KRISHI RUPANTAR

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RICE VALUE CHAIN
Special Edition

Strengthening the Seed System in Assam

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Seed is an integral part of crop production and important means to increase crop productivity and profitability of farmers. Rice is the most important crop for food, nutrition and livelihood security for the farmers of Assam. Rice is cultivated in a 2.5 million ha area with a production of 5.3 million tons. The state is self-sufficient in rice production to date but the increasing population and reducing land resources put great pressure on increasing productivity.

The use of quality seed is the first and foremost way of realizing the yield potential of any cultivar with a recommended package of practices (POP). High-quality pure seed ensures proper germination, adequate crop stand, and freedom from weeds and seed-borne diseases and insect pests.

It is recognized in general, that quality seed ensures 15 to 20 per cent higher yields under the same set of crop management practices.

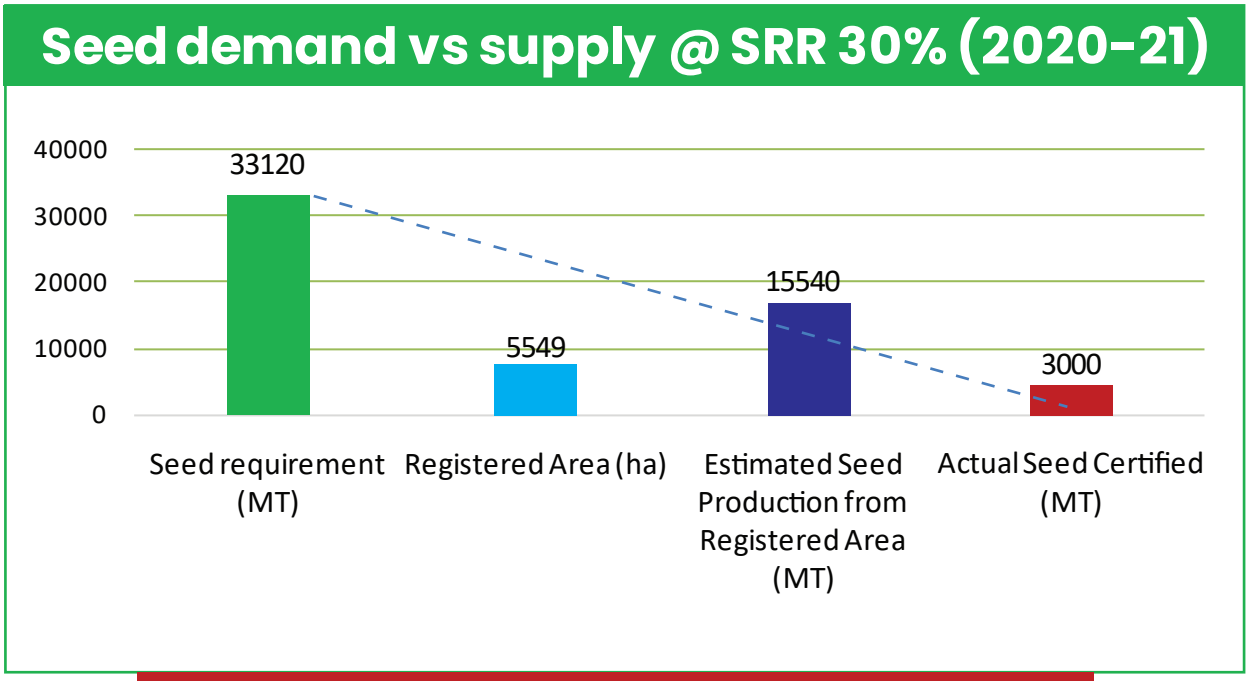
In case of superior quality rice, it even ensures higher prices and profit. Unfortunately, in Assam, enough certified seed is not available and the state has to depend on the neighbouring states to meet its seed demand for paddy cultivation.

Issues of seed production

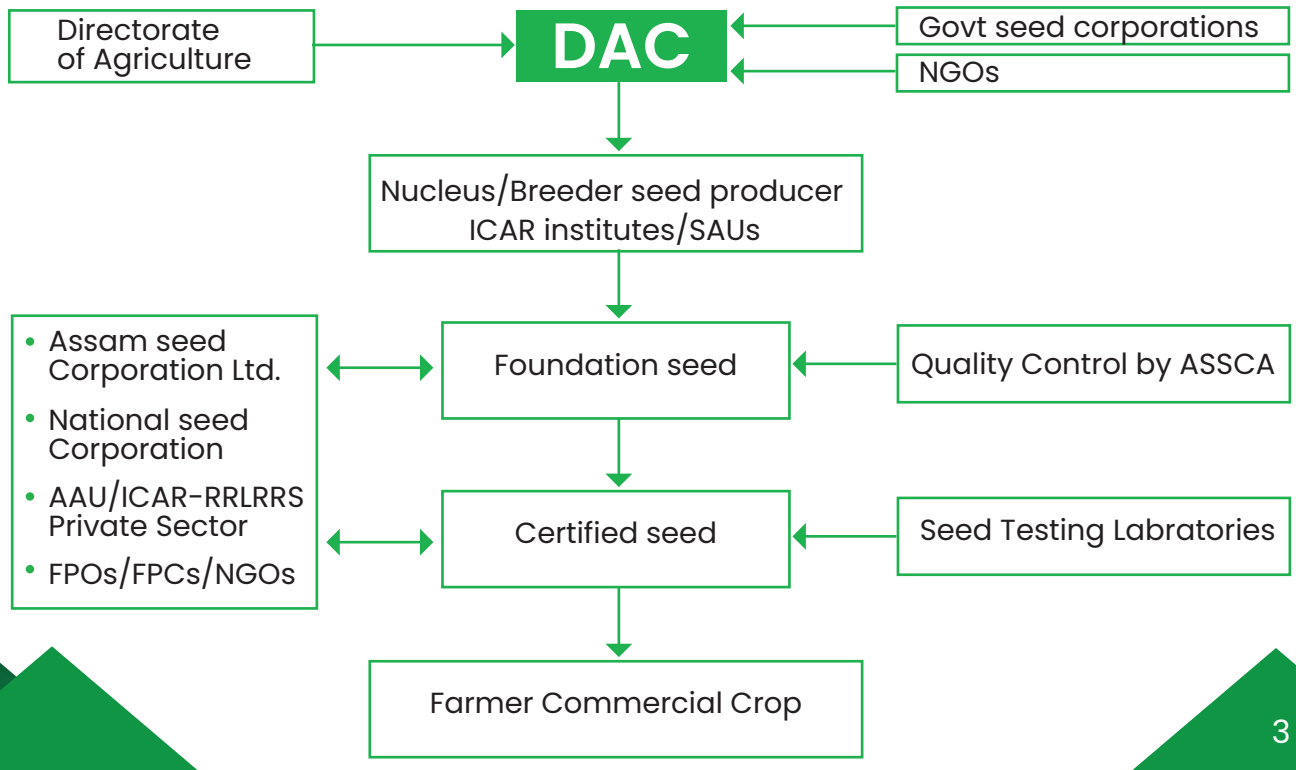
- Both, public and private institutions of seed sectors in Assam suffer from want of functional infrastructure, poor market information system to estimate right demand, product targeting and production and procurement planning to make the quality seeds produced, procured from growers and sold in time.
- There is a lack of synergy between the institutes for proper planning and execution, and there are instances when significant volumes of seed production were planned but could not be achieved due to the poor certification system in Assam.
- Many times, the committed certified seed from registered growers is not procured and they are compelled to sell the potential quality seeds as grains, as a result, they are forced to quit the seed production business in subsequent seasons.
- As a consequence, more than 70 percent of the area is cultivated using farmers' seeds. Thus, there are several issues associated with the use of good quality seed. While the private seed producers need to be encouraged to produce more seeds of the released varieties.
- The potential of seed farms for producing quality seed is untapped due to poor resource and infrastructure at seed farms of ASCL.

Seed industry and critical gap analysis

A high seed replacement rate (SRR) is the key driving force to improve the productivity of the crops. The seed requirement to target approximately 21 lakh ha paddy sown area, after excluding the area under hybrid seed and Specialty rice with SRR of 30%,comes out to be around 33000 tons but the estimated seed production from the registered area of 5549 ha, it is estimated to be about 15500 tons. Therefore, the actual gap (deficit) between seed requirement and existing seed production is approximately 17500 tons. The total seed getting certification is about 3000 tons (ASCCA, 2020) and the remaining seed is sold either as truthfully labeled seed or as simple grain in the open market to the millers.



Organizational set up for seed production in Assam



Ways to strengthen the seed production in Assam

1. Improving institutional linkage for seed production, business flow and access to farmer producer companies (FPCs)/farmer producer organisations (FPOs)/farmers for timely availability of breeder or foundation seed for further multiplication.
2. Organising a workshop by involving public and private seed sectors to formulate a policy plan to strengthen the seed production system
3. Improving the indenting system of breeder seed variety demand and strengthening the local institutes like Assam Agricultural University, Assam Seed Corporation Limited (ASCL) and private seed growers for seed production.
4. Strengthening the seed farms of ASCL and the Department of Agriculture
5. Organising awareness campaign to produce clean and quality seed by involving ASSCA, ASCL, private seed growers, FPCs/FPOs
6. Creating awareness among farmers about the benefits of using clean and quality seed
7. Ensuring seed buyback from the seed growers/FPCs/FPOs with attractive prices
8. Ensuring timely procurement and distribution of HYVs/STRVs for timely seed sowing and crop establishment
9. Establishment of seed processing units for seed cleaning and bagging
10. Increasing the number of sale counters of ASCL at different levels

Rice Education Hub : Bringing Technologies Nearer

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Specialist, IRRI

Dr. Kanwar Singh,
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There are local varieties!! There are stress-tolerant high yielding varieties!! There are hybrids!!There are premium quality rice varieties!!

Which one to select for the *Sali* paddy cultivation? Which will be the best-suited variety for one's field? Which variety will be more productive? How much to spend for growing the improved varieties? Are the varieties tolerant to flood or drought? Which grain size and quality of rice is most preferred by different farmers? Will my soil support the new variety? The best platform to answer these questions is the Crop Cafeteria. One can visit the crop cafeteria and can see the performance of the varieties, evaluate, compare, and find the answer. He will have the reasons to decide the best-suited variety for his field.

Many more questions are likely to arise in the farmer's mind during the selection of a paddy variety and sometimes get even confused to select the best-suited variety for his field. Crop cafeteria is the easiest method to disseminate information and bridge the knowledge gap on variety to be selected. One can see, learn, and evaluate the performance of different varieties at a single location and select the best performing variety based on grain size, yield, plant height, tillering ability, aroma etc.

Under APART, Assam Agricultural University (AAU) with the technical support of the International Rice Research Institute (IRRI) has been conducting crop cafeterias in different Krishi Vigyan Kendras (KVKs) and Regional Agricultural Research Stations (RARSs) since the inception of the Project. The best part of the crop cafeteria is that it provides an opportunity to farmers, millers, processors, dealers, extension functionaries to know about the characteristics of different varieties, to evaluate the performance of the varieties and finally to select the best performing variety that best suits them. In 2021, a total of 103 rice varietal cafeterias are conducted by the Department of Agriculture (DoA) and Assam Agricultural University (AAU) with the technical support of IRRI in Assam. DoA has started it in a very massive way for the first time in the state. This activity is getting an overwhelming response both from extension functionaries and farmers.

With the initiative encouraged by the State Project Director (SPD), ARIAS Society and also the Director of Agriculture, farmers and all stakeholders are getting an opportunity to transfer the technical know-how from lab to land by making it an education hub for farmers. In the crop cafeteria, farmers and extension functionaries are also educated on best management practices (BMPs) in rice cultivation including seed treatment, seedling priming, fertilizer application, water and weed management, assessment of maturity signs, harvesting of the crop, cost of cultivation and economics of crop, observations on growth, yield attributing characters and yield estimation of different varieties.

Some of the varieties, which have been cultivated in the rice cafeterias across the state are local varieties such as: *Ranjit, Aijung/Masuri, Bahadur, Numoli, Ranjana, Bismuthi, Baismuthi, Prafulla, Joymati, etc., some of the stress-tolerant rice varieties including,Ranjit-Sub1, Bahadur-Sub1, Swarna-Sub1, BINA Dhan 11, BINA Dhan 12, DRR Dhan 44, DRR Dhan 53, DRR Dhan 54, DRR Dhan 55, DRR Dhan 56, etc.,some specialty/premium quality rice varieties Include Keteki Joha, BokulJoha, Saheb Ali (Local scented rice), Malbhog Bora, Santi Joha, Tulsi Joha, Chakua 1, Chakua 2, Chakua 3, Joha, Boa Dhan, Kola Joha, Bhog Joha, Kali Jira, Kunkuni Joha, Biroin (Glutinous Rice), Local white Joha, Green rice, Black rice, Bora Dhan, Santi Joha, Black Joha, CR Dhan 909, Kon Joha, Gopal Bhog, Tripura Sikon, BINA Dhan 13, Aghoni Bora, Malbhog Bora, BhogJoha,etc., high yielding rice varieties, SwarnaMahsuri, Banga Bandhu, etc., and hybrid rice such as Arize 6444, Arize 6444 Gold, etc..*

It is noteworthy to mention that the variety replacement rate (VRR) and seed replacement rate (SRR) in Assam is quite low and there is a scope for improvement by supplying the best-suited varieties based on the performance and preference by the stakeholders. The main factors for the low VRR and SRR are: -farmers' lack of awareness, unwillingness to replace varieties, unavailability of quality seed and lack of opportunity to evaluate the significant advantages of different varieties. Things are changing slowly. Of late, due to combined effort of ARIAS Society, IRRI, AAU and DoA positive vibes for the replacement of varieties with new STRVs, premium quality rice varieties etc. have been started in Assam agriculture and now the farmers are convinced, motivated and coming forward to replace their old seed and varieties. It's expected that the introduction of crop cafeteria will further accelerate the replacement process by placing right variety in right place. It is for sure; it will have a big impact in Assam agriculture!!

Rice Variety Cafeteria at Darrang District

Amlan Deep Saikia
Junior Researcher, IRRI

Under Assam Agribusiness and Rural Transformation Project (APART), five rice variety cafeterias were established by both District Agriculture office and KVK in different parts /blocks of Darrang district under the guidance of the International Rice Research Institute (IRRI).

Rice variety cafeteria is the demonstration of identified efficient rice varieties in an agro-metrological region offering an opportunity to the farmers and other stakeholders to evaluate and select a variety suited to their needs including the climate of the place, soil quality, irrigation facilities, etc. In the cafeteria, various varieties including stress-tolerant rice varieties (STRVs), premium Quality Rice (PQR) varieties, locally popular rice varieties as well as traditionally available rice varieties were introduced by the DoA and KVK. The total area per cafeteria is 2000m^2, wherein ten different varieties have been transplanted in an area of 200 m^2 each. All the varieties were transplanted by maintaining a spacing of 20 cm ×15 cm keeping a 0.5m walking path in between them.

Varieties, such as Bahadur-Sub1, Ranjit-Sub1, Swarna-Sub1, Maniram, Bismuthi, CRDhan 909, Bahadur Bora, Ranjit Bora, Latahali, Ranjit, BhogJoha, Joha Bora, Piyali, Bahadur, Bangabandhu-1, KunkuniJoha, etc. have been selected and transplanted in Sipajhar, Becimari, Pachim Mangaldai, Kalaigaon and Dalgaon-Sialmari blocks of Darrang.

Rice Variety Cafeteria at Darrang

Establishment of Rice Varietal Cafeteria at Goalpara

Mridupaban Mudoi
Junior Researcher, IRRI
Priyanka Das
PA, HRS, Kahikuchi

A rice varietal cafeteria is established by the APART team of Horticultural Research Station, Kahikuchi under the technical support and guidance of International Rice Research Institute in paddy field of Sri Upendra Rabha (Pioneer of Black Rice in Assam) at Krishnai Dev. Block of Goalpara district on 2nd August, 2021. Seedlings of 10 varieties categorized into three diverse groups viz., STRVs, PQRs and LPVs were purchased from the farmers of the locality the details of which are mentioned in Table 1.

Table 1: Details of variety selected for establishment of Varietal Cafeteria

Entry no.	Variety Name	Varietal Group
V1	Ranjit Sub 1	STRV (Submergence tolerant)
V2	Kalavati	PQR (Orissa variety)
V3	KunkuniJoha	LPV (Aromatic)
V4	Boga Bora	LPV (Glutinous)
V5	Upendra Black Rice 2	PQR
V6	Bahadur Sub 1	STRV (Submergence tolerant)
V7	Upendra Black Rice 1	PQR
V8	TulsiJoha	LPV (Aromatic)
V9	Manipur Black Rice	PQR (Manipur Variety)
V10	Ronga Bora	LPV (Glutinous)

Various management practices for the Rice Varietal Cafeteria establishment right from main field preparation to transplanting were carried out in a complete organic and eco-friendly manner. The main field area of 2000 sq meters was prepared thoroughly by ploughing around 2 weeks ahead of transplanting to enable the decaying of weeds followed by harrowing and planking. The field was then puddle properly by two passes of modified helical blade puddler. Well dried cow dung as organic manure (10t/ha) was applied at the time of final puddling and was uniformly mixed with the soil. The main field was then divided into 10 small plots/strips of size 200 square meters each with 0.5 m walking path between the two stripsas presented in Fig. 1 and each strip was levelled properly by maintaining a shallow water layer. An irrigation channel of 1 m wide was prepared in such a manner that each small plot receives uniform supply of water. The experimental details along with the protocols followed for laying down the rice varietal cafeteria is presented in Table 2.

Fig 1: Design and layout of the main field incorporating the 10 different rice varieties

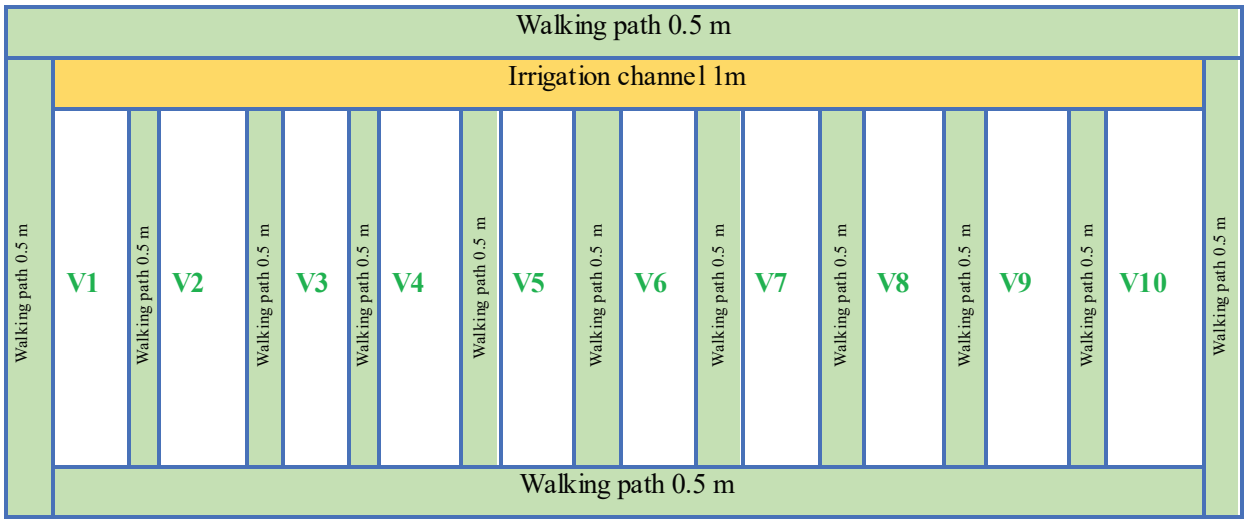

Table 2: Experimental details of Rice Varietal Cafeteria

Sr. No	Experimental details	Protocol
1	Experiment design	Non-replicated strips of different varieties
3	Number of varieties	10
4	Spacing (cm) plant to plant (P-P) and row to row (R-R)	20 x 15 cm
5	Plot size per variety (m^2)	10 x 20 = 200 m^2
6	Total area per cafeteria	200 x 10 = 2000 m^2

Prior to transplanting, the seedling root dip treatment was done by using the bio-control agent Trichoderma viride. The seedlings are transplanted in line at the spacing of 20 x 15 cm. During different stages of the paddy best management practices of nutrient management, water management, IPM, weed management and post harvest management will be followed.

Rice Varietal Cafeteria at Nazira Block

Ankita Sahu
Junior Researcher, IRRI
Moromi Buragohain
ADO, Sivasagar

A Rice Varietal Cafeteria under Assam Agribusiness and Rural Transformation Project (APART) was organized by District Agriculture Office, Sivasagar & FIAC ATMA, Nazira under the guidance of International Rice Research Institute (IRRI). transplanting program was inaugurated by Sabyasachi Kashyap, SDO (Civil), Nazira Sub-division.

Rice Varietal Cafeteria is an exhibition of targeted (traditional, prevalent or newly introduced) varieties at a single location to enable the Stakeholders, Farmers, Millers, Dealers, etc. to evaluate/select a suitable rice variety of their preference. The whole program was implemented with the technical guidance of IRRI. Rice varietal cafeteria was carried out in one of the farmers' field named Mukunda Chetia. A total of 10 varieties comprising of 3 Stress Tolerant Rice Varieties (STRVs) namely, Swarna-Sub1, Bahadur-Sub1 & Ranjit-Sub1, 2 Premium Quality varieties (PQR) namely Kon Joha & Keteki Joha, 2 Glutinous Rice Varieties namely Aghoni Bora & Malbhog Bora and 3 local Varieties namely Mahsuri, Ranjit & Moniram was transplanted in 2000 m2 plot. Each variety was transplanted in 200 m2 plot maintaining a spacing of 20*15cm. All the rice varieties were

Transplanting of different varieties at Rice Varietal Cafeteria

raised and transplanted in such a manner that all the varieties will have synchronous flowering and will mature at the same time.

Ranjit-Sub 1: A Popular Variety in Hajo Block

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Junior Researcher, IRRI

Mr Anil Medhi
BTM, Hajo Block, Kamrup(R)

Large scale demonstrations on stress-tolerant rice varieties viz, Ranjit-Sub1, Bahadur-Sub1, Swarna-Sub1 and BINA Dhan 11 were conducted in the farmer's fields of Kamrup (R) district under APART, since the initiation of the APART in 2018. The variety Ranjit-Sub1 has gained popularity among the farmers of the Hajo developmental block of the district.

During Sali season 2020, around 21.75 ha area of61 farmers in Hajo block was taken for demonstration of the Ranjit-Sub1variety.Most of the farmers were highly satisfied with the performance of this variety, especially because of its submergence tolerance character and higher yield, as compared to the traditional varieties that they were growing over the years. Hajo is a flood-prone area and

frequent flash floods occur every year during the Sali season, damaging most of the paddy cultivated areas. After the recession of the floodwater, farmers of the area had to either sow new nurseries or have to buy paddy seedlings from others. These factors delay their crop season and ultimately the farmers have to face severe yield penalties, besides buying seedlings and re-transplanting the same field increases their total cost of cultivation.

Ranjit-Sub 1 nursery of
Mr Ratneswar Medhi

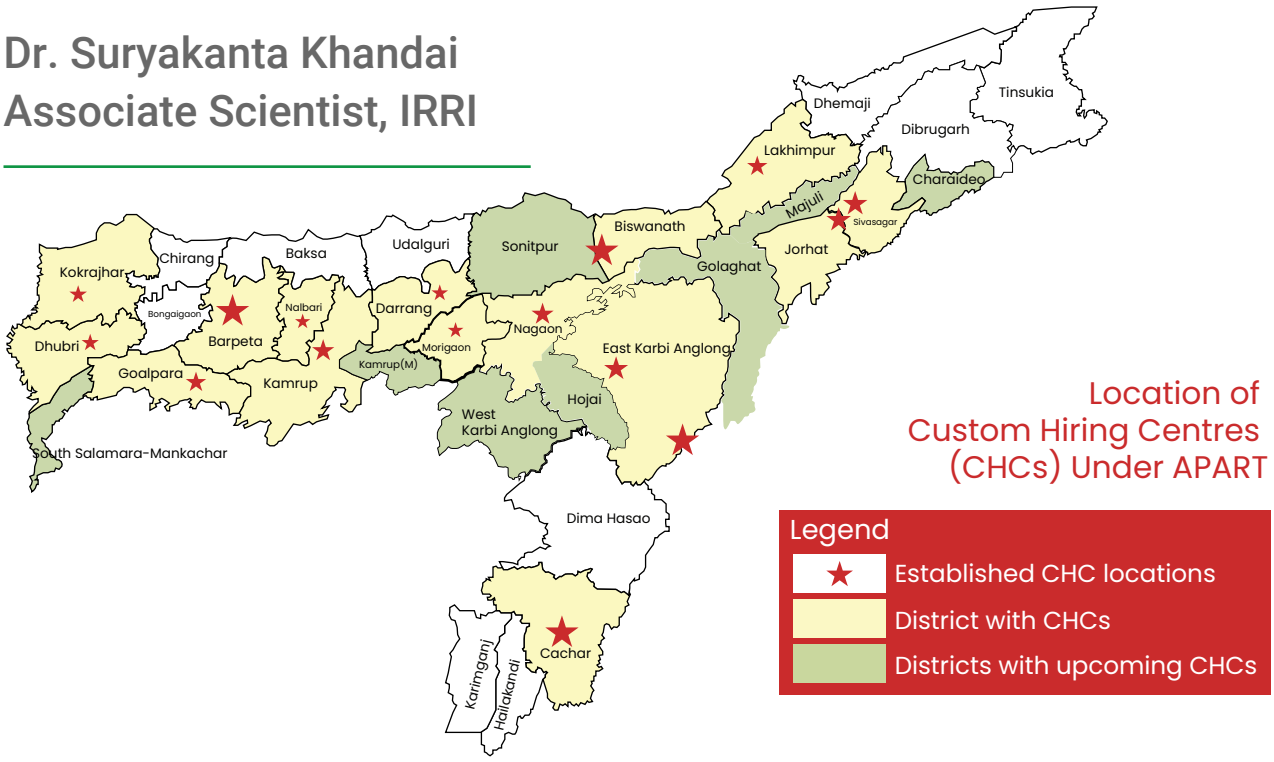
Mr Ratneswar Medhi of Sokamtoli village is one of the farmers whose paddy crop used to be damaged by floods every year. In 2020, he was provided with the seed of Ranjit-Sub1 variety under IRRI supported ICMD demonstration for 2 bighas from DAO Kamrup. Under the guidance of ATM and BTM of Hajo block, Mr. Medhi followed the best management practices (BMP) recommended by IRRI and AAU. During the rainy season, his paddy field was submerged by floodwater after transplanting but the crop survived and in return gave him a good yield. He was happy with the yield as it was much better than the previously grown rice varieties. Being satisfied with the variety, he adopted the Ranjit-Sub1 and increased his field area to 5 bighas, using his own saved seeds during the Sali season 2021. Some of the happy adopters of Ranjit-Sub1 are Kumud Rajbongshi, Jogesh Majumder, Bhabesh Baishya and Krishna Rajbongshi of Hahdia village, Babul Deka of Majorkuri village and Bhaba Medhi of Sokamtoli village. All these farmers have converted their paddy cultivated area from non-stress tolerant rice variety to STRV and adopted Ranjit-Sub1 as one of the most preferred cultivated varieties.

Seeds of Ranjit-Sub 1 variety been distributed among the farmers

The success of any technology lies in its impact and acceptance by the targeted community and how much it has reached people horizontally. An exceptional example of dissemination of STRV has been shown by the beneficiary farmers of Sali 2020 of Hajo block. They had observed that the variety is being cultivated by their fellow farmers. Their decision to adopt the new variety came on seeing the performance of Ranjit-Sub1, for its submergence tolerance which was a relief to the flood-affected farmers of the block. As it is rightly said -"seeing is believing". APART beneficiary farmers distributed around 11qtl seeds from their farm-saved seeds of Ranjit-Sub1 to their fellow farmers during Sali season 2021. Bhagawan Baishya of Sorabori village also distributed 2.5 qtl seeds of Ranjit-Sub1 from his farm-saved seed to about 20 farmers. Ananta Kalita of Kalitakuchi village, Mantu Kalita of Kalitakuchi village, Dharani Das of Sorabori village, Sailen Nath and Jadav Das of Sarulah village and Gautam Kalita of Halogaon village are few others who contributed towards the horizontal expansion of one of the most preferred STRV introduced in Assam under APART.

Concept Of Custom Hiring Centres is Catching Up in Assam

Dr. Suryakanta Khandai
Associate Scientist, IRRI



Indian agriculture is undergoing a gradual shift from dependence on human and animal power to mechanical power because of the increasing cost of operation and growing scarcity of human labour. Further, the use of mechanical power has not only impacted the productivity of crops but also reduced the drudgery, besides facilitating the timeliness of agricultural operations.

However, it is observed the farm power distribution is quite uneven across the states in India, wherein the highest use of mechanical power is in the order of 3.5 kW/ha in Punjab and less than 1kW/ha in states like Assam, Bihar, Orissa, Jharkhand, etc. Mechanical power is largely consumed in big landholdings and is still beyond the reach of small and marginal holdings. The small/marginal farmers are unable to own farm machinery on their own or through institutional credit due to their economic condition. Therefore, to bring farm machinery within the reach of small/marginal holdings, collective ownership or Custom Hiring Centres (CHCs) is being promoted in a big way through APART

Assam Agricultural University (AAU) in collaboration with the International Rice Research Institute (IRRI) has introduced the concept of 'Custom Hiring Centres (CHCs)' to popularise and achieve the objective of farm mechanisation and proposed to set up the centres in selected 16 districts under World Bank-financed APART.CHCs are the units comprising a set of farm machinery, implements and equipments meant for custom hiring by the farmers.

Though certain implements and equipments are crop-specific, the traction units like tractors, power tillers, etc., and self-propelled types of machinery like irrigation pumps, etc., are used in common. Therefore, an ideal model envisaged in this project comprises of farm machinery that is commonly used for crop establishment, post-harvest and rice value chain for paddy.

In the first year of the project, KVK Nalbari and KVK Morigaon established two CHCs at their respective districts with the inclusion of 10 different machines like seed-cum-fertiliser drill, drumseeder, transplanter, power weeder-cum-harvester, sprayer, reaper, axial flow thresher, portable rice mill and dry grinding machine.

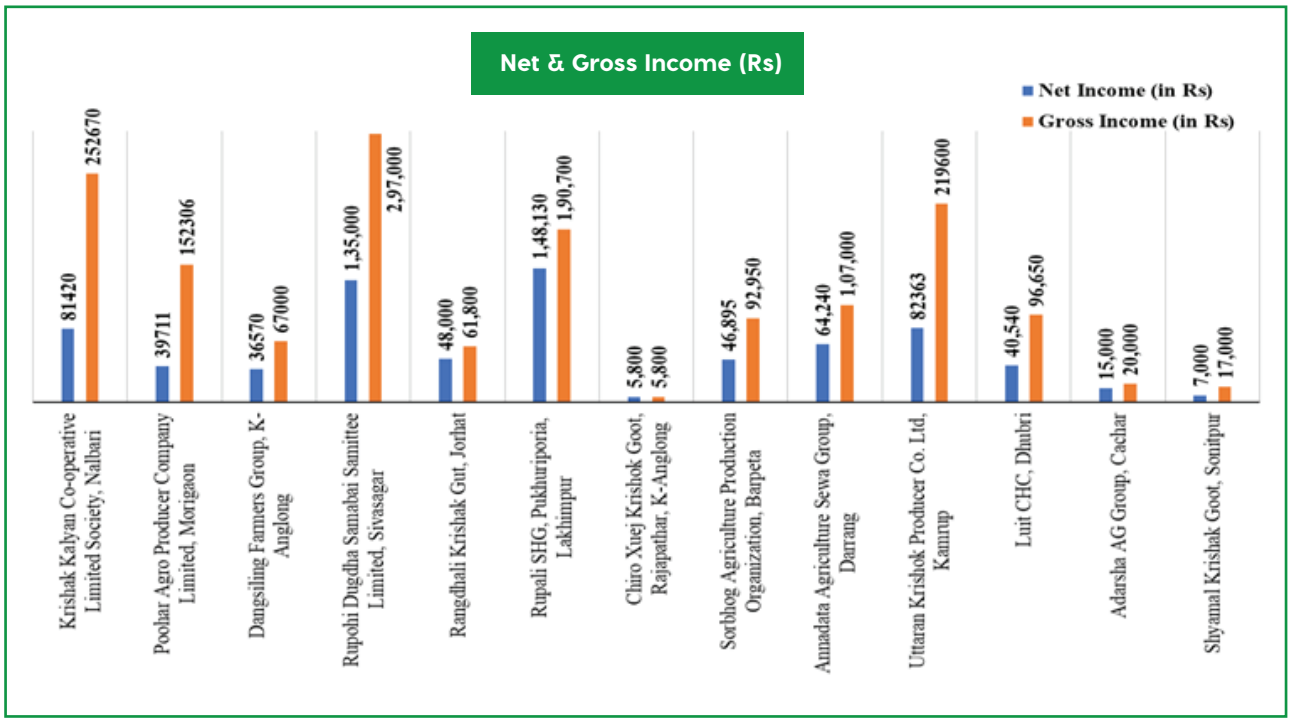
Further, 14 more CHCs were established in the other 13 districts. Currently, 16 CHCs are available in 15 districts (2 CHCs in the Karbi-Anglong district). The locations of CHCs are mentioned on the map. Further, these CHCs are linked with Farmer Producer Companies (FPCs) for additional benefits in terms of Common Service Centre (CSCs) to establish rice mill, seed processing units, etc.

Custom Hiring Centres (CHCs) comprises of a set of farm machineries made available for the small and marginal farmers, to use throughout the year. The new CHCs have fixed the rental rates for different services, which are comparatively lesser than the existing service provider. The execution method of CHC is as follows:

- Hands-on training on the operation of machines
- Business opportunity training and fixing the service fee
- Organize awareness program
- Project supported the repair and maintenance of machines
- APART catalysing the linkages of manufacturers with local dealers of Assam

Month	*Round-the-year service provision opportunities*
January	Field preparation, mat-type nursey
Feb-Mar	Mechanical transplanting
April	Mechanized weeding, fertilization and spraying
May	Field preparation, mechanized DSR, harvesting, threshing
June	Mechanical transplanting, Wet DSR, harvesting, threshing
July	Mechanical transplanting
August	Mechanized weeding, fertilization and spraying
Sep-Oct	Rice milling
Nov-Dec	Harvesting, threshing

Most of the CHCs have started earning and also purchased additional machineries out of their profit. Krishak Kalyan Co-operative Society Ltd., Nalbari has purchased a tractor for their CHC. CHC Darrang has procured reaper and is also in the process of establishing a modern rice mill. The net and gross incomes of different CHC are mentioned here.



Mechanical transplanting of rice (MTR)

Vivek Kumar
Specialist, IRRI

Vipin Kumar
Specialist, IRRI

Rice is a major staple food in Assam which is cultivated in 2.4 million ha of land during three seasons, of which Sali (winter) season shares 1.8 million ha, whereas Boro (summer) and Ahu (Autumn) collectively account for 0.6 millionha. However, the productivity of the state is relatively low and unstable because of prevalent biotic and a biotic stresses attributed mainly to unpredictable and uneven distribution of rainfall, poor access to appropriate cultivars, non-availability of quality seed, lack of knowledge and information, besides the traditional method of cultivation and poor agronomy including late sowing/planting of inappropriately aged seedlings.

Transplanting of rice in Assam is usually done manually through hired labourers which is more expensive and involves a lot of drudgeries. Transplanting of uprooted seedlings by labourers in curved body posture is the most arduous operation in rice cultivation. Manual uprooting of seedlings leads to root damage which ultimately forces farmers to go for higher seed rates. During transplanting, a person puts more number (5-7) of seedlings into a hill in the puddled soil at an inappropriate depth and spacing while moving backwards in bending posture with feet bogged into puddled soil. Besides, this exercise is highly monotonous and labour-intensive. Non-uniform planting of seedlings results

Mechanical transplanting of rice

in poor plant density which leads to lower yield. Moreover, due to the scarcity of labour during the peak season, transplanting is usually delayed, causing a decrease in rice yield. Random placement of seedlings in manual transplanting also forbids mechanical weeding. So, farmers increasingly seek alternate options for rice establishment that overcome labour bottlenecks, besides reduced costs involved in the establishment.

Looking at these issues, several mechanized options for alternate establishment methods have been introduced under APART through Assam Agricultural University (AAU) in collaboration with IRRI, as a technical partner, to improve the productivity and profitability of farmers in Assam. Mechanical transplanting of rice (MTR) using a mat-type nursery is one of them.

Mechanical /machine transplanting of rice (MTR) is the method of transplanting young rice seedlings (specifically grown in a raised mat-type nursery) using self-propelled rice transplanter. Mechanical transplanter saves seed cost by reducing losses suffered while uprooting seedlings under manual transplanting, reduces labour cost for transplanting and increases rice yield by 5-6 q/ha over the normal transplanted rice. The traditional manual transplanting process requires 25-30 persons/ha for transplanting, and another 5-6 labours for the uprooting of seedlings, which is roughly about 25% of the total labour requirement during the crop-growing period. However, when a self-propelled rice transplanter is used, three to four persons can transplant up to 1.5-2.0 ha in a day subject to the size/make of the transplanter. Mechanical transplanting is a sustainable solution to create a service economy by involving rural youth and provides an opportunity to develop as an entrepreneur.

Key Benefits of Mechanical Transplanting of Rice (MTR)

- Quick, efficient process with fewer efforts and ensures timely transplanting.
- Decreases workload and stress.
- Addresses labour scarcity issue (saves up to 20 labour per ha)
- Provides an opportunity for transplanting young and medium-aged seedlings to recover fast and tiller vigorously. Effective & better tillering ensures uniform maturity and a healthy crop.
- Uniform spacing between the plants under MTR helps in smooth wind flow, provides equal sunlight for each plant, effective weed control and ensures fewer chances of disease incidence.
- Ensures optimum plant density (28-32 hills/sqm with 2-4 seedlings per hill).
- The low mortality rate from root damage and/or floating seedlings.
- Higher productivity and increased farmer income.
- Lower water requirement at transplanting time.

Assam Agricultural University under APART purchased 16 machines for MTR and placed them at different KVKs, 40 demonstrations on MTR covering 300 bighas were conducted at various farmers' fields in 16 districts of APART during Boro season 2018-19;which gradually increased to 450 bighas in 2019, 1000 bighas in 2020, and 1623 bighas in *Sali* season 2021. After a series of MTR demonstrations in previous years, farmers are convinced with the performance of machine transplanting of rice and showing their interest to adopt this technology. For better sustainability of the technology, IRRI provided several hands-on training on preparation of mat-type nurseries and operation of transplanters during the last 3 years to train extension functionaries and progressive farmers who can act as a master trainers in the state. During 2021-22, as per the mandate of APART, members of FPCs will be trained on the operation, repair and maintenance of transplanter. Apart from this, 10 (ten) Service providers (SPs) on MTR have been formed till date, and a few more machines are likely to be procured in different districts of Assam in the coming days.

Mechanical Transplanting Adoption in Dhubri District

Akhoy Bharadwaj
Junior Researcher, IRRI

Mechanical transplanting has been demonstrated to farmers by Krishi Vigyan Kendra, Dhubri under APART with technical support from IRRI in various parts of Dhubri district during the last 3 years. Over the years, the farmers have shown keen interest in this practice. In the current Sali season (2021) farmers other than beneficiaries ofAPART also have started adopting mechanical transplanting of rice.

Mrs Santana Bramha, a women farmer, of Ghunghunikhata village of Dhubri district laid down a mat-type nursery for transplanting paddy in 0.8 ha land using Stress Tolerant Rice Variety (STRV) Ranjit-Sub1. She and her family members learnt about the mechanical transplanting of rice by attending a training program organized by KVK, Dhubri. She was inspired by other beneficiary farmers of APART and showed interest in using machines for transplantation of rice. She sought technical guidance from IRRI and APART KVK officials and members of the Custom Hiring Centre (CHC) located in an adjacent village. The officials provided her necessary guidance and support, and accordingly, the nursery was transplanted on July 18, 2021, in her field. The growth of the crop is good and Mrs Bramha is expecting a good harvest from the field

Entrepreneurship Development through Mat-type Nursery

Dibyarishi Bhattacharjya
Junior Researcher, IRRI

Location : *JengoniPothar, Juria, organized by LangiaAgro Producer Co Ltd.*
Location : *Sologuri,Dhing organized by Luitporia Farmers Producer Co Ltd.*
Location : *Bengenati,Pakhimoria organized by Shankar Azan Farmers Producer Co Ltd.*
Season : *Sali 2021*
Intervention : *Mat-type nursery and mechanical transplanting of paddy*
Mat-type nursery area: 1500 m2
Target area : 20 hectares

In this Sali 2021 season, an intervention was taken up to increase the area under mechanical transplanting of rice through the Custom Hiring Centre (CHC) established under Shankar Azan FPC. Accordingly, Regional Agricultural Research Station (RARS), Nagaon and Krishi Vigyan Kendra (KVK), Nagaon planned to bring 20 ha paddy area under mechanical transplanting with technical support and supervision of the International Rice Research Institute (IRRI) under APART. The mat-type nurseries of stress-tolerant rice varieties (STRVs) like Ranjit-Sub1 and Bahadur-Sub 1 were prepared by the FPC at one location to transplant the fields of several beneficiary farmers. When the seedlings were ready, IRRI trained operators/service providers helped in the transplanting the paddy seedlings in the farmer's fields using the machines available at the Custom Hiring Centre (CHC). The rate for hiring the transplanter was fixed at Rs 1200/bigha.

The advantage gained by the small and marginal farmers through this intervention is that they did not have to go for raising a nursery. Moreover, the whole process is cost-effective and time efficient.

In the traditional method of manual transplanting labour charges come to around Rs 1500 per bigha, with an additional cost of around Rs 200 per bigha for the uprooting of seedlings. Moreover, the labour availability during the peak time of transplanting is a big constraint. Farmers have to wait for labourers to transplant their fields. The intervention has showcased the successful business model of mechanical transplanting and mat-type nursery that can potentially be run by a CHC. Farmers too have shown keen interest to use the machine for transplanting their fields as it has many advantages. With the increase in the number of transplanters, there will be a rise in the number of farmers adopting the technology which in turn will increase the area of paddy cultivation.

Mat type nursery

Tech-savvy Farmer Finds Success with Mechanical Transplanting of Paddy

Saurajyoti Baishya
Specialist-IRRI

Mr Palakh Dahatiya, a farmer from Dikhowmukh, Bharalua, Sivasagar has been practising traditional methods of cultivating rice, using machines only for ploughing.

In the traditional manual method, the seedlings are planted randomly without following proper spacing, thus making the intercultural operations difficult. In early 2021, the mechanical rice transplanter and mat-type nursery was introduced in Dikhowmukh village, In the mat type nursery, the paddy seedlings get ready in 15-18 days after sowing and can be transplanted using the mechanical transplanter. Mr Palakh showed interest in adopting and using the new technologies.

Hence with the support of APART he has transplanted his field with the mechanical transplanter, which has saved time and cost. Besides, a proper spacing can also be maintained between the transplanted seedlings. This practice has made the intercultural operations easier as compared to the traditionally transplanted seedlings. He has used machines for weeding as proper spacing was maintained in between the rows.

The cost of mechanical transplanting is in between Rs 500/- Rs 600/- for 1 bigha of land, which would have cost approximately Rs 1400/- in traditional method. Thus a saving of Rs 800/- Rs 900/- could be done in one bigha of land, besides savings in time and labour requirement.

The farmer using transplanter

Mr Palakh, has transplanted 5 bighas of land and is optimistic to bring more land area under machine transplanting in near future. Seeing him, the other farmers of the village are also encouraged to adopt this new technology. They are also willing to go for fully mechanised farming, where machines will be utilised for transplanting, intercultural operations, harvesting and threshing and later hermetic storage.

This intervention has proved to be a more systematic, scientific and farmer-friendly approach to revolutionize agriculture.

Assessing The Impact of The Technologies

Dr Lisa Mariam Varkey
Specialist, IRRI

Impact evaluations (IE) are empirical studies that quantify the causal effects of interventions on outcomes of interest. Sequential studies with such an aim were planned to measure the various outcomes and impacts on the rice-based cropping systems and the associated farming community owing to the IRRI supported project interventions of Assam Agricultural University under APART. This was imperative to learn if the beneficiaries are indeed benefitting from the program and to employ that knowledge to learn what works and what does not work, for improvement in developmental processes, and ultimately outcomes. Owing to COVID restrictions, the first survey, which focussed on seed systems and varieties, was conducted in a much-restricted telephonic mode during August-November 2020. The gist of findings from this survey is being elaborated below. It indicated sustainable uptake of Stress Tolerant Rice Varieties (STRVs) amongst a good proportion of beneficiaries with almost 48 % of them choosing to carry it forward to the next season(s). Additionally, it was learnt that the adopters chose to increase their area with around 68% of the area carried forward. Cluster demonstration and integrated crop management demonstrations/learning centre demonstrations (ICMD/LCDs), characterised by greater visibility due to larger area and presence of additional technologies such crop management demonstrations/learning centre demonstrations (ICMD/LCDs), characterised by greater visibility due to larger area and presence of additional

Impact survey in field

technologies such as Integrated Pest Management/Best Management Practice (IPM/ BMP) were found to have significantly influenced the adoption of STRVs. The participants of dealer demonstrations also displayed improved adoption which we believe resulted from social networking between dealers and farmers.It was also learnt that the adopters of STRVs had a great reduction in crop losses under incident stress (flood/pest & disease occurrence) conditions. With newer STRVs replacing older traditional varieties (most of which were more than 3 decades old), better seed replacement rate (38.5 %), variety replacement rate (2.9 years) and lower varietal age (19 years) placed.

APART beneficiaries are at a higher pedestal concerning productivity of crop and income. It also found evidence of rising crop (gross) income with the ordinal rise in operational land holdings, however, we are yet to learn about the cost advantages obtained (owing to data limitation in the survey).

The second survey, which is an extensive door-to-door survey, focussing on BMPs, various machineries and rice-based cropping systems, has been initiated. Extensive modules capturing knowledge gain, adoption, satisfaction with usage and access to technology and primary spill-overs in the project areas have been included. Measuring market participation has also been an extensive thrust in the current survey. This survey also employs a standardized module to capture women empowerment in agriculture (WEAI) To learn empowerment gained by our female beneficiaries under project activities. With detailed data available from this survey, it is expected that a much detailed analysis of broader impacts and outcomes of project activities including cost-savings and productivity/income gains will be made available in the coming months.

Promotion of sustainable and Viable integrated pest Management (IPM) Interventions in rice-based Cropping systems

Dr M. Sunil Kumar
Specialist, IRRI

Need for the introduction of IPM technologies in Assam

Rice is the most important crop in Assam, grown inabout 70% of the total cultivated land in the state. The insect pests distributed in different districts of Assam include swarming caterpillar, caseworm, gundhi bug, stem borer, leaf folder, hispa, thrips,etc. The rice pests are more abundant during Sali and Ahu seasons than in the Boro season. Stem borer and leaf folder are some major pests at both vegetative and reproductive stages in almost all the districts. Swarming caterpillars and caseworms are localized pests and occur more in the Sali season. Many diseases infest rice plants in Assam, but the most important ones are sheath blight, bacterial blight and blast in Sali; blast and sheath rot in Ahu; and sheath rot and sheath blight in the Boro season. The incidence of false smut was also observed during the grain filling stage in all the seasons. Most of the rice farmers are not aware of the new tools & technologies in pest management and thus necessitate the introduction of Integrated Pest Management (IPM) technologies in Assam for rice farming.

Seed treatment by a women farmer

Demonstrations of IPM technologies in rice

Integrated Pest Management (IPM) interventions were demonstrated under APART in different agro-ecological zones of Assam.The IPM interventions are superimposed on on-farm adaptive demonstrations (OFAD) and cluster demonstrations since 2018-19 and after 2019-20 the OFAD was dropped and IPM superimposition was started on dealer demonstrations. The user-friendly and cost-effective IPM technologies promoted in rice include seed and seedling treatment with bio-agents/systemic chemicals; monitoring and mass capturing adults of major rice insect-pests (stem borer and leaf folder). Similarly, the egg stage of the stem borer and leaf folder was destroyed by deploying tricho cards (egg parasitoids of *Trichogramma japanicum and T. chilonis*). Also, the Indigenous Technical Knowledge (ITKs) of erecting 'T' shaped bird perches, hanging dead frog/poultry to evade gundhi bug during the grain filling stage were promoted in APART.

Since the project inception, IPM interventions were demonstrated in 4854 ha with 8294 beneficiaries. A total number of 22479 and 3835 pheromones traps and trichocards, respectively, were demonstrated. Farmers were sensitized about the IPM interventions through quality seed production training. A total of 130 trainings' were conducted sincethe project inception till date. About 3533 farmers were trained on different pest management interventions across different agro-climatic zones of Assam.

Seedling root dip treatment

Impact of IPM technologies in reducing the pest load improving productivity and mitigating the effect of climate change

Stem borer and leaf folder are endemic in Assam and incur huge losses. The farmers used to adopt improper chemical methods due to poor knowledge of pesticide usage. Pheromone traps and trichocards promoted in APART offer sustainable and safe solutions to stem borer and leaf folder problems. The farmers witnessed these technologies in reducing the pest load and are more interested to adopt these technologies in successive seasons/years. Similarly, swarming caterpillars is more problematic during the early stages of crop growth. In most cases, the farmers are helpless in managing the larvae and experience huge yield losses. A simple and cost-effective technology (erecting 'T' shaped bird perches) is promoted in managing a swarming caterpillar. To evade the gundhi bug population during the grain filling stage, dead frog/poultry was kept hanging in the corner of the field. To promote seedling growth and protect against soil-borne diseases, seed and seedling root dip treatment were promoted with bio-pesticide formulation (*Trichoderma* Sp.) and systemic insecticide/fungicide.

The IPM technologies promoted in rice lead to effective and cost-efficient management of endemic pests, thereby reducing crop losses and increasing farmer's income. The IPM demonstrations recorded an average yield of 5.13 t/ha with an overall advantage of 0.66 t/ha compared to farmer's practice of managing pests.

Increasing the Productivity of Premium Quality Rice

Dr.Rahul Priyadarshi
Specialist, IRRI

Assam is endowed with exceptionally rich biodiversity, and the socio-cultural life of Assamese people is linked to rice cultivation, in many ways. The main festival of Assam "Bihu" is linked to activities of rice cultivation. Due to variation in agro-climatic conditions and diversity of food habits within the consumers of the state, various premium quality rice (PQR) varieties are grown as an integral part of rice culture. Most popular, out of them, are "Joha " "Bora", "Chokuwa" and "Bao Rice". Most of the PQR varieties are traditionally grown, generally for home consumption.

There is a continuous demand from the rice lovers of Assam to technically support this premium quality rice to grab the emerging business opportunities as well as to keep the original quality of this rice intact. Assam Agricultural University (AAU) and the Department of Agriculture (DoA)with the technical support of the International Rice Research Institute (IRRI) under the Assam Agribusiness and Rural Transformation Project (APART) has initiated some interventions to increase the productivity of premium quality rice. From the starting of the project, a novel endeavour is being carried out through demonstrations of PQR varieties by integrating quality seed with best management practices.

In this Sali season, a total of 8610 kg seed of PQR varieties was distributed to the farmers for demonstrations, under APART.AAU and DoA-ATMA have

Premium Quality Rice Varieties

distributed 2710 and 5900 kg seed, respectively. In addition to this, 60 kg of Manipuri black rice &52 kg Odisha black rice varieties' seed were also introduced and provided to some selected farmers of Goalpara district for demonstration. These demonstrations are aimed to link the farmers with the possible buyers for higher returns and to make available of good quality seed for future use. Emphasis is also laid out on the capacity building of farmers on best management practices of rice to improve their productivity. At the same time, a few PQR varieties are also included in the rice variety cafeteria so that different stakeholders can evaluate the individual variety.

Geospatial Technologies for Efficient Targeting of Rice-fallow Areas and Stress-prone Areas of Assam

Suranjana B. Borah
Senior Specialist - IRRI

In order to achieve the primary goal of increasing the cropping intensity and improving the yield of prevailing low productivity rice-based cropping systems in Assam, geospatial technologies play an important role. Detailed characterization of present cropping patterns and resource profiles including biotic and abiotic stresses is required to understand the potential opportunities and constraints in the cropping systems. Geospatial technology including Remote Sensing (RS), which has the advantage of synoptic and repetitive spatial coverage through satellites/aerial platforms and Geographical Information System (GIS), can integrate this technology to create maps, statistics and spatial databases. This is an appropriate tool for making decisions regarding target areas to bring a significant increase in the agricultural outputs in low productivity areas to enhance system productivity.

For the characterization of existing cropping systems of Assam, geospatial technologies have been used to create cropping intensity maps using time-series optical satellite data. Rice area maps have also been prepared using Synthetic Aperture Radar (SAR) images from the satellites, which have the advantage of cloud penetration during Kharif season. Rice-fallow maps are generated based

on these maps so that the areas can be targeted for increasing cropping intensity and substantially improve the food supply, and enhance livelihoods in the state of Assam.

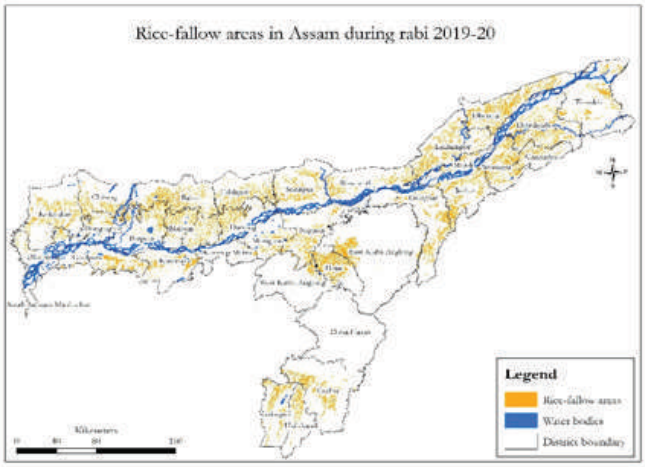
To efficiently target these potential fallows, a detailed characterization of the resources profile is needed. Since Assam is one of the most flood-prone states, a detailed characterization of the flood-inundated area is required for identifying the suitable area to target submergence-tolerant rice cultivars so that loss in rice production due to flood submergence can be minimized. Remote sensing technology using SAR data with cloud-penetration capabilities has also been used to map flood inundation areas across Assam. In addition, the duration and frequency of submergence in the frequent flood-prone areas were extracted.

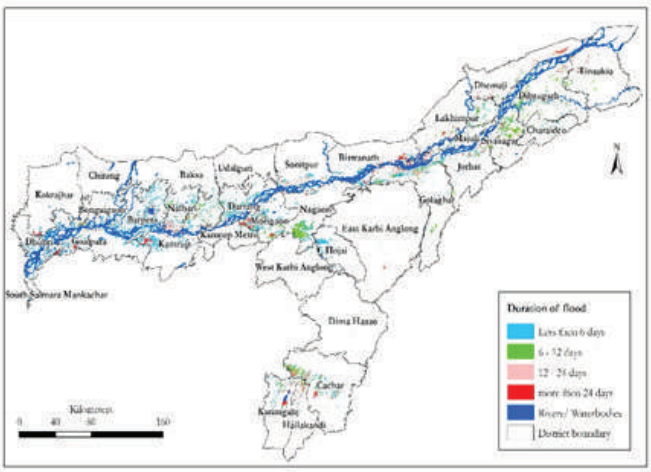
Targeting water-efficient, nutrient enriching crops in rice-fallow areas not only helps intensify the cropping system and enhance crop diversification but also contributes to soil fertility. To achieve this objective, soil moisture maps for rice-fallow areas were prepared using satellite data to precisely target and utilize the short residual soil moisture window.

Based on the availability of soil moisture in rice-fallow areas, a total area of 100 ha each year was selected in few districts for pulses demonstrations during Rabi 2018-19 and 2019-20, and maize demonstrations during 2020-21. The primary objective was to increase the cropping intensity in areas, where farmers are cultivating single crop during the Kharif season.

Field testing demonstrations at few representative sites of specific rice environments were selected during Rabi 2020-21 to test four innovative rice-based cropping systems after harvesting the stress-tolerant rice cultivars. Four cropping systems were tested by including green pea, mustard, potato and lentil after Sali season rice. These crops will help in increasing the net income of the farmers, and in the long run, one of the cropping systems that have the highest return and system productivity can be adopted by the farmers.

Line sowing of a black gram at Nagaon in Feb 2020 and zero-tillage sowing of mustard at Lakhimpur district in Nov 2020





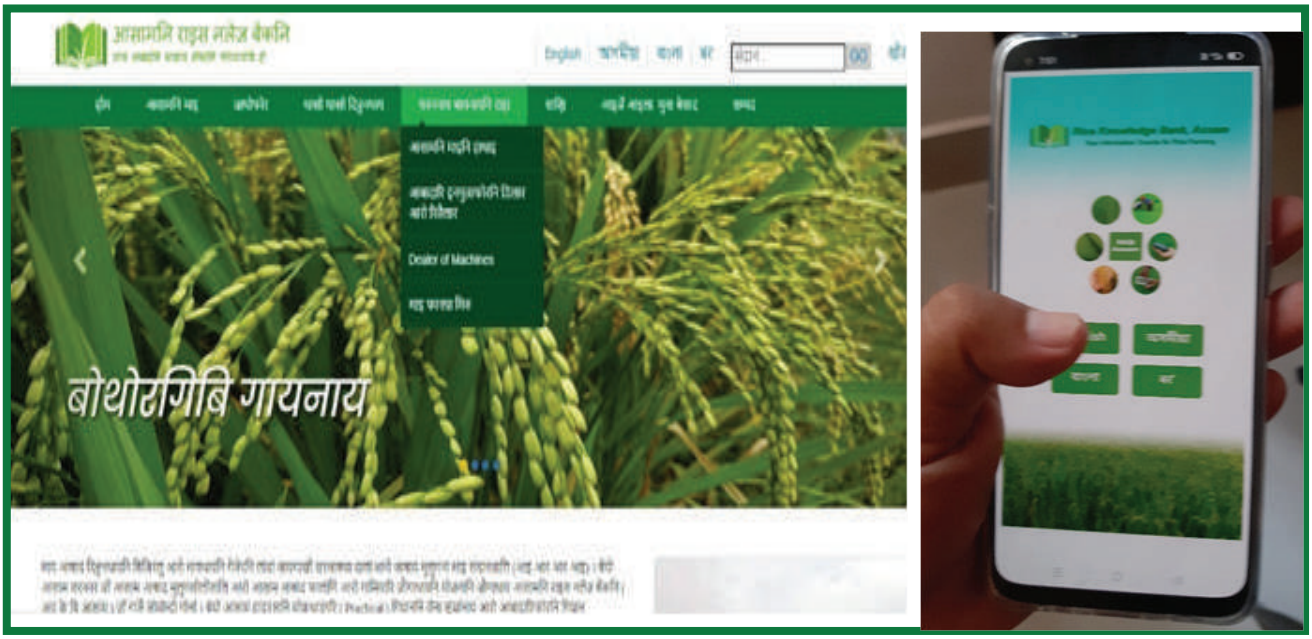
One-Click To Know All About Rice: RKB

Jyoti Bikash Nath
Specialist-IRRI

The agriculture extension system plays a crucial role to disseminate the information and the technologies from the research lab to the field. It makes the technology bridge between farmers and researchers. The traditional method for communication with farmers is through a farm and home visit by extension professionals, which has many limitations as witnessed during COVID-19 pandemic days. Apart from the communication methods including the use of mass mediums like TV, radio and newspaper, the internet-assisted digital agriculture or e-agriculture is nowadays a trusted, simple, and easily accessible method. With the present experience of pandemic, people across the world will be on the same page that anything can happen on the earth, and we may have to forgo anything for the sake of saving human civilization, but we have to go with agriculture by all means; agriculture can't be stopped as it feeds the world -meets the basic need of human life. Hence, to successfully transfer the technologies to the farmer's field crossing all the barriers, a multilingual website, Rice Knowledge Bank, Assam (www.rkbassam.in) on A to Z of rice production technology and value chain has been launched under Assam Agribusiness and Rural Transformation Project by Assam Agricultural University with the technical support from International Rice Research Institute and collaboration with Department of Agriculture. It is one of the most trusted and unique websites for gathering knowledge on rice production technology and the value chain. The mobile app of RKB can be downloaded on any Android phone from the Play Store.

As the name suggests it is a knowledge repository containing the information on step-by-step production of rice, market information, best management practices, block-wise contact details of extension functionaries, zone-wise crop suitability maps and downloadable factsheets, brochures, videos, etc. It is working as a single-window of information for paddy farmers of Assam. It is already launched in two languages viz., English and Assamese and very soon it will also be available in Bodo and Bengali with localized and customised content.

Assam agriculture is full of challenges like biotic and a biotic stresses, unavailability of cost-effective inputs, and non-realization of the proper price of their produce, etc. To increase productivity and profitability by overcoming these challenges what is mostly needed, is the dissemination of technology and its proper adoption in the field. Getting proper information at the proper time can help farmers to escape most of the challenges.



The start can be small, but e-agriculture is necessary to be implemented. It is noteworthy to mention that in 2020, India had nearly 700 million internet users across the country. The number of internet users in India increased by 128 million (+ 23 %) between 2019-20. It is forecasted that 55 per cent of the rural population of India will have access to the internet by 2025. (Source: https://datareportal.com/reports/digital-2020-india). If the farmers receive at least 1 % of the benefits of any technology, they are more than willing to try it out, for sure. No doubt, the basic requirement to "go digital" is that Assam farmers must decide to use a smartphone for grasping agricultural knowledge. Nevertheless, e-agriculture is not just about smartphones, the internet and bringing the population on social media, it is also about educating the farmers and extension agents to leverage it. Hence, a massive awareness campaign is being planned for RKB under APART and steps have been taken to boost Assam farmers' capacity to handle IT-enabled agriculture. Let's hope, in the coming days, Assam farmers and extension functionaries will come forward with more demand of information in RKB to build their capacity.

Women Farmers : The Proactive Adopters

Jyoti Bikash Nath
Specialist IRRI

Women are now at the forefront of training programs with a notebook and pen to write down the fertilizer dose to be applied in the rice field, name of herbicides to be applied, harvesting time, and contact number of Paddy Procurement Centre (PPC) to sell their paddy grain. These days, it is obvious to experience participation of women farmers in training programmes. They confidently ask questions on the different varieties. This curiosity and enthusiasm of women to understand the farming process will be the force behind the transformation of agriculture in Assam.

In Assam, women's role in paddy farming has been traditionally limited to transplanting, weeding, and harvesting. The involvement of women in using farming machines and technologies is significantly limited. But of late, with the initiatives of APART, IRRI and AAU in the Rice value chain, things have started changing, as women are encouraged to join the training programmes, demonstrations and other capacity building activities. Women are now playing a major role in decision making for the selection of inputs, purchasing, and also fund management. Women are gradually breaking their social and cultural confines.

Women sharing their experience and knowledge on farming

Gender friendly farm machineries

The traditional concept "women are not farmers" has started changing to "women are better adopters". Now women farmers proudly come forward to host demonstrations. The farm machineries promoted under APART are gender friendly and of late; it is observed that some women groups have come forward and purchased these farm machineries.

Since women are the main contributors of labour input in rice production, they well understand that use of technology and machines will reduce their drudgery to a maximum level. During the last Boro season, 25,984 women were trained in different activities of Rice value chain, and in this Sali season 2021, 257 women have already been trained, with many of them engaged in different demonstrations.

In the rice value chain, the role of women is now clearly becoming visible. Involvement in preparation of mat-nursery, transplanting by machines, harvesting by crop harvester are some of the areas where women are contributing to the rice value chain. Overall, the importance of women in agricultural operations is realised at every front and the efforts are made under APART to improve their skills with their involvement in capacity building activities and creating them as master trainers. Since its inception, till date, women participation is about 30% in rice value chain activities.

KRISHI RUPANTAR

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