seeds packed and marketed under the name of ASC (Give a brand name) ▪ ASC can have tie-up with good reputed private seed companies for Hybrid paddy & Maize seed and take bulk from them and brand under the name of ASC and supply to the farmers. ▪ Apart from supplying seeds under subsidy program, ASC should also supply seeds to private dealers so that authentic seeds are available to all the farmers. ▪ Apart from notified field crops, ASC should also plan to market vegetable seeds. ASC should make a separate marketing team for supplying seeds to various seed dealers. ASC seed should be routed through FPOs retail outlet. ▪ ASC can have a tie-up with IIHR for Hybrid vegetable seeds. IIHR have developed good hybrid vegetable seeds suitable to grown in Assam state. ▪ ASC can appoint their own private dealer network in the state as it is done by MSSDC, Telangana & Gujarat State Seed Corporations. ▪ All the seed and planting materials supplied under subsidy should be routed through ASC so that single point monitoring is possible
FPOs	▪ Every FPO should have a retail outlet for seed & planting materials supplies. ▪ Members of FPOs should be trained on seed varieties and sowing seasons so that they can guide farmers. ▪ FPOs should be financially supported for conducting seed training programs.
Private Seed Companies	▪ Every private seed company selling their seed in the state of Assam should have a stock point in Assam. ▪ If possible, they can have seed repacking centre in the state of Assam. ▪ Technical person need to be deputed for sharing knowledge about seed they are supplying to the farmers. ▪ Need to conduct training programs for their dealers on awareness of seed varieties of particular company. ▪ Need to conduct farmers training program about their brand of seeds with focus on aspects like sowing season and cultural practices for obtaining better yields.

	▪ Govt. should encourage private seed companies for setting up marketing network in the state.
Seed dealers and retailers	▪ Increase number of seed retailers. ▪ Training of seed dealers on seed quality and distribution. ▪ Financial support for creating better seed storage facilities. ▪ Seed dealers may also be involved in subsidy seed supplies.
Nurseries	▪ Increase number of quality Banana nurseries in the state. ▪ Provide subsidy for shadenet and polyhouse for developing new nurseries. ▪ Training program should be conducted to nursery growers.

Seed licensing system

Even though state of Assam has framed procedures for seed license for retailers and wholesalers, it not being implemented properly. It was observed during the study that more than two-third of the retailers are selling seed without any seed license. The retailers with fertilizer license are selling seed without obtaining required seed license. A full proof seed licensing system is required in the state for supply of quality seeds to the farmers. The licensing system is required to be retailer-friendly at the same time not to compromise on any quality issue of seed supplied by the retailers to the farmers.

Present seed licensing system in Assam

There are two type of seed licenses issued by the Department of Agriculture for selling seed in the state.

1) Wholesale seed dealer license
2) Retailer seed dealer license

As per the rules of Seed Act, every dealer/ wholesaler has to obtain seed license from Department of Agriculture by applying for the same in the prescribed format for selling seeds. However, most of the dealers are selling seeds without obtaining license from concerned authorities, and there are no strict regulations implemented for unauthorized dealers selling seeds in the state of Assam.

Licenses for private seed companies from other states selling seed in Assam

There are no particular rules framed for private seed companies from other states for selling their Hybrid seeds in the state. Some of private seed companies are selling their seed varieties without proper testing to verify the suitability of their seed varieties in the state and resulting in lot of crop failure complaints. In order to prevent such issue, there is need to develop a sound licensing system for private seed companies to sell their products in the state of Assam.

A model which is followed by most of the states like Telangana, Gujarat, Maharashtra, Andhra Pradesh and Chhattisgarh can be implemented in the state for giving sales permission to the Hybrids of the private seed companies in the state of Assam. Some of points considered by other states while issuing central seed license to private seeds companies are as listed below –

- Seed companies should submit all the detail of seeds handled by the company alongwith morphological and parental characters.
- Company details like R & D, processing, packing facilities availability and proof of the same should be submitted.
- For the first year, the Department of Agriculture or seed licensing authorities may issue a trial marketing permission for each crop and variety limiting minimum sales quantity.
- Meanwhile, the private seed companies should test their varietal performance trials with AAU or Horticulture College with paid up trials.
- Once AAU/designated institute provides reports of the particular variety/ hybrid performance and suitability for Assam state then permanent sales permission may be issued.

Suggestions

Some of the suggestions to improve seed licensing system in Assam are as listed below –

- The Department should strictly implement licensing for seed retailers
- Create awareness among retailers on importance of procuring seed license
- Simplify the process of issuing seed license to the retailers and encourage them to enter into the system so as to improve monitoring process

- Seed sampling from retailers – The interaction with the limited stakeholders considered under the study suggested that no seed samples are taken from the seed retailers. This indicates that the process of taking samples from the retailers is not given much importance for ensuring the quality of seeds distributed by the retailers. The concerned department should develop a proper plan to draw seed samples at least once in a season from seed selling retailers to monitor the seed quality which is being sold in the state.

Licensed Dealers

Unauthorised Retailers

Subsidy System – Supply of Seed & Planting Material

Government of Assam is supporting farmers of Assam by providing seeds & planting materials under subsidy schemes. Even then the farmers are not able to get quality seeds due to some lacunas in present subsidy supply system.

- The company who quotes lowest price (L1) is given chance to supply seeds and planting material under subsidy schemes. Due to which, the companies whose varieties are superior quality and high yielding can't match with the L1 prices, hence farmers does not have choice of buying seeds of their choice.
- It has been observed based on interaction with different stakeholders that the quality of seed supplied (paddy) under subsidy program are not up to the standards.
- There is not much awareness among the farmers about the subsidy schemes available on seed and planting material, hence they are purchasing seeds at higher cost from the retailers.

- Subsidy seed & planting materials are only supplied through govt. agencies, hence many times farmers face the problem of proper and timely seed distribution.

Suggestions & Recommendations

- Govt. has to approve all the company prices individually and fix subsidy amount. If some gap is there, same may be paid by the farmer. If farmer needs his own choice of seed, he has to pay the differential amount. Hence farmer will have choice to buy seed of his preference.
- Regular check of seed quality should be done which are supplied under subsidy program. If any quality problem is found, such companies should be black listed and their license should be cancelled.
- Involve private dealers in distribution of subsidy seeds so that farmers get seed on time before season.

Seed Traceability

Seed traceability helps build trust and confidence amongst all the players within value chain, government institutions, seed companies, wholesalers, retailers, farmers and research institutions. Seed is the essential input of any agricultural process and plays a significant role in attaining higher crop yields and sustained growth. The distribution of quality seeds is as critical as its production. The majority of Indian farmers do not have access to high-quality seeds due to exorbitant prices. Another challenge is the availability of spurious seeds in the market. In India, around 35 percent of seeds in use are from the cultivated crops saved by the farmers, only 45 percent go through the ICAR system, which certifies the products. The balance comes from private companies and doesn't go through an authorized certification process. A fool-proof traceability system is, therefore, the need of the hour. A sound system ensuring availability of quality seeds can help in increasing agriculture productivity and production. There is need to develop a strong traceability system in seed supply chain so as to track the movement of seed from research, production, marketing and delivery to the end consumer in the state of Assam. Already some of the states like Telangana and Jharkhand have successfully introduced traceability in seed supply system.

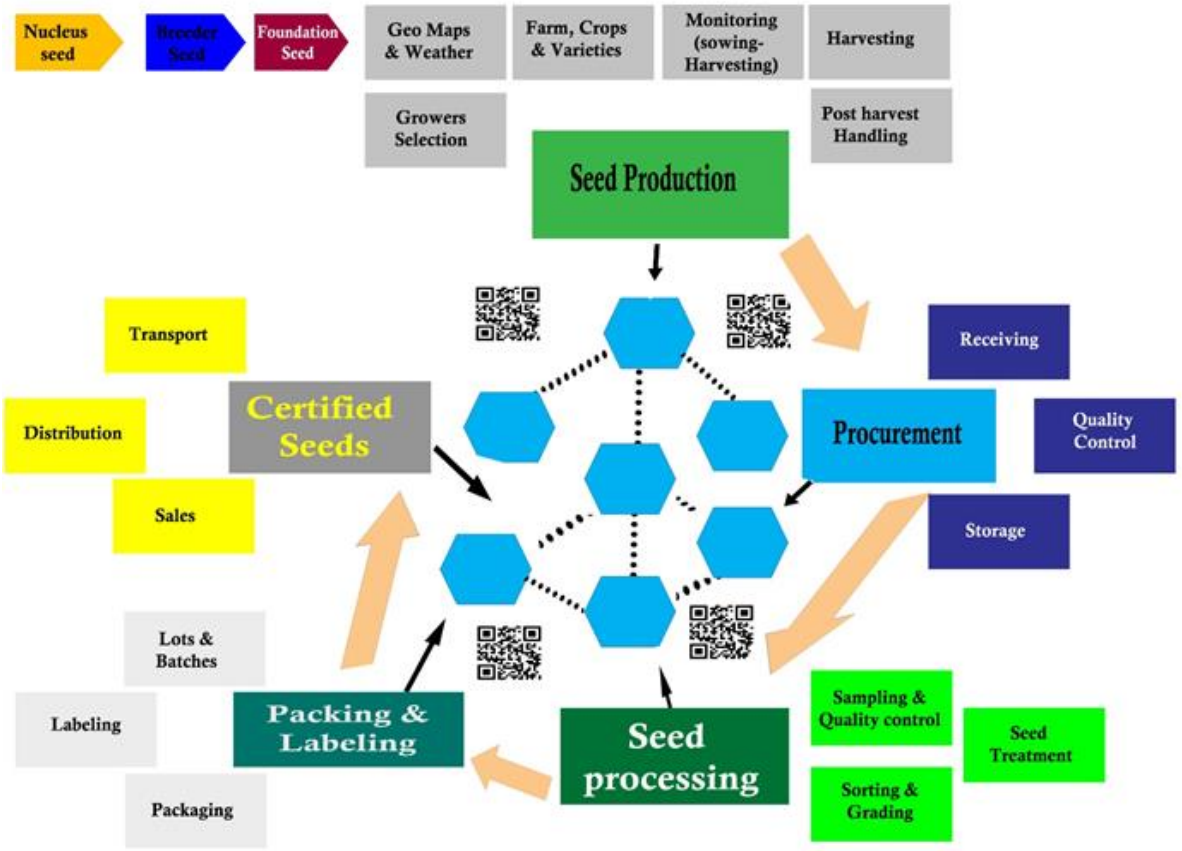


Figure 11. Figure depicting seeds to sale traceability

Seed traceability and how it functions

It can be ensured through a simple software which can be accessed by farmers using a smart phone. Upon scanning the QR code, the farmers can assess and learn about the quality and genuinity of seeds. The QR Codes can be printed and displayed anywhere on the containers and labels. Once the QR code is scanned, immediately, all the details about the seeds, including the place of manufacture, time and manufacturer details, processing and packing locations, seed quality tests results, tests date and expiry details are flashed on the screen. It is not just the farmers, this will be beneficial to the seed manufacturers as well. After checking all the details, farmers will be confident enough to purchase QR coded seed bags compared to the conventional ones, which lack these tags. It will be highly helpful in exporting the seeds as well. It improves the credibility of manufacturers and value addition for seeds in the market and farmers can purchase genuine seeds. The law enforcement authorities can check on-spot information on seed genuinity with the help of sound traceability system and initiate stringent action against offenders.

Telangana is set to become the first State in the country to implement a Seed Traceability System that will help farmers buy quality and genuine seed. The new system, which will also help in curbing the menace of spurious seed, is likely to be implemented soon. Telangana made it mandatory for Telangana Seed Organisations to implement the QR Codes and Seed Traceability. Jharkhand is another state having used blockchain based traceability system for distribution of quality seeds. Jharkhand has become the first state in the country to distribute seeds through the blockchain system. In just one month of the Kharif season, 1,01,065 farmers have been registered on the blockchain-based seed traceability platform. 123 FPOs have also been registered. Along with the seeds, the benefit of other government agriculture schemes of the Directorate of Agriculture will also be extended to the registered farmers and FPOs.

Capacity Building – Seed Supply Chain

Capacity building is a continuous process for imparting knowledge, skill and required competencies to farming community. Capacity building of the various stakeholders of seed supply chain is required to be built for having better seed supply system in the state. There is need to strengthen the available institutes and involve them in capacity building programs for different stakeholders mainly the farmers. The program for farmers may cover aspects like –

- Training programs to farmers on seed production.
- Conducting field visits of farmers to other successful seed production farms.
- Educating farmers on seed production & certification.
- Training programs for members of FPOs on seed production & certification.
- Use of online technology for imparting trainings to farmers and FPOs.
- Training programs on protected cultivation of high value vegetables (Capsicum).
- Trainings on nursery management for fruit crops.
- Educating farmers on use of quality seeds by conducting awareness programs by involving ASC, KVK and AAU.
- Giving training to farmers on package of practices to be followed for various crops.
- Awareness programs on government subsidies on seed & planting materials.

Training strategy for Private Seed Companies & Private Nurseries–

- Conduct programs and meeting to make them understand the requirement of the seed and planting materials in Assam.
- Conduct awareness programs for private seed companies to orient them on the laws to be followed for selling the seeds in the state and their role in supply of quality seed and planting material to the farmers.
- Private seed companies to conduct field training programs for farmers to help them know about how to grow the seed supplied by them.
- Conduct joints group meetings with Private Seed Companies, ASC, ASOKA, state research institutions, FPOs, Dealers & Farmers to facilitate exchange of seed knowledge.
- Conduct demonstrations on new farming and seed technologies.
- Conduct motivational programs for rural youth on creating interest in farming.

Training strategy for Seed Dealers –

- Training programs to be conducted for seed dealers/ retailers on seed law enforced by the state.
- Training programs on cultivation practices of various leading crops for seed dealers/ retailers so that they can provide crop-specific advise to the farmers.

Capacity building in an area having participation of wide range of stakeholders is always going to be challenging and therefore, a comprehensive strategy covering all the stakeholders and aspects of inputs supply system is required to be implemented. Some of the important aspects related to limitations associated with capacity building of different stakeholders and strategies required to overcome the same are discussed below –

Constraints	Strategies
1. Human Resources ▪ Inadequate number of gross root level institutions. ▪ Wider extension worker – farmer ratio ▪ Lack of homogeneity among participants.	▪ Conduct training of trainers (ToT) programs. ▪ Training farmers as technology agents to provide guidance to fellow farmers.

▪ Socio-economic constraints among participants. ▪ Lack of motivation. ▪ Lack of convergence of stakeholders. ▪ Divergent skill sets required by the participants. ▪ Lack of trained resource persons.	
2. Infrastructure facilities ▪ Inadequate infrastructure. ▪ Inadequate funds.	▪ Adequate manpower and infrastructure support. ▪ Creating virtual learning facilities
3. Managerial ▪ Lack of managerial skill ▪ No training and development component ▪ Inadequate follow-up ▪ Limited technology backup	▪ Proper linkage among the institutions associated with capacity building programs. ▪ Recognizing and rewarding farmers/ extension personnel. ▪ Use of trained participants as resource persons. ▪ Proper usage of modern ICT in capacity building. ▪ Providing economically viable and socially acceptable profitable technologies. ▪ Evaluation of capacity building programs ▪ Wide coverage of successful entrepreneurs in mass media. ▪ Impact assessment and yield gap analysis. ▪ Focus on knowledge management and farmers innovations. ▪ Programs to encourage youths to take up different agricultural activities including seed production

Infrastructure development for strengthening seed supply

Infrastructure is another important aspect required to be given proper attention to have an efficient input supply system. In order to strengthen the seed supply chain in the Assam, the infrastructure development requirement is as discussed below –

1) Assam Seed Corporation (ASC)

- ASC processing facility is not in running conditions at present. It is required to make it operational and also to upgrade the same with latest seed processing machineries.
- ASC should develop district wise seed processing units in major seed producing districts of the state.
- Seed testing lab should be developed separately for ASC.
- Seed storage godowns should be constructed to facilitate proper storage of seeds

2) **FPOs**: FPOs should be provided with mini seed processing & drying units and storage godowns to be constructed.

3) **Tissue culture labs**: Infrastructure for new tissue culture banana labs under both public and private sectors.

Linkage of stakeholders in Seed Supply System

The different stakeholders participating in seed supply chain are playing their role for development of better seed supply system in the state but individually. There is a need to have an integrated approach to link all the relevant stakeholders for better monitoring and implementation of seed supply system in the state. For linking stakeholder there is a need for forming Seed Supply Chain Management Consortium (SSCMC) as depicted at Figure-12. Seed supply chain management consortium will consist of representatives from each public department, company and agency having participation in the system, covering –

1. AAU – Assam Agricultural University (Research Institution)
2. APART – Assam Agribusiness and Rural Transformation Project
3. KVK – Krishi Vigyan Kendra
4. RARS – Regional Agricultural Research Stations
5. DOA – Department of Agriculture

6. DOH – Department of Horticulture
7. STL – Seed Testing Lab
8. FPO – Farmer Producer Organization
9. ASC – Assam Seed Corporation
10. ASOCA – Assam Seed & Organic Certification Agency
11. PSC – Private Seed Companies
12. TCL – Tissue Culture Labs
13. Nurseries – Banana, Pineapple & other Fruit Crops
14. Seed Dealers
15. Farmer representatives

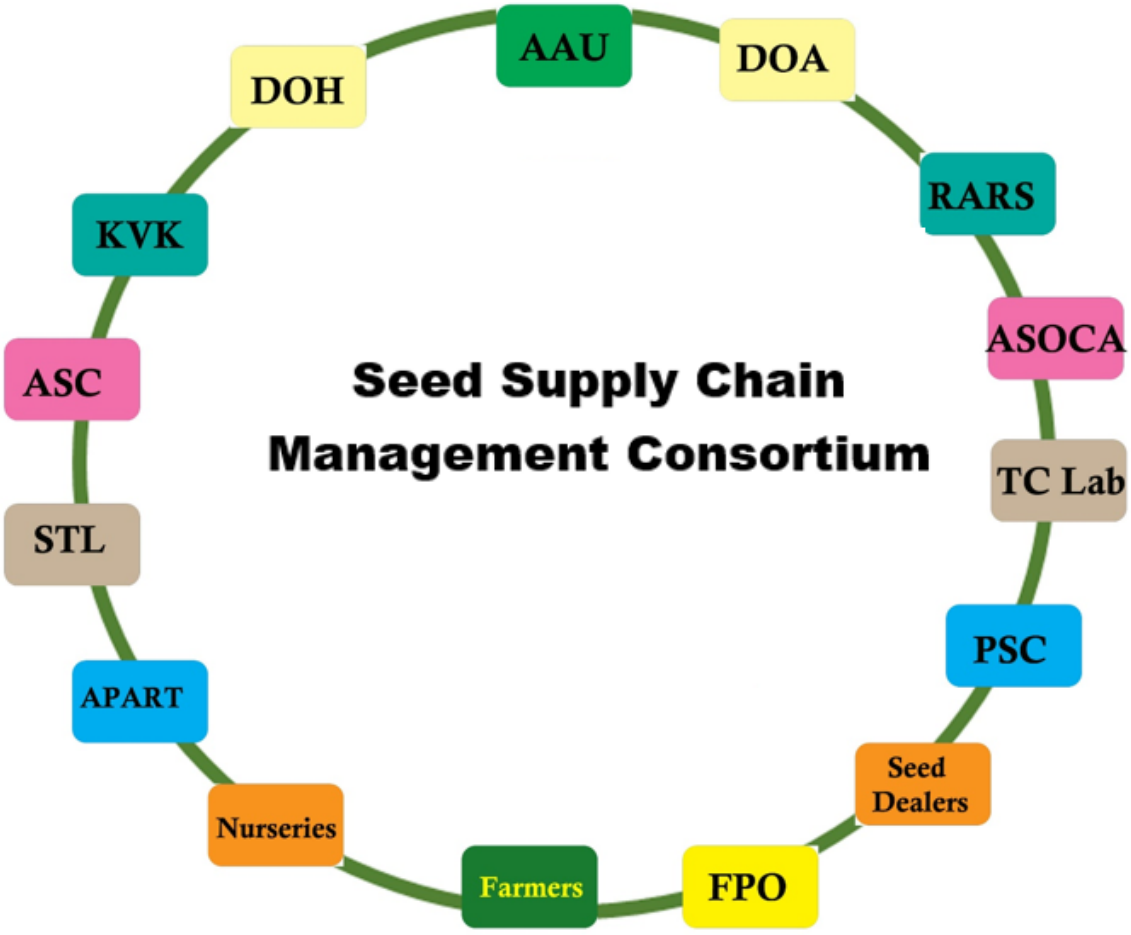


Figure 12. Seed supply chain management consortium

Activities of SSCMC

- Coordination between different stakeholders in the seed supply chain.
- Share information on day to day issues in seed supply chain.
- Monitor smooth running of seed supply chain.
- Conduct farmers meeting and training programs on seed production and certification.
- Monitor proper supply of seeds to farmers under various subsidy programs.
- Establishing linkage between research, production, certification, quality control and distribution of seed and planting materials.
- One point solution for all seed and planting material related activities.
- Finding the gaps in existing seed supply chain and providing the solutions to bridge the same.

Challenges

Seed is made available to a farmers through a multidimensional system which not only consists of production and distribution but also about ensuring delivery of quality seeds. About 40 percent of the respondents highlighted the issue of poor germination. About 8 percent of the respondents also emphasised on the issue of duplicate packaging and purity of seed supplied (Table-17). Government has an important role ot play in ensuring availability of good quality seeds in a transparent manner by developing appropriate strategies involving different stakeholders mainly the private players. There is also need to come-up with a sound strategy by involving private companies and distributors to create awareness on various aspects of procurement of good quality seeds and their efficient use.

Table 17. Major seed challenges faced by different stakeholders

Major Challenges	%
Germination problem	40
Mixture of variety (purity)	4
Duplicate packaging	4
No response	52

Some of the other issues as highlighted by the farmers and seed distributors contacted during the field visit are as listed below –

- Majority of farmers involved with seed production do not have proper buy-back arrangement.

- Most of the farmers do not get premium price for the seed produced by them.
- No proper training imparted to farmers on seed production.
- No proper seed processing infrastructure available to seed production farmers.
- Only about one-third of the farmers received subsidy for the seeds they purchase.
- Majority of farmers buy seed from retailers, to some extent paddy seed are supplied by ASC.
- Majority of farmers lack proper knowledge on seeds and their efficient use.
- A little more than one-third of the farmers suggested lack of purchasing power for high cost hybrid seeds.
- Majority of farmers feels the need to travel long distance to access retail outlets for purchasing of seeds.

The interaction with different stakeholders mainly farmers highlighted the limitations prevailing in Assam seed supply system. The major issues, as perceived by them, are limited buyback arrangements, inability to get any premium price for certified seeds and limited training on seed production. Majority of the farmers, received the seed on time but had issues with quality of seeds supplied to them. Most of the farmers are either procuring seeds from retailers or using own seed with limited supply from ASC and FPOs. This suggests the scope for involvement of farmers' organizations and also the role played by informal sector in seed supplies in Assam. Credit linkages and after sales support has also been a major limiting factor. Majority of the farmers suggested the need for awareness programs due to limited knowledge on seed production and use. There is a need to develop a strong seed licensing system in the state of Assam to control of unauthorized and spurious seed selling in the state. Seed tractability system implementation will be the best method for having a better seed system in the state. Seed village program should be strengthened and implemented properly in the state for better quality seed production. It is suggested to have a seed supply chain management consortium for better seed supply system in the state in which all the stakeholders coordinate for better seed supply system in the state of Assam. Capacity building programs to be conducted to farmers, FPOs, & seed-dealers for strengthening seed supply system in the state.

Section – IV

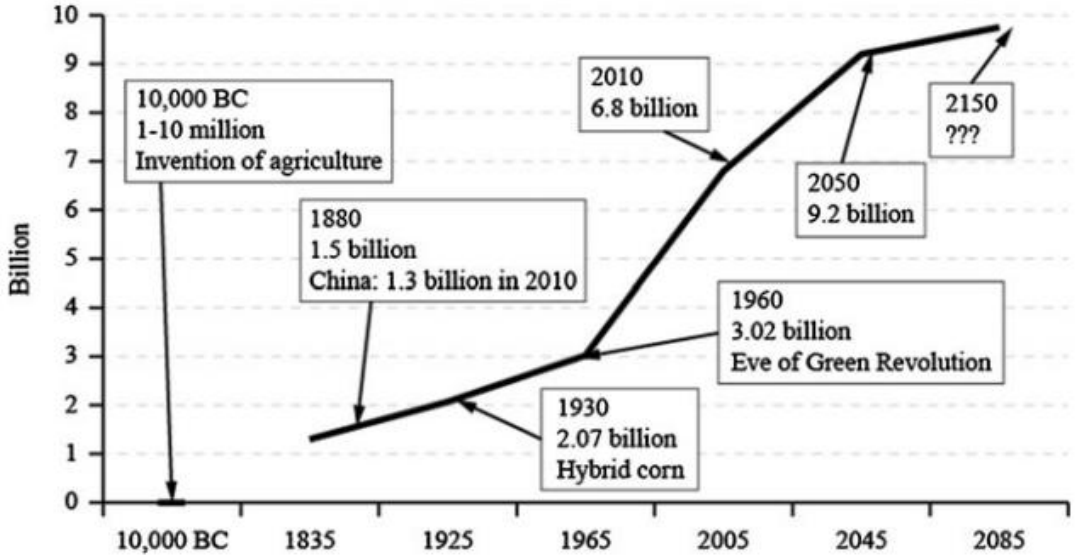
Agrochemicals

Section – IV
Agro-Chemicals

Background

The Green Revolution has allowed world food production to increase substantially in the past 50 years. Roughly during the same period, the human population has more than doubled to reach seven billion. In 2050, the population is projected to increase by 30 percent to about 9.2 billion (Figure-13). Due to the increasing global population, demand for food production is projected to increase by 70 percent (FAO 2009). An important aspects of this increase in demand is the exposure of crop to losses both at production and at post-harvest stage. Globally, an average of 35 percent of potential crop yield is lost to pre-harvest pests (Oerke 2005). In addition to the pre-harvest losses, food chain losses are also relatively high (IWMI 2007). At the same time, agriculture at a global level must meet the rising demand for food, feed, fibre, biofuel and other bio-based commodities. The provision to bring additional land under cultivation is limited, as agriculture expansion would have to happen mostly at the expense of forests and the natural habitats of wildlife, wild relatives of crops and natural enemies of crop pests. Given these limitations, sustainable production with increased productivity on existing land is by far the better choice. Equally important is to avoid waste all along the food supply chain. Though, technology will hold the key for many of the long-term global food security issues, much can be done with existing technology and knowledge as well. In order to make agriculture more productive and profitable in the face of rising costs and rising standards of human and environmental health, it is important to use the best possible combination of available technologies. Much of the increase in yield per unit of land can be attributed to more efficient control of (biotic) stress rather than an increase in yield potential. Developing strategy to reduce yield losses caused by pests, pathogens and weeds is a major challenge faced by Indian agriculture (Oerke and Dehne 2004). The intensity of crop protection has increased considerably as suggested by a 15 – 20 fold increase in the quantum of pesticides used worldwide (Oerke, 2005).

Figure 13. World population growth projections



Source: FAO (2009)

Again, the diverse ecosystems of the world have been replaced in many regions by simple agro-ecosystems which are more vulnerable to pest attacks. In order to safeguard the high level of food and feed productivity necessary to meet the increasing human demand, these crops require protection from pests (Popp 2011). Food security is only the first step towards greater economic independence for farmers (FAO 2009). However, enabling farmers to minimise the loss of their crops will be a key factor in promoting food security.

Crop losses to pests

In natural ecosystems, different pests coexist in a complex relationship with plant communities. Different species of plant-feeding/infecting pests must search out their host plants from the mixed vegetation. In this search, they face the dangers of annihilation by various abiotic and biotic agents. Therefore, the damage caused by pests is quite limited in the natural ecosystems. In contrast, the natural regulating factors play only a limited role in the agroecosystem and pest outbreaks are quite frequent.

It is estimated that agricultural crops of the world are damaged by more than 10000 species of insects, 30000 species of weeds, 100000 diseases (caused by fungi, viruses, bacteria and other microorganisms) and 1000 species of nematodes (Dhaliwal et al., 2007). However, less than 10 percent of the total identified pests are generally considered major pests and contribute 35 percent of the potential pre-harvest crop yield loss. Region-wise and crop-wise crop losses caused by different pests are presented in Table-18 and Table-19.

Table 18. Crop losses due to different pests in different continents

Continent	Crop loss (%)			
	Animal Pests	Pathogens	Weeds	Total
Africa	16.7	15.6	16.6	48.9
N. America	10.2	9.6	11.4	31.2
Latin America	14.4	13.5	13.4	41.3
Asia	18.7	14.2	14.2	47.1
Europe	10.2	9.8	8.3	28.2
USSR	12.9	15.1	12.9	40.9
Oceania	10.7	15.2	10.3	36.2
Mean	15.6	13.3	13.2	42.1

Source: Modified from Oerke et.al. (1994)

Information presented in Table-19 suggests that rice experienced the highest loss of more than 51 percent due to different pests. It highlights the importance of having a sound pest management system as paddy is a major crop for Assam.

Table 19. Global estimates of crop losses in different crops due to different pests

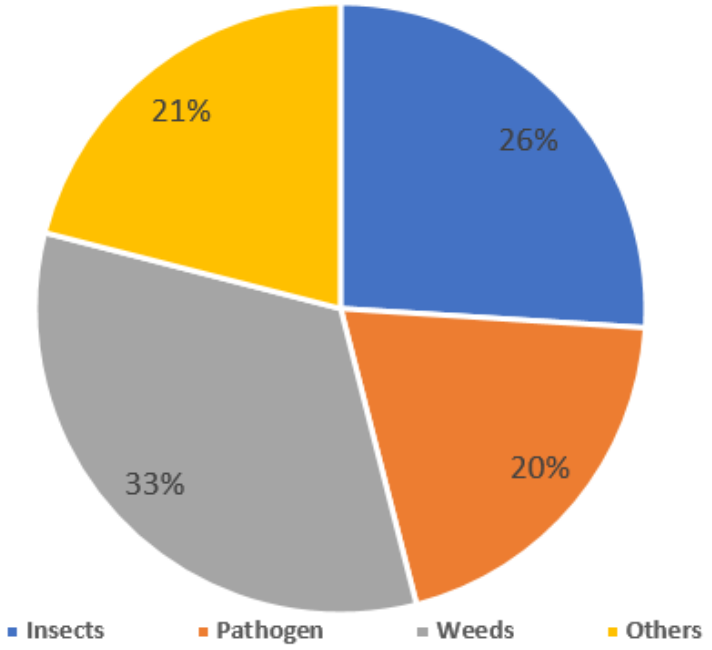
Crop	Loss (%)			
	Animal pests	Pathogen	Weeds	Total
Rice	20.7	15.1	15.6	51.4
Wheat	9.3	12.4	12.3	34.0
Maize	14.5	10.9	13.1	38.5
Potato	16.1	16.3	8.9	41.3
Soybean	10.4	9	13	32.4
Cotton	15.4	10.5	11.8	37.7

Source: Oerke et al. 1994

Indian scenario

India is no exception in terms of crop losses due to the widespread presence of pests in agricultural crops. There is a paucity of reliable data on the extent of food losses caused by these biotic agents. Though, attempts have been made from time to time to estimate the losses due to the invasion of pests in different crops. The information presented in Figure-14 reveals a significant loss caused by each category of pests.

Figure 14. Crop yield loss due to different pests in India



Source: Directorate of weed research, Jabalpur

The crop-wise loss in yield as compiled from different studies is presented in Table-20. The loss of yield can be as high as 50 percent in cotton which has come down to 30 percent in recent years. Same has been the case with, sorghum and wheat. Though, the level of yield loss is still high. Many crops like rice, pulses, groundnut and sugarcane are experiencing similar kind of losses over years.

Table 20. Crop yield loss due to different insect pests in different crops in India

Crop	Pradhan (1964)	Pradhan (1983)	Dhaliwal & Arora (1996)	Lal (1996)	Dhaliwal *et.al.* (2007)	Puri& Ramamurthy (2009)	Dhaliwal *et.al.* (2010)	Dhaliwal *et.al.* (2015)
Cotton	18	18	50	22	50	50	30	30
Rice	10	10	25	18.6	25	25	25	25
Oilseeds	5	5	35	25	25	25	15	20
Pulses	5	5	30	7	15	15	15	15
Groundnut	5	-	15	-	15	15	15	15
Wheat	3	-	5-10	11.4	5	5	5	5
Maize	5	-	25	-	25	25	25	25
Sorghum and Millets	3.5	-	35	10	30	30	10	8
Sugarcane	10	-	20	15	20	20	20	20

Yield losses due to major insect pests in vegetable crops in India have been compiled in Table-21. The information suggests that yeield loss has been osberved in vegetable crops which ranges between 11- 99 percent highlighting the importance of insect pest management in agriculture.

Table 21. Yield losses due to major insect pests in vegetable crops in India

Crop/Pest	Yield loss (%)	Crop/Pest	Yield loss (%)
Tomato		Cabbage	
Fruit Borer *(Helicoverpaarmigera)*	24-73	Diamondback moth *(Plutellaxylostella)*	17-99
Brinjal		Cabbage caterpillar *(Pierisbrassicae)*	69
Fruit and Shoot borer *(Leucinodesorbonalis)*	11-93	Cabbage leaf webber (Crocidolomiabinotalis)	28-51
Chillies		Cabbage borer *(Hellulaundalis)*	30-58
Thrips*(Scirtothrips dorsalis)*	12-90	Cucurbits	
Mites *(Polyphagotarsonemus latus)*	34	Fruit fly *(Bactroceracucubitae)*	
Okra		Bitter gourd	60-80
Fruit Borer *(Helicoverpaarmigera)*	22	Cucumber	20-39
Leafhopper (*Amrascabiguttulabiguttula)*	54-66	Ivy gourd	63
Whitefly *(Bemisiatabaci)*	54	Musk melon	76-100
Shoot and Fruit Borer *(EariasVittela)*	23-54	Snake gourd	63
		Sponge gourd	50

Source: Shivalingaswamy et.al. (2002); Dhillon et.al. (2005); Satpathy et.al. (2005); Raju et.al. (2007); Singh et.al. (2007); Ghosal et.al. (2012)

Uses of pesticides

Improving productivity

Judicious use of chemicals to control the infestation of insect and pest can be an important management strategy. Tremendous benefits have been derived from the use of pesticides in forestry, public health and domestic sphere and in agriculture as well which is a sector of great relevance for Indian economy. Foodgrains production, which stood at a mere 50 million tons in 1948-49 increased to 308.65 million tons in 2019 – 20 from an estimated 129.34 million hectares of cropped area. This has been an outcome of use of seeds of high-yielding varieties, advanced irrigation technologies and application of advance inputs in agriculture. Webster et al. (1999) stated that “considerable economic losses” would be suffered without pesticide use and quantified the significant increases in yield and economic margin that result from pesticide use.

In medium land, rice even under puddle conditions during the critical period warranted an effective and economic weed control practice to prevent reduction in rice yield due to weeds that ranged from 28 to 48 percent, based on comparisons that included control (weedy) plots, weeds reduce the yield of dry land crops by 37–79 percent (Behera and Singh, 1999). Severe infestation of weeds, particularly in the early stage of crop establishment, ultimately accounts for a yield reduction of 40 percent and use of herbicides provide both economic and labour benefits.

Vector disease control

Vector-borne diseases are most effectively tackled by killing the vectors. Insecticides are often the only practical way to control the insects that spread deadly diseases such as malaria, resulting in an estimated 5000 deaths each day (Ross 2005). In 2004, Bhatia wrote that malaria is one of the leading causes of morbidity and mortality in the developing world and a major public health problem in India. Disease control strategies are crucial even for livestock.

Quality of food

In countries of the first world, it has been observed that a diet containing fresh fruit and vegetables far outweighs potential risks from eating very low residues of pesticides in crops (Brown 2004). Increasing evidence (Dietary Guidelines 2005) shows that eating fruit and vegetables regularly reduces the risk of many cancers, high blood pressure, heart disease, diabetes, stroke and other chronic diseases. Lewis *et al.* (2005) discussed the nutritional properties of apples and blueberries in the US diet and concluded that their high concentrations of antioxidants act as protectants against cancer and heart disease. Lewis attributed doubling in wild blueberry production and subsequent increases in consumption chiefly to herbicide use that improved weed control.

Other areas – transport, sport complex and buildings

The transport sector makes extensive use of pesticides, particularly herbicides. Herbicides and insecticides are also used to maintain the turf on sports pitches, cricket grounds and golf courses. Insecticides protect buildings and other wooden structures from damage by termites and wood-boring insects, suggesting wise use of pesticides outside agriculture.

Development of Indian agro-chemical industry

Agriculture is backbone of the Indian economy and holds an important place in socio-economic development of the country as it provides employment to about half of workforce and contributes about 20 percent in the GDP of the country. The Green Revolution towards the beginning of the 1970s had major economic effect in terms of production and productivity. The Green Revolution lead India from a food deficit to a food surplus country. It has not only helped in increasing exports of agricultural products but has also helped in satisfying the demands of huge population of the country.

The population of the country increased more than 100 percent from 0.62 billion to 1.3 billion during 1975 to 2014. However, agricultural production in India has increased 1400 percent, means multiplied 14 times which in value terms suggests an increase from US$ 25 billion to US$ 367 billion. Agricultural production in India has increased in variety and volume, not only to ensure the food security of the nation but also for good exports.

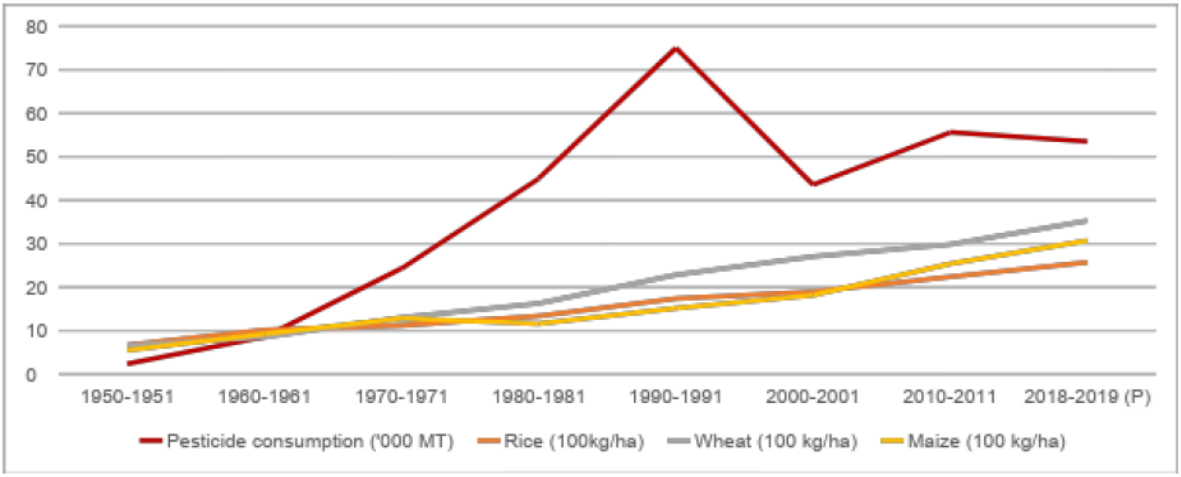
Crop Protection Chemicals played a vital role in increasing agricultural production in India by protecting the crops and produce from pests and increasing farm productivity. Insecticides dominate the Indian crop protection market and form almost 53 percent of the domestic crop protection chemicals market, followed by Herbicides at 24 percent, Fungicides at 19 percent, and others at 4 percent. Major applications of pesticides in India are on rice and cotton. Herbicides are emerging as the fastest growing segment amongst agrochemicals.

Indian currently ranks second in the world in agricultural production with a value of USD 367 billion and cultivated land area of about 150 million hectares. India is also the 8th largest agricultural produce exporter with a value of USD 35 billion.

As far as the Pesticide Industry is concerned, India currently is the fourth largest global producer of pesticides after the USA, Japan, and China. Domestic consumption of pesticides in India is worth US$ 2.77 billion while exports are worth US$ 2.31 billion, thus, the total market size is worth US$ 5.08 billion. The growth was significantly contributed by the exports by Indian companies' generic segment producing a wide range of world-class formulations.

However, the agro-chemicals sector in India has huge unrealized potential for growth given the low level of application in India in comparison to global norms. The average consumption of pesticides in India at 0.65 gm/ha against the global average of 3 kg/ha. The use of pesticides in India over years is presented in Figure-15.

Figure 15. Pesticide consumption (thousand tonnes) and yields of Wheat, Rice and Cotton (100kg/ha) during 1950–2019 in India



Assam Scenario

During the past few decades, Assam has witnessed a substantial increase in the use of pesticides in terms of both volume and value. The demand for agro-chemicals depends upon the type of crops grown, farmers' knowledge about technologies and their profitability and the availability, affordability and ease of accessing the input and output markets. The steady increase in productivity of different crops in Assam during the past three decades was, by and large, achieved by increased use of fertilizers and pesticides. But of late, in the rice and vegetable growing areas of the state, chemicals are being used indiscriminately without considering scientific recommendations. The choice of chemicals/brand preferences is steered by traders and other market functionaries. The judicious application of pesticides, therefore, is the concern of all stakeholders in view of the low productivity in the state compared to the productivity in other states like Punjab, Telangana and Tamil Nadu.

Plant Protection Chemicals (PPC) or pesticides

Plant protection chemicals/pesticides are substances manufactured through chemical or biochemical processes containing the active ingredient in a definite concentration designed to protect crops from insects, diseases and weeds which eventually rescue crop from losses caused by the pests.

PPCs are broadly classified as synthetic (manufactured by chemical process) and bio (derived from natural substances like plants, animals, bacteria, and certain minerals and control pests by nontoxic mechanisms). Depending on the type of pest

they control they are classified as insecticides, herbicides, fungicides, rodenticides, nematicides, etc.

Insecticides – Insecticides provide protection to the crops from insects by either killing them or preventing their attack. Insecticides can further be classified based on their mode of action.

- **Contact insecticides –** These insecticides kill insects on direct contact and leave minimum residual activity, hence causing minimal environmental damage.
- **Systemic insecticides –** These are absorbed by the plant tissues and destroy insects when they feed on the plant. These are usually associated with long-term residual activity.

Fungicides – Fungicides are substances that are used to protect the crops from the attack of fungi and to control diseases on crops caused by fungi. Fungicides are of two types – protectant and eradicant.

- Protectants prevent or inhibit fungal growth
- Eradicant kill the disease on the application which in turn improves productivity, reduces blemishes on crops and improves storage life.

Herbicides – Herbicides also called weedicides are used to kill undesirable plants. Herbicides are of two types based on their mode of action. **Selective herbicides** kill specific plants, leaving the desired crop unharmed, while **nonselective** herbicides are used for widespread clearance of ground and are used to control weeds before crop planting. Herbicides can be classified into three categories based on their stage of application like (i) Pre-Emergence – Used before sowing of the crop (ii) Post-Emergence – Used after the emergence of the weeds and (iii) Early Post-Emergence – Used immediately after sowing.

Trend in consumption of pesticides in Assam

Assam agriculture can be divided broadly into two segments, one is plantation which includes mainly tea and the other is field crops covering cereals, pulses, oilseeds, vegetables, and other horticultural crops. Tea is the major segment with certain consumption of pesticides and planters follow a proper schedule to control pests. It is more organized than the field crops segment, where farmers do not follow any schedule and the use of pesticides is mainly need-based. Assam is traditionally a low pesticide-consuming state. Some districts like Karbi Anlong and other upper Assam

districts are traditionally using fewer pesticides for growing field crops like rice and vegetables. In recent past, there has been a huge growth in consumption of technical grade pesticides in Assam in comparison to all India figure in 2019-20 over previous years (Table-22). Though, the consumption is still low in comparison to even small states like West Bengal, Haryana and J&K (Figure-16). A similar trend is also observed in the case of consumption per unit. If the consumption of pesticides in tea is excluded, per unit consumption in field crops will be much less than the average all India consumption of pesticides of 4.6 MT per lakh ha (Figure-17). A steady growth in consumption of bio-pesticides has also been observed in the state during the same period. Though, total consumption is again quite low in comparison to other states like West Bengal and Haryana as was observed in case of chemical pesticides.

Table 22. Trend in consumption of pesticides in Assam (Quantity in MT Tech. Grade)

Pesticides	2016-17	2017-18	2018-19	2019-20	2020-21
Chemical Pesticides (Assam)	306	241	256	410	420
Chemical Pesticides (India)	58634	63406	59670	61702	62193
Bio-Pesticides (Assam)	188	217	234	243	248
Bio-Pesticides (India)	7190	7174	7203	8847	8645

Source: http://ppqs.gov.in/statistical-database

Figure 16. Trend in consumption of pesticides in major states

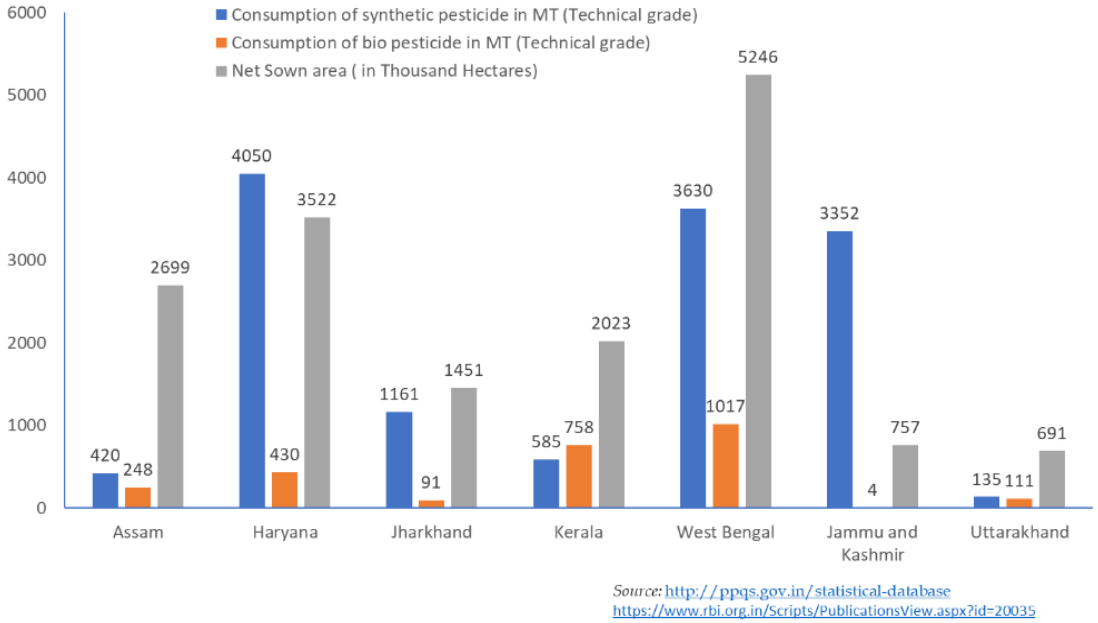
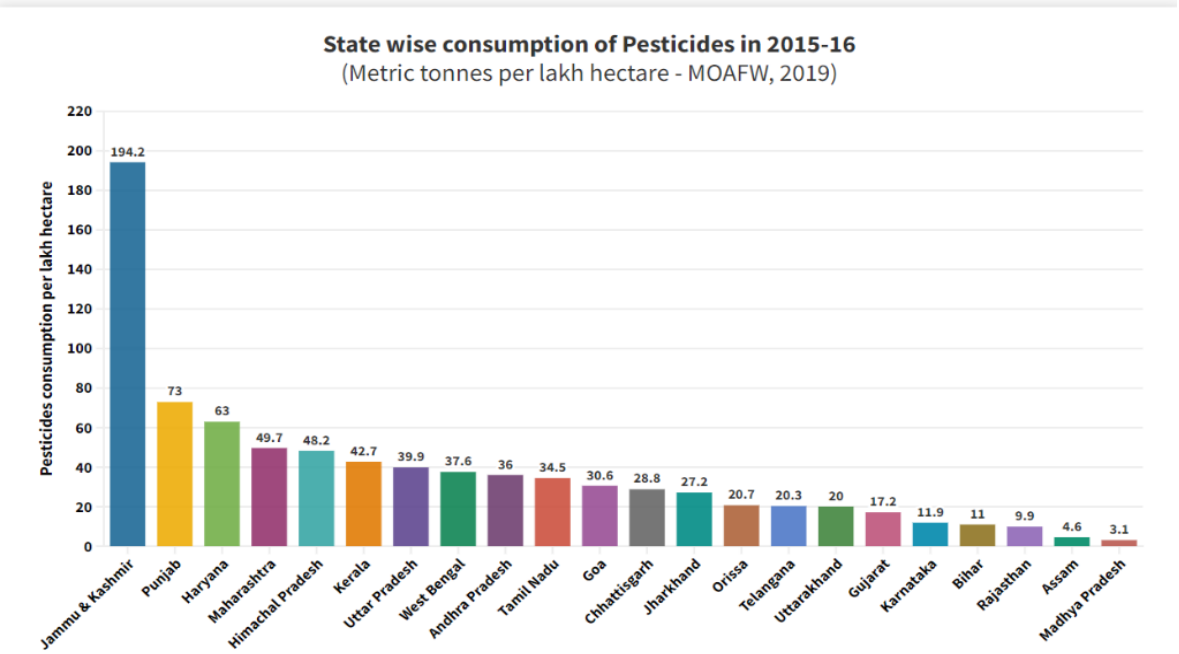
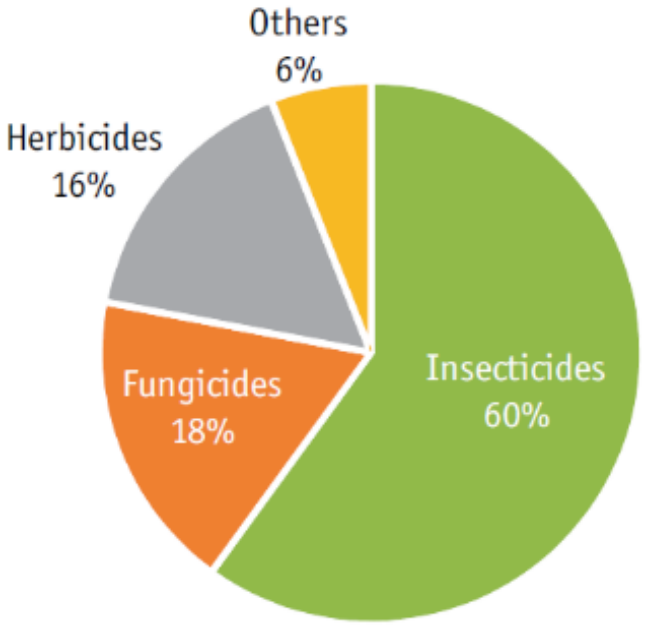


Figure 17. Per ha consumption of pesticides in different states of India



Availability of information on segment-wise consumption of pesticides in public domain is limited. However, it is assumed that the Assam market is also dominated by insecticides as is the case at national level (Figure-18). Though, the proportion of insecticides and fungicides to the total consumption may be little less as compared to the national trend as herbicides are regularly used in tea.

Figure 18. Market share of different pesticide segments (India)



The observations from the field also suggests a similar picture. The information collected from retailers and distributors on major pest occurrence and pesticides use has been compiled in Table – 23. The table reveals that about 48 percent of the retailers and distributors considered under the study feel that insects are the major pest and roughly same number of retailers and distributors perceive that insecticides contribute the highest share of the total pesticide consumption in the state, followed by fungicides, herbicides and PGR.

Table 23. Major pest occurrence and pesticide use as suggested by retailers and distributors

Category	Items	Percent Response
Pest Occurrence	Insect	47.62
	Fungus	28.57
	Weed	23.81
Pesticide use by type	Insecticide	47.92
	Fungicide	25.00
	Herbicide	22.92
	PGR	04.17

Major synthetic pesticide molecules used in Assam

The molecule-wise data on annual consumption in Assam is not available in the public domain. However, it is quite clear that the pesticide market of Assam is mainly dominated by insecticides. Generic pesticide molecules compared to specialty or patented molecules are more popular in the field crop market because of their price advantage and abundant availability (73% of the interviewed farmers were aware only about the old generic molecules) but are associated with problems of resistance development in pests, residues and health hazards. The molecules in three major categories of pesticides, predominantly in use in Assam, are as listed below –

- **Insecticide –** Thiamethoxam, Acetamiprid, Chlorantraniliprole, Chlorpyriphos, Spinetoram; LamdaCyhalothrin, Cypermethrin, Profenophos+Cypermethrin, Cartaphydrochloride, Fipronil, Acephate, Carbofuran, etc.
- **Fungicide –** Mancozeb. Copper oxychloride, Carbendazim,Carbendazim +Mancozeb, Validamycin, Chlorothalonil, Tebuconazole, Cymoxanil+ Mancozeb, Hexaconazole, etc
- **Herbicide –** Glyphosate, Paraquat, Pendimethalin, Pretilachlor, pyrazosulfuran ethyl etc.

Major bio-pesticides used in Assam

According to the Directorate of Plant Protection, Quarantine and Storage (DPPQS), there is only one biocontrol laboratory available in Assam which is operating under the supervision of the state government but is not involved with the production. A few small private players are active in production but their capacity cannot fulfil the requirement of the entire state. Again, they are also not manufacturing the entire range of bio-pesticides registered in India. Out of the 970 bio-pesticides registered in India, only neem and Trichoderma viridae-based insecticides are in regular use in field crops of Assam. Other bio and botanical pesticides have a long way to go before they become popular in Assam. The challenges in wider use of bio-pesticides in Assam are related to the efficacy, shelf-life, production methods, narrow range of host or target pathogens pests, poor performance in the field, problems in the delivery system, economics, regulations, lack of fundamental knowledge of the farmers and other stakeholders in the supply chain. Of late, a new practice has also emerged by which some companies are selling insecticides in the name of 'bio-products' to avoid rigorous registration procedures and hence, formulating it in an illegal and untested manner. Dr C D Mayee, Chairman, AFC India Limited launched a campaign against fake pesticides in early 2014. He collected samples of products claiming to be bio-pesticides but laced with chemicals. Avermectin B1 a, Avermectin B1 b, Acetamiprid and Thiamethoxam are the most common chemicals found.

The compilation of information from the field based on the interaction with retailers and distributors suggests that nearly two-third of the retailers and distributers are interested in diversifying their portfolio by including bio-pesticides (Table-24). Though, the major challenges as expressed by the retailers and distributors in getting associated with bio-pesticides are related to lack of knowledge (52 percent) and issues related to non-availability (32 percent) and availability of quality products (32 percent). Only a limited number of bio-stimulants are being handled by about 48 percent of the retailers and distributors considered under the study. Though, quality has been highlighted as a major issue with bio-pesticides but only a limited number of retailers and distributors (24 percent) are concerned about the bio-efficacy report before selling a particular bio-stimulants. The state government is required to come up with appropriate policies for creating the awareness on the use of bio-pesticides and means to be adopted to ensure their quality. Production is also required to be considered to address the issue of non-availability.

Table 24. Aspects related to diversification towards bio-pesticides

Sr No.	Items		Percent
1	Interested in selling bio-pesticides		60
2	Major problems associated with bio-pesticides *(multiple responses)*	a) Non-availability	32
		b) Quality issue	32
		c) Lack of knowledge	52
3	Types of bio-stimulants is handling	a) Less than 5	48
		b) More than 5	44
		c) No response	08
4	Asking bio-efficacy report before selling bio-stimulants	a) Yes	24
		b) No	68
		c) No response	08

Pesticide Licenses

As per the Insecticide Act (1968) and Rule (1971), it's compulsory for any organization to get the registration of the pesticides (Synthetic or bio) it wants to manufacture, store or sell at the central level. In order to manufacture, make formulation, sell, stock, or exhibit for sale or distribute insecticides (synthetic or bio), any organization needs to get a license from the licensing officer of the respective state government. During our interaction with different stakeholders, it was observed that some organizations are selling pesticides in the name of growth enhancers or bio-pesticides without getting a proper license. It is a case of violation of the act and rule. The department needs to be more vigilant and more sampling and testing to be done and appropriate action taken for such fake bio-pesticide.

Pesticide companies active in Assam

Unlike other states, data on the number of pesticide companies which are legally authorized to sell and market pesticides in Assam is not available (77% of the government officials and 60% of retailers and distributors agreed on this point). Based on the information compiled through interaction with different stakeholders, 7 MNCs, more than 25 Indian multinationals and local companies are marketing different pesticide formulations. Each of these companies is having authorized distributors/ dealers that facilitates the sale and promotion of pesticide through a network of organized/ unorganized market functionaries.

Market share of different companies

Authentic information on the market share of different pesticide companies is not available in the public domain. However, based on the discussion with the company personnel and state government officials, top five pesticide companies and their market share in terms of revenue may be as follows –

- Bayer Crop Science (19 %)
- Jivagro Limited (15%)
- Syngenta India Limited (12%)
- UPL Limited (10%)
- Rallis India 5%

The information presented above indicate the highly concentrated pesticide market in Assam limiting the consumers from enjoying the price advantage from the competition.

Availability of pesticides

Though, there is no study available on the actual demand vs supply, it is evident that the state has never experienced complete crop failure due to the unavailability of pesticides in the recent past. On the contrary, the state may be having the problem of excess supply as lots of unauthorized players are active in the state and no centralized process is available to capture the actual sales by the different companies in the state.

Plant protection chemical delivery system

After land, the provision of farm inputs such as seeds, machinery and equipment, fertilizers and agro-chemicals are probably the most important factors influencing agricultural productivity. Farmers require the right inputs, in the correct quantities, at the right time and at affordable prices to optimally utilise the resources and ensure higher productivity and production. The effectiveness of input supply system in fulfilling these requirements is largely influenced by the structure, conduct and regulatory environment governing the supply system. It also enables farmers to receive inputs in a transparent and corruption-free market environment and minimizes administrative costs of delivery of farm inputs.

Existing Plant Protection Chemicals (PPC) delivery system in Assam

Broadly, the plant protection chemical delivery system in Assam can be divided into three major sub-sectors –

- **Marketing Channel –** It consists of the traditional channel through which a pesticide formulation finds its way from the primary manufacturer to the end users i.e. the farmers. It is dominated by the private sector players as the Government of Assam has hardly any presence in manufacturing and distribution of PPC in the state.
- **Regulatory Body –** It is mainly the Government of Assam through the Ministry of Agriculture that plays an important role in the seamless delivery of PPC in the state. Major roles of the State Government are issuing licenses to the PPC marketing companies, dealers, distributors, and cooperatives checking the quality of the materials which are being sold to the farmers, checking the presence of spurious and substandard materials in the marketplace, imparting training to other stakeholders and sometimes purchase and free distribution of PPCs to farmers is also the responsibility of the state government. It basically acts as a watchdog in the entire system and provides an interface between different stakeholders. Occasionally, Government is also engaged in procurement and free distribution of PPC among the farmers.
- **Knowledge Sector –** Major stakeholders in this sector are Assam Agricultural University and the Research & Development and the Marketing Department of the primary manufacturers and formulators of pesticides. The University through its extensive network of Krishi Vigyan Kendras (KVKs), the Directorate of Extension and the Directorate of Research play an important role in the dissemination of knowledge related to pests and PPC to all the relevant stakeholders in present in the system including farmers. The Research & Development Department of the primary manufacturer and formulators acts as a primary source of knowledge related to every aspect of pesticides and plays an important role in the dissemination of information to other actors participating in the system.

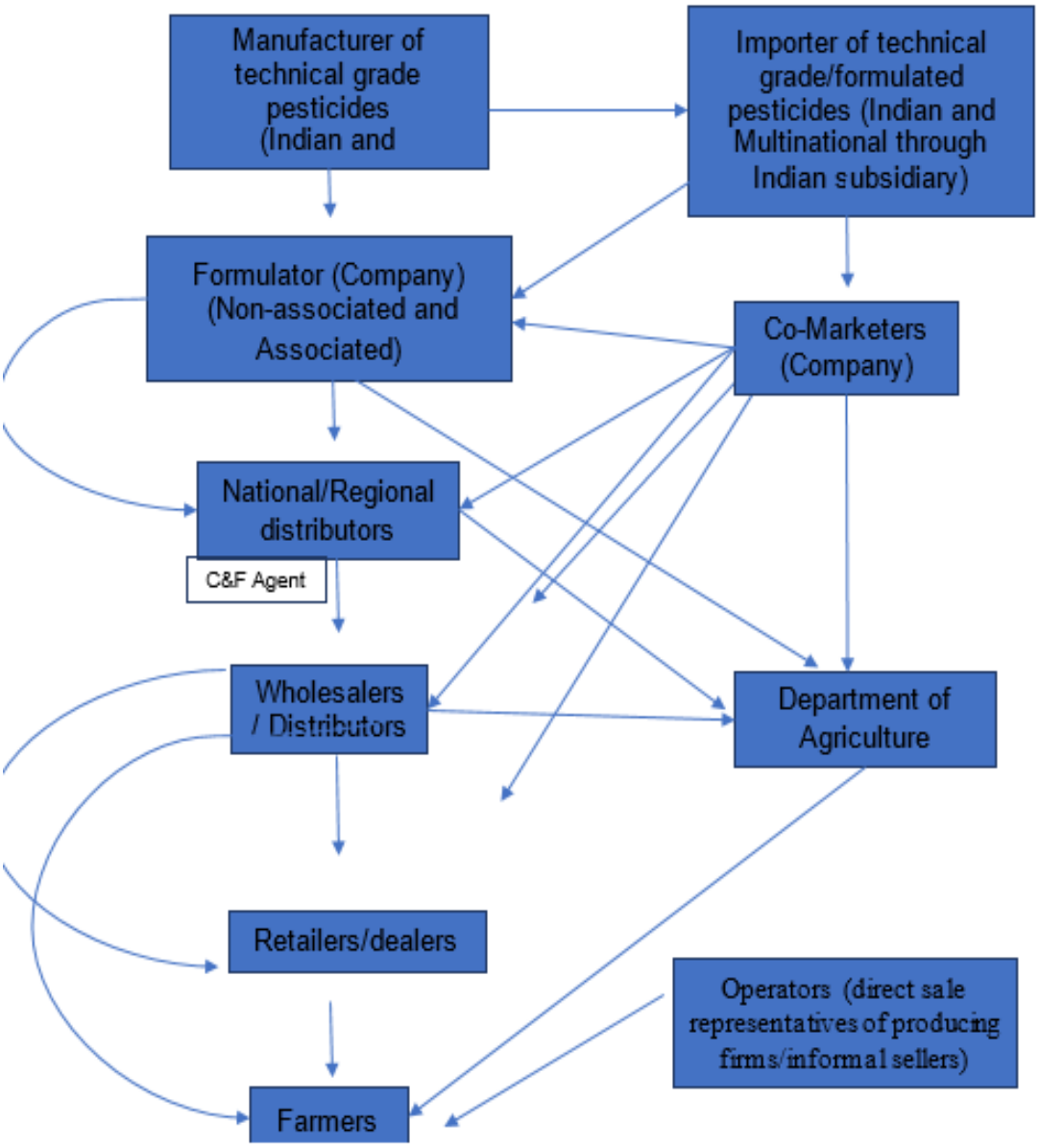
Agro-chemicals supply chain

The structure of the existing supply chain is as depicted in the Figure-19.

1) **Manufacturer of technical grade pesticides (Indian and Multinational) –** Pesticide manufacturer means a person who (1) manufactures or prepares compounds or propagates or processes any device or active ingredient used in producing a pesticide; (2) who possesses an establishment number with the Central Insecticide Board and Registration Committee pursuant to the Insecticide Act 1968. There are about 125 technical grade pesticide manufacturers in the country of which about 60 are in the organized sector and 10 are multinationals. As there is no technical grade manufacturer present in Assam, the state must fulfil 100 percent of its requirements by importing from other states or countries.

2) **Formulator (Exclusive) –** Pesticides in their original form are highly concentrated. Therefore, they cannot be applied directly to plants/target organisms. Formulators convert these pesticides into an applicable form by using suitable solvents or other adjuvants. The total number of registered formulators in the country are about 800. Out of them, 160 are associated formulators (having their own technical grade manufacturing facility) and the rest are non-associated formulators (depends on technical grade manufacturer for the active ingredients). Associated formulators are associated with technical grade material manufacturers and hence get credit and raw materials easily even in the peak season. Moreover, their products receive promotion and market support from big companies. A very few formulators are in operation in Assam and there is a need to create indigenous formulating facilities to provide better quality at optimum cost.

Figure 19. Existing supply chain of agro-chemicals



Some observation about the formulators

- It is not possible to have direct outlets in each rural market and therefore, firms need to have the services of the wholesalers, dealers and retailers**.** The heavy dependency on traditional distribution channels increases the cost of the products.
- Plants for pesticide formulation are being put up for more than the required capacity with the assumption that demand will increase in the near future.

The variations between the installation costs of high and low-capacity plants are not linear and there are scale economies.

- Vastness of the rural farming areas with a different types of cropping patterns makes it difficult for agri-input industries to push their efforts.
- Transport problem with lack of all-season roads in rural areas for making the pesticides available at the time of need.
- Rural agricultural input marketing requires a large marketing organization and staff.

1) **National/ regional distributors/ wholesalers/ dealers –**The end users of pesticides are farmers and households but, except in a few cases, formulated products are not sold directly to them but through wholesalers/distributors who inturn sell the materials to the farmers either directly or via retailers. Many local formulators sell their products to distributors and to retailers, such formulators pass on a small percentage of their profits from direct sales to retailers to the concerned area distributors.

Some observation about the distributors

- No wholesaler sell or distributor distribute the products of all the companies who have authorization to sell or market pesticide in Assam
- Almost all distributors of pesticides also operate retail outlets.
- Most of the distributors do not have any information about the companies who are authorized to sell pesticides in Assam (60% of the respondents do not have any idea about the legally authorized pesticide marketing companies in the state).
- Very few distributors have technical educational (agriculture/ plant protection) or have undergone any kind of training in plant protection.
- Period of credit (maximum three-four months) is not enough because the retailers generally are looking for six months credit period.
- The lifetime of the formulated pesticides is about two years for most of the products. Once a certain quantity of pesticides is purchased by the dealer, it is his responsibility to sell it before its expiry date. The company is not bound to replace the unsold quantity of pesticides. Thus, the dealer must either bear the loss or try to sell the outdated stock at a low price.

- Most of the distributors do not have any policy for expired stocks.
- Most of the distributors are dependent on the company personnel for the dissemination of technology to their retailers and farmers.
- Most of the distributors do not have the capacity to conduct a training program for the retailers and the farmers.

2) **Retailers –** Retailers are the main interface between the manufacturer, formulators, distributors and the end users i.e. farmers. Pesticide distribution in Assam is handled mainly through a large number of sale points operated by private owners. Department of Agriculture (public sector) is not participating in direct sales of pesticides in the state. The absence of the public sector and week cooperative sector to act as a buffer leaves the pesticide markets mainly in the hand of private sector. The private sector retail of pesticides is common in urban centres also, wherein they concentrate on chemicals for household pest control and ornamental garden maintenance. Often, the retail also acts as service centres for pest control operations in residential buildings, office buildings and other commercial units. The sale of certain chemicals for pest control especially domestic is common through retail stationery shops as well.

Some observations about the retailers

- Retailers varied in their business experience widely, but most are in the business for the last 15 - 20 years.
- Only a limited number of retailers have technical educational (agriculture/ plant protection) or have undergone any kind of training in plant protection (Only 32% of the retailers contacted during the field survey carried out during the study have undergone training on agri-inputs conducted by AAU).
- The business in small villages would be efficient and economic only through diversification in the sale of products. Thus, most of them (74 percent) are involved in dealing with various kinds of agricultural inputs like fertilizers, organic manures, pesticides, farm implements, etc. and only a very few are involved completely in pesticide retailing.
- The retailers are legally bound to state the sales and stocks of pesticides handled by them to the pesticide inspectors every month. This practice is followed regularly by a few retailers only.

- Period of credit (maximum three months) from the wholesalers is not enough because the farmers are in need of credit for six months, i.e., for one complete crop season.
- The lifetime of the formulated pesticides is about two years for almost all the products. It is responsibility of the retailers to sell pesticides before its expiry date once a certain quantity of pesticides is purchased by them. Thus, the loss is to be borne by the retailers as the company/ distributor is not bound to replace the unsold quantity of pesticides.
- The retailers are not fully trained on the appropriate use of pesticides.
- Bad debt is a problem as some retailers have reported about waiving-off a part of the credit provided by them to the farmers due of crop failure
- Long distances for input retailers to source their goods on roads with poor infrastructure (which worsens in the rainy season) is one of the greatest setbacks to deliver the input to the farmers. The increase in distance and transport costs affect the price at which they can sell their goods or services. This creates business constraints for the input retailer to be competitive and accessible for the smallholder.
- With climate change and increase in pest/ insect resistance, smallholder farmers and input retailers are expected to adapt accordingly. However, input retailers find it difficult to access the latest market information. Input retailers feel the need for training on latest development in agriculture and agro-chemical products.
- Demand for inputs is often in small quantities by farmers, majority of them being smallholders, due to lack of financial resources, poor organization and seasonal changes. The sizes in pesticide packaging is also a barrier for some farmers who can only purchase a small quantity at a time. This makes it difficult for input retailers to provide chemicals to farmers at the right time and right place with required quality inputs.
- In developing communities, input retailers often work informally without the business support and training required to grow. Business skills required to support accounting, marketing, overall management and employees were very immature which can lead to inefficiencies in operations.
- Most of the time, retailers are not aware of the recent developments in the pesticide sector unless the company personnel convey about the same.

- In the absence of appropriate skills, it become difficult for retailers to market or offer new products. This results in limited market reach on the upstream and on the downstream, this affects the purchasing power of retailers to get inputs from their suppliers.

3) **Operators –** There are large numbers of operators (direct sale representatives of producing firms/ informal sellers) who operate in rural areas during the peak agricultural seasons. They directly sell the produce to the farmer and often do not have permanent sale points and their presence is only seasonal.

4) **Department of Agriculture –** Although, the state Government is not involved directly in the retailing of the pesticides but does procure pesticides from the open market under different projects to distribute among the farmers free of cost.

Some observations about the Government procurement

- Government procurement is not regular and is based on the availability of funds under different State and Central Government Projects.
- Procurement is done through an open tender that is awarded to the lowest bidder which sometimes creates problems with the standard of the materials purchased.
- Most of the time procurement is done for the generic molecules (old technologies) rather than the specialty molecules (newer technologies).

5) **Farmers –** farmers are the end users. Some observations about the farmers are presented below –

- Due to a lack of adequate information and awareness, farmers are dependent on the local dealers/ retailers. This allows channel partners to take advantage by selling non-genuine products, improper advisory, and pushing the products with higher profit margin (56 percent of the farmers were dependent on the retailers in the identification of the problems and selection of pesticides).
- Most of the farmers failed to read the expiry date on the label allowing dealers and retailers to sell outdated stocks quite often.
- The smaller packing size is comparatively costlier than the large sizes. Most farmers are operating on small holdings and their requirement for

pesticides is also limited at a time. So, small farmers have to pay more in relative terms.

- There is variation observed in recommendation made by the companies and the Agricultural Universities and Research Stations. There is also significant variation between the dosages recommended by the manufacturers and the institutions. This creates confusion on type and quantity of pesticides to be used.
- Plant protection chemicals especially the patented specialty ones, are very expensive and most of the farmers are not able to purchase the same from their own savings due to poor economic conditions (65% of the farmers were not happy with the pricing structure of the pesticides). Moreover, most farmers are not aware of the latest development in pesticide chemistry due to a lack of flow of information from developer to end user.
- In general, farmers very rarely face the problem of non-availability or insufficient supply of pesticides (82% of the farmers never experienced shortage of pesticides even during the peak season).
- The farmers do face the problem of poor quality and adulteration in pesticides and other plant production chemicals like PGR and bio-stimulants.
- Most of the time farmers are required to travel a distance to get pesticides from the retailers mainly in case of remote areas of some districts of the state. It sometimes causes more economic losses due to delay in control measures.
- Most farmers are not aware of the terms like ETL (Economic threshold level) or IPM (integrated pest management) and end up with unnecessary application or overuse.
- Most of the time, farmers could not recognize the causes of any problem and ended up using the wrong products.
- Farmers do not have the technical ability to judge the compatibility of the different pesticides in tank mix but most of them go for mixing multiple products which sometimes causes loss to the efficacy or even crop injury. Observations from the field also suggest a similar picture. About 52 percent of the farmers considered under the study have never undergone any kind of training on plant protection).

- Farmers are not aware of the pesticide residue management, waiting period and mandatory re-entry interval for pesticide applications. It sometimes causes serious health hazards and reduces the quality of the produce, especially in vegetable crops.
- Farmers are not aware of the mechanism of development of resistance to pests. Most of the time they do not follow the recommended dose and the frequency of application as suggested by the manufacturer which makes the problem even more complicated.

Density of the sale points of pesticides in Assam

As per the data available, Assam has a good number of licensed distributors and retailers available at the bottom of the delivery system and important role is played by them in making the products available at right time and place close to the farmer-field. However, a comparison with other states suggests that Assam may have to increase the number of sale points to deliver plant protection chemicals efficiently. The distribution of the sales points is also not uniform across the state (Table-25). Although, district-wise information on the number of sale points is not available, based on the interaction with stakeholders it is understood that most likely districts like Barpeta, Tinsukia, Dibrugarh, Sonitpur, Darang, Udalguri, and Nagaon have the major share of the sales points available in the state (43% of the farmers need to travel a reasonable distance to procure pesticides and 30% were solely dependent on single retailer in their area).

Table 25. Number of sale points of pesticides during 2020-21 in Assam

Distribution Points					
State Deptt. of Agriculture	Co-operatives/ Agros	Other Institutions	Private Traders		Total
			Distributors	Dealers	
--	121	--	4085	164	4370

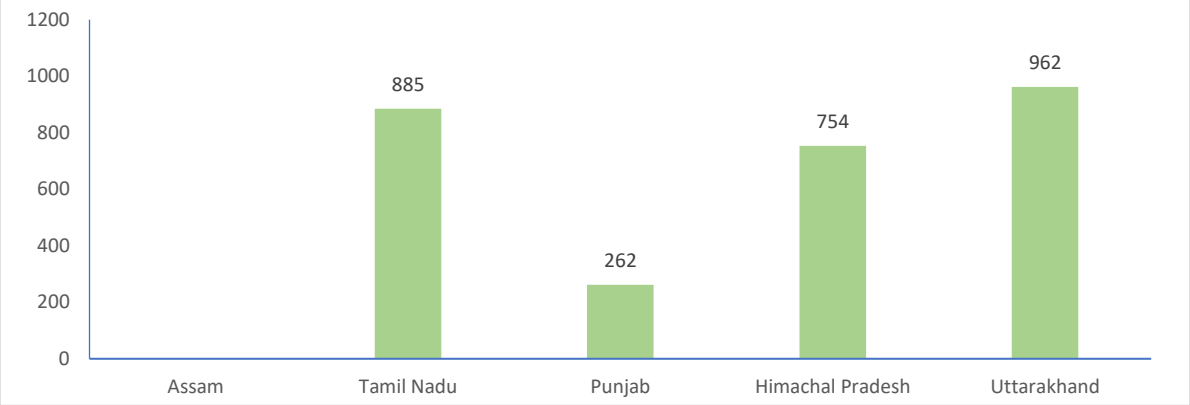
Source: *http://ppqs.gov.in/statistical-database*

Involvement of Co-operatives and State Government

Government of Assam is also involved in the distribution of pesticides to farmers but only to a limited extent. It does not run any sales counter as is the case with many other agriculturally developed states like Tamil Nadu, Punjab and Himachal Pradesh

and is involved only in free distribution. The Governments of states like Himachal Pradesh and Uttarakhand with limited area are also active in establishing sale points for distribution of pesticides in the states (Figure-20). Assam has lots of geographically challenging districts and the state government may think of starting its own sale counters and can serve those districts in a better way. Approximately, 78% of the farmers who interacted with the team of experts had the opinion that the government should enter into the direct selling of pesticides and it was supported by 77% of the government officials as well.

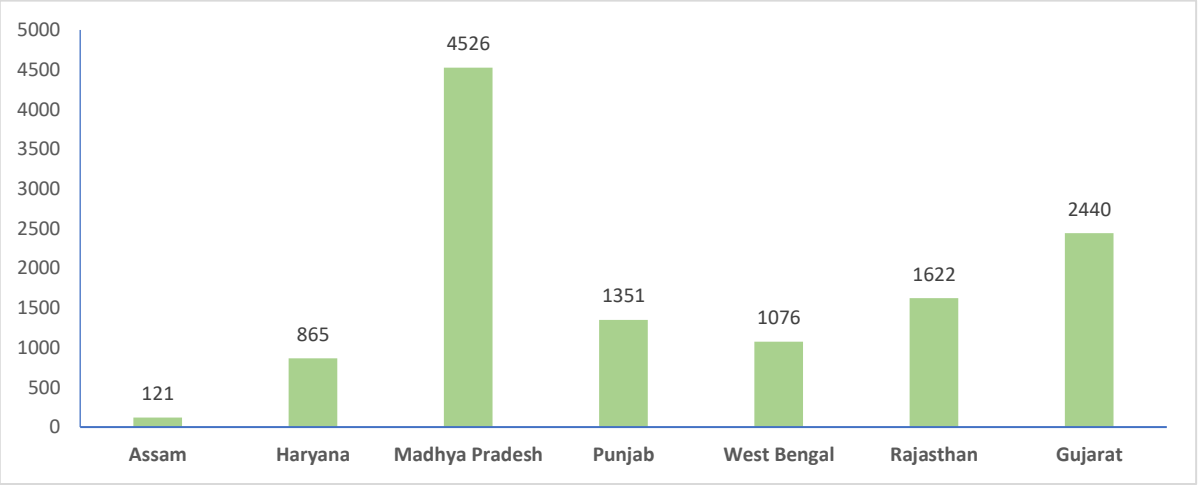
Figure 20. Number of sale points own by the state government compared to other state



Source: http://ppqs.gov.in/statistical-database

The cooperatives and other farmers' organizations are also not active in the distribution of pesticides in Assam whereas other states like West Bengal, Punjab and Haryana are very active (Figure-21). The advantage of cooperatives is a fair price and genuine products availability to farmers.

Figure 21. Number of co-operatives active in pesticide supply system as compared to other states



Source: http://ppqs.gov.in/statistical-database

Regulatory body

Pesticide is a deregulated sector in India and the state governments have limited power to regulate pesticides. Even though, the State government plays an important role in the smooth and transparent functioning of the pesticide supply system in the state.

Some of the important players in the pesticide supply system are as follows –

1) **Joint Director of Agriculture (Plant Protection) –** JDA (PP) is responsible for all matters relating to plant protection, epidemic control, pest surveillance and enforcement of the Insecticides Act. Issue of licenses to deal with plant protection chemicals, biological pest control measures and analysis, integrated pest management and matter related to the issue of phytosanitary certificate are also the responsibility of JDA (PP). Also assigned with the additional duty of State Public Information Officer (SPIO) who is liable to provide information under and in accordance with the provisions of the RTI Act and to handle all matters relating to RTI means the right or access to information relating to the affairs of agriculture.

2) **Deputy Director of Agriculture (IPM) –** Functioning of Bio-Control Laboratory, matters related to Plant Health Clinic, coordination in training on IPM and Rodent and functioning of Quality Control Laboratory (Pesticides).

3) **Surveillance Officer –** All matters relating to plant protection, to assist JDA(PP) in implementing the scheme and to assist SPIO to handle matters relating to RTI.

4) **Agricultural Development Officer (ADO) –** Each ADO shall remain in-charge of his circle of the block and play a promotive and facilitative role for more purposeful and effective extension service to the farming community including implementation of all ongoing schemes. Discharging duties as fertilizer/ seed/ pesticide inspector and implementation of other agricultural legislations as notified by Government within the jurisdiction and to ensure that the Control Acts/ Orders are strictly adhered to.

5) **Pesticide inspector –** Insecticides Inspector will be responsible to inspect not less than three times in a year all establishments selling insecticides within the

area of his jurisdiction, to satisfy himself that the conditions of the license are being complied with, to procure and send for test and analysis, samples of insecticides which he has reason to suspect are being sold, stocked, or accepted for sale in contravention of the provisions of the Act or rules made there under, to investigate any complaint in writing which may be made to him, to institute prosecution in respect of breaches of the Act and the Rules made there under, to maintain a record of all inspections made and actions taken in the performance of duties including the taking of samples and seizure of stocks and to submit copies of such records to the licensing officer, and to make such inquiries and inspections as may be necessary to detect the sale and use of insecticides in contravention of the Act. It is observed that the sampling done by the inspectors regarding the quality of pesticides is far below the number required to check the spurious and substandard products.

6) **VLEW (Village Level Extension Worker) –** VLEW is responsible to facilitate the process to raise the productivity in every farmland keeping harmony with the environment and protecting soil, water and other natural resources. She/He should make a whole-hearted effort in delivering sustainable agricultural technology. She/He is basically the interface between the Department of Agriculture and the farmers and plays an important role in transferring new technologies to farmers. The role covers advising the farmers in better farming, benefits of fertilizer, pesticides, etc and reporting complaints and needs of farmers and other villagers to the respective authorities for timely and necessary action. It has been observed the VLEW operating in field are not trained or qualified to solve the plant protection-related problems of the farmers

Monitoring the quality of pesticides entering the state

Proper use of pesticides can be of immense support to improve the functioning of the agriculture sector to its full potential. On the other hand, its irrational use can have dangerous implications for environment and human health. Therefore, various public sector initiatives have been undertaken to regulate the pesticide manufacturing companies in the country. In Assam, state-owned pesticide testing laboratories have been established in Guwahati to monitor its chemical composition with a capacity to

test 200 samples in a year. It is supposed to be equipped with state-of-the-art technologies and modern developments to aid the testing procedures to ensure the best interest of farmers and therefore maintain superior standards of quality. Though, it is observed to have some functional issues during last few years.

Number of samples analysed for ensuring quality of pesticides

As the state pesticide testing laboratory is not functioning properly, the Department has to outsource the facility to other States or Central Insecticides Laboratory, Faridabad. As per the information presented in Table-26, only 169 samples have been tested in Assam from 2017-18 to 2020-21 which seems to be insufficient in view of the porous border and volume of pesticides being sold in the state. A small state like Tripura has also tested more samples during the same period. More interestingly, not a single sample was reported as non-standard.

Table 26. Number of pesticide samples tested for quality assurance compared to other states (2017-18 to 2020-21)

Year	No of Sample analyzed		
	Assam	Tripura	Haryana
2017-18	31	55	1506
2018-19	76	22	1540
2019-20	-	79	2143
2020-21	24	68	1469
2021-22	38	188	1676
Total (5 years)	169	412	8334

Source:
http://ppqs.gov.in/sites/default/files/analysis_of_pesticides_samples_for_quality_control_in_sptls_during_last_5_years_0.pdf

Monitoring and documentation system

The guidelines mentioned at http://ppqs.gov.in on the process for monitoring pesticides states that the Pesticides Unit of the Directorate of Agriculture should monitors the demand and availability of pesticides in States for the adoption of crop protection measures. The Unit coordinates with the Ministry of Chemicals & Fertilizers and the Department of Chemicals & Petrochemicals for assessing the demand for pesticides for ensuring their timely availability. Every year, the Pesticides Unit also compiles the data received from different district/ zonal heads of the state

and presents it during the Zonal Conferences conducted by the Department of Chemicals & Petrochemicals and Directorate General of Statistics & Commercial Intelligence, Kolkata for assessment of Kharif and Rabi Seasons requirement of pesticides. With the coordination of the Statistical Unit, it also collects and compiles data on demand and consumption of pesticides and sale points for the distribution of pesticides. As pesticide is a deregulated sector, the entire process is not in place and the Pesticide Unit itself is facing the issue of shortage of manpower.

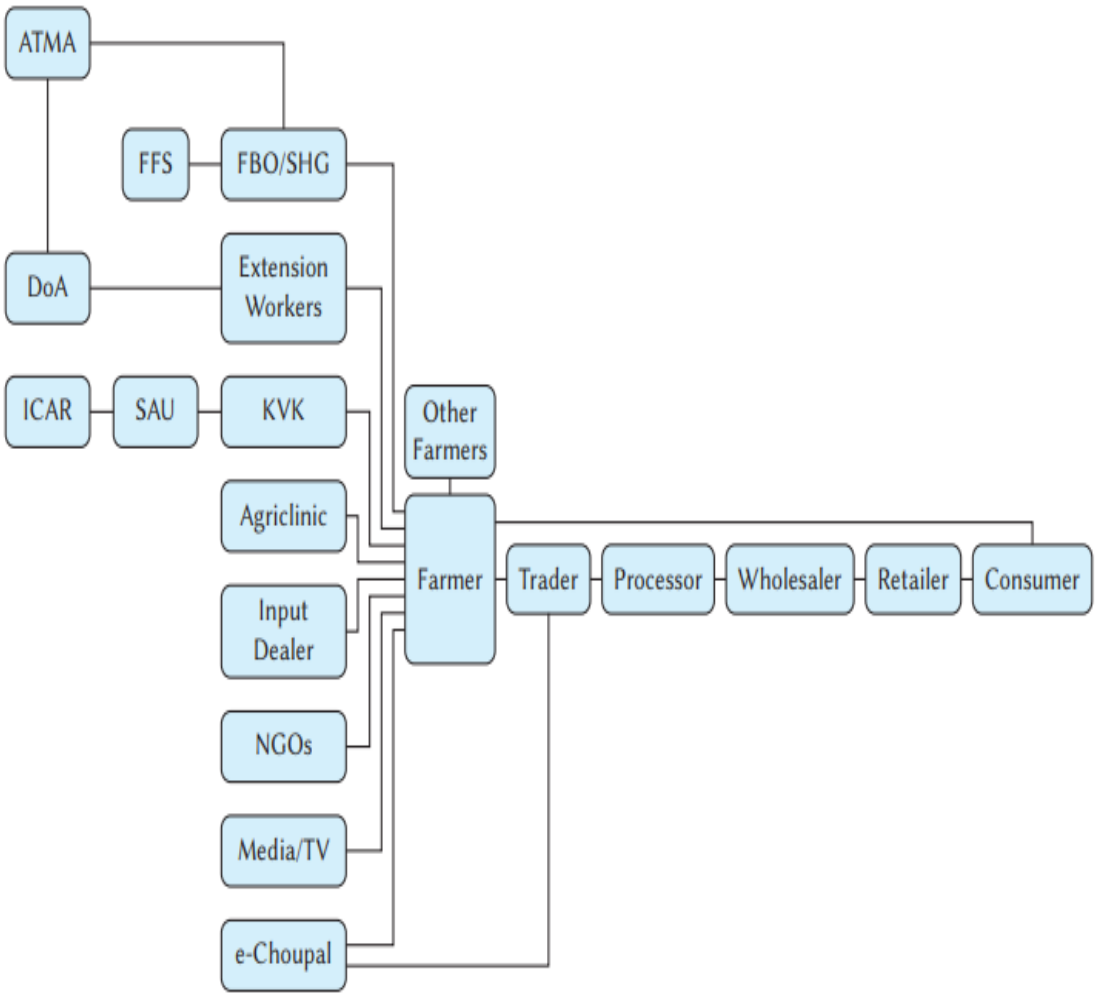
Flow of information (knowledge) in pesticide supply system

Information plays an important role in the decision making process. The right type of information at right time is essential for farmers to make the appropriate decision to improve their technology adoption. Farmers are observed to have different sources of information which varies depending on the location, preferences and credibility of sources. Information related to agricultural technologies reached to farming communities broadly through public extension systems, private extension systems and mass media including ICTs (Figure-22).

It will be difficult for the Public Extension System alone to meet the information requirement of farming sector. In order to overcome the challenge, attention has been given to multi-agency extension services including private agriculture input companies, farmers organizations, agripreneurs, cooperatives and other agencies in the non-governmental sector including practicing input dealers and retailers in farm advisory services in the different parts of the country.

About two-third of the farmers are not served by any extension agency or functionaries (NSSO, 2014). The absence of initiatives like e-Choupal in Assam and limited presence of NGOs, co-operatives, and agripreneurs curtail the flow the knowledge among different stakeholders. The company personnel and the agri-Input dealers are the most important information sources for the farmers in this system for being the first contact point and anytime availability.

Figure 22. Flow of knowledge in pesticide supply system in India (Source: Glendenning et al. 2010; modified)



Public extension system though has good networks but is not able to provide advisory services to the satisfaction of farmers due to lack of manpower and limited mobility. The main problem in the case of agro-advisory services provided by the public extension system for reaching the farmers is the gap in the communication process. In India, the ratio of extension agents and farmers is 1:2000. So, it is not possible for the extension workers to communicate with every farmer individually and therefore, the advisory services reach the farmers indirectly through various sources. As farmers are more inclined toward localized sources of information, agro-input dealers are their preferred source for getting farm advisory services. Many a time, agro-input dealers are guided by company people who are basically profit oriented. This may encourage for sale of non-recommended pesticides and chemical and result in adverse effects on crop in general and human and animal health in particular. Educational qualification and skills of the frontline company personnel

have also been observed as one of the limitations in conducting training programs related to the transfer of technologies to the farmers. This is one of the reasons for the recent failure of new pesticide technologies in the state.

Training programs for the pesticide retailers

In order to upgrade the knowledge of existing pesticide dealers not having the required qualification for the pesticide license as per the Insecticide Rule 2017, the Government of India through the Gazette Notification G.S.R. 07(E) dated 2nd January 2020, allowed them to undergo certificate course in insecticides management from any State Agriculture University or Krishi Vigyan Kendras or National Institute of Agricultural Extension Management, Hyderabad or National Institute of Rural Development and Panchayati Raj or National Institute of Plant Health Management, Hyderabad, State Agricultural Management and Extension Training Institute, Central or State research institutes or any other Government recognized university or institute. In view of this, the Government of Assam has directed Assam Agricultural University (AAU), Jorhat to conduct training for retailers operating in Assam. AAU has also developed course content for a self-financed 12 days training programme. They have already completed 38 such programmes covering 950 dealers or retailers in 20 districts of Assam. There are gaps observed in the content developed by AAU and the one developed by the National Institute of Plant Health Management, Hyderabad as per the direction of the Ministry of Agriculture and Farmers Welfare, Government of India, which needs to be addressed appropriately.

Pest surveillance and forecasting system

Pest monitoring through field surveys and surveillance helps in forecasting the population build-up of pest. It reduces the load of pesticides application and forms the basis for effective pest control in agriculture. Pest forecasting is the perception on future activity of biotic agents which is expected to adversely affect crop production. In other words, it is the prediction of severity of pest population which can cause economic damage to the crop. The systematically recorded data on pest population or damage over a long period of time along with other variable factors,

which affect the development of pest, may be helpful in forecasting the pest incidence.

The forecasting of pests guide the farmers about the timing and biology of insect incidence, and to eliminate blanket applications, reduce pesticide amounts, and achieve quality results. The farmers can take timely action by applying various pest control measures to harvest maximum returns. Most of the agriculturally advanced states of India, like Tamil Nadu and Maharashtra have well-defined surveillance and advisory system for important crops of the state. Maharashtra has developed a web-based system called Crop Pest Surveillance and Advisory Project (CROPSAP). The system can be accessed easily by visiting the webpage of the system https://cropsap.maharashtra.gov.in/. Farmers can get an advisory regarding pest incidence and their control measures very easily. Such system will not only help the private sector companies to mobilize the resources in time but will also save the farmers from severe damage to their crops. Assam does not have an active surveillance and forecasting system in place. Seventy-four per cent of the farmers who were interviewed were not happy with the system of surveillance and forecasting of pests in the state.

Problem of sub-standard, spurious/counterfeit pesticides

Current scenario of non-genuine/illegal pesticides in India

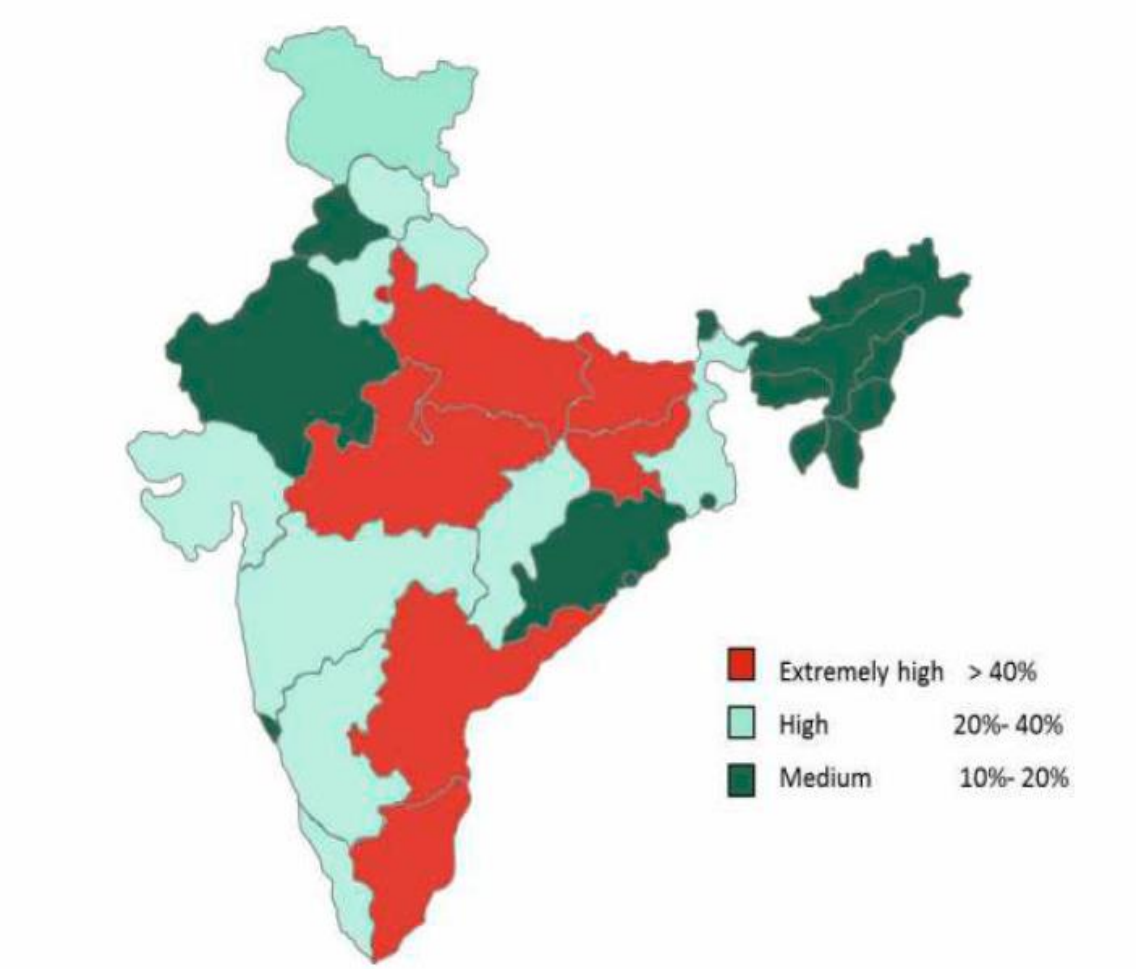
With the growth in market for registered pesticides and legitimate authentic brands in India, the growth of non-genuine/ illegal pesticides business has also been witnessed. The business of non-genuine/ illegal pesticides is observed to be growing even in relatively developed rural markets. Illegal imports of technical grade chemicals without the C.I.B&R.C registration has also led to the formulation of non-genuine/ illegal pesticides locally.

Trend in Assam

As per the information presented in Figure-23, Assam is moderately affected by the presence of spurious and inferior quality pesticides. Though, it may be an understatement as the state is having a very porous national and international borders. A proper sampling and testing method for the quality testing of pesticides is required to address this issue. Forty four percent of the retailers and distributors

agreed on the presence of inferior quality products in the state and 50 percent of the government officials also expressed the same opinion during the various interactions conducted during the study period.

Figure 23. States affected by non-genuine/ illegal pesticides, India-FY14



Source: Industry response, analysis by Tata Strategic

The information on active ingredients affected by non-genuine/ illegal pesticides in India during financial year 2014 is presented in Table-27. The information presented in the table reveals that the generic insecticides are most affected genre of pesticide. Insecticides constitute 70 percent of the non-genuine/ illegal pesticides market followed by fungicides which constitute 20 percent of the market in India. Moreover, Copper Oxychloride, Buprofenzin and Fipronil are some of the active ingredients where the percentage of non-genuine/ illegal pesticides is highest. The famous brands of reputed companies are targeted, in general, because of the large customer base.

Table 27. Active ingredients affected by non-genuine/ illegal pesticides, India

Technical Name	Genre of Pesticide (Insecticide/ Herbicide/ Fungicide)	Percentage volume of Non-Genuine product in Market
Copper Oxychloride	Fungicide	25-30%
Fipronil	Insecticide	20-25%
Buprofenzin	Insecticide	20-25%
Imidacloprid	Insecticide	20-25%
Flubendiamide	Insecticide	20-25%
Chlorantraniliprole	Insecticide	20-25%
Hexaconazole	Fungicide	15-20%
Emamectin Benzoate	Insecticide	15-20%

Source: Industry response, analysis by Tata Strategic

Implications of spurious inputs on end users/farmers

Due to the untested nature of the non-genuine/ illegal pesticides and possible imbalance of active ingredients or no active or wrong active, these products pose danger to the health of farmers. Apart from health implications, the farmer would also suffer economic loss because even though the non-genuine / illegal pesticides cost less at the time of purchase, the overall price paid by the farmer for these products in the entire season is more. This is primarily because of the higher dosage requirements and more frequent application compared to a genuine pesticide with limited results.

The yield can get reduced to more than half to nil because of the use of non-genuine/ illegal pesticides and the farmer is oblivious to the reason for crop loss due to the dependence of crops on various other environmental factors and possibility of human error. The apprehension on the availability of spurious pesticides in the market has also been suggested by retailers and distributors considered under the study. A good number of 44 percent of the retailers and distributors perceive the presence of spurious pesticides in the market. This problem may further be amplified by the limited level of understanding of the retailers and distributors on various aspects of the business (Table-28). More than half of the retailers and distributors (56 percent) were not even aware about the companies that are legally eligible to sell the pesticides in their areas. Only a limited number of retailers and distributors (48 percent) are concerned about the authenticity of the company before distributing/

selling its products. The limited understanding of demand leading to procurement of wrong amount of pesticides lead to the problem related to handling of expired stocks (40 percent). There is need to create awareness among the retailers and distributors by involving the public agencies and responsible private agencies on various aspects related to safe delivery of quality pesticides covering list of companies and verification of authenticity of the company. Equally important is to cover issues related to assessment of demand which will help in addressing the problem of disposal of expired chemicals by procuring the right amount of product.

Table 28. Perception of retailers and distributors on aspects related to availability of quality pesticides

Sr No	Category	Yes (%)	No (%)	No Response (%)
1	Lack of awareness on the list of companies that are legally eligible to sell pesticides in a particular area	40	56	4
2	Lack of understanding to enquire about the authenticity of company before distributing/ selling its products	48	44	8
4	Issues related to safe disposal of expired stocks	40	44	16
5	Availability of spurious pesticides in the market	44	28	28

Price of pesticides

As observed during interactions with different stakeholders, high price of pesticides especially the patented ones make them unaffordable for the farmers. Again, as pesticide is a deregulated market, it is difficult for the regulatory authorities to control the price. An effort can be made to control the price the way National Pharmaceutical Pricing Authority (NPPA) is doing for the pharmaceutical industry (https://www.moneycontrol.com/news/economy/policy/in-depth-spadework-begins-for-affordable-medicines-in-india-8849251.html). The NPPA, under the Department of Pharmaceuticals, fixes the ceiling price of scheduled medicines as per provisions of the Drugs (Prices Control) Order, 2013. Scheduled drugs are those that are included in the National List of Essential Medicines and are procured by the government for various health programs and are supplied mostly free of cost through government hospitals.

Capacity Building

Capacity building is an important component of the stakeholders all along the supply chain to not only ensure the effective use of chemicals in terms of quantity applied and result achieved but also to ascertain the safety of different players. Both public agencies and companies have an important role to play to ensure capacity building of all the stakeholders. Manufacturers of pesticides and their associations used to organize training programs for officials of the agricultural departments, extension workers, village level workers, dealers and farmers on the correct use of pesticides. The training program will focus on the transfer of new technologies to the different stakeholders in the system. Of late, the number of such programs has gone down due to different reasons like the dearth of budget, lack of interest among different stakeholders and lack of quality of manpower in pesticide companies. Though, pesticide companies keep making their efforts to create awareness among the farmers, about 32 percent of the retailers and distributors, with the help of pesticide company personnel, conducted at least one technical training in a year for the farmers. Whereas, 24 percent retailers and distributors did not share any information regarding the same. More such programs are required to transfer the technology to the end user. Private companies need to improve their efforts to create awareness among the retailers and distributors and educate them on new technologies related to pesticides. The information compiled based on the interaction with selected number of retailers and distributors reveals that mostly the source of information is fellow-distributor, public agencies and even internet in case of about one-third of the retailers and distributors (Table-29). The private companies need to actively participate in extension activities to take their product to the end users.

Table 29. Source of information about any new technology related to pesticide

Sr No	Items	Percent
1	Fellow retailer and distributor	48
2	Public Departments	16
3	Internet	28
4	Others	08

Equally important is to build the capacity of the retailers and distributors. Only about one-third of the retailers and distributors have undergone some king of training on plant protection and safe handling of pesticides. Out of these, 36 percent have been trained by Universities and Directorate of Agriculture (Table-30). The private

companies need to make deliberate efforts on designing programs to take knowledge related to their products to their distribution force which in-turn will take the same to end user i.e. farmers.

Table 30. Capacity building status of retailers and distributors

Sr No	Particulars	Percent (%)
1	Training on plant protection and safe handling of pesticides	32
2	Training conducted by	
	a) AAU	16
	b) Directorate of Agriculture	20
	c) Others	64

Assam agro-chemical market is broadly dominated by generic pesticides with limited exposure to newer technologies. Effective use of agro-chemical may help in realizing the full potential of agriculture in states. The state government will have to come up with a comprehensive strategy covering production, awareness, training, certification, infrastructure creation and diversification toward new products and technology to ensure smooth delivery of chemicals to farmers and helping them realise the optimal production.

Section – V

Fertilizers

Section V
Fertilizer

Background

Fertilizer is substance such as manure or a chemical mixture used to make soil more fertile. Fertilizers serve as food for plants to help them grow to their optimum yield. A HYV variety of crop cannot give expected results in the absence of proper nutrition which is to be ensured either through proper management practices or application of manure or fertilizers. Though, it is always a challenge to ensure smooth delivery of fertilizers in a cost-effective manner to farmers. Global fertilizer market is experiencing so many changes on account of high input cost, soaring fuel prices leading to either higher production cost or low production. Supply has also been disrupted by factor like sanction and export restriction and various socio-political factors. Some of these issues influencing the global fertilizer market with reference to India & Assam are discussed in this section.

High input costs

Rising natural gas prices mainly in Europe have led to widespread production cutbacks in ammonia which is an important input for nitrogen-based fertilizers. The limited supply of coal leading to its soaring prices have also forced fertilizer factories to cut production in countries like China.

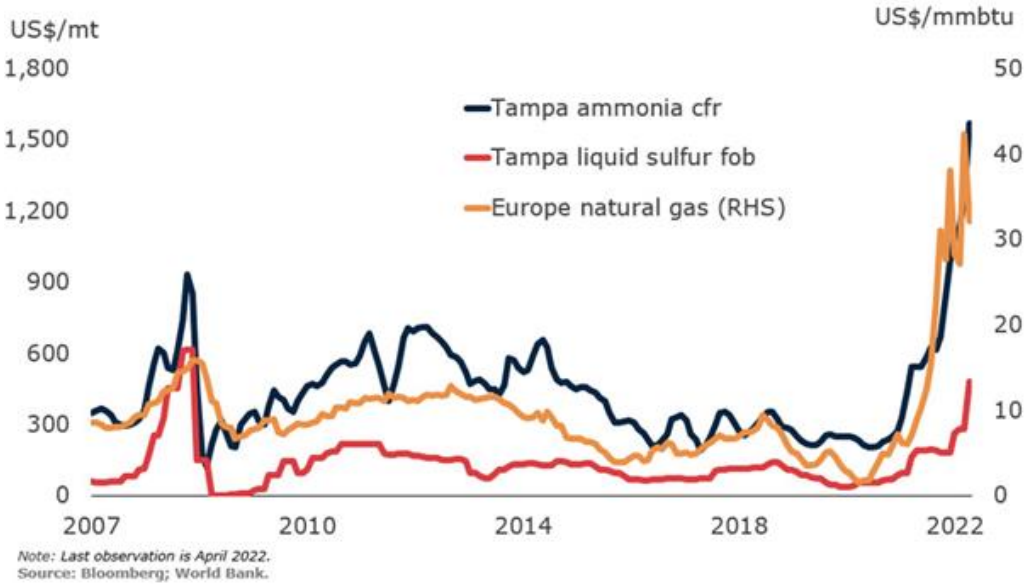


Figure 24. Status of global fertilizer input-cost

The information on input costs compiled in Figure-24 suggests that input-cost has soared up in recent past. This has contributed to increase in urea prices. Higher prices of ammonia and sulphur have also driven up phosphatic fertilizer prices.

Sanctions and export restrictions

Fertilizer prices rose in response to the war in Ukraine, reflecting the impact of economic sanctions and disruptions in Black Sea trading routes. Russia accounts for about 16 percent of global urea exports and 12 percent of DAP and MAP exports. Russia and Belarus together are responsible for two-fifths of global MOP exports. Adding to supply concerns, China has also suspended exports of fertilizers for a major part of 2022 to ensure domestic availability of fertilizers.

Supply disruptions

The prices of fertilizers are presented in Figure-25. The figure suggests that the prices of urea and DAP have retracted in recent weeks due to lower tender offers in India as buyers await clarity on Indian fertilizer subsidies. However, the prices of potash have shown no signs of easing. Fresh sanctions on Belarus and Russia (on top of the sanctions imposed on Belarus last year) have increased the potash supply shortages and uncertainty. Moreover, Lithuania has halted the use of its railways' network to transport Belarusian potash to the port of Klaipeda, which typically handles 90 percent of Belarusian fertilizer exports.

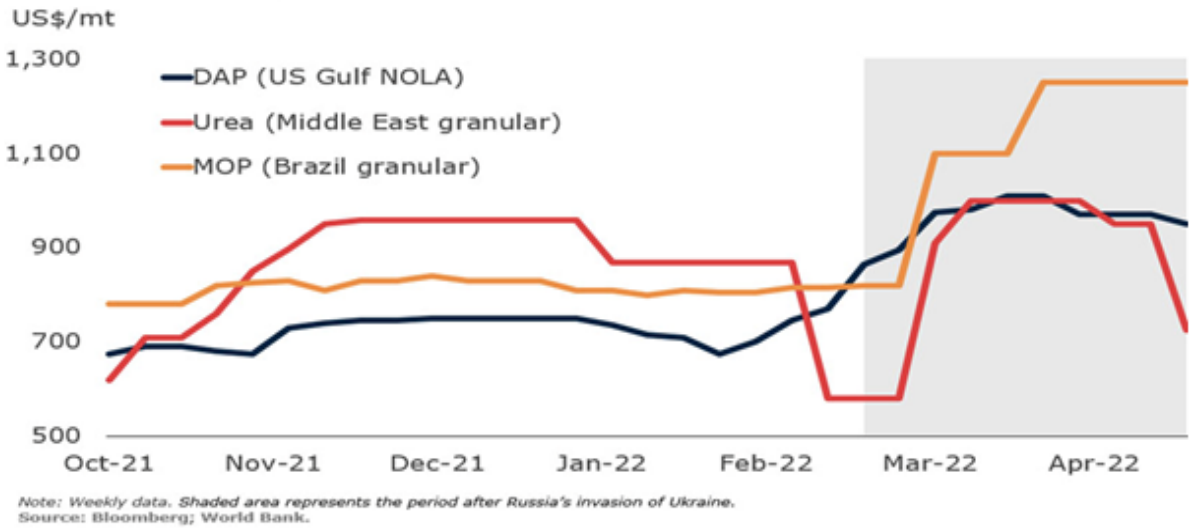


Figure 25. Recent fertilizer prices in the world

Robust demand

Global fertilizer consumption has remained strong throughout the COVID-19 pandemic. Brazil and the United States have allocated record acreage to soybean (a fertilizer-intensive crop). Demand is also strong in China due to increased feed use, especially maize and soybean meal, as the country is rebuilding its hog herd population following the African swine fever outbreak. Fertilizers are now at their least affordable levels since the 2008 global food crisis, despite higher crop prices, which may limit fertilizer use.

Outlook and risks

Urea prices are expected to remain at historically high levels as prices of fuel like natural gas and coal remain elevated. Similarly, DAP prices are projected to remain high until ammonia and sulphur prices ease. Apart from input costs, risks to the outlook depend on whether urea and DAP exports from China will resume soon. In case of potash, prices are anticipated to remain high during the next year unless supply returns to international markets from Russia and Belarus.

Fertilizer market scenario in India

India is a leading consumer of fertilizers but depends heavily on imports as has been illustration Table-31. The table highlights that roughly one-third of urea demand is met through imports making it an expensive affair for the Government to supply the fertilizer at low price to the farmers. In case of DAP, the dependence of imports is about two-third, whereas India depends completely on imports for MOP. Therefore, about 20 million tonnes of chemical fertilizers are being imported by India and the rising global prices are increasing the subsidy burden on the Government.

Table 31. Fertilizer demand, domestic production and imports in India

Fertilizer	Demand (million tonnes)	Domestic Production (million tonnes)	Imports (million tonnes)
Urea	35	25	10 (28.57%)
DAP	12	5	7 (58.33%)
MOP	3	Nil	3 (100%)
NPKs	12-13	12-13	Nil

Source: FAI Fertiliser Statistics

Fertilizer ratio

The agreed ratio of NPK elements for balanced soil health and crop growth is 4:2:1 but the average ratio of NPK used in India is 8.2:3.2:1.0. There is again high variation observed across states like it varied from 33.7:8.0:1.0 in Punjab to 1.3:0.7:1.0 in Kerala during 2019-20. In case of Assam, the NPK consumption ratio is 4:1:1 which is not highly skewed but region-wise disparity is expected to be huge as suggested by the stakeholders during the interaction as part of field survey visits to different districts.

The hilly pockets of the region are still away from the touch of modern genetic engineering as well as harmful chemical fertilizers and pesticides (Das, 2021). In order to realise potential of alternative forms of agriculture and ensure effective use of available supply of fertilisers mainly Urea, state government can also explore potential available under various other schemes and program of the Government like Pradhan Mantri – Promotion of Alternative Nutritious and Agriculture Management (PM-PRANAM) scheme.

In tea plantation of Assam, fertilizers are generally added in two phases – 60 percent in April-May and 40 percent in July-August. Failure to apply fertilizers on time may greatly affect the yield of tea production. Urea is a source of Nitrogen, a nutrient crucial for crop growth and development. Calculation of Fertilizer consumption in Tea Plantations in Assam.

Urea	Area under tea plantation – 4,00,000 ha
	Tea plantation apply 130 kg Nitrogen per ha = 130/0.46= 283 kg Urea/ha*
	Total annual requirement of Urea =283kg x 4,00,000 ha = 1,13,200 MT
SSP	40 kg of Phosphorous per ha = 40 kg/0.16 = 250 kg of SSP/ha
	Total annual requirement of SSP = 250kg x 4,00,000 ha = 1,00,000 MT
MOP	40 kg of Potassium per ha = 120kg/0.60 = 200 kg of MOP
	Total requirement of MOP = 200kg x 4,00,000 ha = 80,000 MT

Source – Information compiled from NETA

Although the recommended dose of Urea in tea plantation is 283 kg/ha, but farmers apply approximately 400 kg/ha of urea as emerged from the interaction with Government officials and Director, Tea Research Association and farmers. Taking into consideration the fertilizer consumption in Assam during 2021 and comparing the same with the minimum requirement of Tea Plantations, as worked out above

and rest of the fertilizers available for entire gamut of crops in whole of the cultivable land, the availability will appear like –

NPK Analysis of Assam 2021 (Qty in MT)			
Fertilizers Type/ Items	Fertilizer Consumption of Assam	Minimum requirement of Tea Plantations	Fertilizer Available for rest of Crops
Urea	3,34,000	1,13,000	2,21,000
DAP	55,000	--	55,000
MOP	43,000	80,000	-37,000
NPKS	23,000	--	23,000
SSP	99,000	1,00,000	-1000
Total	5,54,000	2,93,000	2,61,000

Mass awareness programs need to be conducted throughout the state for educating farmers about the balanced use of fertilizers, as the farmers at present have limited knowledge on the balanced use of fertilizers as per the soil conditions and cropping pattern practiced by them. Awareness programs/ out-reach programs should be organized at district and block level before the start of every cropping season on optimum and balanced usage of fertilizer nutrients, ill effects of imbalanced use of fertilizers including its impact on soil fertility and new developments in the field of fertilizer usage and management. Latest prices of fertilizers are as given in Table-32. The price suggests the importance of judicious use of fertilizers for their contribution in the economics of crop production.

Table 32. Farmgate prices of fertilizers

Items	NPK (10-26-26) w.e.f. 15.10.21	NPK (12-32-16) w.e.f. 15.10.21	NP (20-20-0-13) w.e.f. 15.10.21	DAP (18-46-00) w.e.f.11.10.19	Neem Coated Urea w.e.f. 12.01.19
Rs./MT	28,800	29,000	24,400	24,000	5922.22
Rs./Bag	1440 (50 kg bag)	1450 (50 kg bag)	1220 (50 kg bag)	1200 (50 kg bag)	266.50 (45 kg bag)

Source: MoF

Channel partners in fertilizer marketing

The total quantity of fertilizer materials distributed annually in India increased from 0.3 million tonnes in 1951 to around 60 million tonnes in 2021-22. The distribution of

such a large volume of fertilizer is ensured through a well-developed marketing network spread throughout the country which consists of state cooperative marketing federation, district level cooperatives, village level cooperative societies, state agro-industries, corporations, commodity federations, service centres, wholesalers, depots and outlets and retailers. Cooperatives play an important role in the supply of fertilizers in India. Cooperatives supply almost 35 percent of the total quantity available from domestic production and importation whereas private channels distribute the balance (65 percent). This is connected with the ground through a network of sale points spread throughout the country. The country is having a good number of sale points at 2,82,468 as suggested by an old reference of 2004. Out of these sale point, about 77 percent were privately owned and 23 percent were in the fold of cooperatives and other institutional channels (Figure-26).

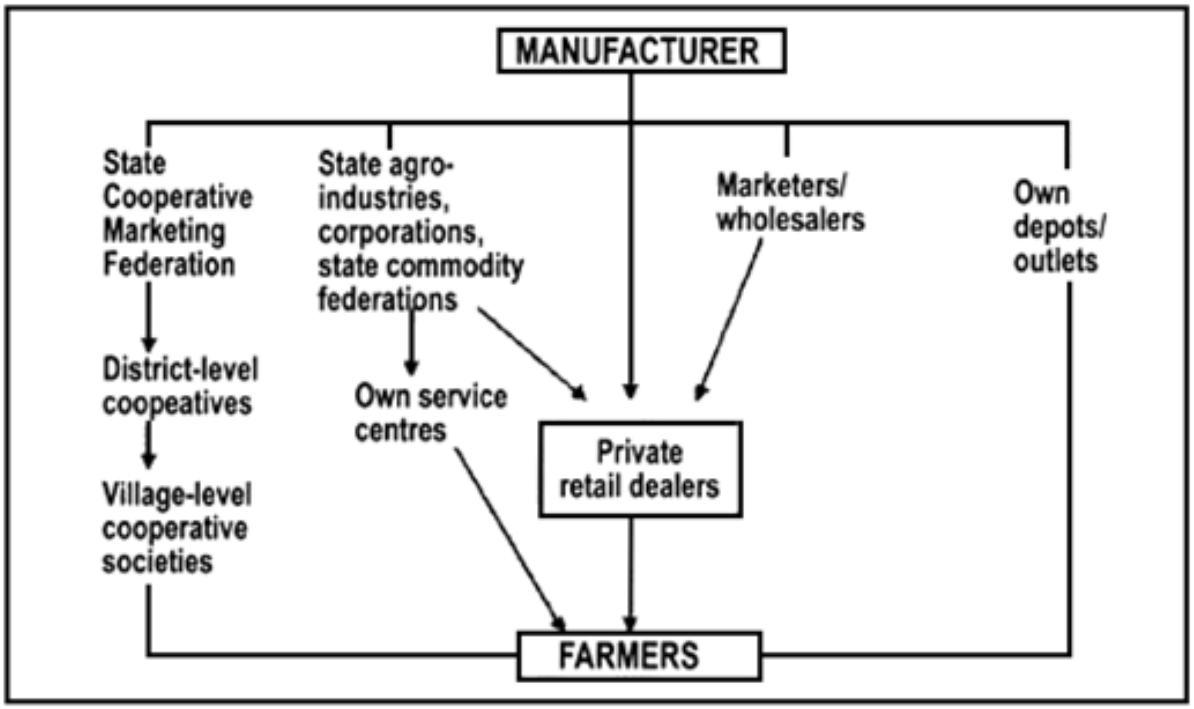


Figure 26. Fertilizer marketing and distribution channels in India

Indigenous fertilizers are distributed through institutional channels involving cooperative societies, agro-industry corporations, state commodity federations, etc. and private trade. The cooperative marketing structure varies from state to state (two to four tiers). Handling agents distribute imported urea, whereas state agencies and domestic manufacturers distribute imported DAP and complex fertilizers, MOP and SOP.

Most of the states have at least one public or cooperative organisation to ensure smooth delivery of fertilizers. However, the Assam Government is observed to have lacking the same. The fertilizers in the state of Assam is distributed primarily through private channels making the performance of fertilizer distribution in terms of availability (quality and price) solely influenced by the convenience and objectives of the private players. Private sector is driven by commercial interests and not by the expectations of the farmers. There is a need to have a public agency playing the guiding role in the distribution of fertilizers in the state, to monitor the performance of private trade and to safeguard the conflicting interest of different stakeholders. The presence of such government institute based on strong rural network can also help in efficient implementation of various schemes and projects of the state and central government related with agriculture development as has been done by various other states.

Importance of transportation and storage in distribution of fertilizer

Transportation and storage play an important role in making fertilizer available at a cost-effective price. At present, about 75 percent of the total quantity of fertilizer is moved by rail and the remaining 25 percent by road. The average distance of fertilizers moved by rail is about 850 km. However, within a radius of 200 – 250 km from the plant, most of the fertilizer material is moved by road as road transportation only up to this distance is supported by economics of movement. The marketing cost of urea is about Rs. 1000/tonne. The information presented in Figure-27 suggests that only freight charges accounts for 55 percent of cost followed by distribution margin at 18 percent, handling and storage charges for 10 percent. Rest 17 percent are contributed by administrative cost, inventory carrying costs and sales. Transportation is important not only for its share in the total cost of delivery but also for the role it plays in timely delivery of inputs to the farmers. The interaction with retailers and distributors reveals that only 44 percent of the respondents found the transportation facilities satisfactory to support movement of inputs in Assam. It is therefore important for the government to improve transportation infrastructure to provide connectivity and improve efficiency in delivery of inputs in Assam mainly in remote areas.

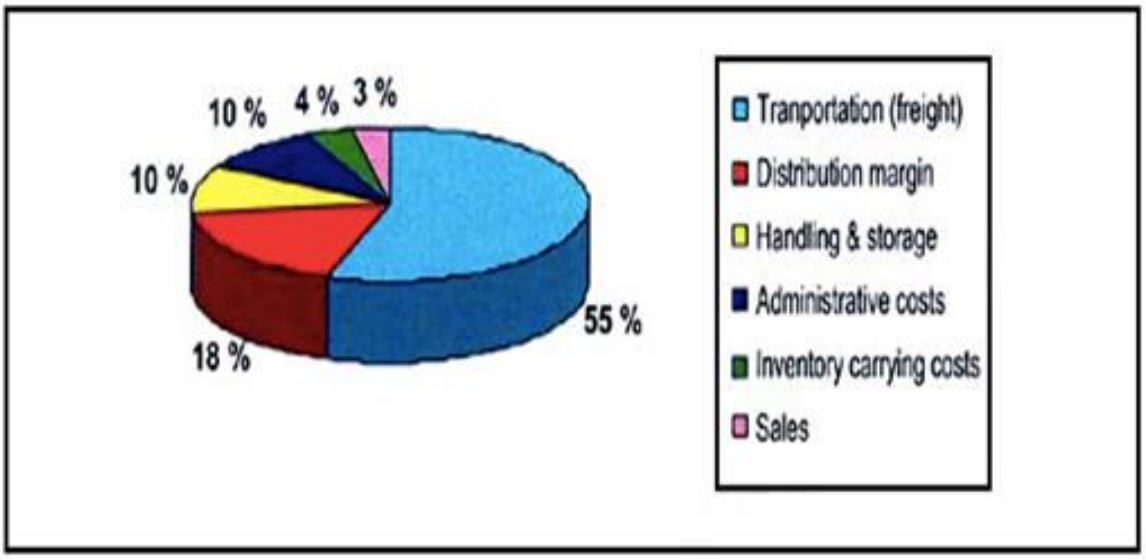


Figure 27. Share of various components in marketing cost of urea

Storage is important to maintain continuity between production which is a continuous process and consumption which is seasonal. In India, there are two main cropping seasons, Kharif during April–September and Rabi during October–March. Consumption is characterized by a peak period followed by lean spells and, therefore, fertilizers are stored before the onset of each season making storage an important factor in fertilizer marketing and distribution. There are about 2060 central and state warehouses with an aggregate capacity of 30.1 million tonnes. In addition, the Food Corporation of India has a storage capacity of 23.95 million tonnes. About 65,970 godowns are also operating under cooperative sector with a capacity of about 14.12 million tonnes. These godowns are used for storage of foodgrains, fertilizers and other commodities.

Importance of credit in fertilizer distribution

Most of the farmers cannot afford to purchase fertilizers on a cash basis. Similarly, many of the dealers also find it difficult to pay cash for fertilizers. This highlights the important role played by credit distribution and use of fertilizer. Generally, two types of credit are available for fertilizer distribution and use. One is distribution credit, which is used by a dealer for purchasing fertilizers from the manufacturer or wholesaler, whereas the other type is production credit, which is used by a farmer for purchasing inputs, of which fertilizer is the major one. Various agencies provide credit to the agriculture sector including cooperative banks, regional rural banks, commercial banks and others. Kisan (farmer) Credit Cards (KCCs) were launched in 1998 to facilitate access by farmers to production credit. These credit cards are

issued by 27 commercial banks, about 200 regional rural banks and almost 4000 cooperative banks. Number of Operative KCCs in December 2020 were more than 65 million. Some of the leading states are Uttar Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Andhra Pradesh and Telangana in same order. Assam was having only 7.4 lakhs operative KCC constituting 1.14 percent of total operative KCC in the country (Table-33).

Table 33. State-wise status of Kisan Credit Card Scheme (December 2020)

Sr. No.	States/UTs	Number of Operative KCCs (in Million)	(%)	Amount outstanding under Operative KCCs (Rs Billion)	(%)
1	Uttar Pradesh	10.65	16.31	1131	16.22
2	Karnataka	7.47	11.44	441	6.33
3	Madhya Pradesh	5.90	9.03	664	9.52
4	Maharashtra	5.77	8.84	451	6.47
5	Rajasthan	5.73	8.77	780	11.19
6	Andhra Pradesh	4.52	6.93	476	6.83
7	Telangana	4.08	6.25	358	5.14
8	Odisha	4.01	6.14	176	2.53
9	West Bengal	3.04	4.65	120	1.73
10	Bihar	2.80	4.29	190	2.72
11	Assam	0.74	1.14	39	0.55
12	Others	10.59	16.22	2145	30.78
	Total	65.28	100.00	6970	100.00

Source: https://m.rbi.org.in/Scripts/PublicationsView.aspx?id=20275

Fertilizer market scenario in Assam

In order to understand the fertilizer business in Assam and to come up with a sound strategy facilitating smooth supply of fertilizers in the state, it is important to understand the types of fertilizers in Assam market and the significance of each fertilizer from the point of view of farmers and the crop cultivated by them. It is equally important to understand different stakeholders participating in the supply chain and the role played by them.

Types of common fertilizers in Assam – Some of the common fertilizers observed to be popular in Assam fertilizer markets are as given below –

- Urea
- Di Ammonium Phosphate (DAP)
- Muriate of Potash (MOP)
- NPK Mixtures
- Single Super Phosphate (SSP)
- Organic Fertilizers
- Micro-Nutrients

Importance of Urea

Urea as a source of Nitrogen (N) is required in maximum quantity by any plant. Nitrogen is vital for plant growth for being an important component of chlorophyll, the compound by which plants use sunlight energy to produce sugars from water and carbon dioxide (through the process of photosynthesis). It is also a major component of amino acids, the building blocks of proteins. The plant will wither and die in the absence of proteins.

Supply-chain and marketing of Urea is different from all other fertilizers due to heavy subsidy and government regulations on the sale of Urea. Urea becomes the most sought after fertilizers for its significance for plant, cheap price and control of government on its distribution and marketing.

All other fertilizers are essentially required for meeting the remaining 16 nutrients required by the plant (the total nutrients required by plant are 17) to maximise productivity and to maintain fertility and sustainability of soil.

Fertilizers are controlled and governed by Fertilizer Control Order (FCO) for their relevance and attempt to ensure smooth distribution. This makes it important to have a look at policies of the government to regulate different channel partners involved in the marketing and distribution of fertilizers.

Standard Operating Procedures (SOP)

The Government of Assam has recently issued a GO dated 20th February 2022 regarding a comprehensive Standard Operating Procedures (SOP) for Fertilizer (Urea) administration (shared at annexure).

The order defines the roles, responsibilities, eligibilities and authorities of different stakeholders involved in supply chain of fertilizers. Some of them are mandatory by GoI and some are self-imposed by the State Government. This scheme was to be implemented from 1st July 2022 and Assam government was showing keenness in implementing it but subsequently the implementation of Urea SOP has been extended till 30th October 2022 vide office order dated 30th July 2022 of the Director of Agriculture (DOA), Government of Assam (copy of order shared at annexure).

This deferment indicates that probably the procedure of sale of fertilizers were not being followed properly and also the preparedness of the responsible institutions to implement the provisions of SOP. These observations was substantiated during the interaction with farmers, retailers, government officials and manufacturers/ companies organised as part of survey conducted in six districts during July 2022 under the study. The Standard Operating Procedures (SOP) was introduced due to the requirement to regulate the fertilizer market in Assam. The proper implementation of SOP ensuring regulated supply by safeguarding the interest of all the stakeholders mainly famers by ensuring regular supply at reasonable price may actually be the game-changer.

Role and responsivities as per Urea SOP

Role and responsivities of different stakeholders as defined under Urea SOP are discussed below –

Responsibilities of Companies

- Rake placement & allocation – Responsibilities of companies and authority of Department of Agriculture, the Government of Assam
- Allocation of districts – Prior approval of rake placement by the companies from Department of Agriculture (GoA) which has to be monitored rigorously
- Logistics – It is expected from the authorities of Assam Government to ensure one minimum rake point for every two districts in coordination with companies and railway authorities. The most important and essential task is in improving the numbers of active “Rake Points” in the State. A senior officer from DOA has to take responsibility of placement of rakes according to stock positions of district. Assam Government has to maximise movement of fertilizers by rakes

- Distribution of Urea – Companies are expected to carry the fertilizers up to the sale point/ godown of retailer. BVFCL as the Lead Fertilizer Supplier (LFS) of Assam will coordinate with all fertilizer companies for rational distribution of fertilizers. Inter district movement of urea is not allowed, whereas all other fertilizers are exempted.
- Companies have to designate one person for each district to participate in District Level Standing Committee meetings.

Department of Agriculture, the Government of Assam has to coordinate with fertilizer industry of the state for improving the supply chain of fertilizers in Assam. As a lead supplier of state, BVFCL may conduct a meeting for proper coordination but companies will do it from commercial angle, whereas the Government interventions are farmers oriented.

Retailer

- Qualification and licensing of retailers
- Jurisdiction of retailers
- Implementation of “Point of Sales (PoS)” machines
- Stock limit of a retailer
- Sales limit of a retailer to a farmer or planter

There were around 3700 retailers prior to the Urea SOP. After the implementation of SOP, 1267 licenses have been suspended in an already scanty network of retails present in the state. It is difficult to supply Urea in remote villages with existing retailer network at fair prices as transportation cost is the major cost in marketing of fertilizers. Moreover, existing retailers are feeling compelled to exit from fertilizer business either due to prevailing malpractices or limited commercial opportunities in fertilizer business. The situation is grim not only for urea but for rest of fertilizers as well, as all fertilizers fall within the ambit of FCO.

In an environment where existing retailers are feeling compelled to leave due to limited business opportunities, it will be difficult to encourage new retailers to join the distribution network. This may be an outcome of strict implementation of the provisions of Urea SOP by the officials with limited overall preparations. The licenses of retailers at many places have been cancelled by officials for not having PoS machine, which is mandatory. The guidelines also suggest an aspirants willing to join the fertilizer trade as retailer to have completed graduation/ diploma or must have

completed a training program from an accredited government institution. MANAGE also offer the requisite training for the aspirants through different training institutes spread throughout the country. Assam Government has also conducted one such training program through Assam Agricultural University for a batch of around 25 persons. There is need to accelerate the pace at which candidates are trained so that they become eligible to obtain license for operating as retailers which will help develop a sound network and make the fertilizers available throughout the State including difficult areas.

There are instances where retailers are observed to charge unfair prices for urea from the farmers in the State of Assam. This may be for reasons like dealers/ retailers have to pay hundred percent advance for the material and retailers also have to pay additional transport charges in getting the supplies to their doorsteps which add to their sales price. The Maximum Retail Price (MRP) can be moderated in other fertilizers but that is not the case for urea.

Limitation on procurement and sales of urea coupled with territorial restrictions have added more difficulties for retailers in Assam. Retailer density in Assam is far less than in any other agriculturally developed state. There has to be a designated monitoring officer to strengthen retail network through public and private channels. Major part of unfair price of urea is due to additional transport expenditure incurred by the retailers. It is learnt that around Rs.20 Cr budget has been sanctioned by the Assam Government towards additional secondary transport cost. It will be important to ensure proper implementation of the funds.

Assam State Agricultural Marketing Board (ASAMB) as wholesaler

The introduction of a public agency in the supply chain system of fertilizers in Assam has been suggested in the order regarding Urea SOP. The inclusion of Assam State Agricultural Marketing Board (ASAMB) as a public agency in the fertilizer supply chain will offer benefits to both the famers and the Board. If implemented properly, it will have positive impact on all the leading players existing the supply chain. According to the new SOP of Urea distribution, ASAMB is expected to play a pivotal role as a Wholesaler for the entire state. The role of ASAMB can be compared with the GUJCOMASOL or GAIC (the agencies for fertilizer distribution in Gujarat) having a major role to play in distribution and sales of all agri-inputs. Involvement of

government agency not only ensures delivery of good quality inputs but also at the fair prices which has been observed as a major challenge in Assam. Moreover, ensuring at least one *"fair-price-shop"* in every district will restrict milking approach of private trade.

However, it is difficult for ASAMB to prepare for this new role in such a short period without any prior experience in fertilizer trade and limited capacity of the employees. The Department of Agriculture (GoA) started cancelling all wholesale licenses leading to all the wholesalers becoming retailers without any preparedness on the part of ASAMB to implement it and take the responsibility of wholesaler.

Analogous organisations in other States

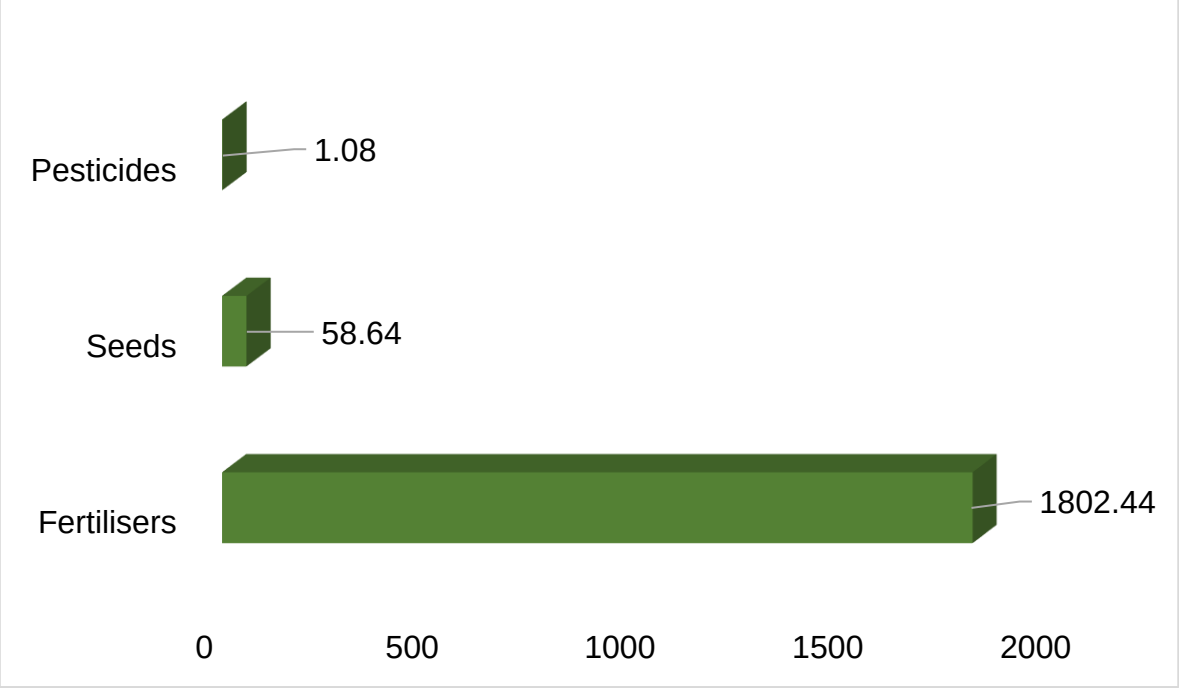
The study of two companies in Gujarat with similar role and responsibility, one under Cooperative Sector and other a Government Undertaking can help in understanding the new role of ASAMB.

Gujarat State Co-operative Marketing Federation Ltd. (GUJCOMASOL)

Gujarat State Co-operative Marketing Federation Ltd. (GUJCOMASOL) is an Apex Cooperative Marketing Federation of the state Gujarat. GUJCOMASOL was established in 1960 by Great Cooperative Leader Shree Tribhuvandas Patel. The federation is registered with Registration No - 24090 / 7 dated 19th April 1960. It is engaged in the business of agro inputs and procurement of farm outputs of the farmers with an annual turnover of more than Rs. 2763 crores. It also provides various types of services to the farmers through its strong cooperative network in the state. GUJCOMASOL is back bone for the upliftment of farmers. It helps in increasing the farm yield and prosperity of farmers by providing them with its best quality of agricultural inputs like seed, pesticides, fertilizer, consumer goods, trading of agriculture commodities, warehousing and various other services relevant today.

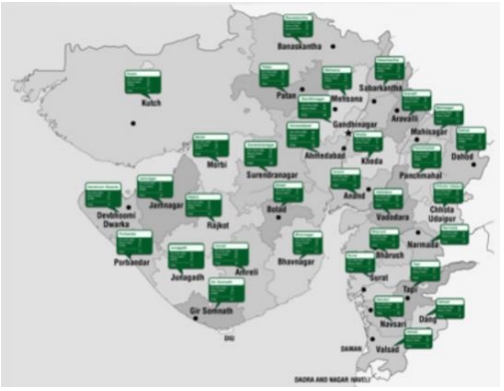
Apart from that, GUJCOMASOL is responsible for educating farmers on advanced package of practices and updating them with latest information on technological advancement in farming, conducting awareness programs and providing various types of services at their doorstep. Being a cooperative, the organisation is service oriented and is dedicated for overall development of the farming community of the state. The PACS is a vital institution for any village economy. It also plays important role in rendering services into the village even in critical and adverse condition of natural calamities. GUJCOMASOL is directly connected with more than 6000 PACS and more than 40 lakhs farmers of the State through PACS. GUJCOMASOL leading activities cover fertilizers, seeds and pesticide sales, seeds and food processing and commerce of output. The information compiled in Figure-28 speaks about the share of fertilizers, seeds and pesticides in the turnover of GUJCOMASOL in crores during the financial year 2020-21.

Figure 28. Turnover of GUJCOMASOL in Crores during 2020-21



GUJCOMASOL has also developed storage and processing capacity over years. The Federation is having more than 2 Lakhs MT storage capacity and rice mills (02), pulse mills (02), oil mill (01), ginning and pressing unit (01), seeds processing plants (03) and one pesticides factory. The Federation is reaching the farmers directly if cooperative structure is not available in a particular area.

Gujarat Agro Industries Corporation (A Government Enterprise)



The nucleus of all the activities of GAIC is the farmer. GAIC has a strong presence in rural Gujarat through its network of 18 district-level centres and 1300-plus agricultural business centres run by private sector entrepreneurs which provide services at the doorstep of farmers. Lakhs of farmers visit these outlets regularly. GAIC also offers its network to other companies for marketing their farmer-related produce. Presently, it is being used by bio-fertilizer and bio-pesticide manufacturing companies. GAIC is also tying up with financial institution in order to provide easy-to-obtain credit. GAIC distributes chemical fertilizers like Urea, Di-Ammonium Phosphate (DAP), Ammonium Sulfate Phosphate (ASP), Ammonium Sulfate (AS), Calcium Ammonium Nitrate (CAN), Nitro Phosphate (N.Phos), Murat of Potash (MOP), Single Super Phosphate (SSP) (granules & powder), etc., produced by reputed companies such as GSFC, GNFC, IPL, RCF and CFCL. GAIC is implementing agency for various State Government & Central Government projects and schemes apart from selling seeds, fertilizers and pesticides. GAIC is associated with taking benefits to different stakeholders available under schemes implemented by APEDA, National Horticulture Board, SFAC, National Biogas and Manure Management Programs, wire fending scheme and cluster development program.

Policies & Schemes
Comprehensive Agro Business Policy
APEDA Schemes
National Horticulture Board Schemes
State Government Schemes
SFAC Schemes
National Biogas and Manure Management Programmes
Agri-implements Subsidies
Wire Fencing Scheme
Cluster Development Programme

Emergence of ASAMB in the arena of fertilizer market

ASAMB was primarily formed with the objective of providing markets and value-addition to local produce but achieved limited success. Assigning the role of wholesaler of Urea for the entire state is an enormous opportunity for ASAMB to

emerge as a successful organization and operate as a multi-purpose government agency with vital contribution in the development of farming community.

The organizations like GUJCOMASOL and GAIC have been able to create such an impact in Gujarat. Though, GUJCOMASOL and GAIC are supported by so many other organisations like cooperative giants – IFFCO & KRIBHCO, State Government Companies – GSFC & GNFC, Central Government Undertaking – NFL & RCF along with a number of private companies operating in Gujarat. ASAMB has a huge potential to emerge as a major player in fertilizer distribution in Assam and create great impact on agriculture sector in the absence of any competition. The strength, weakness, opportunities and thread associated with the Board are discussed below –

SWOT Analysis of ASAMB

Strengths	Weakness
If properly managed, it can be a robust system to address following issues – • Unfair prices • Promotion of other essential nutrients • Equitable distribution of resources	○ Lack of knowledge of FCO ○ Lack of knowledge about fertilizers ○ Lack of infrastructure and tools to perform responsibilities ○ Employees are overaged ○ Lack of experience
Opportunities	**Threats**
○ Optimum utilisation of available manpower ○ Revival of ASAMB ○ ASAMB can gradually diversify toward other agri-inputs like seeds, fertilizers and agro-chemicals	○ Quick response by private players ○ This may expect ASAMB also to improve their response time to remain competitive and achieve the envisaged objective

ASAMB has no prior experience of handling fertilizers. The proposal to restructure the staff and organization may raise concerned amongst the employees. There may be problem of lack of motivation and enthusiasms to implement something new due to issues related to the age of the staff. ASAMB has to map places for warehouses for even distribution of fertilizers. This is necessary to stock Urea during lean season when companies are more willing to supply. During peak season companies generally face difficulties in supplying to all the states due to limitation in production capacity and getting rakes from railway authorities. The Board may gradually diversity toward other products and services to remain competitive and

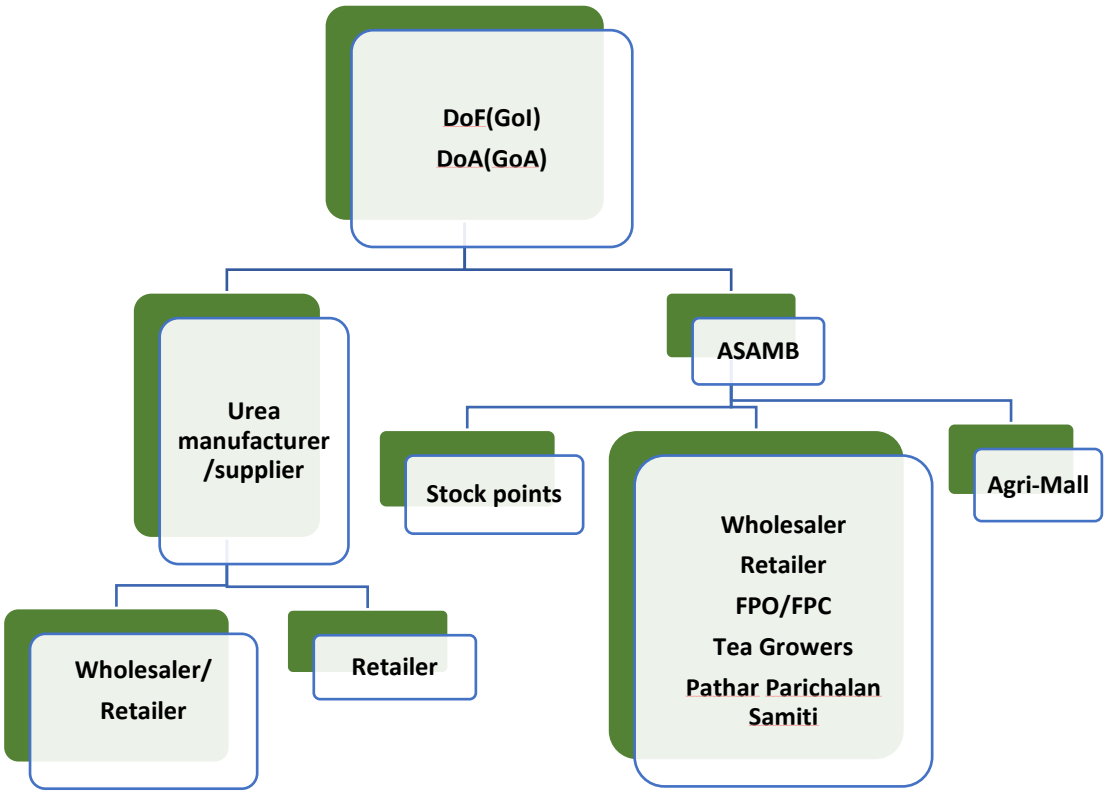
financially viable. The diversification plan may include input business, output business and advisory services.

In the present scenario, it is important to build the capacity of staff and officers of the Board on various aspects, like –

- Knowledge about Fertilizers & FCO
- Different aspects of fertilizers logistics and handling
- Training on iFMS system and PoS machines
- Training on balanced use of fertilizers and more efficient new and innovative fertilizers

Model of market structure after implementation of Urea SOP

Fertilizer delivery system in Assam was paralysed during the peak period of fertilizer requirement. ASAMB was able to obtain licenses only in three districts by the end of July 2022 required to issue Form-O to dealers and retailers without which retailer cannot do fertilizer business. Now with the extended time, ASAMB should make a PERT chart of 'Action Plan' for different activities like obtaining licenses, finalisation of stock-points and warehouses and the biggest task of creating a network of retailers. When Assam is consuming NPK of only 72 kg/ha against national average of 162 kg/ha, producers of Assam needs help not only in encouraged use of inputs but also in marketing their produce preferably at a premium price.



The board can gradually diversify toward marketing of agricultural produce. Assam is having availability of various important crops like fibreless-ginger, pineapple, kiwi and lichi. ASAMB will get immediate connect with farmers of the state because it will ensure input requirements at fair price and will help farmers in fetching better price for their produce. Success of the Board will not only control the problem of unfair prices of fertilizers but its network can also be used to implement various other schemes and projects of State Government and Central Government along with providing market to farmers. It can create a huge impact on agriculture of Assam.

Prospective diversification

ASAMB at present has to focus on the role defined under the Urea SOP to ensure timely delivery of fertilizer at fair price to farmers. However, the Board can gradually diversify toward marketing of agri-produce on the lines of GUJCOMASOL and operate as a lead agency for implementation of various schemes of the Government. The vision of ASAMB operating as Agri-Mall with facilities for input distribution, facilitating marketing of agri-produce and offering advisory services to the farmers is depicted in Figure-29.

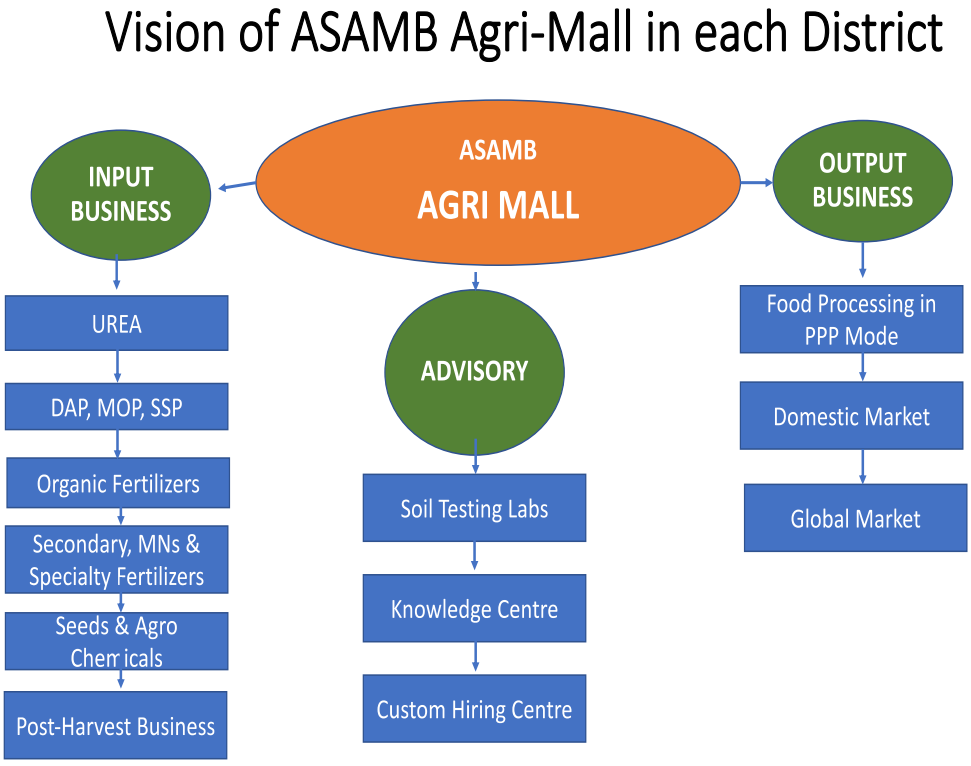


Figure 29. Vision for ASAMB Agri-Mall in Assam

Input Business	Advisory Services	Output Business
• No prior experience of fertilizer handling • Identification of the staff for fertilizer handling has to be done immediately • Appropriate support is required to be provided to perform duties like computers and internet connections • Capacity Building of identified staff on various aspects like (i) Knowledge about fertilizers & FCO (ii) Nuances of fertilizers logistics and handling (iii) Training on iFMS system and PoS machines and (iv) Training on balanced use of fertilizers & more efficient new fertilizers • Mapping of own "Retail Points/ Agri Malls" • Mapping of Warehouses/ Stock Points • Only Urea handling will not be sufficient for financial viability of ASAMB • "Full Basket of Agri Inputs" – that includes other fertilizers, seeds and agro-chemicals • They can have "Post-harvest products" also • Agri Mall should be exempted from 100MT cap to ensure fair price by private players also	• Manned by agri-experts through network with research institutes, universities and KVKs • Soil Testing Labs may be established under PPP mode to issue Soil Health Cards and maintain records. Advice to be provided on recommended dose of fertilizers and agro-chemicals • Knowledge Centre to disseminate information on various GoI & GoA schemes. Advise to handle natural calamity like floods, droughts or pest attack. • Information on new verities and crops • Custom Hiring Centre with focus on drone service on rent or other machineries on rent	• Food Processing Units to be established under PPP mode with the assistance of MoFPI • Logistics support by GoA, APEDA for export something similar is attempted by Government of Gujarat • Infrastructure mainly to support post-harvest activities and processing of seeds will have a huge impact on enhancing income of farmers and overall economic development of the states

The success of the Board though will depend on the capacity of staff and officers to take up the responsibility of fertilizer distribution and the thorough monitoring by the Department of Agriculture to ensure timely availability of fertilizer to farmers. Training and capacity building of staff and officers of ASAMB and other relevant Departments has to be the integral part of the plan for involving the Board in the distribution of fertilizer. In order to ensure monitoring of the progress and activities carried out by the Board and coordination between different players participating in the supply chain, DOA may consider developing a Program Monitoring Unit (PMU) with focus on distribution of inputs in the state and develop a portal for monitoring the movement of fertilizers from rake point to warehouse of the retailers. There is also need for panel provision for non-compliance of regulations. It is reiterated that the fertilizer policy involving ASAMB provides a golden opportunity to the Board to get revamped and revolutionize the distribution network in the state.

Allocation – planning & supply

The requirement of fertilizers for each cropping season is assessed by the Department of Agriculture, Cooperation and Farmers Welfare (DAC&FW) in consultation with the states/ UTs and conveyed to Department of Fertilizers (DoF) with month-wise breakup. The mandate of DoF is to ensure adequate and timely availability of fertilizers at the state level. The extra availability vis-à-vis sales is one of the indicators of comfortable availability of fertilizers. In case of urea, the gap between the assessed requirement and the indigenous production is met through timely imports by DoF. In case of P&K, the imports come under Open General License (OGL), wherein the companies import the fertilizers based on their commercial judgments. These imports are planned well in advance with a sufficient window for the consignments to reach the various Indian ports and thereafter, to the hinterland through rail/ road/ inland waterways. Half of the work is done, if proper estimation of demand is done by the State government and indent has been placed to MoF.

Supply situation of fertilizers is visible in the consumption of NPK ratio. N:P:K ratio in Assam is 4:1:1 which is heavily skewed if we see the total consumption of N, P & K fertilizers, requirement of Tea Plantations and remaining fertilizers available for rest of the crops. There is a scope to study the methodology of assessing the requirement/ demand of fertilizers by the state government and deviation in actual supplies. DoA collects the month-wise requirement from the DAO twice in a year

(during February for Kharif and August for Rabi). After compilation, month-wise indent/ demand is being placed to MoF for allocation and supplies. Accordingly, MoF instructs different companies to supply but allocated quantities are not as per indent. Further, even companies are not adhering to the given plan by MoF. That may be due to several practical and justifiable reasons, most common among them being availability of rake from the railways.

There is shortage in the supply of other fertilizers as well, as is visible from the response of retailers and distributors considered under the study. Though, based on a limited number but still suggests the gap in the demand and supply. About two-third of the respondents suggested shortage of Urea, limited availability of DAP has been indicated by 25 percent of the respondents whereas this number was 14 percent in case of MOP and 8 percent in case of SSP. No shortfall was suggested for micronutrients which probably was due to limited understanding and diversification towards Micronutrients. Therefore, apart from Urea action plan, there is need for preparing plans for sourcing other fertilizers like DAP, MOP & SSP.

Table 34. Limited availably of fertilisers as perceived by the retailers/ distributors

Sr No	Category	Percent
1	Urea	67
2	DAP	25
3	MOP	14
4	SSP	08
5	Micronutrients	--

Due to Russia - Ukraine war, prices of MOP will hit the roof and availability will also be influenced. Future planning will save the day. Good quality fortified SSP has to be ensured and regular checking of the product is required at production, wholesaler and retailer level. Month-wise requirement of urea plan given to MoF has to be prepared cannily. Instead of demanding in peak season, Assam has to build up stocks for the peak season. Stakeholders from most of the districts considered under the study for interactions, informed non-availability of MOP, which is an important input for cultivation of horticulture crops having great potential in the state. Availability situation of DAP & MOP will remain grim at least in 2023 also. GoA has to push IPL & IFFCO to plan adequate quantities for the state.

Awareness about the concept of balanced use of fertilizers is lacking. Most of the farmers in Assam know only Urea, DAP, MOP & SSP. Awareness on the benefits from secondary and micro-nutrients has to be created. Farmers in Assam, in terms of awareness and understanding, are observed to be far behind the farmers from states like Gujarat, Maharashtra, Andhra Pradesh, Telangana and Tamil Nadu. There is only one recommended grade of Micro-nutrient mixtures for all the six agro-climatic zones and different crops. Micro-nutrients combination being the state subject, DoA has to come up with more number of Micro-nutrient mixtures for various climatic zones and crops.

Fertilizers having secondary nutrients (Ca, Mg & S) have to be promoted as they play significant role in enhancement of production and productivity. Crop-wise/ area-wise analysis of NPK consumption ratio will reveal the true picture. The tea plantation consumes most of the Urea without using much of P & K fertilizers. Therefore, if we consider non-tea growing areas, the NPK ratio will be heavily skewed. The reason has to be diagnosed and most likely it will be due to non-availability of Urea at right time. SOP of Urea needs more elaboration on certain issues to avoid ambiguities/ confusions/ duplication in overall process. There is need to understand the basis of plan from the competent authorities and understand why DAP, MOP, NPKs & SSP are less in supplies.

Nano-fertilizers

Nano fertilizers have the potential to resolve the issue of Nitrogen availability for the farmers and the state governments also but if implemented with correct technology. Nano fertilizers has to be applied through drip-irrigation systems through power sprayers. There is hardly any acreage under drip irrigation system in Assam. Only way to promote Nano-fertilizers in Assam is by drone technology. This will resolve the issue of high transportation cost in hilly terrains and also the ease of spraying. Nano-fertilizers has to be sprayed in “mist” form, ordinary sprayers will kill the technology. In the Standing Committee, the Secretary of the Department of Fertiliser was asked, if the Department is designing any scheme so that we can promote Nano technology and reduce the usage of fertilizers, the Secretary of the Department replied as under –

“…..the main challenge with Nano technology is the delivery system. The traditional fertilizers are given by hand mechanism but here you need fertigation. I

think we need to promote fertigation in a big way to take advantage of Nano technology. There is already an existing scheme to promote fertigation among the farmers. We have to dovetail both these Nano fertilizer and fertigation technology and spread it among the farmers. We have to now look at that linkage**".**

Organic fertilizers

Even though the chemical fertilizers provide immediate results in the form of increased yield, in the long run, their improper use may lead to various environmental hazards like reduction in soil fertility and pollution of ground water. Hence, it is very much necessary to encourage large scale production of city compost/ organic or bio-fertilizers. In this regard, the Government may encourage smaller units which can manufacture city compost/ organic or bio-fertilizers locally and support such initiatives by providing financial help so that more people are encouraged to come forward to set up such units. Some interesting observations on use of organic fertilisers in Assam are as listed below –

- Hilly districts (Dimahasao, Karbi & West Karbi) and tribal districts (Chirang, Kokrajhar, Buxo, etc.) do not use/ use limited chemical fertilizers. There is scope to study the kind of organic fertilizers they are using and how the value-addition can be done to optimize yield.

- Soils of Assam are acidic in general, making absorption of most of the essential nutrients difficult by the plants. Need to educate farmers on proper use of various products to correct soil conditions for optimum yield.

- Mainly three types of organic fertilizers are being used in Assam, i.e., City Compost, Vermi-compost and Bio-stimulants.

- Scope to introduce new 'Mixed Fertilizers' (combination of inorganic and organic nutrients) and dissemination of concept will ensure high productivity level of organic farmers without adversely affecting soils.

- The low level of consumption of fertilizers can be taken as an opportunity to promote use of mixed fertilizers ensuring high productivity and avoid deterioration of soil composition.

- There are various new organic fertilizers introduced in the Indian market, such fertilizers can be introduced in Assam as well.

Rake-points

- In recent past, number of rake-points has been increased from 4 to 14 and three more are going to be added. There is scope to study the infrastructure available at the new rake points and to have an action plan for development of infrastructure.
- In case of new rake-points, aim is to have the warehouse opposite to rail-head, this will curtail the expenditure of loading/ unloading operations. The same concept is being followed by various other states.
- Companies try to bring rake at those rail heads where they can sell entire quantities due to fast recovery of sales-proceed and to save on logistics and warehousing cost. Not following the district-wise allocation is countered by the justification that rake is not available for other destinations.
- ASAMB & DoA need to have good liaising with Railways authorities to get the rake placed at the station of their demand, also, 2-3 points rake are needed.
- The provision of Rs. 20/ tonne in the SOP of Urea can take care of additional secondary transport. This year a sum of Rs.11.2 Crore has been claimed under this provision. This resource can be utilised to build ASAMB or any other government agency. This provision is directly linked with volumes, therefore, more urea sale means more budget allocation. Last FY, department could not avail full benefit due to limited sales because of the introduction of Urea SOP.

Fertilizer consumption

The major Tea growing area is upper Assam and total area under Tea is 3.36 lakh hectares. Out of this, 2.23 lakh hectares is under big gardens, whereas 1.13 lakh hectares is under small tea growers. Recommendation of doses for tea is 130 kg N/ha i.e., 290 kg of Urea but farmers are using around 400 kg of Urea/ha. Consumption of per hectare fertilizers in Assam is low in comparison to most of the states. It is even lower to all India average. The state-wise consumption of fertilizers is given in Table-35.

Table 35. State-wise per hectare consumption of fertilizer (N+P+K) (kg/ha)

State/ Union Territory/ Zone	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
SOUTH ZONE								
Andhra Pradesh	242.9	199.7	220.1	237.2	225.7	186.3	184.8	173.3
Telangana	.	.	213.0	231.4	268.9	252.6	253.0	245.3
Karnataka	193.7	130.3	153.7	176.2	175.0	166.7	164.5	183.2
Kerala	113.2	106.9	62.5	40.6	43.8	35.1	47.6	36.4
Tamil Nadu	214.8	184.2	143.1	163.7	175.2	161.0	149.5	186.4
Puducherry	798.9	607.3	637.7	284.7	262.2	289.2	268.9	227.9
Andaman & Nicobar Islands	50.6	40.0	28.2	29.1	-	34.6	20.0	16.1
Lakshadweep	-	-	-	-	-	-	-	-
WEST ZONE								
Gujarat	132.4	106.5	119.6	132.8	124.5	128.0	144.7	135.5
Madhya Pradesh	84.0	80.8	80.5	78.2	83.6	79.6	82.0	90.3
Chhattisgarh	105.2	105.7	86.5	92.1	100.1	102.6	86.8	86.3
Maharashtra	137.9	113.0	117.7	125.6	122.5	114.8	123.9	126.0
Rajasthan	55.3	56.1	45.9	54.5	61.6	51.9	47.4	60.8
Goa	46.5	33.0	53.5	46.9	49.1	144.6	39.1	36.5
Daman & Diu	23.3	56.7	26.2	-	41.1	41.2	35.9	38.6
Dadra & Nagar Haveli	45.9	40.0	57.6	67.9	56.1	73.1	31.7	13.9
NORTH ZONE								
Haryana	220.1	211.8	206.9	221.4	220.4	206.7	212.9	224.5
Punjab	242.6	250.6	219.4	227.5	248.6	232.6	213.8	224.5
Uttar Pradesh	165.0	180.1	138.4	150.5	155.5	154.3	168.2	170.1
Uttaranchal	147.0	135.7	164.1	160.0	169.2	169.3	152.1	140.7
Himachal Pradesh	54.1	50.3	51.3	54.0	57.1	61.4	63.2	63.3
Jammu and Kashmir	86.2	94.4	-	-	63.8	61.2	70.7	61.9
Delhi	14.9	24.5	33.0	82.3	57.5	76.5	77.0	112
Chandigarh	-	-	-	-	-	-	-	-
EAST ZONE								
Bihar	180.5	196.3	169.9	178.7	220.2	196.9	213.0	227.3
Jharkhand	136.6	119.3	37.7	38.4	54.5	43.6	50.6	59.8
Odisha	103.7	96.7	57.1	57.5	62.6	62.6	68.7	70.6
West Bengal	172.9	161.2	126.9	150.9	173.8	158.3	162.9	161.1
NORTH EAST ZONE								
Assam	66.0	65.7	88.8	90.2	44.8	74.6	63.5	73.7

Tripura	50.2	69.1	50.7	41.2	43.0	46.2	27.4	0.0
Manipur	21.9	35.1	31.8	44.4	41.6	34.7	58.0	68.3
Meghalaya	14.0	14.3	47.3	-	-	0.0	0.0	0.0
Nagaland	3.0	4.4	5.2	6.3	6.0	-	-	-
Arunachal Pradesh	2.4	2.0	-	-	2.1	0.0	0.0	-
Mizoram	12.3	15.2	27.7	-	18.2	22.9	36.8	55.9
Sikkim	-	-	-	-	-	-	-	-
ALL INDIA (Average)	142.3	130.8	118.5	127.5	130.7	124.4	127.9	133.1

N+P+K: Nitrogen, Phosphorus and Potassium
Source: Agricultural Statistics at a Glance, Ministry of Agriculture and Farmers Welfare, Government of India.

It is clearly evident that in last decade, fertilizer consumption in Assam was as low as 44.8 kg/ha (2015-16) and as high as 90.2 kg/ha (2014-15). The rate of consumption was observed to be 73.7 kg/ha during 2018-19. It is noticeable that demand and requirement of fertilizers are much higher than the actual consumption suggesting huge scope to increase the productivity and profitability of farmers in Assam, if fertilizer supply can be improved. The state season-wise sales and availability of fertilizers is presented in Tabe-17.

Table 36. State season-wise sales and availability of fertilizers

Product Group	Requirement	Monthly Plan	Receipts	Surplus/ Deficit
Kharif -2021				
Urea	170000	183821	140001.57	-43819.43
DAP	50000	55326.3	22653.5	-32672.8
MOP	40000	47233	22400.65	-24832.35
NPKS	10000	17039	6071	-10968
SSP	50000		25587.75	
Total	320000	303419.3	216714.47	-86704.83
Rabi -2021				
Urea	215000	223607.1	194030.51	-29576.59
DAP	39000	48591.95	32605.1	-15986.85
MOP	45000	35215.6	20636.95	-14578.65
NPKS	7000	21758.65	16972.65	-4786
SSP	70000	74318.75	73755.9	-562.85
Total	376000	403492.05	338001.11	-65490.94

Total				
Urea	385000	407428.1	334032.08	-73396.02
DAP	89000	103918.25	55258.6	-48659.65
MOP	85000	82448.6	43037.6	-39411
NPKS	17000	38797.65	23043.65	-15754
SSP	120000	74318.75	99343.65	-562.85
Total	696000	706911.35	554715.58	-152195.77

Issues related to fertilizers in Assam

Demand-supply gap in Urea is culminating into various problems not only in the supply chain of fertilizers but also in the other agri-inputs. Urea being the backbone of agri-input and primarily marketed and distributed through private channels, leads to retailers supplying the input at unfair prices and may also compromise the quality of other inputs to increase their margins. Urea being the main fertilizer for nitrogen and being heavily subsidized, is not available to the farmers at the prescribed prices. In some of the cases, it is being sold as high as Rs.50/- to Rs.75/- per bag instead of Rs. 66.70 per bag as fixed by GoI. Sometimes, there may be actual logistic related issues leading to delivery of product at the retail point at higher than expected cost. Some of the issues which need immediate attention of the policy makers, are as listed below –

- Right quality of agri-inputs - Fertilizers, Seeds & Agro-chemicals
- Right fertilizers – Appropriate doses of N, P & K
- Right price
- Access and reach to farmers

The Government of Assam has taken a praiseworthy step by preparing SOP for Urea to ensure smooth supply of the fertilizer and by roping in ‘Assam State Agricultural Marketing Board’ as a government arm to market Urea in the entire state, while private channel will also continue to co-exist.

Purpose of the SOP for Urea is to smoothen the supply-chain of agri-inputs in the State of Assam and to ensure that right inputs are made available to the farmers at right time and at right prices. This is very much in line with the policies followed in other states, like Gujarat, Telangana, Andhra Pradesh, Uttar Pradesh and Madhya Pradesh.

As far as quality of fertilizer is concerned, there is need for regular checking by department through drawing samples from retail points to ensure the fertilizer quality in the state mainly in case of fertilisers other than urea like SSP, micro-nutrients, etc.

Farmers are inclined to leave agriculture despite having lands because of poor income in agriculture in comparison even to the earning of a daily-wager. The fertiliser market is disturbed in the month of July 2022 due to implementation of Urea SOP. Roughly half of the retailers find it difficult to perform the business because of confusion created by the implemented of provisions defined under Urea SOP. Quitting of fertiliser business by retailer will lead to serious problems in any input distribution channel as they are vital in providing connectivity with the farmers and delivery of product. It is important to encourage all manufacturers and suppliers to increase their network by developing some strategy with district-wise targets. A sound fertiliser system will involve various services like testing laboratories & Soil Health Card, food processing and value-addition, development of Brand and marketing of agri-produce, warehousing and secondary transportation contractors and operations of pooled machinery. The Government need to come up with a comprehensive policy covering provisions to encourage investment by private players, exploring opportunities under PPP and availing benefits available under various schemes and programs of the Government.


ONE DAY MEETING WITH NATIONAL INSTITUTE
of

Section – V

Summary & Suggestions

Section – VI Summary & Suggestions

In order to facilitate the readers have a quick glance at different farm-input sectors and probable action plan suggested based on the findings of the Study, farm-input sector-wise summary of the findings and actionable points is presented in this section.

Seeds

Seed research, production and distribution are the major activities involved in ensuring smooth delivery of quality seeds to the farmers. There is an urgent need to work out a strategy based on the findings made during the study and implement the same to improve seed supply system in Assam. Some of the major findings and suggestions are mentioned below –

Observations	Reasons	Recommendations
Research – Seed & Planting Material		
Low varietal replacement ratio in most cereals & pulses Not much research has been done on hybrid paddy varieties and vegetable varieties suitable for the state	ARS are only focused on developing straight varieties. All vegetable seed is supplied by private seed companies	Develop new paddy varieties with flood tolerance, high yield and disease resistance Need to focus on releasing hybrid rice & maize varieties Need to develop OP varieties for vegetables like tomato, gourds and chilies suitable for cultivation in Assam State A comprehensive list of varieties of important crops suitable for cultivation in Assam needs to be developed by involving different agencies mainly the regional research stations and University. A tentative list has also been compiled under the study.

Production of Seed & Planting Material		
Field Crops Low seed yield, less recovery of good seed, low seed viability and poor seed quality	Lack of training to farmers on seed production. Low quality foundation seed, climatic conditions, high humidity, uncertain rains and high seed moisture	Avoid seed production in flood effected areas. Identify areas and agro-climate suitable for particular crop type. Quality of certified seed should be maintained. Proper seed drying facilities should be provided to the farmers. Seed should be dried properly and stored at optimum moisture levels (8-10%). Encourage private seed companies to involve in seed production in the state
Banana Conversion of farmers from traditional banana plants to tissue culture plants is very low. Most of the farmers are using their own planting materials which is resulting in low yields	Lack of awareness among farmers on the advantages of using TC Banana. Non availability of TC Banana nurseries in the state. Less TC labs availability	Create awareness among the farmers on TC Banana cultivation. Encourage private TC Banana nurseries to be established in the state. Increase more TC labs in the state in PPP mode
Seed Certification		
Percentage of seed registered for certification and seed issued for certification is very low	Lack of proper buyback arrangement. No premium paid for certified seed. Most of the private seed companies are selling TL seed in the state	Demonstrate the difference to farmers by using CS & TL seed. Encourage private seed companies to have buyback arrangement with farmers for certified seed production. Price difference between grain and certified seed should be 20 to 30 percent so as to encourage farmers have interest in getting their seeds certified. Involve FPOs in CS production

Seed Processing, Packaging & Storage		
Paddy seed available in the state is not uniform and quality is also not up to the mark	Limited seed processing facility available in the state. Even ASC processing facility is not fully operational. The processing machinery used is out dated and can't process seed properly. No proper storage facilities for seed produced and processed leading to seed damage	ASC should upgrade their present processing unit and increase processing capacity. At least each district should have one seed processing unit with latest machinery including seed drier. Encourage private seed companies to install seed processing units in the state by providing incentives for supplying seeds under subsidy schemes in the state. Construction of separate warehouses exclusively to store seeds
Seed Quality Testing		
Seed quality issues related to seed germination & purity are due to improper seed quality testing done before supplying the same to the farmers	There are only four seed testing lab in the state. Considering the size of state, there is lack of sufficient seed testing labs in the state. Only Government lab is available which does not have capacity to test all the seed samples	Number of seed testing labs should be increased in the state. New labs can be established with qualified trained entrepreneurs under private setup or under PPP model.
Seed Distribution		
Seed is distributed through ASC dealers and retailers. ASC supplies mostly certified seed of field crops to farmers through Agriculture Department under various subsidy schemes. Seed dealers and retailers supply mostly TL and certified seeds of private companies to the farmers. No proper guidance is given	ASC does not produce and supply total seed required in the state. Retailers have limited knowledge on seeds. The retail seed outlets available in the state are not sufficient	ASC should increase its production and supply capacity. In order to have a robust system of distribution, ASC may consider supplying seeds to private retailers as well. Retailers should be trained on seed and FPO should also be encourage to have retail outlet for supplying the seeds.

to the farmers by the retailers on seed varieties. ASC does not supply seeds to the retailers.		
Licensing System		
It is observed that more than two third of the seed retailers do not have seed license. A number of unauthorized seed is being sold in the state	Not much importance and focus is given to seed sales in the state. No inspection is done by the Department to verify licenses of the seed sellers. There is lack of proper system to stop unauthorized seed entry in the state	Issue seed licenses to all the stakeholders involved in seed sales in the state. Make an easy licensing system so that all the seed selling retailers come in the system. Subsequently, the same system can be strengthened with strict seed rules
Subsidy System		
Only few companies are given preference in seed under seed subsidy in the state. The quality of the seed provided by them has not been considered of good quality by the users.	Seed supply order under subsidy program are given only to L1 companies. Farmers do not have choice to buy seeds of their preference under such programs	Fix subsidy amount for each crop and approve all the qualified companies under subsidy, farmers will pay the differential amount and buy seeds of their choice
ASC Farms Utilization		
52 seed farms operating under ASC (12 farms of ASC and 40 farms of Directorate of Agriculture handed over to ASC)	Lack of proper infrastructure in these farms. Lack of availability of sufficient staff	These farms can be developed with the involvement of private seed companies, either by leasing to them or developing under PPP mode for production under various foundation seed programs Vegetable seed production can be done in these farms. One of the farms can be developed as a model farm for specific crop. FPOs can also be involved in developing these farms. In each farm, seed processing units can be established. Common seed

		production facilities to be developed and these facilities can be utilized by seed farmers on paying nominal fee
Specialty crops to be focused for seed distribution & development		
Local crops and varieties in Assam are not being promoted properly. State is having lot of local paddy varieties like back rice, joha rice, scented rice, etc. with lots of export potential. Assam local lemon, ginger & turmeric are also special crops which need appropriate focus.	Lack of ability to understand the market potential of such crops	Encourage farmers to grow such special crops in Assam and promote them. Arrange a buyback agreement with exporters for such crops
Strengthening the seed supply system in Assam		
There is need to build capacity of all the stakeholders all along the supply chain mainly the farmers Implementation of concepts like traceability to ensure delivery of quality seeds to the farmers and explore possibilities of export to other states and countries	Lack of ability to understand the importance of concept like capacity building and traceability in strengthening the supply chain	A compressive strategy covering all relevant stakeholders and aspects of inputs supply system All the institutes and agencies involved in development, production and distribution of seed to be involved in capacity building programs Focus to be given on involvement of players like company and their team of distributors and retailers in taking the right kind of information to farmers Farmers awareness and training to be made an integral part of the distribution network so as to ensure proper use of seeds and other inputs

Agro-Chemicals

Parameters	Observations	Problem associated	Remarks/ Action plan
Supply of Materials	Apparently, there seems to be no shortage in supply of pesticides in Assam. None of the stakeholders has informed any crop failure due to a shortage of pesticides or experienced any scarcity during the peak cropping seasons in the recent past (76% of the retailers and distributors considered under the study never experienced a shortage of pesticides and the statement was supported by 77% of the government officials who never experienced crop failure due to the shortage of pesticides). Though, it may have been a matter of concern is some geographically difficult areas. No centralized data is available on category wise consumption of pesticides.	Per ha consumption of pesticides maybe low in the state and therefore, leading to crops loss which is required to be quantified by the authorities The lack of centralized data on category-wise consumptions creates a basic difficulty in understanding whether the pattern of use of insecticides, fungicides, and herbicides is in line with the actual requirements of the state.	District-wise mapping of dealers should be done to identify the areas with a smaller number of sale points and government may enter into direct selling through cooperatives or its own counters as has been experienced in Himachal Pradesh and Uttarakhand. A simple web-based portal may be developed to generate data on category-wise sales with the help of the existing C&F agents who may be asked to update the actual category-wise sales at the end of every month. It will help the authority to keep a track of the actual availability in the marketplace.
Choice of pesticides (dependency on generic molecules)	Assam is predominantly a state of generic pesticides. Farmers are not using or have sown reluctance to use speciality molecules or formulations due to various reasons like lack of knowledge, availability, price, etc.	Due to the development of resistance against some pesticides or groups of pesticides, farmers are bound to use multiple rounds of pesticides to control a single pest leading to the problem of limited effectiveness and residue and health hazards.	Pesticide companies with speciality molecules should be encouraged to create awareness among different stakeholders Government may also think to incentivise them to do so as their efforts will supplement the extension efforts of the Government

			One of the ways may be to buy and distribute the patented pesticides directly from the parent company.
Choice of pesticides	Most of the farmers are not technically sound to identify the problems faced by them during the cropping cycle. They are mostly dependent on the retailers and the field staff of the pesticide companies.	Chances of farmers ending-up in using the wrong products or the products as preferred by retailers of the companies having their own agenda are relatively more.	Creation of awareness among the farmers is the key. Public and private sector institutes covering NGOs and FPOs can play an important role. A portal in the local language like TNAU Agritech Portal may be developed with the help of the scientific community of the state.
Application of Pesticides	Farmers are not using the recommended dose of applications, following repeat application interval, pre-harvest interval and are generally going for tank mixing of multiple products. Tank mix without scientific knowledge is widely practiced in the state. Overuse of pesticides is a reality in Assam *(https://www.sentinelassam.com/topheadlines/pesticide-heavy-metals-in-food-gauhati-hc-takes-it-seriously-636144). It creates the problem of rejection of consignments by the importing counties when the presence of residue exceeds prescribed MRM for any commodity. It is important for Assam as is exporting tea across the globe. Growers need to be trained on the issue.*	Problem of development of resistance to the pests, residue in the finished product and loss of efficacy in tank mix application MRL issues	Creation of awareness among the farmers has an important role to play in overcoming these issues. Pesticide companies also have a role to play to extend the life of pesticides by promoting the proper application procedure. Training on MRL is needed particularly for the organizations who are exporting agricultural commodities form Assam
Quality of pesticides	Lack of testing facility of the quality of pesticides available in the marketplace. State Pesticide Testing Laboratory is not functioning properly. The number	Spurious/sub-standard materials are in circulation, failure of pest control, increase in the cost of cultivation, etc	Renovation and upgradation of the State Pesticide Testing Laboratory may be taken up under Public-Private Partnership mode.

	of samples collected for quality testing is very low as compared to other states.		Outsourcing of testing facilities with the help of private sector institutions. All the stakeholders who are designated as pesticide inspectors should increase the number and frequency of sampling, especially in the remote areas of the state.
Bio-pesticides	Assam has considerable potential for bio-pesticides as some parts of the state are traditionally organic. Though, there is a considerable gap between the potential and actual use because of many reasons like lack of availability, short life span, lack of efficacy, low level of knowledge, etc. (52% of the retailers and distributors suggest lack of knowledge as one of the major factor for the low acceptance of bio-pesticides in Assam. Sixty-six per cent of government officials had the same opinion) Most of the stakeholders have a negative impression about the bio-pesticides Sixty percent of retailers and distributors considered under the study have shown interest in selling bio-pesticide.	More emphasis on chemical pesticides by the stakeholders	The state biocontrol laboratory which is not functioning properly since 2015, must be renovated with infrastructure and restructuring of manpower resources. People from the private sector who are having knowledge of manufacturing, testing and marketing may be inducted to strengthen the supply chain. The government may also encourage small and medium enterprises to set up small but economically viable units across different parts of the state with an assured buyback policy. A quality control laboratory is a must for the success of bio-pesticides.

Bio-pesticides	Many products fortified/spiked (most likely with pesticides) are available in the market and are getting sold at a very high cost.	The problem of residue and increase in the cost of cultivation in name of bio-pesticides	Sampling and testing of available bio-pesticides for the presence of chemical pesticides. The state government is required to come up with appropriate policies for creating the awareness on the use of bio-pesticides and means to be adopted to ensure their quality and availability. Production is also required to be considered to address the issue of non-availably.
Pest surveillance and forecasting	Pest surveillance and forecasting system in Assam is not very active as has been experienced in some of the states like Maharashtra and Tamil Nadu	Farmers end up with severe crop damage and economic loss due to the lack of advanced scientific advisory for effective pest control.	A web/app-based system can be developed with guidance from the following publication - https://farmer.gov.in/imagedefault/handbooks/BooKLet/MAHARASHTRA/20160725144307_CROPSAP_Booklet_for_web.pdf. Pesticide companies can be linked to this web-based portal through automated emails or messages in regular interval so that they can mobilize the resources well in time and can prevent severe crop damage due to delay in pest control.
Clearing and forwarding	C&F agents don't have any role in the quantities of materials indented by the company. Sometimes extra materials brought by the sales personnel of the	Disposal of expired pesticides is a problem as it can create serious environmental hazards. Some part of the	Government should establish a hazardous waste treatment incineration plant in Assam to

(C&F) agents	respective companies get stuck up and expired. Assam does not have any dedicated disposal site for pesticides.	stock may find its way to the market.	facilitate the disposal of expired pesticides.
Retailers/ dealers/ distributors	The level of technical knowledge on plant protection among the retailers is low. Most of the time, they fail to identify/ recognize the problem of farmers and end up recommending the wrong products or a mixture of many products	Increase in cost of cultivation, loss of yield and quality, residue in finished products, development of resistance to pests, etc.	Technical training on a regular basis (maybe once a year) by the plant protection experts should be made mandatory for all the authorized retailers. Technical persons from the pesticide companies must take part in those training programs. The online platform may be used to reduce the cost of a physical program.
Retailers/ dealers/ distributors (legal aspect)	Do not have knowledge about the legally authorized pesticide marketing companies in the state.	Chances of marketing of unauthorized, inferior, sub-standard and spurious materials	A comprehensive list of authorized companies should be prepared and distributed among the retailers/ dealers/ distributor and the list should be displayed at their respective business places as ready reckoner in local language
Farmers (knowledge and distribution)	Lack of technical knowledge about plant protection	Being influenced by the local retailers and company field staff	Mass communication media may be used to reach out to the farmers particularly during the peak cropping season. A user-friendly interactive chat portal may be developed in local languages
Farmers (plant protection)	Lack of knowledge to identify pests	Possibility of application of the wrong pesticide.	A WhatsApp-based service portal may be developed, where farmers can upload pictures of the problems. The portal should be linked with a

			few dedicated experts for prompt solution. It can be done at the district level to reduce the workload on a centralized system.
Mandatory training for the pesticide retailers	The State Government with the help of AAU and its KVKs to conducted training for the input dealers (including fertilizer, seeds and pesticides) and use a generalized form of module developed by them. There are gaps in the module developed by AAU and the one developed by National Institute of Plant Health Management, Hyderabad which needs to be addressed appropriately.	Dealers/retailers dealing with pesticides exclusively may lose focus on plant protection.	Module developed by the National Institute of Plant Health Management, Hyderabad, should be used for exclusive pesticide dealers/ retailers trainings.
Training for ADOs, VLEWs and others who are dealing with the farmers on a regular basis	Most of the ADOs and VLEWs have lost the fine touch of plant protection and are not updated about recent developments in the field of plant protection chemicals. (77% of the government officials have never undergone any specific training on plant protection/ pesticide chemistry)	Failure to provide solutions to the farmers and loss of yield and quality.	A periodical training (online and offline) on recent developments in plant protection should be conducted with the help of plant protection experts to update the knowledge base of the concerned persons. Research and development experts of the reputed pesticide companies must be included in the training as experts to share their experiences.
Procurement and distribution of pesticides	The state government is involved in the procurement and distribution of pesticides under different schemes operating in the state. Procurement is done through open tender and the	The quality of the supplied materials may be compromised	Procurement should be done directly from the primary manufacturer and random sampling of supplied

by the state government	lowest bidder always (L1) gets the purchase order. Procurement is done based on a test report from any NABL accredited Lab furnished by the supplying organization. A sampling of supplied materials for quality is done very rarely.		materials must be done to confirm the quality of the supplied pesticides.
Spurious/ sub-standard pesticides	As the number of samples for quality checks by the competent authority are very less, the possibility of presence of spurious/ sub-standard pesticides in the marketplace is very high. The non-availability of an active State Pesticide Testing Laboratory makes things more complex.	Farmers may get cheated, increase in the cost of cultivation and yield and quality may get compromised.	There is need to have a sound testing mechanism in the State to address issues related to quality of chemical products

Stakeholders-wise suggestions – Agro-chemicals

Stakeholder	Recommendations
Farmers and farmers associations	▪ A sound farmers awareness campaign having its concentration during peak production season to create awareness among farmers on various aspects of procurement, application and storage of agro-chemicals ▪ Farmers should continue to attend awareness training programs organized by Government and the agro-chemical companies ▪ Farmers should utilize customer care telephone number written on the packaging to validate the authenticity of the product ▪ Farmer community at village level should identify authorized retailers and encourage farmers to ask for a receipt after each purchase

Pesticide company	▪ Invest in farmer education programs for identifying authentic products and ill effects of spurious/ illegal products ▪ Track the end retailers by modifying the procedure of issuance of principal certificates from distributors to retailers ▪ Make distributors realize the importance of use of branded genuine products for farmers ("Know Your Supplier") ▪ Provide special helpline telephone numbers to resolve farmer's queries
Government	▪ Provide special helpline telephone numbers to resolve farmer's queries ▪ Formulate an anti-counterfeiting committee to coordinate the problem of non-genuine / illegal pesticides ▪ Revamp the State Pesticide Testing Laboratory maybe under PPP model and increase the number of samples collected from marketplace for quality check

Fertilizers

Sl No	Observation	Solution	Remark
1	Unfair price and non-availability of Urea	▪ ASAMB has to be strengthened for sale and distribution of Urea like GUJCOMASOL & GAIC of Gujarat ▪ Same infrastructure can be used for variety of other purposes. ▪ Monitoring of ASAMB on regular basis to assess their preparedness for taking up the responsibility. The frequency may be weekly or fortnightly during the initial phase of implementation ▪ DoA has to set targets for fertilizers companies to intensify their retail network.	Budget allocation for ASAMB. GoA has to increase the demand of Urea from GoI and ensure district-wise supplies.

2	Lack of experience - ASAMB Staff	Training of staff on – ▪ Fertilizers and its balanced use ▪ FCO ▪ Handling of fertilizers ▪ iFMS & PoS Machine	ASAMB should prepare training calendar with the budget
3	Tools for ASAMB	▪ Computers, internet connection, etc.	--
4	Allocation	▪ Method of assessment of fertilizer requirement and proposal to GoI for proper allocation. ▪ Planning the requirement of DAP, MOP and SSP ▪ Follow-up with Urea suppliers for adhering to supply plan ▪ Tie-ups with more companies for supply of other fertilizers	▪ It is vital to estimate the demand in the state properly to have appropriate allocation for the state as shortfall of almost all the fertilisers was observed in the state ▪ Almost all retailers, farmers & planters were of the opinion that Urea is about 50 percent short in supply
5	Rake points	▪ Infrastructure has to be checked at new rake-points ▪ Half rake points to be developed. ▪ ASAMB should develop at least one rake point for every pair of two-districts ▪ Appointment of efficient H&T contractor at all the rake points	▪ More rake points will reduce the freight subsidy and extra burden on state government.
6	ASAMB operations	▪ The Board should sell all the quality agri-inputs ▪ The Board should have Soil Testing Labs on PPP mode ▪ The Board should have "Pooled Services" to offer	▪ Chain of model Agri Malls

		▪ The Board can go for 'Food Processing' and 'Marketing' in PPP mode	
7	Organic Fertilizers	▪ New efficient fertilizers to be introduced ▪ Combination of chemical & organic fertilizers should be in the package of practice ▪ Quality of organic fertilizers should be monitored effectively	--
8	Diversification	▪ There is no fertilizer for secondary nutrients ▪ There is only one grade of MN, more crop and area specific grades are required	State government needs to promote secondary and micro-nutrients Nano-fertilisers also offer great potential if policy environment is created to provide support infrastructure
9	Awareness program	▪ Limited focus on educating farmers on balanced use of fertilisers	It is important to encourage balanced use of fertilisers to achieve optimal production with minimum impact on environment and also to reduce cost of production The use of fertilisers in Assam is skewed towards nitrogen. There is need for mass awareness for educating farmers on balanced use of fertilisers

References and Annexure

References

FAO (2009) Feeding the world in 2050. World agricultural summit on food security 16–18 November 2009. Food and Agriculture Organization of the United Nations, Rome

Oerke EC (2005) Crop losses to pests. J AgrSci 144:31–43. doi:10.1017/S0021859605005708

Oerke EC, Dehne HW (2004) Safeguarding production—losses in major crops and the role of crop protection. Crop Prot 23:275–285

Popp J (2011) Cost-benefit analysis of crop protection measures. Journal of Consumer Protection and Food Safety 6(Supplement 1):105–112. doi:10.1007/s00003-011-0677-4, Springer, May 2011

Oerke EC, Dehne HW, Schonbeck F, Weber A (1994) Crop production and crop protection—estimated losses in major food and cash crops. Elsevier Science, Amsterdam, 808 pp

Zadoks JC, Schein RD (1979) Epidemiology and plant disease management. Oxford University Press, Oxford

Boote KJ et al (1983) Coupling pests to crop growth simulators to predict yield reductions. Phytopathology 73:1581–1587

Food and Agriculture Organization of the United Nations (FAO). FAO Statistical Databases (2001).

World Health Organization (WHO). Public Health Impacts of Pesticides Used in Agriculture(WHO in collaboration with the United Nations Environment Programme, Geneva, 1990).

Anonymous. 2015b. Vision 2050. Directorate of Weed Research (ICAR), Jabalpur (MP), 32p.

FAOSTAT, Food and Agriculture Organization of the United Nations. http://www.fao.org/faostat/en/#data/QC
OECD-FAO Agricultural Outlook 2012. Organisation of Economic Co-operation and Development and Food and Agriculture Organization of the United Nations. https://www.oecd-ilibrary.org/agriculture-and-food/oecd-fao-agricultural-outlook-2012_agr_outlook-2012-en

Gianessi, Leonard P. and Nathan Reigner. September 2005. The Value of Fungicides in U.S. Crop Production. http://croplifefoundation.files.wordpress.com/2012/07/completed-fungicide-report.pdf

Tilman D et al (2002**) R**eview article**:** Agricultural sustainability and intensive production practices**.** August 2002 Nature 418(6898):671-677

IWMI (2007) Water for food, water for life: a comprehensive assessment of water management in agriculture. Earthscan and Colombo. International Water Management Institute, London

Shivalingaswamy, T.M.S. Satpathy, S. and Banerjee, M.K. 2002. Estimation of crop losses due to insect pests in vegetables, In:Resource Management in plant protection, Vol-I (SaratBabu, B., Vara Prasad, K.S., Anita, K. Rao R.D., Chakraborty, S.K. and Chandukar, P.S. eds.) Plant Projection association of India, Hyderabad, pp-24-31.

Ghosal, A., Chatterjee, M. L. and Manna, D. 2012. Studies on some insecticides with novel mode of action for the management of tomato fruit borer (Helicoverpaarmigera Hub.). Journal of Crop and Weed, 8(2): 126-129.

Dhillon, M.K., Singh, R., Naresh,J.S. and Sharma, H.C. 2005. The melon fruit fly, Bactroceracucurbitae: A review of its biology and management. Journal of Insect Science, 5:40.

Satpathy, S., Kumar, A., Singh, A. K. and Pandey, P. K. 2005. Chlorfenapyr: A new molecule for diamondback moth (Plutellaxylostella L.) management in cabbage. Annals of Plant Protection Sciences, 13: 88-90.

Singh, S K., Singh, A. K. and Singh, H. M. 2007. Relative resistance of okra germplasm to shoot and fruit borer, EariasvittellaFabr. under field conditions. Journal of Applied Zoological Researches 18(2): 121-123.

Raju, S.V.S., Bar, U.K., Uma Shankar and Kumar, S. 2007. Scenario of Infestation and Management of Eggplant Shoot and Fruit Borer, LeucinodesorbonalisGuen., in India. Resistant Pest Management Newsletter, 16(2): 14-16.

Tladi-Sekgwama, F. M. and Tselaesele, N.M. (2010) Agricultural Extension in Botswana: Growing a

Hybrid over Decades of Selective Experience, Proceedings of the Workshop on Information

Sharing among Extension Players in the SADC Region, pp 5.

Dhaliwal, G.S., Dhawan, A.K. and Singh, R. (2007) Biodiversity and ecological agriculture: Issues and perspectives. Indian J. Ecol. 34(2):100-109

Behera B, Singh G S (1999) Studies on Weed Management in Monsoon Season Crop of Tomato; Indian Journal of Weed Science; Volume: 31, Issue : 1&2: 67-70.

Webster JPG, Bowles RG, Williams NT. Estimating the Economic Benefits of Alternative Pesticide Usage Scenarios: Wheat Production in the United Kingdom. *Crop Production.* 1999;18:83.

Bhatia MR, Fox-Rushby J, Mills M. Cost-effectiveness of malaria control interventions when malaria mortality is low: insecticide-treated nets versus in-house residual spraying in India. *Soil Sci Med.* 2004;59:525.

Ross G. Risks and benefits of DDT. *The Lancet.* 2005;366(9499):1771.

Brown Ian UK Pesticides Residue Committee Report. 2004. (available online http://www.pesticides.gov.uk/uploadedfiles/Web_Assets/PRC/PRCannualreport2004.pdf also available on request).

Lewis NM, Jamie R. Blueberries in the American Diet. *Nutrition Today.* 2005;40(2):92.

https://news.agropages.com/News/NewsDetail---32430.htm

http://ppqs.gov.in/statistical-database

National Sample Survey Organisation Report (2014)

Seednet.gov.in – Government of India seed portal

Agricoop.nic.in – Portal

Ascltd.assam.gov.in - Portal

Des.assam.gov.in – Directorate of Economics & Statistics, Govt. of Assam

Seed World Technology Conference – Report on seed industry scenario – 2019

Agricultural Statistics at A Glance 2021 – Ministry of Agriculture & Farmers Welfare Department

Statistical Handbook of Assam – 2021

Understanding the relation between farmers seed demand and research method – By Connym marcel

National Seed Association of India (NSAI) Report – 2020

Horticulture Statistics at A Glance 2021 – Horticultural Statistics Division, Department of Agriculture and Farmers Welfare

Economic Survey of Assam 2021-22 – Government of Assam, Transformation and Development Department

Assam Seed and Organic Certification Agency

Status paper on Rice in Assam by T. Ahmed, S.K.Chetia, R.Choudary&S.Ali

Production of Banana and Pineapple in Assam – Status and Challenges by NilutpalChutia and Ritopan Borah

https://agri-horti.assam.gov.in/frontimpotentdata/types-of-pesticides-and-uses-0 and https://diragri.assam.gov.in/sites/default/files/swf_utility_folder/departments/diragri_medhassu_in_oid_4/do_u_want_2_know/Types%20of%20Pesticides%20and%20uses.pdf

https://croplife.org/wp-content/uploads/2015/10/Study-on-sub-standard-spurious-counterfeit-pesticides-in-India.pdf

https://prsindia.org/

Annexure 1

STAKEHOLDERS OF AGRI-INPUTS

S.No.	SEED	FERTILIZER	AGRO-CHEMICAL
1	Farmers	Farmers	Farmers
2	Retailers	Retailers	Retailers
3	Distributors	Dealers / Distributors	Wholesaler
4	Agriculture University	Agriculture University	Agriculture University
5	KVKs	KVKs	KVKs
6	ADOs	ADOs	ADOs
7	FPOs	Railway Rake Points	Pesticide Marketing Co
8	APMC	Tea orchards / Research Institutes	C&F Agency
9	Private seed companies	Fertilizer Manufacturers	
10	Seed processing companies	Soil Testing Labs	
11	Assam Seed and organic Certification Agency	Fertilizer Quality Control Labs	
12	Assam Seed Corporation	Warehouses	
13	Banana Tissue culture Nurseries	H&T Contractors	
14	Pine apple nurseries		
15	Poly house / green house		

QUESTIONNAIRE FOR FARMERS

SEED

S.No.	Personal information	
1	Name of the Farmer	
2	Village	
3	Block	
4	District	
5	Division	
6	Contact No.	

S.No.	Information on Seed		
1	What are the crops and area under seed production? 1. 2. 3. 4.	Crops grown	Area (in acres)
2	What type of Seed you produce at present?	c Foundation Seed c Certified Seed c Truthful Seed c Others	
3	For whom you do seed production?	c ASC c Pvt Seed Cos c Risk production c Others	
4	Do you have buy-back agreement with the Co for the seeds?	c Yes (with……..) c No	
5	What is the premium price seed Co give you for your seed?	c Same as grain price c 10% more c 20% more c 30% more	
6	What type of seeds & planting materials you use?	c Local source c Unspecified c Certified c Improved c Hybrid c Others	
7	What variety of seeds & planting materials are you using? 1. 2. 3. 4.	Crop	Variety
8	Where did you get major seed & planting material from?	c Assam State Seed Corporation c Assam Horticulture Department c Seed Retailers c FPOs c From known Farmer	

		c Own production
9	Did you get Bank loan for purchase of your inputs?	c Yes (Bank ……..) c No
10	Did you get any subsidy for seeds/ planting materials you purchase?	c Yes c No
11	If yes, from which Dept / agency you got subsidy?	c Assam Agriculture Department c Assam Horticulture Department c APART c Others
12	Are you getting seed supply on time before sowing season?	c Yes c No (reason ……..)
13	Does seed supplier / retailer give after sales support?	c Yes c No
14	Have you faced any quality problem of seed?	c Yes (pl specify…) c No
15	Does your seed supplier attends to your quality problem complaint?	c Yes c No
16	Has the seed supplier compensated you when loss incurred due to substandard quality seeds supplied by them?	c Yes (what extent?)c No
17	Have you complained to the Dept of Agriculture / concerned Authority regarding seed quality problem you faced?	c Yes c No
18	Have the Govt officials attended your complaint on seed quality and solved your issues?	c Yes c No
19	To whom are you selling your produce?	c APMC c Co-operative societies c Private traders c Exports
20	Do you get supportive price (MSP) for your produce?	c Yes c No
21	Do you have proper processing facilities for the seed you produce?	c Yes c No
22	Do you have proper storage facilities for storing your seeds?	c Yes c No

<table>
<tr><td>23</td><td>Is your seed production insured?</td><td colspan="3">c Yes c No</td></tr>
<tr><td>24</td><td>Are you using modern farm machinery for cultivating crops?</td><td colspan="3">c Yes c No</td></tr>
<tr><td>25</td><td>What are the new crops you are interested in to grow for more returns?</td><td colspan="3"></td></tr>
<tr><td>26</td><td>Do Agriculture & Horticulture Departments conduct training & awareness programs on seed</td><td colspan="3">c Yes c No</td></tr>
<tr><td>27</td><td>What type of support you need from Govt for better seed & planting material supplies</td><td colspan="3"></td></tr>
<tr><td>28</td><td>What type of support do you expect from the Pvt sector for better supplies & seed business?</td><td colspan="3"></td></tr>
<tr><td rowspan="6">29</td><td rowspan="6">Do you have access to mass media? If yes, how frequently?
1. Radio
2. Television
3. Newspaper
4. Printed material
5. Others, pl specify</td><td colspan="3">Mass media accessibility & frequency</td></tr>
<tr><td>Regularly</td><td>Occasionally</td><td>Never</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>30</td><td>What are your major constraints in having access and use of agri-inputs?</td><td colspan="3">c Timely availability of inputs
c Spurious / substandard products
c Higher than specified price
c Retail outlet too far / inaccessible
c Lack of know-how of input use
c Poor extension / training services
c Lack of purchasing power
c Others</td></tr>
</table>

Land Use and Cost of Cultivation

S. No.	Crop	Area under the Crop (Acres)	Irrigated Area (Acres)	Cost of Seed	Cost of Fertilizer	Cost of Agro-Chem	Cost of Labour	Total Cost
1								
2								
3								
4								
5								
6								

FERTILIZER

(1) Crops, PoP& Productivity

S No	Crop	POP		Crop Stages		Yield (kg/acre)	Market Price (Rs/T)	Remarks
		Fertilizer	kg/acre	1st Application	2nd Application			
1		Urea						
		DAP						
		MOP						
		SSP						
		MNs						
		Others:						
2		Urea						
		DAP						
		MOP						
		SSP						
		MNs						
		Others:						
3		Urea						
		DAP						
		MOP						
		SSP						
		MNs						
		Others:						

(2) Price & Business terms

Product	Price (Rs/Bag)	Credit Period	Remark
Urea			
DAP			
MOP			
SSP			
Zinc			
Boron			
Others:			

(3) Source of Fertilizer

Do you buy fertilizers from one/many sources?	
Name & address of Dealer	
Distance from farm	
Name & address of Dealer	
Distance from farm	
Name & address of Dealer	
Distance from farm	

(4) Availability

Items	Yes	No
Do you get all fertilizers when you need?		
In case of "No":		
How long you have to wait?	Name of Fertilizer	No. of days
	Urea	
	DAP	
	MOP	
	SSP	
	Others;	

5	Are you satisfied with the quality of your fertilizers?	c Yes c No If No, pl specify products & concerns……..
6	Does your dealer sell any other product along with Urea?	c Yes c No If Yes, pl specify ……..

7	Do you get advice from KVK / other government agency?	c Yes c No
8	Are you aware of Secondary & Micro Nutrients?	c Yes c No If Yes, which one you use:……. Application method: c Basal application c Foliar spray
9	Do you use organic fertilisers?	c Yes c No If Yes, pl specify: c FYM c City compost c Vermi Compost c Any other
10	Are you dealing in Specialty Fertilizers?	c Yes c No If Yes, pl specify ……..
11	Your suggestion for better availability of fertilizers	
12	Have you availed any training program conducted by Govt / Pvt Agency?	c Yes c No If Yes, pl specify ……..

AGRO-CHEMICALS

S.No.	Information on Seed			
1	What are the major pests of your crops? 1. 2. 3. 4.	Insects	Insects	Weeds
2	What are the major seasons of use of pesticides? 1. 2. 3. 4.	Kharif	Rabi	
3	What are the pesticides you use to control pests? 1. 2. 3. 4.			
4	How many pesticide dealers are in operation in your area?	c 2	c 3	c More than 3
5	Do they have license to sell pesticides?	c Yes	c No	

6	Which companies are authorized to sell pesticides in your area?	c Yes c No
7	Do you need to travel to get pesticides from the dealer?	c Yes c No
8	Who helps you to identify the problem in your crop?	c On my own c Retailer c ADO c Co. representative
9	How do you select the right pesticides to control the pests?	c With the help of the retailer c With the help of Company person c Own decision
10	Do you know about the expiry date mentioned on the pack?	c Yes c No
11	Does the retailer tell you about the rate of application, process to make the solution, safety equipment?	c Yes c No If Yes, do you follow them? c Yes c No
12	Have you ever received any training on plant protection?	c Yes c No If Yes, who gives you Training? ……
13	Have you ever encountered the failure of pesticides to control pests?	c Yes c No
14	Do you receive any forecasting on pest incidence and prophylactic application of pesticides to counter the incidence?	c Yes c No
15	Do you visit ADO office?	c Yes c No If Yes, how often? ……
16	Does the local ADO visit your area?	c Yes c No If Yes, how often? ……
17	Are you happy with the price of pesticide you purchase?	c Yes c No
18	Do you think Government to start fair price shops to cater PPC?	c Yes c No
19	Does the Government distribute pesticides?	c Yes c No
20	What do you think about the retailers?	c Profit oriented c Genuine service provider

21	Have you ever experienced shortage of pesticides during peak season?	c Yes	c No
22	Do you buy pesticides other than your local dealers?	c Yes	c No
23	Does VLEW visit & suggest pesticides regularly?	c Yes	c No

QUESTIONNAIRE FOR RETAILERS / DEALERS / COMPANIES

SEED

S.No.	General information			
1	Name			
2	Address			
3	Village / Town			
4	District			
5	Division			
6	Contact details: Telephone (O) Telephone (R) Mobile No. WhatsApp No. Email Id			
7	Status of Firm / Company, and branches, if any	c Proprietary c Partnership c LLP c Others Branches:		
8	Type of Business, and no. of years in business	c Retailer c Dealer c Distributor c Others No of years in business:		
9	No of Customers	c Retailers …….. c Farmers ……		
10	Ratio of business	c Wholesale ……% c Retail …… %		
11	Area covered / No. of villages catered			
12	Existing facilities (Area in Sqft): a) Showroom b) Display arrangement c) Godown / Storage			
13	Transportation facilities: (No of days to deliver) a) Transport b) Courier			
14	Business Turnover (Lacs per year) a) Seed b) Fertilizer c) Agro-chemicals d) Farm Machinery / Equipment e) Others	Wholesale	Retail	Total

15	License No.: a) Seed b) Fertilizer c) Agro-chemicals d) Farm Machinery / Equipment e) Others	License No.	Date of Issue	Valued at

S.No.	Information on Seed	
1	What type of Seed are you selling?	c Local c Certified c Truthful c Hybrid
2	What is the source of Seed?	c Govt agency c State Pvt Seed Co c Local Pvt Seed Co c Others
3	Does seed supply done by the companies on time?	c Yes c No (reason……..)
4	How is your transportation facility for receiving the seed supplies?	c Good c Satisfactory c Poor c Don't have
5	Do you supply seeds to farmers as per their choice?	c Most of the time c Advise for better seed
6	How do you sell seeds, on cash or credit?	c Cash c Credit
7	Do you provide technical support on seed to the farmers?	c Yes c No
8	Do you receive seed quality complaints from the farmers?	c Yes (how frequently?) c No
9	What are the major seed complaints you receive?	c Germination problem c Mixture of variety (purity) c Duplicate packaging c Others
10	Does seed supplier supports in solving seed quality problem with the farmers?	c Yes c No
11	Have you paid compensation for seed complaints to the farmers?	c Yes (what extent) c No
12	Does Agriculture Department supports you while solving seed quality problems?	c Yes c No
13	Do Agriculture & Horticulture Departments conduct training	c Yes c No

	& awareness programs on seeds?	
14	Does Bank provide loans for your business?	c Yes c No
15	Does Seed Inspector take samples from your shop?	c Yes (frequency…) c No
16	Are you satisfied with the government steps taken to control spurious seeds?	c Yes c No
17	Do Agriculture & Horticulture Departments conduct training & awareness programs on seeds	c Yes c No
18	Have you availed any such training & awareness program?	c Yes c No
19	What type of support do you need from Govt for better supplies & seed business	
20	How do you think the Pvt sector can be strengthened for better seed business?	

SEED SALES							
Crops	**Variety**	**Local / Hybrid**	**Brand Name**	**Quantity Sold (kg)**			
				2019-20	**2020-21**	**2021-22**	**2022-23**
Cereals							
1							
2							
3							
4							
Pulses							
1							
2							
3							
4							
Vegetables							
1							
2							
3							
4							

FERTILIZER

(1) Peak period & Companies

Name of Fertilizers	Period (Months)	Companies handled by you
Urea		
DAP		
MOP		
SSP		
MNs		
Specialty Fertilizers		
FYM/CC/VC		
Others		

2	Do you have Fertilizer License and “Form–O” from the companies you are dealing with?	c Yes c No
3	Do you get supplies as per your requirements? 1. Urea 2. DAP 3. MOP 4. SSP 5. MNs	c Yes c No c %age short…….. c Yes c No c %age short…….. c Yes c No c %age short…….. c Yes c No c %age short…….. c Yes c No c %age short……..
4	At what point you get the supplies?	c Your retail counterc Your warehouse c Co’s warehouse c Rail head
5	Do you get freight subsidy?	c Yes c No If Yes, when and how much?.....

(6) Are you satisfied with the quality of service and products?

Name of Fertilizers	Product Quality	Packing quality	Credit Policy	Replacement Policy	Accounts
Urea					
DAP					
MOP					
SSP					

MNs					
Specialty Fertilizers					
FYM/CC/VC					
Others					

7	How often you / company conduct training for your retailers & farmers?	
8	Access to assistance from the Bank in terms of the loan?	c Yes c No
9	Your idea about the presence of spurious and inferior quality materials in your market and approximate volume?	
10	Any other issue you want to share?	

AGRO-CHEMICAL

SrNo		
1	How long you are in wholesale business?	c Less than 5 yrs c 5-10 yrs c More than 10 yrs
2	Who started the business?	c Myself c Family business
3	What is you educational qualification?	c Graduate c Postgraduate c Agri Graduate c Other
4	Number of companies you are dealing with?	c Less than 5 c 5-10 c More than 10
5	Number of retailers you are dealing with?	
6	Are you also in retail sales?	c Yes c No
7	What are the major pests in your area?	c Insect c Fungus c Weed
8	What are the major segment of pesticides used in your area?	c Insecticide c Fungicide c Herbicide c PGR
9	What is the major season of use of pesticides?	c Kharif c Rabi
10	Have you undergone any training on plant protection and safe handlining of pesticides?	c Yes c No

11	Who conducted the training?	c AAU c Directorate of Agri
12	Are you interested in selling bio-pesticides?	c Yes c No
13	What are the problem associated with bio-pesticides?	c Non-availability c Quality issue c Lack of knowledge
14	What is your source of information about any new technology related to pesticide?	c Co. personal c Department c Internet
15	Do you know the name of the companies that are legally eligible to sell pesticides in your area?	c Yes c No
16	Do you enquire about the authenticity of a company before distributing/selling its products?	c Yes c No
17	How often do you conduct training for your retailers and farmers?	c Once in a year c Twice in a year c More than 5 in a year
18	Have you ever experienced a shortage in the supply of pesticides?	c Yes c No
19	Your concerned about the safe handling of short expiry and expired stocks?	c Yes c No
20	Do you think that the spurious pesticides are available in the market?	c Yes c No
21	Minimum Capital needed to start a new wholesale business?	
22	Are bank loans easily available to start a new busines?	c Yes c No
23	What is the time required for breakeven?	c 2-5 years c More than 5 years
24	What is your gross margin (%)?	
25	How many times have you encountered pesticide inspector/department people for quality check?	c Once in a year c 2-5 times in a year

26	How many types of bio-stimulants do you handle?	c Less than 5 c More than 5
27	Do you ask for any bio-efficacy report before selling bio-stimulants?	c Yes c No
28	What is your catchment area?	
29	No of other players in your area?	c 2-3 c 3-5 c More than 5
30	Any issue you want the Agriculture Department to take up?	

Data Collection

20th July 2022 (Wednesday) – Jorhat

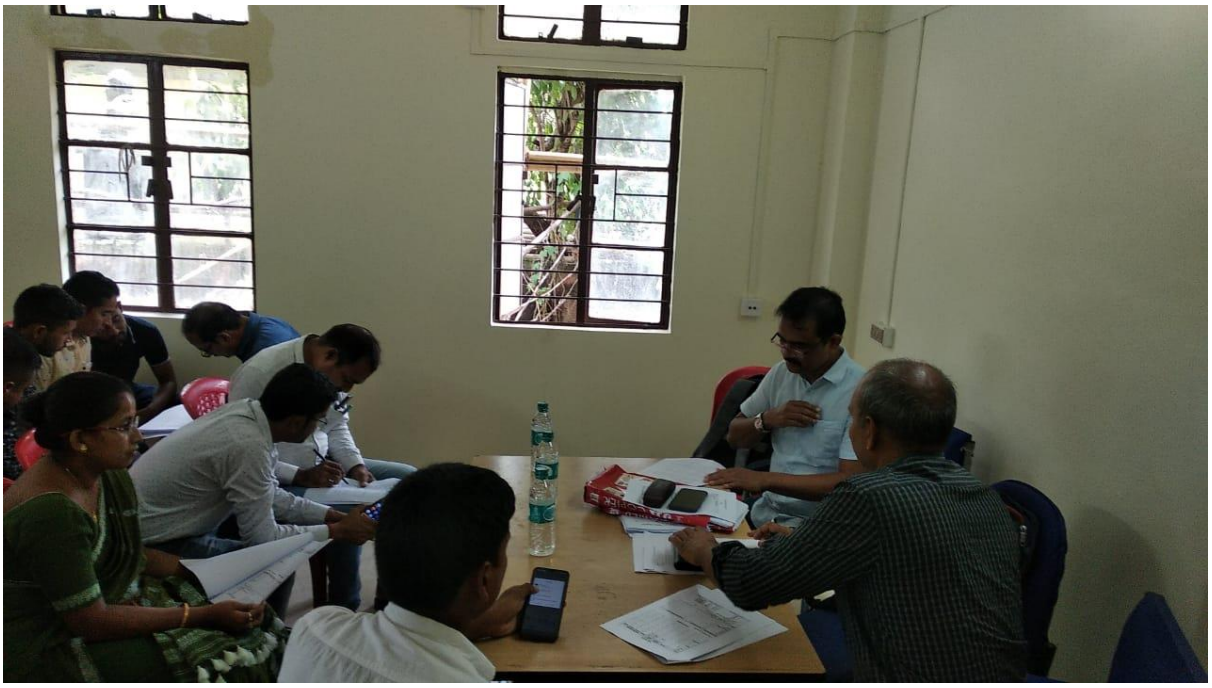
21st July 2022 (Thursday) – Sonitpar

22nd July 2022 (Friday) – Nagaon

24th July 2022 (Sunday) - Karbi Anglong

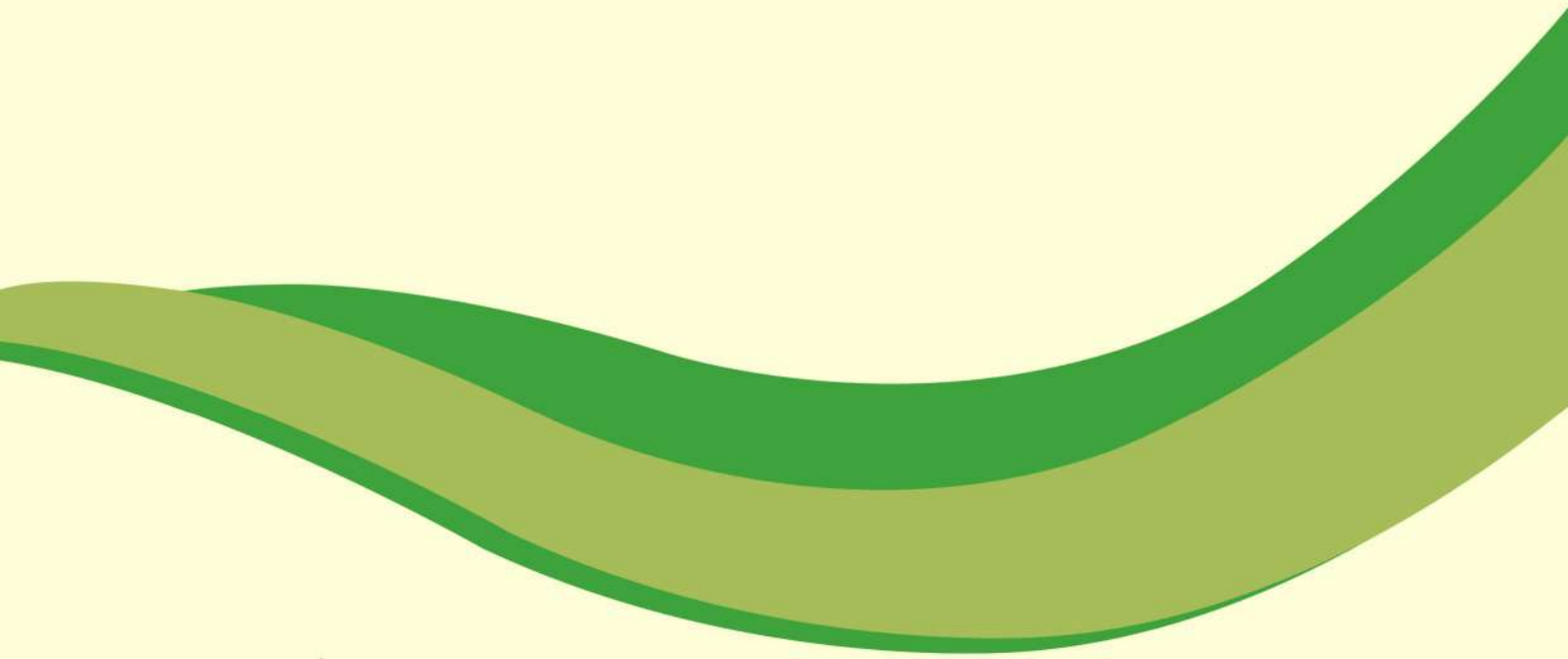
25th July 2022 (Monday) - Karbi Anglong

26th July 2022 (Tuesday) – Kamrup



17th October 2022 (Monday) – Cachar

20th October 2022 (Thursday) – Barpeta



National Institute of Agricultural Extension Management (MANAGE)
(An Autonomous Organisation of Ministry of Agriculture and Farmers Welfare, Govt. Of India)
Rajendra Nagar Hyderabad – 500 030, Telangana, India