অসম চৰকাৰ

सत्यमेव जयते

GOVERNMENT OF ASSAM

Climate Resilient Technologies and Rice Value Chain

IRRI Supported Activities

ARIAS Society

GOVERNMENT OF ASSAM

Assam Rural Infrastructure and Agricultural Services Society

ASSAM AGRICULTURAL UNIVERSITY

विज्ञान नाकुसंवारतमं

IRRI

This product has been developed under the Assam Agribusiness and Rural Transformation Project (APART), funded by the World Bank through the Assam Rural Infrastructure & Agricultural Services (ARIAS) society

Assam Agribusiness and Rural Transformation Project (APART) is the third generation Project in series in the area of Agriculture and Agribusiness to be managed by ARIAS Society. The major focus of APART is promoting climate resilient production and processing of prioritized agriculture and allied commodities, investment promotion, agri-entrepreneurship development, efficient marketing including market-intelligence and credit linkage etc. The project has been adopting a value chain and cluster approach. The Project Development Objective (PDO) of APART is to "add value and improve resilience of selected agriculture value chains, focusing on smallholder farmers and agro-entrepreneurs in targeted districts of Assam".

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Acknowledgements: Lisa. M. Varkey, Kasturi Goswami, Mridupaban Mudoi, Pankaj Barman, Dibyarishi Bhattacharya, Ankita Sahu, Saurajyoti Baishya, Govind Singh, Swati Nayak, Poornima R Shankar, Najam W. Zaidi, Pardeep Kumar Sagwal

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Preface

India, predominantly an agricultural country and agriculture sector involving 58 per cent of the population, contributes 18 per cent to the gross domestic product (GDP). Rice plays a critical role in the food security and economic growth of India, with the largest area (44.5mha) worldwide, and the 2nd highest production after China. In Assam, Agriculture is of subsistence nature, and a principal means of livelihood for more than 70 per cent of the population, and also engaging 53 per cent of the workforce for their survival. About 89 per cent of rice in Assam is grown as rainfed in the basins of Brahmaputra and Barak rivers receiving heavy rainfall. Rice is an important staple food of the state and will continue to remain so, for the years to come.

Assam is having approximately 2.5 million ha under rice in three distinct growing seasons i.e. *Sali* (winter), *Boro* (summer) and *Ahu* (Autumn). However, the productivity of the state is relatively low because of prevalent biotic and abiotic stresses, attributed mainly to the uneven distribution of rainfall, heavy floods in a few months and too little rainfall in another few months, impacting growth at certain stages to get normal yields of the crop. Besides natural calamities, poor access to appropriate cultivars, non-availability of quality seed, lack of knowledge and information and poor agronomy including late sowing/planting of inappropriate aged seedlings, limited availability of irrigation water, poor weed and nutrient management, add on the low productivity affecting the production.

The occurrence of flood and drought is a ubiquitous across Assam, causing severe losses in production, and the farmers are destined to face the apathy year after year. Records show that average annual area affected by flood is 0.93 M ha, of which almost half (0.45M ha) area is chronically flood-prone. The recurrent flash floods occur in different regions, at different crop growth stages, for different duration and variable depth of standing water. In the event of early season flood, deposit of eroded debris may bury the fledging seedlings in the nursery or newly transplanted crop.

The sustainability of rice production with reduced resources including land, water energy, chemicals and a lower environmental footprint is a matter of prime concern. The productivity of Assam in this context could be increased by accelerating the adoption of STRVs, growing healthy nurseries, transplanting appropriately aged healthy seedlings, improved management of soil/weed/water/nutrients and insect-pest, increasing cropping intensity, increased mechanization, reducing harvest- and post-harvest losses and shifting from traditional to mechanized options of crop establishment.

International Rice Research Institute (IRRI), a premier institute in rice science, with its main vision to eradicate poverty and hunger, strives to improve the livelihood of farmers. Using Marker Assisted Back Cross (MABC)technique, IRRI has developed a number of Stress Tolerant Rice Varieties (STRVs) by implanting Sub1 gene in the indigenous mega varieties, in collaboration with NARES partners including Assam Agricultural University (AAU).

Assam Agribusiness & Rural Transformation Project (APART) on "Increasing Productivity and Profitability of Small and Marginal Farmers in Rice-based Cropping Systems "was signed between Assam Rural Infrastructure and Agricultural Services (ARIAS) Society and IRRI on March 16, 2018. IRRI, as one of the major international technology partners in

APART, is providing technical support to the Department of Agriculture (DoA)-Agriculture Technology Management Agency (ATMA) and AAU centers viz., Krishi Vigyan Kendra's (KVKs), Regional Agricultural Research Stations (RARSs) and Horticultural Research Station (HRS) for implementation of APART around following specific objectives:

I. Strengthening seed systems and adoption of high yielding stress-tolerant rice varieties
II. Raising productivity, profitability and resource-use efficiencies of rice-based cropping systems in Assam through improved crop and natural resource management, and scale-appropriate mechanization and a supporting service economy
III. Strengthening postharvest management by introducing improved practices including postharvest mechanization and a supporting service-economy to reduce losses, increase efficiency and profitability and improve rice value-chain
IV. Developing extrapolation domain of cropping systems for efficient targeting of technologies in low-productivity rice-fallows and stress-prone areas.
V. Developing knowledge materials, fostering strategic partnership and capacity development of the various stakeholders (public, private and developmental partners) of extension functionaries in Assam.

This handbook will give basic information on the varieties introduced in Assam, alternative crop establishment methods and rice value chain technologies that are being promoted under APART. We look forward to your comments and suggestions regarding this handbook.

A glimpse of rice-based interventions introduced under APART by IRRI through

Assam Agricultural University

Make sure farmers apply BMP for a better crop

Ensure quality grain through proper post-harvest practices and create access of sufficient number of PH machines

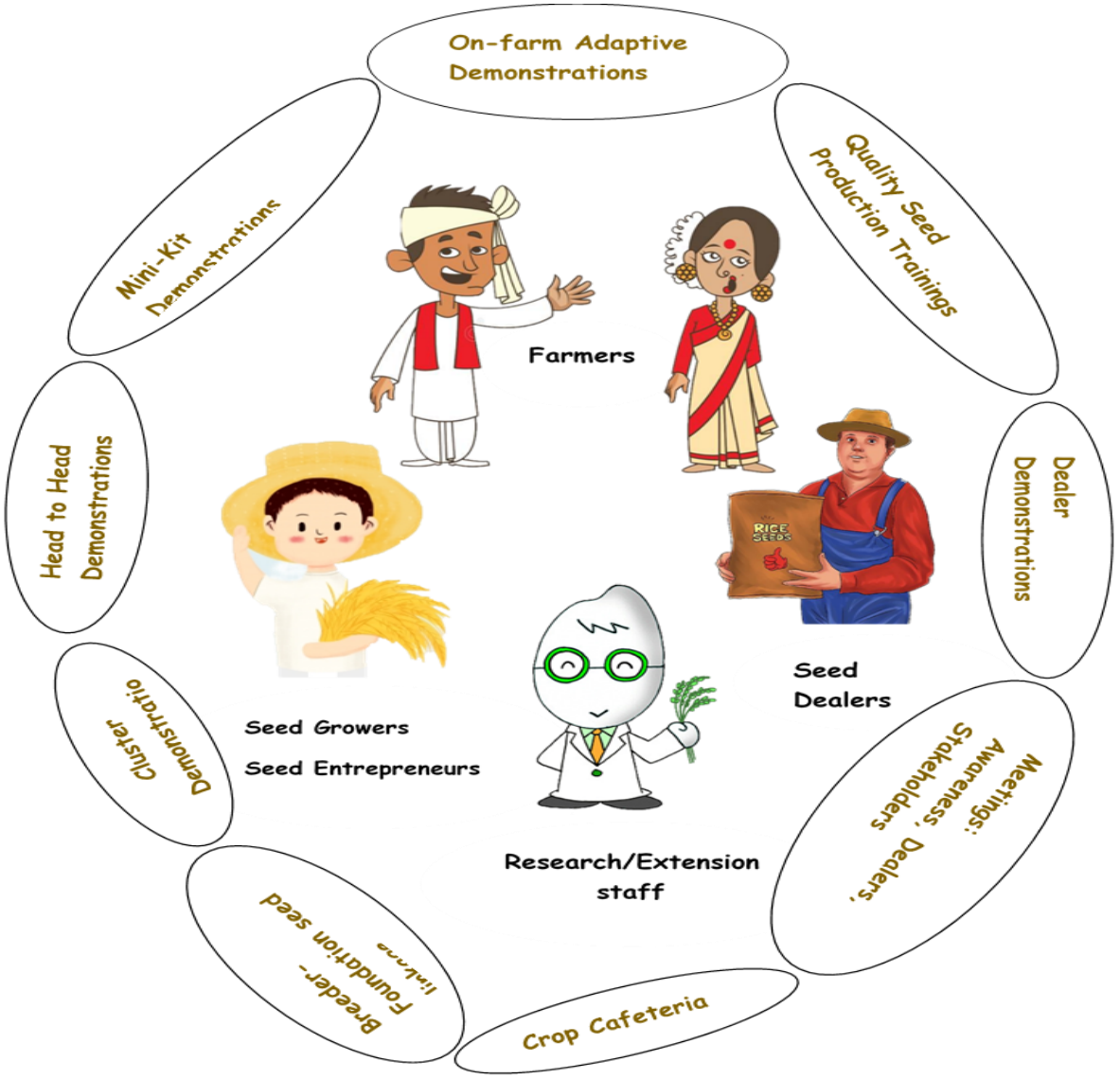
Maintain the quality during drying and storage

Get materials & services in place before season

Ensure quality seed supply and production

Ensure timely procurement @ MSP

Objective I. Strengthening seed systems and adoption of high yielding stress-tolerant rice varieties



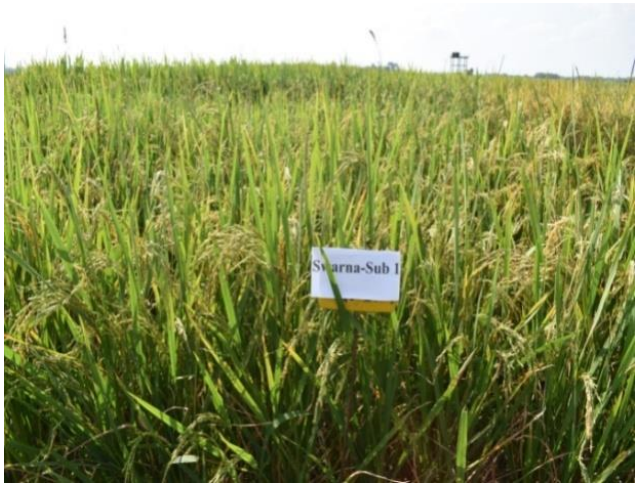
Flood tolerant rice varieties

BINA Dhan 11 (Ciherang-Sub1, IR09F436)

- Parent variety : IRRI149, Ciherang
- Year of notification : 2015 (Assam, Tripura, West Bengal)
- Duration : 115-120 days (*Sali* season)
  Up to 135 days (*Boro* season)
- Suitable land type : Medium or shallow low land
- Grain type : Medium slender
- Plant height : 107-115 cm
- Yield : 5.5-6.0 t/ha
- Submergence tolerance : Up to 2 weeks

Swarna-Sub1

- Parent variety : Swarna*3/IR 49830-7-1-2-2
- Year of notification : 2009
- Duration : 140-145 days (*Sali* season)
- Suitable land type : Lowland
- Grain type : Medium bold
- Plant height : 100 cm
- Yield : 5.5-6.5 t/ha
- Submergence tolerance : Up to 2 weeks



Bahadur-Sub1

- Parent variety : Bahadur/Swarna - Sub1//Bahadur
- Year of notification : 2018
- Duration : 150-155 days (*Sali* season)
- Suitable land type : Lowland
- Grain type : Medium bold
- Plant height : 115 cm
- Yield : 5-5.5 t/ha
- Submergence tolerance : Up to 2 weeks

Ranjit-Sub1

- Parent variety : Ranjit/Swarna-Sub1//Ranjit
- Year of notification : 2018
- Duration : 150-155 days (*Sali* season)
- Suitable land type : Lowland
- Grain type : Medium slender
- Plant height : 115 cm
- Yield : 5.0-5.5 t/ha
- Submergence tolerance : Up to 2 weeks

Drought tolerant rice varieties

DRR Dhan 46 (IET 23420; RP5333-41-2-3-IR83383-B-B)

Salient features: DRR Dhan 46 is a high yielding short duration variety, which can replace other existing low yielding varieties of same duration during *kharif* and *rabi* seasons. It can tolerate drought well and offers yield advantage of 1.0 to 2.0 t/ha over other similar duration rice varieties under drought stress conditions.

- Parent variety : IR72022-46-2-3-3-2/ IR57514-TMI-5-B-1-2
- Year of notification : 2016
- Duration : 115-120 days
- Suitable land type : Upland and drought-prone shallow lowland
- Grain type : Long slender
- Plant height : 100-105 cm
- Yield : 4.5 to 7.0 t/ha

DRR Dhan 44 (IR 93376-B-B-130)

Salient features: DRR Dhan 44 is the latest released drought tolerant rice variety in India & Nepal (Hardinath 3). It has excellent yield potential and good grain quality. It is resistant to blast and moderately resistant to bacterial leaf blight (BLB).

- Parent variety : IR 71700-247-1-1-2/IR 03 L120
- Year of notification : 2016
- Duration : 115-120 days
- Suitable land type : Upland and drought prone shallow lowland
- Grain type : Long slender
- Plant height : 100-105 cm
- Yield : 5-5.5 t/ha

Demonstrations of STRVs

Mini-kit demonstration

To introduce new STRVs to the appropriate stress-prone areas and farmers

Cluster demonstration

To create awareness, sensitization and mass visibility of new STRVs

On-farm adaptive demonstration

To infer and acknowledge the consistency of varieties under local circumstances, actual farming system and local preferences.

Dealers' network demonstration

To engage private sector players like seed dealers, or farmer producer groups /seed sellers in the varietal extension program

Head to head demonstration

To enable farmers in comparing the performance of two varieties; their own variety against the newly introduced STRV

Crop cafeteria

To accelerate the uptake and sustainable adoption of the STRVs at key selected locations

Ranjit-Sub1 – Successfully survives flood at seedling stage; Cluster demonstration under RARS, Kokrajhar

- Flood occurrence: 10 days after transplanting
- Duration of flood: 7 days
- Variety: Ranjit-Sub1
- Village: Bhumka, Kokrajhar

Bahadur-Sub1 – Successfully survives flood at seedling stage; Cluster Demonstration under RARS, Kokrajhar

- Flood occurrence: 10 days after transplanting
- Duration of flood: 7days
- Variety: Bahadur-Sub1
- Village: Hatigarh F.V., Kokrajhar

BINA Dhan 11 – Successfully survives flood in early seedling stage

Direct seeding of rice on July 2, 2019

12-day submergence lasting from July 9-21, 2019

Heavy weed infestation at 33 days after receding of flood water

Fully recovered crop after using IWM (mechanical weeding + spray of 2,4-D 38% EC @ 1500 ml/ha) practices

Objective II. Raising productivity, profitability and resource-use efficiencies of rice-based cropping systems in Assam through improved crop- and natural resource management and scale-appropriate mechanization and a supporting service economy

Objective II: Our Interventions. Our Beneficiaries

Resource efficient crop establishment methods

As labor and energy costs have risen across South Asia, farmers are increasingly seeking mechanized options for rice establishment that overcomes labor bottlenecks while reducing other establishment costs. Alternate methods such as mechanical transplanting, mechanized dry drill-seeded rice (DSR) and wet drum-seeded rice not only overcome problems of labor scarcity and reduce cost but also bring opportunities for early crop establishment

Mechanical transplanting

Mechanical transplanting of rice is the process of transplanting young rice seedlings in reduced puddling, which are grown in a mat nursery, using rice transplanter. The seedlings are raised in a layer of soil mix, arranged on a firm surface and while transplanting seedling are uprooted like a mat.

Advantages

- Timely transplanting of seedlings at the optimal age (14-18 days)
- Ensures uniform spacing, optimum plant density (2-4 seedlings per hill)
- Added productivity (5-6 q/ ha) compared to traditional methods
- Addresses the problem of labor scarcity and
- Better employment opportunities for rural youth by developing custom service center. Engagement of women in nursery enterprise
- Less drudgery for labor

Mainly two types of rice transplanter i.e., riding type & walk-behind type are in practice. Riding-type can usually transplant 6-8 lines, whereas walk-behind transplant 4-6 lines in one pass.

Cost: INR 2,40,000 – 2,85,000 (Walk-behind type) and 2,65,000 – 3,00,000 (Riding type)

Capacity: 6 hrs/ ha **Prime mover**: Self-propelled (Petrol or diesel engine)

Mechanized Direct Seeding of Rice

Mechanized Dry-DSR: By using seed-cum-fertilizer drill

Advantages

- Saves labor, fuel energy and water
- Reduces in methane emission and global warming potential (GWP)
- Ensures seeding at optimum and uniform depth
- Maintains spacing between the rows
- Uniform seed rate throughout the field
- Good soil and seed contact- improved germination
- Provides option for fertilizer placement at the time of sowing
- Conducive for intercultural and plant protection measures

Cost: INR 85,000 (tractor operated) and INR 35,000 (power tiller operated)
Capacity: 2.5 hr/ha for tractor operated and 6 hr/ha for power tiller operated
Prime mover: Tractor (35 hp or more) and power tiller

Wet-DSR: By using drum seeder

Advantages

- Saves labor in comparison to transplanting
- Reduces in methane emission and GWP
- Requires less seed than broadcast
- Suitable to sow the pre-germinated paddy seeds directly in wetland
- Suitable option for late sowing condition in the event of early-season flood in Assam, as crop maturity is advanced by 7-10 days than in transplanting
- Cost: INR 6,000- 10,000
- Capacity: 5 hrs/ ha
- Prime mover: Manual

Fertilizer management

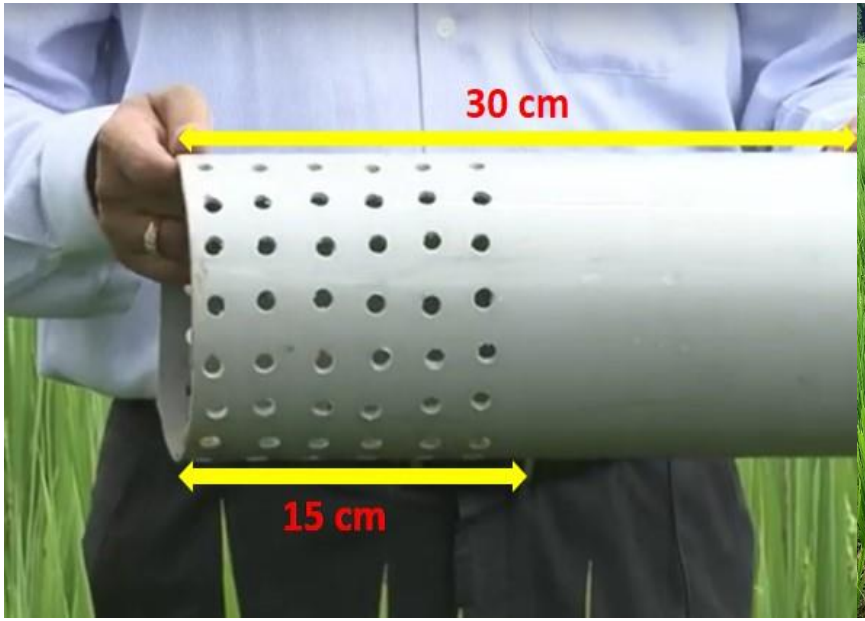
For transplanted rice, fertilizer recommendation per hectare is 60-20-40-5: N-P-K-Zn during *Sali* season & 60-30-30-5: N-P-K-Zn during *Boro* and early *Ahu* season. The nitrogen dose is divided into 3 equal applications - about 1/3rdas basal, 1/3rdat tillering, and 1/3rd at panicle initiation. Under submerged condition, additional 20 kg N and 20kg K_2O is applied 5-7 days after recession of flood to facilitate regeneration, and boost recovery from flood-shock during *Sali* season. The detailed schedule and method of applying all nutrients is given in the table below:

Stage of fertilizer application	Name of fertilizers	*Sali* Season 60-20-40 (N-P-K) + 25kg ZnSO4 once in 3 years		*Boro*/early *Ahu* Season 60-30-30 (N-P-K) + 25kg ZnSO4 once in 3 years		Application method
		Fertilizer application (kg/ha)		Fertilizer application (kg/ha)		
		Through DAP	Through SSP	Through DAP	Through SSP	
Basal (same day at transplanting)	Urea	23.0	40.0	18	43	Broadcast & Incorporate in soil at the time of field preparation
	DAP	43.0	-	65.2	-	
	SSP	-	125.0	-	187.5	
	MOP	66.7	66.7	50	50	
	$ZnSO_4$	25.0	25.0	25	25	
Tillering (20-25 DAT), after first weeding	Urea	45.0	45.0	43	43	Broadcasting
Panicle initiation (40-45 DAT), after second weeding	Urea	45.0	45.0	44	44	Broadcasting
Additional fertilizer 5-7 days after flood recedes	Urea	45.0		-	-	Broadcasting
	MOP	33.0		-	-	

Water management

Alternate Wetting & Drying (AWD)

During *Boro* season rice, in the absence of rain, application of 5 cm irrigation water 3 days after disappearance of ponding water is recommended in medium and heavy soils. AWD, using field tubes, a climate smart water management technology for rice, was introduced during 2018-19 *Boro/early Ahu* season for saving water in Assam. During *Boro* season demonstrations, on an average four irrigations were saved which accounted to almost 20 per cent of water saving over the farmers' practice of continuous flooding.




Integrated weed management (IWM)

Integrated weed management (IWM) is an appropriate combination of different weed control methods, rather than relying on herbicides only. No single weed control method is effective and sustainable against all weeds. Also it develops resistance to herbicides; hence integrated management is needed. Ideally, IWM helps in improving productivity, reduce the cost of labor, fuel, fertilizer, water and pesticides and a sustainable process of weed management.

The major weed control methods are cultural, mechanical, biological and chemical.

Mechanical weed control

Weed control is one of the most difficult tasks on an agricultural farm. Mechanical weed control not only uproots the weeds between the crop rows but also keeps the soil surface loose, ensuring better soil aeration and water intake capacity. The power weeder is a multipurpose machine which can be used for weeding and other operations like harvesting as well as mowing.

Advantage

- Intra-row weeding in rice fields with uniform row spacing
- Save in time and labor
- Cost effective

Specification of two-row power weeder

Cost	: INR 37000 – 47000
Prime mover	: Self-powered (petrol engine)
Fuel consumption	: 1lt/ hr
Capacity	: 6 hr/ha

Chemical weed control

Weeds are the main constraints in paddy production. Weed management by using weedicides is a simple, efficient and cost-effective method. Both pre- and post-emergence weedicides are used to control grasses, broadleaf and sedges. Accurate weed identification is essential for efficient targeting and control of weeds, as weeds differ in their responses to control measures.

Advantages

- Increased herbicide efficacy with the use of multi-nozzle boom sprayer
- Cost effective and reliable measure of weed control
- Facilitates inter and intra-row weed control
- Weedicide use is inevitable, when mimetic grassy weeds (*Echinochloa* spp., weedy rice etc.) escape in hand weeding and the perennial sedge like *C. rotundus* and the aquatic weed such as *Monochoria* spp. are difficult to control by single (cultural or mechanical) means
- When continuous unfavorable weather or soil condition inhibit use of cultural and/or mechanical methods of weed control.

Specification of Battery operated sprayer-cum-spreader

Cost: INR 6,000 (for sprayer only) and 10,000 (for sprayer-cum-spreader)

Capacity: 8 hrs to spray 1 hectare

Prime mover: Battery (12 v)

Integrated pest management (IPM)

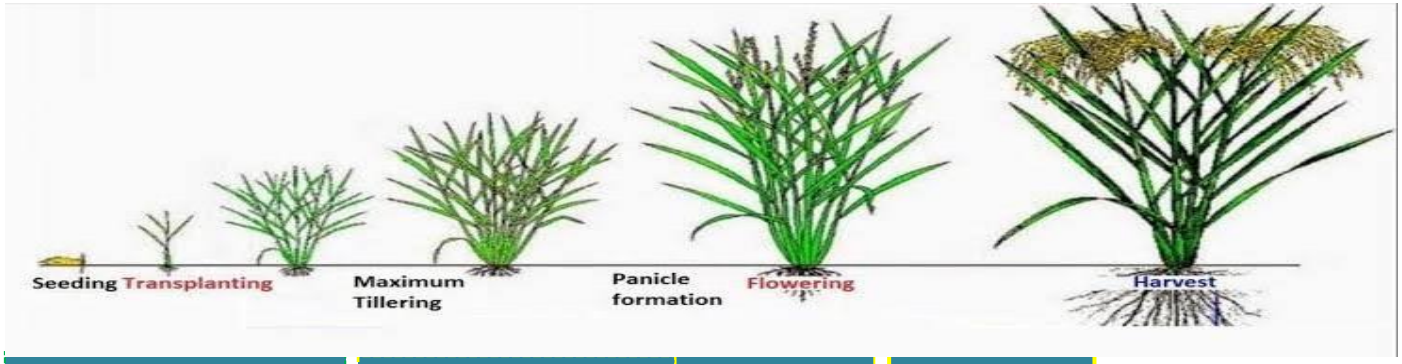
Integrated pest management makes use of a dynamic ecological system approach and help the growers to consider and use the full range of best pest-control options available while considering the economic, environment and social concerns. IPM approach is an easily adaptable approach which relies on the available resources and knowledge of the farmer to combat the problem of pest and diseases in rice ecosystem. IPM technology maintains the environmental equilibrium by avoiding overuse of pesticides and other management practices in order to maintain a healthy pest-predator ratio.

Superimposing IPM on On-farm Adaptive Demonstrations (OFAD)

The key objective for superimposing IPM on on-farm adaptive demonstrations is to evaluate the effect of the developed basic IPM module along with the new varieties under local conditions and managements in farmer's field (which is closely monitored by KVK) or KVK/RARS/Research centers. This can help to establish and generate reliable evidence about the acceptability of IPM practices with the newly introduced varieties. The IPM superimposing on OFADs would also help infer and acknowledge the consistency of both, the IPM module and the new varieties under local circumstances, actual farming system and local preferences.

Superimposing IPM on Cluster Demonstrations for more visibility

IPM is also superimposed on cluster demonstrations to support cluster activities. Since the cluster demonstrations have a considerable scale and widely spread across diverse geographies/ localities, covering large number of farmers and land area, hence can generate mass visibility and evidence about the IPM practice along with the variety. This would create awareness and help in sensitizing farmers of any new IPM intervention introduced in the region and notice the performance of the variety along with the disease and pest management strategies. IPM in cluster demonstrations has a great scope to strengthen the seed system and encourage quality seed production of STRVs.



Seeding	Transplanting	Maximum Tillering	Panicle formation	Flowering	Harvest
Thrips Swarming caterpillars Stem borer	Thrips Caseworm Hispa Grass hopper Leaf folder Swarming caterpillar	Stem borer Leaf folder BPH	Gundhi bug		

Seeding	Transplanting	Maximum Tillering	Panicle formation	Flowering	Harvest
Brown spot BLB Blast Bakanae	Brown spot Sheath blight Blast BLB	Sheath blight Blast (node, collar and neck) Tungro	False smut Grain discolouration		

Objective III. Strengthening postharvest management by introducing improved practices including postharvest mechanization and a supporting service-economy to reduce losses, increase efficiency and profitability and improve rice value-chain

The postharvest system consists of a set of operations, from harvest to consumption, aiming to minimize the losses and maintain the grain quality, until the grain reaches consumers. The competence of managing farms and postharvest operations determine the quantity and quality of final product. As pre-harvest operations like selection of efficient technologies, better input management, and their application schedule play a critical role in improving productivity and quality of the produce. Similarly, the postharvest operations are equally important for reducing losses and improving quality, and to obtain reasonable prices for the main- and by-products

Harvesting is the process of cutting the mature rice crop from the field. Paddy harvesting activities include reaping, stacking, handling, threshing, cleaning, and hauling. These can be done individually or a combine harvester can be used to perform the operations simultaneously.

Reaper

Reaper is used for harvesting of crop.

Benefits

- Straw is not destroyed and it remains in the field as in manual harvesting
- Reduces grain loss by harvesting the crop in right time
- Time saving and reduction of labor-cost

Capacity: 3.5 hrs/ha,

Prime mover: Self-powered

Cost: INR 1,50,000- 1,70,000

Mini Combine Harvester

The combine harvester or combine is a machine that harvests different grain crops. The name combine is derived from its combining three separate operations comprising harvesting—reaping, threshing, and winnowing—into a single operation. A combine has a reaper and thresher wheel together to harvest, thresh and clean the grain from the straw in one operation.

Cost: INR 12,00,000 – 13,00,000

Prime mover: Self-powered

Use: Harvesting, threshing, separating, cleaning and collecting

Advantage

- Straw will not be destroyed, and it will stay on the field as manual harvesting
- Applicable for both rice and wheat harvesting
- Reaping, threshing, winnowing and packing done at a time in crop field
- Applicable for both dry and wet land
- Works in moist field also
- Harvesting capacity is more than 1 acre/hr

Axial Flow Thresher

Threshing is the operation of separating the grains from the plants. These operations may be carried out in the field or on the threshing floor by hand or with the help of animals or machines.

Advantages

- In one operation it can thresh and clean the paddy
- Threshed paddy, straw and chaff collected separately
- Helps to vacate the fields earlier so that 2nd crop can be planted in sequence

Capacity: 16 q/hr

Prime mover: Tractor (35 hp or more) Cost: **INR** 1,65,000 – 180,000

Open Drum Thresher

This machine is more affordable and easier for such end-users to operate compared to the larger machines which may not be available in the market or accessible to smallholder farmers.

Advantages:

- Specially designed for women farmers use
- Threshing and winnowing in one operation
- Portable thresher with wheel system
- Diesel engine is provided that helps to operate in rice field
- Protective concave is present to avoid accident

Cost: INR 35,000 **Capacity:** 5-7 q/hr **Prime mover:** Diesel Engine (4.5 hp)

Mechanized drying methods

Drying reduces the moisture content in the grain which is a pre-requisite if it is to be stored. Delaying the drying process or drying it unevenly would result in a qualitative loss. Solar bubble dryer and recirculating batch dryer can effectively be used for drying.

Grains should be dried as per details below

- 14-16% for storage up to 2 weeks
- 12-14% if it's to be stored for 6-8 months
- 9% or less for long-term storage

Solar Bubble Dryer

- Uses only solar energy, no operating cost except labor
- Drying time similar to sun drying during sunny days, 2 days with cloudy sky
- Only two labor required for drying
- Grains can be dried in cloudy condition
- Protection from rain, animals, birds etc.

Cost: INR 1,50,000 for 0.5-ton and INR 2,50,000 for 1.0-ton capacity

Dimensions:25m x2m for 1ton and 15 m x 2m for 0.5 ton

Recirculating Batch Dryer

Grains are fed from feeding hopper then conveyed by bucket elevator to upper screw conveyer, in turn grains are distributed evenly in tempering bin by distributor. In one cycle of drying, moisture removal can be easily reached to 0.65~1.0% per pass, i.e. 15~20 times of circulation to complete drying from initial moisture content of 25% to final moisture content of 13%.

Cost: INR 12,00,000 (for 4 ton)

Super Bag

Hermetic storage is a type of modified atmosphere that has now been applied for the protection of stored agricultural commodities including rice, maize, pulses and other crops grain as well as seed. It is also called "sealed storage" or "airtight storage" or "sacrificial sealed storage" or "hermetic silo storage". Hermetic storage allows safe storage for periods ranging from a few weeks to many months, as well as during shipment across intercontinental distances with storage losses typically well below 1%.

Advantages

- Seed and grain can be stored hermetically
- No insect/fungus attack
- Germination rate and seed viability is maintained
- Life is 2-3 years and any commodity can be stored

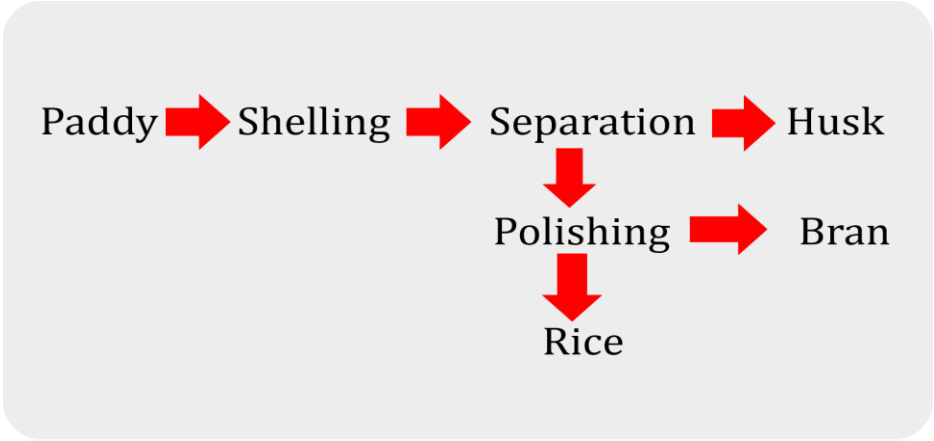
Cost: INR 90/bag

RCC Ring Bin

Improved storage devices are made up of RCC rings that are commonly available for construction of ring wells were placed over one another on a specially designed RCC slab. The slab is placed over four brick pillars. Grain outlet is provided at the bottom ring with sliding metal plate for closing. The top ring is covered with another slab with an observation hole at the center normally closed with a metallic lid. The joints of the rings are sealed with cement mortar. The capacity of such bins made up of four rings is around 5.50 quintal

Rice value addition technology

Processed products can give more income to farmers. Value addition enhances the profitability of rice production. A wide range of products can be prepared from rice. There are technologies to convert the by-products to a marketable product like rice puff, flake etc. Here, few of them are highlighted



Portable Rice Mill

The basic objective of a rice milling system is to remove the husk and the bran layers to produce an edible, white rice kernel that is sufficiently milled and free of impurities. The milling yield and quality of rice are dependent on the quality of the paddy, the milling equipment used, and the skill of the mill operator. In comparison with traditional milling machines, the tractor-operated portable rice milling machine with rubber roller is an option for higher shelling efficiency.

Cost: INR 3,00,000 to 3,50,000

Capacity: 1 ton per hour

Use: Milling and polishing

Diesel consumption: 3 liters/hour

Prime mover: Tractor PTO operated (42 hp or more)

Benefits:

Use of rubber roller minimize the less broken percentage (2-4%) and thus give high head rice recovery. Brown rice can be obtained. There is option for polishing to get white rice in one operation with automated elevator. It is easy for transportation for door to door service

Indent Cylinder Separator

Indent Cylinder Separatorseparates whole grain and broken grain. It consists ofindents whichhelplifting the particles thatare fited in the indents. Other particles that do not fit in the indents drop out from the cell.

Cost: INR 2,50,000

Prime mover: 15-20 hp

Dry Grinding Machine

Dry grinding machine can be used grinding rice to flour. The broken rice separated by indent cylinder separator can further be value added by making rice flour. Rice flour is used to prepare different kinds of delicious *pithas*. Packaging and marketing of rice flour is also a good business opportunity for women SHGs.

Cost: INR 80,000 - 2,50,000

Prime mover: 15-20 hp motor

Rice Flake Machine

Rice flake is the husked rice that is flattened into flat, light dry flakes. These flakes of rice swell when added to liquid, whether hot or cold, as they absorb water, milk or any other liquids. The thicknesses of these flakes vary between almost translucently thin (thermo-expensive varieties) to nearly four times thicker than a normal rice grain. These are also known as POHA.

Advantages

- Better quality flakes with good texture are produced
- High strength with flawless finish
- Minimum breakage

Cost: INR 5,00,000 – 7,00,000 **Capacity:** 1200kg/hr

Prime mover: Single motor driven system (20-25hp), double 'V' belt and pulley.

Rice Puff Machine

Since puffed rice is easily digested and assimilated, it has wide acceptance among a cross-section of households. It is a versatile product with an excellent market potential.

Advantage:

- Makes continuous production possible.
- Less hazardous to health as no sand is used (In traditional method, the traces of sand remain on the surface of puffed rice which is hazardous to health.)
- Feasibility of prolonged operation, since the operator is not exposed to high heater smoke as in the traditional method.

Cost: INR 2,50,000 – 4,00,000 **Capacity:** 350 kg/hr **Prime mover:** Self-powered

Objective IV: Developing extrapolation domain of cropping systems for efficient targeting of technologies in low-productivity rice-fallows and stress-prone areas

Keeping in view the goal of doubling income and improving agricultural productivity and climate resilience, geospatial tools, which include the technologies of Remote Sensing, Geographical Information System (GIS) and Global Positioning System (GPS) are most useful for generating reliable and real-time data. The technology can be used for providing information on crop-area enumeration, identification of fallow areas, farming infrastructure, farming practices, availability of agriculture inputs, and geographic variation of crops.

Stress Mapping

To efficiently target suitable technologies in low-productivity areas of Assam, the detailed characterization outputs are generated using Remote Sensing and GIS technology, including abiotic stresses (e.g., flood extents, inundation duration and depth, drought and groundwater availability, etc.) and biotic stresses to systematically understand the potential opportunities and constraints at the cropping system level.

Remote Sensing for flood mapping

Synthetic Aperture Radar data, due to cloud penetration characteristics, are used to generate flood maps of Assam. In particular, C-Band SAR data (VV polarization, 12-day temporal frequency, 20 m spatial resolution) from Sentinel-1A by the European Space Agency (ESA) were used to identify locations affected by floods in Assam. A more detailed SAR data from Radarsat-2 was used to derive flood duration information for Assam indicating the most frequent and extensive nature of flood with duration of less than 14 days.

Benefits of Flood Mapping

In the event of natural calamities, such as cyclone, or flood at critical stages of the rice crop growth, there is an urgent need to acquaint the responsible agencies with timely and accurate estimates of the affected crop areas and eventually loss in production. This information is necessary for emergency aid, seed and other input distribution as well as other required interventions to assess rice production shortfalls. Flood duration maps suggesting flood-tolerant rice varieties will have strong potential to contribute in reducing the impact of flood to rice farmers in Assam.

Drought stress mapping:

Optical and SAR (coherence) satellite data are used to generate drought map for Assam. The intensity of drought will be characterized based on the Normalized Difference Vegetation Index (NDVI).

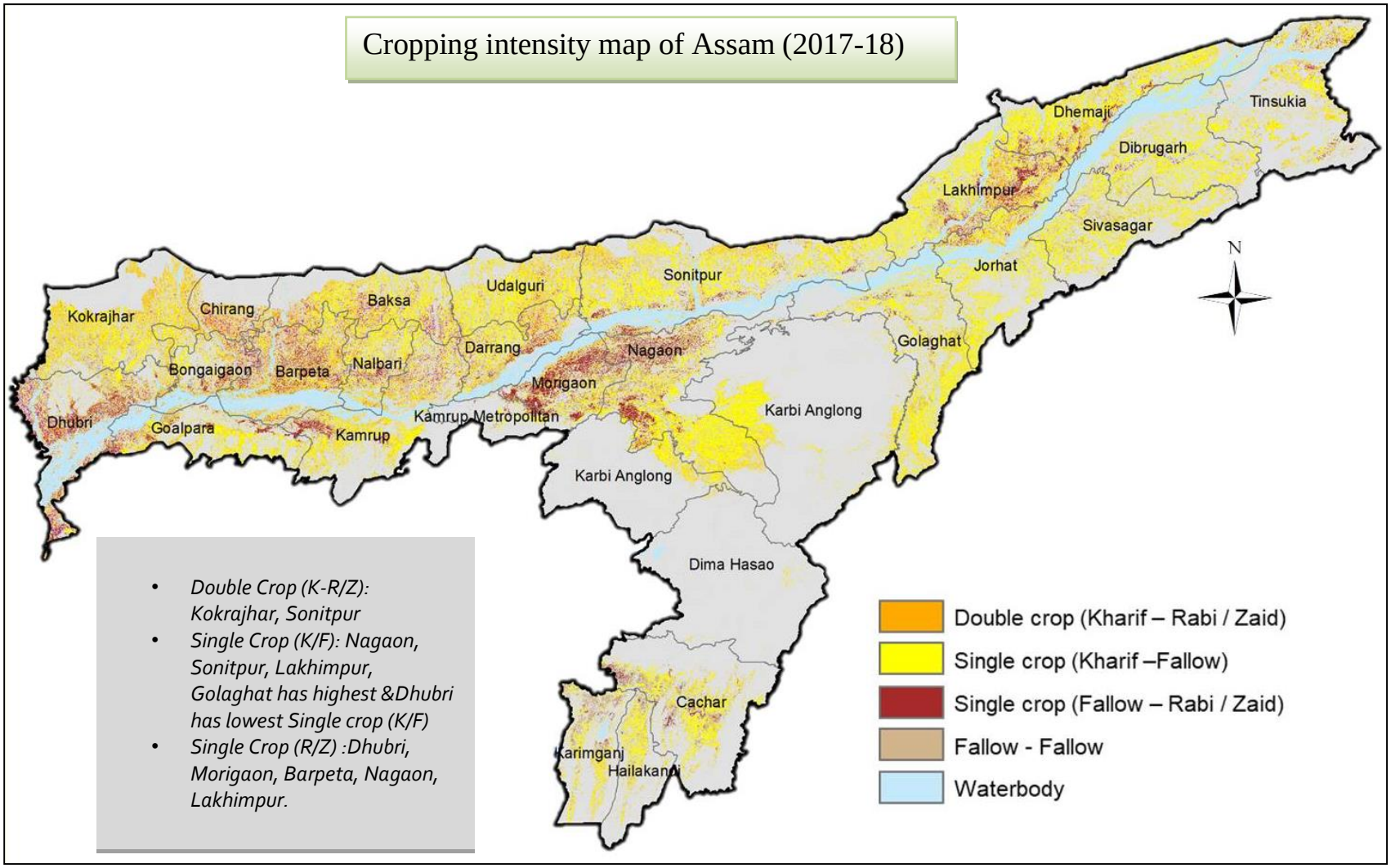
Benefits of mapping drought-prone areas:

Identification of drought-prone areas will be useful for introducing drought resistant varieties of rice and inclusion of low water requiring crops like pulses and oilseeds for increasing rice-based cropping system productivity. Better management practices such as promotion of short-duration varieties can be implemented by identifying drought-prone areas to increase the cropping intensity of Assam.

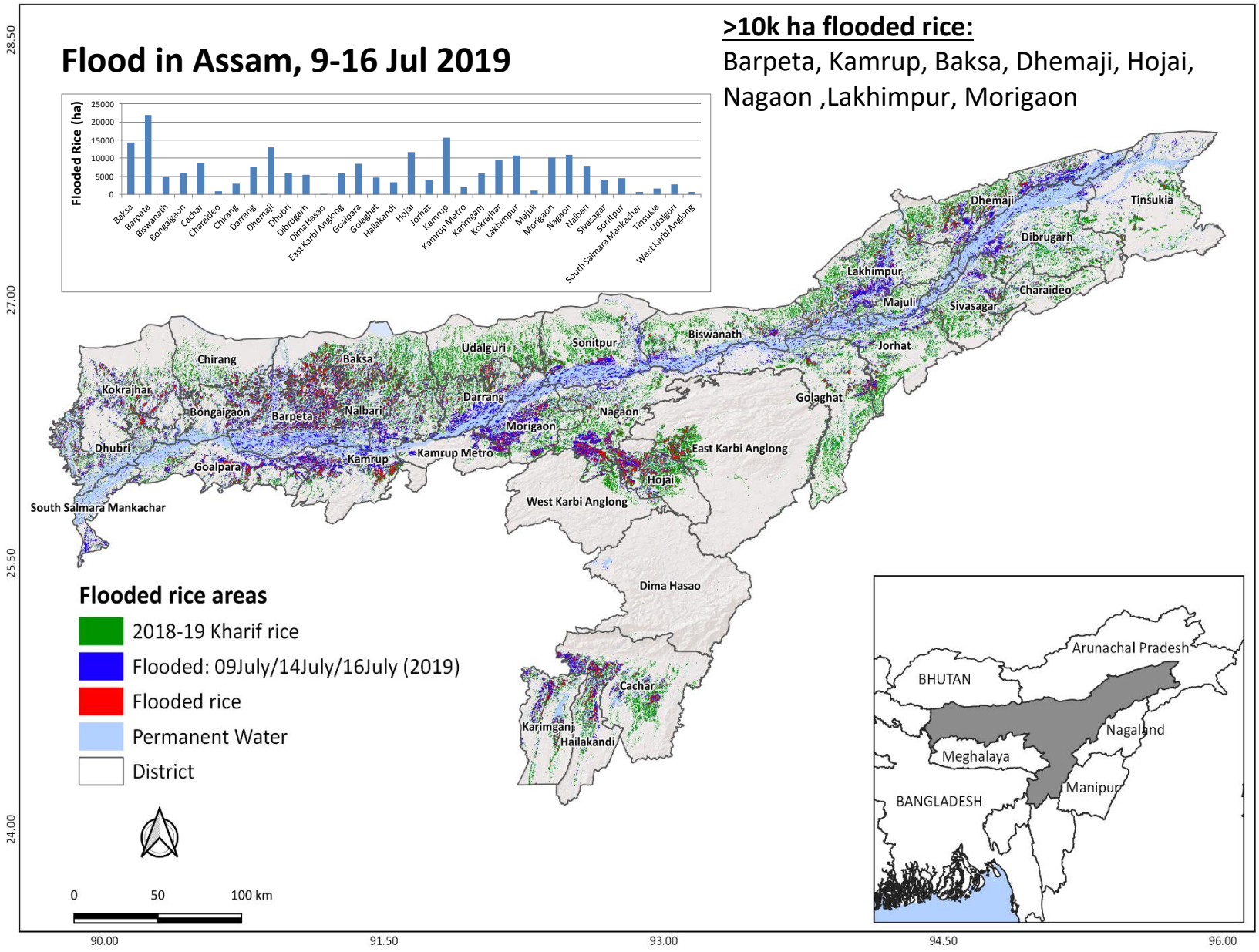
Characterization of existing cropping systems:

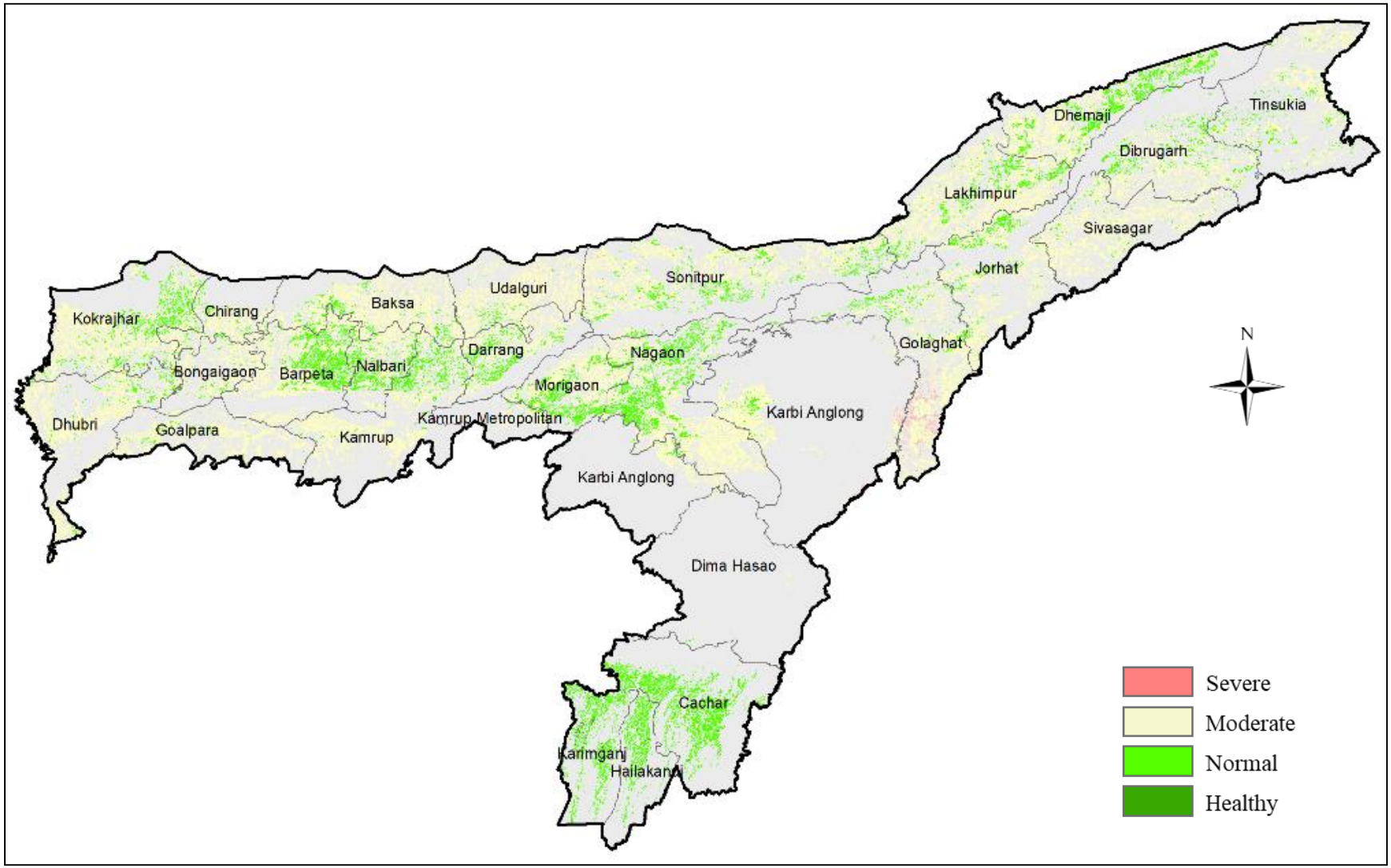
Geospatial technologies have been used to create cropping systems and cropping intensity maps using time-series satellite data. Rice area maps for *Kharif* and *Rabi* seasons were prepared for 2017, 2018 and 2019. Rice-fallow maps were generated so that these areas can be targeted for increasing cropping intensity and substantially improve the food supply and enhance livelihoods in the state of Assam.

Cropping intensity map of Assam (2017-18)



- *Double Crop (K-R/Z): Kokrajhar, Sonitpur*
- *Single Crop (K/F): Nagaon, Sonitpur, Lakhimpur, Golaghat has highest &Dhubri has lowest Single crop (K/F)*
- *Single Crop (R/Z) :Dhubri, Morigaon, Barpeta, Nagaon, Lakhimpur.*


Flood in Assam, 9-16 Jul 2019
>10k ha flooded rice:
Barpeta, Kamrup, Baksa, Dhemaji, Hojai, Nagaon ,Lakhimpur, Morigaon
Flooded Rice (ha)
25000
20000
15000
10000
5000
0
Baksa
Barpeta
Biswanath
Bongaigaon
Cachar
Charaideo
Chirang
Darrang
Dhemaji
Dhubri
Dibrugarh
Dima Hasao
East Karbi Anglong
Goalpara
Golaghat
Hailakandi
Hojai
Jorhat
Kamrup
Kamrup Metro
Karimganj
Kokrajhar
Lakhimpur
Majuli
Morigaon
Nagaon
Nalbari
Sivasagar
Sonitpur
South Salmara Mankachar
Tinsukia
Udalguri
West Karbi Anglong
28.50
27.00
25.50
24.00
90.00
91.50
93.00
94.50
96.00
Flooded rice areas
2018-19 Kharif rice
Flooded: 09July/14July/16July (2019)
Flooded rice
Permanent Water
District
0
50
100 km
Arunachal Pradesh
BHUTAN
Nagaland
Meghalaya
Manipur
BANGLADESH



Identification of Drought Prone areas in Assam

Objective V : Developing knowledge materials, fostering strategic partnership and capacity development of the various stakeholders (public, private and developmental partners) of extension functionaries in Assam.

Training of Trainers

The capacity building of all actors involved in different processes is an important and integral part of the project through training of trainers (ToTs) approach with a strong influence on 'learning-by-doing' with action and reflection. The master trainers (MTs) created at the district level would help to achieve scale and ensure sustainability of the sustainable intensification (SI) technologies. Training modules on direct drill-seeded rice (DSR), mechanically transplanted rice (MTR), and integrated weed management (IWM), including herbicide spraying techniques, post-harvest and rice value chain technologies are developed and tested for creating MT's.

Season-long training (SLT) of 5 to 8 working days, distributed over the rice growing season aligned with the importance of different crop management practices, help in knowledge back stopping and capacity building of extension agents.

Exposure visits/learning tours

Exposure visits/learning tours are being organized to expose progressive farmers and extension agents to innovative technologies. These are critical extension tools used for introducing and illustrating the performance of creative interventions to the farmers. Farmer-to-farmer interaction increases the diffusion of innovative technologies and also provides the opportunity to farmers to interact with fellow farmers, who have already adopted an innovative technology, to gather knowledge and get their practical feedback on them.

Assam Rice Knowledge Bank (RKB) www.rkbassam.in

Rice in Assam

- Offers information on the status of rice and rice cultivation in the state
- Users can view and gain information on the various agro-climatic conditions, agro-ecological zones of the state.
- Section enriched with ground truthed data on the basis of research

Varieties

- Offers information on the varieties grown in the state
- Users can sort and select varieties on the basis of agro- climate, district and season
- Localized, district content
- Passport data for all important varieties of Assam available

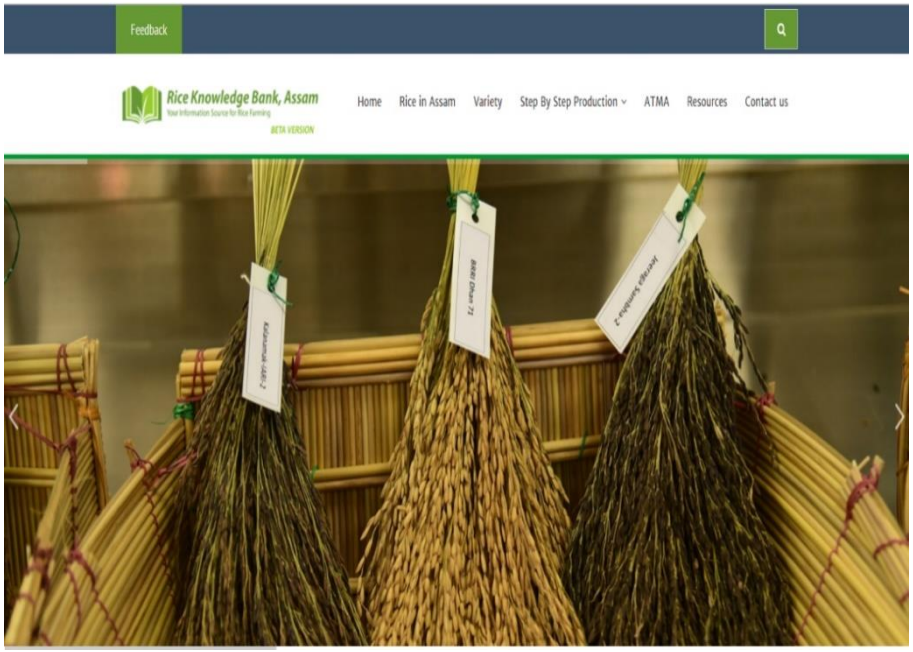
Step-by-step production

- Offers information on research-based best management practices.
- Crop-cycle based seed to market information system
- Localized, state-specific content
- Presented in various formats

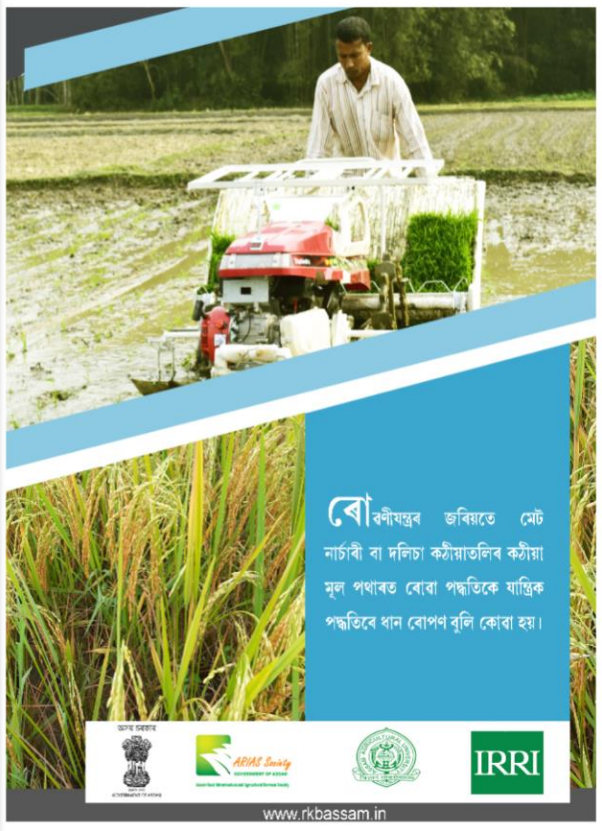
Resources

- Offers downloadable materials for use
- Presented here are factsheets in Assamese and English
- Research-based videos on best management practices
- The videos follow an instructional and teaching format

The Assam Rice Knowledge Bank showcases rice production techniques, agricultural technologies and best farming practices based on the pool of knowledge from research findings, learning and media resources from AAU and IRRI. To bridge the gap between research and practice in rice production, IRRI has developed RKB, a digital extension service that provides practical knowledge solutions specialized for small-scale farmers in developing countries, and as a part of its country collaborations, has localized the content of the knowledge bank for countries and states.



Exposure Visit and Publications








অসম চৰকাৰ
GOVERNMENT OF ASSAM

ARIAS Society
GOVERNMENT OF ASSAM
Assam Rural Infrastructure and Agricultural Services Society

ASSAM AGRICULTURAL UNIVERSITY
विज्ञानं लोकसेवारतम्

IRRI

The World Bank is the funding agency of APART.
Department of Agriculture, Govt. of Assam is the nodal department for implementation of APART.
ARIAS Society is state Level coordinating and monitoring agency for APART.
Assam Agricultural University is the leading Agricultural University of the state and implementing agency of APART, imparting research and scientific support.
IRRI is the rice global leader providing technical and hand holding support in the implementation of APART.

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