(AAU/DR/18(BL)/229/2018-19)

CLIMATE RESILIENT AGRICULTURE

EXPERIENCES FROM NICRA IMPLEMENTATION IN NORTH BANK PLAINS ZONE OF ASSAM

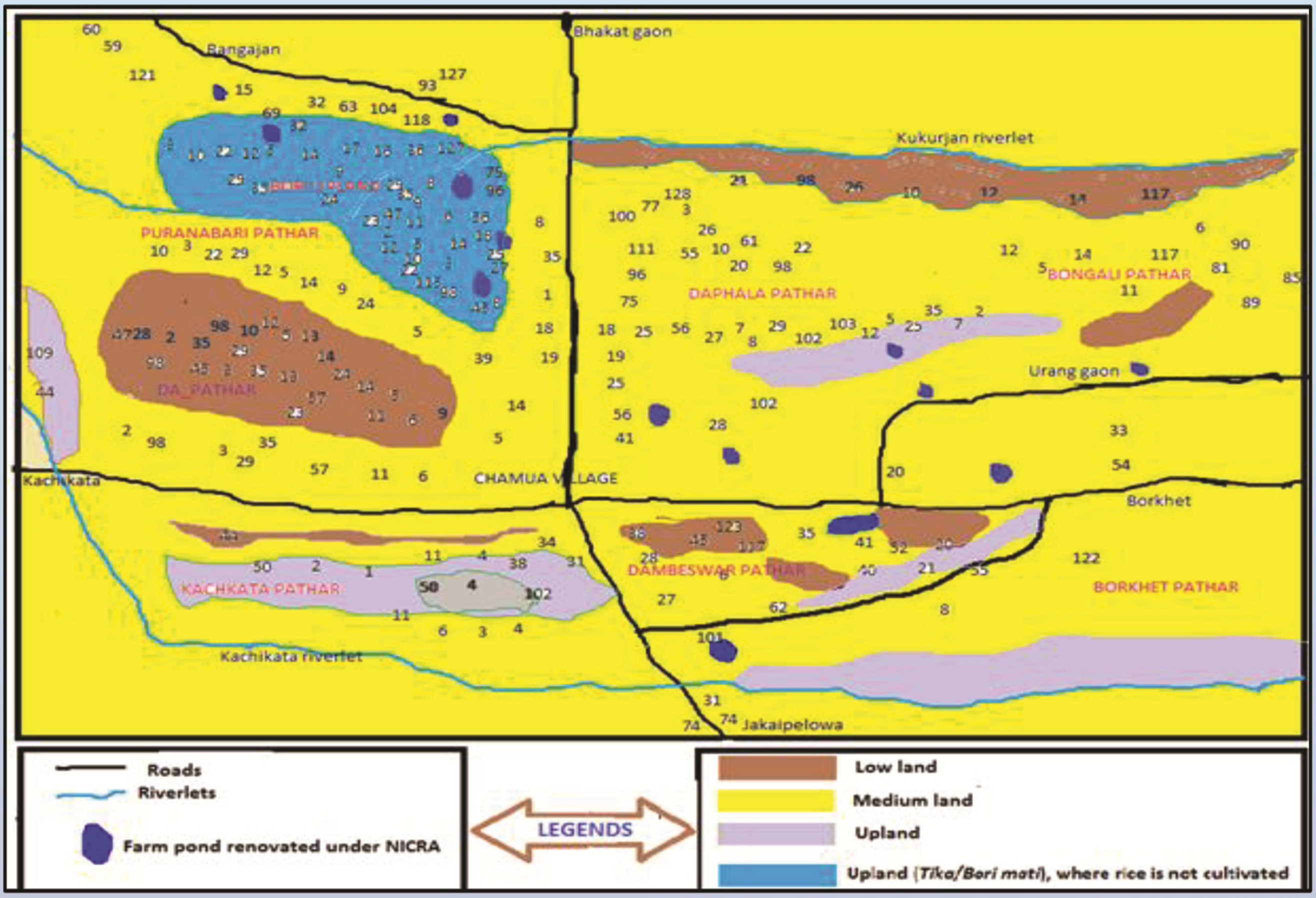
NATIONAL INNOVATIONS ON CLIMATE RESILIENT AGRICULTURE

ALL INDIA COORDINATED RESEARCH PROJECT FOR DRYLAND AGRICULTURE

BISWANATH CHARIALI CENTRE

BISWANATH COLLEGE OF AGRICULTURE

ASSAM AGRICULTURAL UNIVERSITY


Bhakat gaon
Rangajan
Kukurjan riverlet
PURANABARI PATHAR
DAPHALA PATHAR
BONGALI PATHAR
DA_PATHAR
Urang gaon
Kachikata
CHAMUA VILLAGE
Borkhet
DAMBESWAR PATHAR
KACHKATA PATHAR
BORKHET PATHAR
Kachikata riverlet
Jakaipelowa
Roads
Riverlets
Farm pond renovated under NICRA
LEGENDS
Low land
Medium land
Upland
Upland (Tika/Bori mati), where rice is not cultivated


09/12/2014 07:29

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Climate Resilient Agriculture - Experiences from NICRA implementation in North Bank Plains Zone of Assam.

(AAU/DR/18(BL)/229/2018-19)

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Message

The climate change and climate variability are the major challenges impacting agricultural production in many parts of the world. The country is experiencing increased climate variability and during past decade, frequency of droughts, cyclones and hailstorms has increased. Frequent and more intense extreme events may become the norm of the day for common farming community. Agriculture of the country with 80% of farmers being small holders is vulnerable to climate change in view of fact that a major part of the agriculture of the country is rainfed. Though the south-west monsoon accounts for nearly 75% of the natural precipitation received, rainfall aberrations during the monsoon season continue to be the major factor contributing to instability in agricultural production in the country. Similarly, the North Bank Plains Zone (NBPZ) of Assam is also facing extreme weather abnormalities such as increase in numbers of flash floods and seasonal droughts. Therefore, identification of various adaptation strategies including use of climate resilient crops and cultivars for different agro-situations is very important to cope with climate variability.

It is appreciated that Scientist from AICRP(DA), BNCA, AAU Biswanath Chariali have documented their experiences gained from implementation of NICR.A in NBPZ of Assam and prepared a bulletin covering all the available farm technologies that have adaptation potential to increase farm production and productivity vis-à-vis continuous management of natural and manmade resources . I sincerely believe that the bulletin will provide the tome meaningful information on climate resilient agriculture.

16/5/18

(Ashok Bhattacharyya)

FOREWORD

Climate change impacts on agriculture are being witnessed all over the world, but countries like India are more vulnerable in view of the huge population dependent on agriculture, excessive pressure on natural resources and poor coping mechanisms. The warming trend in India over the past 100 years has indicated an increase of 0.60°C. The projected impacts are likely to further aggravate field fluctuations of many crops thus impacting food security. There are already evidences of negative impacts on yield of wheat and paddy in parts of India due to increased temperature, water stress and reduction in number of rainy days. Increased abnormalities in amount and distribution of rainfall has also been observed in North Bank Plains Zone (NBPZ) of Assam along with increase in numbers of wet spell driven flash floods and seasonal droughts in recent years.

Planned adaption is essential to increase the resilience of agricultural production to climate change. Several improved agricultural practices evolved over time for diverse agro-ecological regions in India have potential to enhance climate change adaptation, if deployed prudently. Management practices that increase agricultural production under adverse climatic conditions also tend to support climate change adaptation because they increase resilience and reduce yield variability under variable climate and extreme events.

Keeping this in view, National Innovations on Climate Resilient Agriculture was implemented under All India Coordinated Research Project for Dryland Agriculture, Biswanath Chariali centre on 2011in two selected villages of North Lakhimpur, Chamua and Ganakdoloni. The main aim of the project is to enhance resilience of Indian agriculture to climate change and climate variability through strategic research and technology demonstration.

In this bulletin the authors have penned down the experiences gained from implementation of NICRA in NBPZ of Assam. It is hoped that the bulletin will be able to serve the purposes towards achieving its objectives and act as a benchmark study for the entire area. It is expected that the information contained in this bulletin will be exploited by the scientist of different disciplines and extension officials for making rational recommendation.

The authors will remain ever grateful to Project Coordinator, (AICRPDA), CRIDA, Hyderabad and Director of Research (Agri), AAU for their guidance, encouragement and sincere support. The authors extend thankfulness to the fellow Scientists, Research Associates and other technical staff for their cooperation and help. The authors express their thankfulness to Sharada Offset, Biswanath Chariali for printing the report.

Authors

CONTENTS

1. Indroduction

Climate change is perhaps one of the biggest challenges faced by humanity of today as its multitude impacts poses great risk to our ecology, economy and society. The impact of climate change has been increasingly visible in terms of change in temperature, precipitation, retreating ice caps and glaciers, sea level rise, atmospheric circulation pattern and ecosystems. The negating impacts of climate change are likely to be increased over the next decades. Fifth assessment report of Inter Governmental Panel on Climate Change (IPCC, 2014) has concluded that there is an unequivocal evidence of current trend of global warming caused by anthropogenic emissions. At this point of time the average surface temperature of the earth is 0.89°C above than the preindustrial level. The surface temperature is likely to rise in next decades even in case of the minimum emission scenario. The IPCC (2014) estimated that the global average temperature would increase in the range of 1.0 to 3.7ºC by 2081-2100. The warming trend in India is in the order of 0.60°C over the past 112 years (IMD, 2012) with accelerating warming of 0.21°C per decade since 1970 (Krishna Kumar, 2009).

In regional scale also warming is realized. Analysis of temperature data (1951 to 2010) indicated that the mean temperature in Assam had increased by +0.01ºC/year (Rathore, 2013) and it might further increase by 1.7-2.0°C during 2021 to 2050 (ASAPCC, 2015). It is widely acknowledged that climate change is not simply the increasing temperature, but indeed responsible for increasing frequency of extreme weather events like heat wave, cold wave, droughts, floods etc. It was confirmed by IPCC (2014) that heat waves would occur more frequently and last longer and number of extreme precipitation events would turn out to be more in many regions. In India, increased frequency of pronounced heat waves, cold waves, droughts and floods have already been realized in last few decades.

Climatic variability in northeast India has been documented in terms of rainfall variability. Analysis of long-term rainfall data (1901 - 2010) confirmed the significant decreasing trend of annual as well as monsoonal rainfall in both the Brahmaputra and Barak basins of Assam (Deka *et al*, 2013). They also reported that the variability of rainfall has been increasing in terms of increased frequency of high intensity rains and reduced number of rainy days, leading to localized flash flood and occurrence of multiple dry spells. Similar decreasing trend of rainfall was also observed in North Bank Plains Zone (NBPZ) of Assam. Critical analysis of rainfall data of the region revealed that abnormalities in distribution of rainfall during monsoon have been increasing in recent years and the region has been facing from wet spells driven flash floods as well as mid season/terminal dry spells (Neog and Sharma, 2014).

2. Impact of climate change on agriculture:

Climate change has caused impacts on both environment and people's livelihood and impact of ill effects of climate change are likely to increase in near future. Agriculture in high latitude may be benefited by increasing temperature due to climate change. Similarly some dry areas may get more rainfall. But millions of people of the world who depend on rain fed/dry land agriculture or natural ecosystem for their livelihood and peoples who live in low lying areas like Indo-Gangetic plains or Brahmaputra valley are the most vulnerable and may face severe consequences of inevitable climate change. Therefore, climate change will put additional stress that pushes exiting agricultural systems over the edge and thus climate change will act as 'risk multiplier' (CGIAR, 2009). Plants are sensitive to high temperature during their critical stages. Increase in temperate will adversely affect on crops by accelerating crop growth rate, reducing crop duration, reducing yield , increasing rate of evaporation/evapotranspiration and decreasing fertilizer use efficiency. Soil health will also be affected due to greater evapotranspiration, soil water deficit, more mineralization and increase in temperature in higher temperature environment. High temperature coupled with drought may be the cause of disaster to farmers' field. As insect pests and diseases of crops or animals are sensitive to temperatures and relative humidity, survival and distribution of pest will be affected due to climate change. There is the likelihood of increasing ranges and population of pest in warmer environment. Some insects or diseases will become prevalent in areas where they were previously unknown due to congenial climate. Expected increase in frequency of extreme weather events like wet spells, dry spells, flood, drought, heat wave, cold wave etc will adversely influence on standing crops and will cause significant yield loss due to impact on physiology or mechanical damage to the crop. Since rainfall is the key variable that influences crop productivity, expected changing precipitation pattern is going to influence the rainfed farming more profoundly. Both the amount of monsoon rainfall and its distribution are crucial factor influencing performance of Indian agriculture. The probability of monsoon rain being erratic is 40% of the time which implies that in 4 out of 10 years there would be an adverse impact on crop production and make the Indian Agriculture more vulnerable (Srinivasrao, 2013).

3. Climate change impact - Assam situation:

The economy of Assam is predominantly agrarian, where more than 87 percent of the population live in rural areas and this sector contributes 40% to the state GDP. Rice dominates the agriculture scenario of the state which is grown almost entirely as rainfed. The predominantly small farmer-oriented mono-crop farming of state is often affected by several constrains including risks of weather like flood and drought. Flood is one of the major problems causing sluggish growth of agricultural sector in the state. Due to occurrence of high intensity-rainfall, the incidence of floods has been a typical in Assam, making the state highly vulnerable to risk and uncertainty. The multiple waves of flood during the monsoon season cause extensive damage not only to the standing rice crop but also cause permanent loss of areas due to heavy siltation and erosion. Though the recurrent floods have been the major cause of crop loss, occurrence of intermittent dry spells (mid season and terminal) affects growth and yield of *Sali* rice. In the recent 30-year normal period significant decreasing trend of monsoon and annual rainfall was observed in Assam. The last decade (2001-2010) was the leanest decade of the last 110 years in the state due to more number of deficient years. The recent rainfall fluctuations with large amplitudes indicate greater degree of likelihood of heavy floods as well as short spell droughts which is bound to pose major challenge to agriculture, water and allied sectors in the near future (Deka *et al*., 2013). Similar trend of decreasing rainfall and increase in high intensity rainfall events is observed in smaller scale like district level (Fig. 3.1).

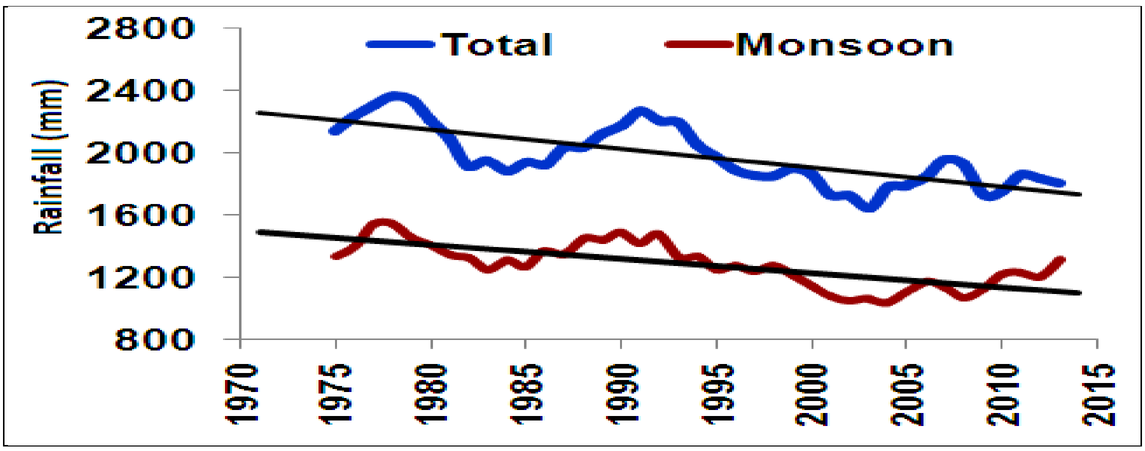

Fig. 3.1: Decreasing trend of rainfall- Annual & monsoon at Lakhimpur district of Assam

4. Climate resilient agriculture in Assam:

The innate problem of flash floods along with the occurrence of multiple dry spells during rice growing season in our region is likely to be aggravated in future due to increase in rainfall variability associated to climate change. Therefore appropriate mitigation and adaptation strategies are needed to be developed to deal with such eventualities so that resilience can be brought to the agriculture sector in spite of inevitable climate change because agriculture and forestry sector alone contribute 30% of total green house gases, therefore if agricultural emission is solved, 30% of global warming is solved. However, the mitigation potential is only 5 to 40% for different green house gases emitted from agricultural sectors. Moreover, available mitigation options cannot be adopted wholly as there are many constraints like lack of assured irrigation, suitable machines and tools, fertilizers, awareness among the farmers, government policies etc (Pathak *et al*., 2012). The other way to reduce vulnerability and enhance resilience of agricultural system to adjust to the observed and anticipated impacts of climate change is to opt for adaptation strategies. Improved technologies along with traditional wisdoms available among the farmers should be captured and perpetuated to cope with the climate variability. Evaluation and demonstration of stress tolerant cultivars, adoption of efficient cropping system, integrated water, nutrient, weed and pest management, rainwater harvesting and use, use of improved farm machinery tools, strengthening old age integrated farming system, exploitation of unused and misused areas through alternate land use, weather forecasting and weather based agro advisories etc may be the solution for combating the challenges arising due to climatic change. Under NICRA project implemented under AAU, efforts are being made to identify technologies as well as demonstrate available technologies for management of weather aberrations like dry spells and flash flood so that resilience to climate change can be brought to the rice based cropping system of Assam. In NICRA project focus is given on four thematic areas *viz.* i. Real Time Contingency Crop plan ii. Rain Water Harvesting and Efficient Use iii. Efficient Energy Use and Management and iv. Alternate land use for carbon sequestration and ecosystem services. Crop/soil/water/pest management adaptation strategies for managing different types of weather aberrations were demonstrated under NICRA project

NICRA-AICRPDA project of AAU is being implemented since 2011 in two villages - Chamua and Ganakdoloni village located in the NBPZ of Assam. *Sali* rice grown in the mid land and upland crop fields of Chamua village are often affected by intermittent dry spells, on the other hand other village (Ganakdoloni) is affected by 3 to 5 flash floods, each of 7 to 15 days duration, with flooding depth of more than 1.5 m, during June to October causing extensive damage to the crop almost every year. In recent years, adverse impact of intermittent dry spells in *Sali* had been increasingly visible (Table. 4.1) in the locality.

Table. 4.1: Effect of intermittent dry spells of different stages of growth of *Sali* rice in adopted village under NICRA in recent years.

Year	Vulnerability	Crop growth stages affected
2001	Dry spells	Tillering/PI/grain growth
2005	Dry spells during Sept/Oct	Tillering/PI/grain growth
2006	Dry spells (Aug/Sept/Oct)	Tillering/PI/grain growth
2009	Dry spells (early and late season)	Sowing/transplanting/ tillering/PI/Grain growth
2011	<u>Onset was delayed</u>, mid season and terminal drought – weed/insect/disease	Sowing of Sali rice was affected, tillering ,PI stage, grain filing stage were affected
2012	Heavy rainfall up to mid October, <u>*no rainfall in rabi seasons*</u>	Tillering and PI stage

2013	Delayed onset of monsoon, terminal dry spells , very less rainfall during rabi	Sowing of Sali rice was affected, grain filling stage was affected
2014	Delayed onset, Terminal dry spells , less rainfall in *rabi*	Sowing of Sali rice was affected, grain filling stage was affetced
2015	Terminal dry spells	Long duration varieties were affected

4.1 Two extreme cases of weather aberration experienced during the NICRA
4.1.1 implementation: Intermittent dry spells during 2011:

During 2011 *Sali* paddy grown in the Chamua village was terribly affected by intermittent dry spells. Onset of monsoon was delayed by three weeks which resulted in delayed sowing. Moreover, the crop was exposed to long dry spell due to very scanty rainfall from mid of August. Late sowing followed by exposure of crop to water stress during tillering, PI and grain filling stage resulted in drastic reduction of yield of Sali rice. It was observed that the yield of the very popular variety *Ranjit* was reduced to the extent of 0.9 t/ha. Even in some cases there was no emergence of panicle of the variety leading to total crop failure.

Fig. 4.1: Performance of Ranjit variety at *Chamua* during 2011

4.1.2. Flash flood continued up to second week of October, 2012:

During 2012, *Sali* paddy in the Gankdoloni village was affected by four number of flash flood of total 32 days duration and submergence continued up to end of September (21-28 September) and second week of October (2-8 October), while crop was at the panicle initiation stage. The normal farmers' varieties including *Ranjit*, *Mahsuri*, and *Punjublahi* were completely damaged by the flash floods. Demonstrated submergence tolerance variety Jalkunwari could not survive, however another variety *Jalashree* showed relatively greater tolerance to submergence which might be due to the observed greater regeneration ability and extended vegetative growth period of the variety under heavy submergence up to first week of October, 2012, but yield of the variety was very low (0.9 t/ha), which was not economically viable.

Fig. 4.2: Performance of normal and submergence tolerant cultivars at Ganakdoloni village during 2012

5. Initiative undertaken under NICRA-AICRPDA

5.1 Management of flash flood:

The performance of five traditional floating rice (*bao*) varieties along with other normal and submergence tolerant (Jalshree and Jalkunwari) varieties were evaluated under NICRA during 2012-15. In all the years, the rice fields were affected by multiple floods to a depth of up to 173 cm, causing extensive damage to the standing rice crop in the village. Though submergence tolerant rice varieties can withstand submergence up to 15 days during the seedling and tillering stages, the same varieties fail to survive if exposed to submergence for a few days during or after the panicle initiation stage (2012). During 2014, four improved deep water varieties (*Panchanan, Panindra, Basudev* and *Padmapani*) were also evaluated. But these varieties could not withstand multiple flashes with a depth of more than 150 cm. However, against the failure of normal, submergence tolerant and improved deep-water rice varieties, six traditional *bao* varieties evaluated in the village could survive intermittent submergences in different crop seasons and produced grain yield ranging from 1900 – 3000 Kg/ha (Table.5.1).

Table.5.1: Yield of traditional and improved *Bao* varieties at Ganakdoloni village during 2013, 2014 and 2015

Varieties	Yield (kg ha^{-1})			
	2013	2014	2015	Average
Kekowa	2672	2275	2078	2342
Dhusuri	3000	2438	2312	2583
Rangabao	1900	1628	2458	1995
Maguri	2813	2321	2854	2663
Bahadur	2963	2200	1901	2355
Tulshi	2400	2100	-	2250

One of the additional advantages of the traditional *bao* varieties is that green leaves of these varieties can be cut and used as green fodder for the live stock from July to October when there is acute shortage of fodder particularly in the flood affected areas. Experiment carried out under NICRA also revealed that without significant decrease in grain yield green fodder of 2041 q/ha can be harvested from single cut of these traditional *bao* varieties (NICRA-AICRPDA, AAU, 2015)

Thus it can be concluded that the problem of intermittent submergence (of depth more than 1.5 m) due to multiple flash floods which may continue up to the second week of October can be addressed by introducing traditional deep water or floating rice varieties, which can tolerate both flash floods and the occasional drought and possess genes for stem elongation, kneeing ability and submergence tolerance. However, genetic diversity of local *bao* varieties should be evaluated for several years and at different locations to identify the best varieties with the widest adaptation to environmental stresses like floods and droughts and suitable for developing climate resilient agriculture in flash flood affected areas of NBPZ of Assam. Moreover, a breeding programme involving the traditional *bao* varieties should be initiated to develop high yielding resilient varieties for flash flood affected areas of the region.

Fig. 5.1: Performance of normal *Sali* rice (Cv. Mahsuri) and (b) traditional bao varieties in Ganakdoloni village during 2013

Fig. 5.2: Performance of (a) improved *bao* verities and (b) traditional *bao* varieties

5.2. Management of Dry spells :

5.2.1. Through varietal manipulation:

Crop based approach of adaptation strategies can effectively be employed for management of dry spells in *Sali* rice grown under different land situations. Impact of dry spell on crop performance varies with length of the dry spell, type of crop/varieties grown and the land situations. Under similar condition of soil and length of dry spell, performance of the crops varies from one another depending upon water requirement of the crop. Similarly, same variety grown under different land situations responds differently to the same length of dry spell. Therefore, dry spell can be effectively managed through manipulation of crops/varieties for different land situations/soil types.

From the participatory evaluation trials of varieties of different durations in different land situation conducted at the NICRA village Chamua for last five years it was observed that in upland well drained loamy soils, short duration varieties like Dishang, Lachit, Kolong, Luit etc performed consistently better (3.22 t/ha) as compared to the farmers' cultivar or long duration cultivars (Table.5.2.1). However, average yield of farmers' variety grown on upland situation was only 1.8 t/ha. Under extreme situation (during 2011), a yield of 0.9 t/ha was realized in case of farmers' variety grown under upland situation.

Table 5.2.1: Performance of Short duration varieties in upland situation at NICRA village during 2011 to 2015 (No of participant farmers 38)

Variety	Yield (Kg/ha)
Disang	3595
Kolong	3141
Lachit	3295
Luit	2840
Total	**3218**

Fig.5.2.1: Performance of farmers' varieties under upland situation at NICRA village during 2011.

Fig.5.2.2: Comparative performance of farmers' variety and improved short duration variety (Dishang) at upland situation at Chamua village during 2013

It was found that in case of medium land and moderately well drained soil, medium duration varieties like TTB-404, Mulagabharu, Basundhara *etc* consistently performed better (4.0 t/ha) as compared to long duration or farmers varieties (with average yield of 3.0 t/ha) in spite of occurrence of terminal dry spells(Table.5.2.2).

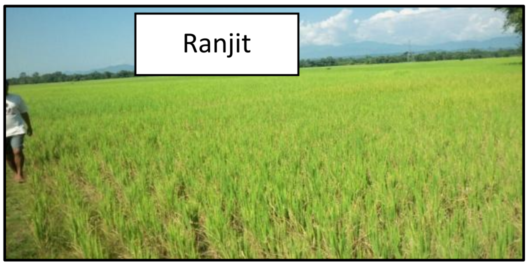

Fig.5.2.3: Long duration variety (Ranjit) affected by terminal dry spell at chamua

Fig.5.2.4: Medium duration varieties escaped terminal dry spell at Chamua village

Table.5.2.2: Performance of medium duration varieties at NICRA village during 2011 to 2015 (no of participant farmers 34)

Variety	Mean yeild (Kg/ha)
Basundhara	3915
Mohan	3722
Mulagabharu	4116
TTB-404	4364
Total	**4029**

From the above discussion, it can be concluded that intermittent dry spell can be effectively managed by replacing long duration high yielding and traditional rice cultivars with short and medium duration cultivars in upland and medium land situation respectively.

In low land situation and soils with poor drainage, the effect of terminal dry spell is the minimum. Therefore long duration varieties like *Ranjit, TTB-303-2-23, Gitesh, Moniram,* Mahsuri etc should be grown instead of farmers' variety or medium duration varieties**.** However, in case of delay in onset of monsoon, if these varieties cannot be sown in time (within 3rd week of June), there is every possibility that these may be affected by terminal dry spells. Therefore, farmers are encouraged to complete the sowing of the long duration rice cultivars before mid of June. This helps in early transplanting of rice seedlings which facilitates better establishment, better growth and better yield of long duration cultivars in case of occurrence terminal drought.

5.2.2. Alternate crops and crop diversification:

Rainfed rice requires higher quantity of water during crop growing season as compared to other crops. Therefore, with same type of soil and same amount of rainfall some other crops may perform better as compared to rice in upland and well drained medium land situations. Before implementation of the NICRA project in the Chamua village, rice was grown in all types of land situations (up, medium and lowland) available in the village and yield of rice varieties grown in such land situations reduced to a great extent in the years with multiple dry spells. The situation was worst during 2011 and yield of rice crop grown under such situation reduced to a great extent even below 0.9 qt/ha.

Fig.5.2.2.1: With same soil and same amount of rainfall rice field terribly suffered from dry spells; however other crops grown nearby in the same field did well in NICRA village Chamua during 2011

An alternate strategy of growing crops (that require less water) like ginger, turmeric, sesame, colocasia, balckgram, greengram and summer vegetables *etc* were taken up as contingency measure for management of dry spells under NICRA-AICRPDA, AAU. Growing of alternate crops and crops diversification proved to be more resilient to stress situation arising during mid season and terminal dry spells during *kharif* as well in *rabi* season. Moreover, crop diversification helps in achieving nutritional security, more employment and income generation, eco-friendly and poverty alleviation and comparative advantage in the trade. Farmers of NICRA village who adopted crop diversification instead of monocropping of *Sali* rice, especially in upland situations could earn net income as high as Rs. 1066275.00 per annum which was many fold more than their income from the monocropping of *Sali* rice (Rs. 20,000/ year) (Table.5.2.2.1)

Table.5.2.2.1: Drought management with alternate crops/crop diversification at Chamua village during 2015-16

Farmer	Crops	Rice equivalent yield (Kg/ha)	Net Income (Rs/ha)	Increase in net return (Rs/ha)	B:C ratio
Farmer-1	, Rice, Maize, Chili, Potato Rapeseed, Cabbage, Cauliflower, Brinjal	157745	1066275	1046275	3.16

Farmer -2	Rice, Maize, Sugarcane, Potato, Rapeseed ,Pea	598034	265498	245498	2.0
Farmer-3	Rice, Maize, Ridge gourd, Cucumber Ladies finger, Potato, Cabbage, Cauliflower, Knolkhol , Rapeseed	129747	811610	791610	2.71
Farmer-4	Maize, Turmeric, Colocasia, Ridge gourd Cucumber, Bhindi, Cow pea, Green gram, Sesame, Potato, Rapeseed, Cabbage, Brinjal	128059	897752	877752	3.93

It is worth to mention that Mr. Harendra Neog (Farmer-1), a progressive famer of Chamua village was awarded the "Best Dryland Farmer Award", 2014 by CRIDA-ICAR for adoption of crop diversification as climate resilient technology

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Lakhimpur farmer bags award, unit named best centre under agricultural initiative

Man who understood the ways of the land

SMITA BHATTACHARYYA

Jorhat, March 16: Harendra Neog, a farmer of Chamua village in Lakhimpur district, is all too familiar with how the land lies and is smiling all the way home.

Neog bagged the best dryland farmer award recently for successfully participating in the National Initiative for Climate Resilient Agriculture (NICRA), increasing his annual income almost tenfold in the process.

The initiative is under the aegis of the All India Co-ordinated Research Project for Dryland Agriculture, being implemented in 22 centres across the country by CRIDA, Hyderabad. The Indian Council of Agriculture and Research, New Delhi, funds it.

In Lakhimpur, the Biswanath Chariali AICRPDA centre, Assam Agricultural University, has been implementing the initiative since 2012. The Lakhimpur unit also received the best centre award.

Pallab Kumar Sarma, the chief scientist of the research project, said Neog and his son Diganta owned nearly five *bighas* of agricultural land, on which they were sowing only paddy.

"Our centre guided him in crop diversification and he sowed nearly 22 crops per year on the land, which is part owned and part leased. Apart from paddy, he sowed mustard, cabbage, peas, pumpkins, different varieties of gourds, other vegetables and pulses," Sarma said.

On how a place in Assam, particularly prone to flooding and heavy rainfall, could be selected under the dryland farming project, Sarma said in most places of Assam, the winter (Rabi) crop was not sown at all due to lack of irrigation.

"We have a prolonged dry season of nearly eight months after the monsoon is over. There is crop failure. In the recent years, we have had to contend with an erratic monsoon. Sometimes it turns dry mid-term or towards the end. We have to teach our rain-fed agricultural farmers how to cope with such situations," he said.

Some of the technological interventions involve rainwater harvesting, renovation of ponds and use of climate-resilient seeds. "Under our guidance, Neog was given interventions and an agriculture calendar, which helped in timely planting and harvesting of crops along with knowhow to tackle pests," a scientist said.

Neog told The Telegraph over phone from Lakhimpur that he was extremely happy with the result. "The number of crops I sowed yielded rich dividends and the profit I made was more than Rs 1 lakh in a year," he said.

Panjab Singh, the director-general of ICAR, emphasised the need for research and development in dryland agriculture. Sarma said of 22 network centres, the Biswanath Chariali centre at Assam Agricultural University was the youngest. It bagged the prestigious Best Centre Award, along with Bangalore (1970) and Indore (1971).

The award was in recognition of all-round performance of the centres in research, extension and upscaling of technology among the rain-fed farmers.

Sarma said the centre was implementing the climate resilient technology in Dhemaji and Nalbari districts and effecting an upgrade in Sonitpur.

Harendra Neog

5.2.3. Multiple cropping:

In Assam **o**pportunities are there to increase crop productivity by 3-4 folds through conversion of conventional monocropping of rice to double or multiple cropping. Under NICRA, land situation specific, profitable and climate resilient double cropping systems were identified and implemented at the village (Table.5.2.3.1).

Table.5.2.3.1: Double cropping systems identified different land situation of NICRA village

Sl.no.	Land situation	1st crop (Variety)	Second crop (variety)
1	Upland	*Sali* rice (Short duration varieties like Dishang)	Rapeseed (TS-36/TS-38)
2		*Sali* rice (Short duration varieties like Dishang)	Potato (Kufri Jyoti/Pokhraj)
3	Mid Land	*Sali* rice (Medium duration varieties like TTB-404)	Rapeseed (JT-90-1) Potato (Kufri Jyoti/Pokhraj)
4	Low land (relay)	*Sali* rice (Long duration varieties like Ranjit, Gitesh etc)	Pea (as relay crop)
5	Up/Mid/Low land situation	Rice	Maize

Demonstration of double cropping has been implemented in the NICRA villages continuously for last three years (2013-14, 2014-15, and 2015-16). It was observed that rice equivalent yield as well net income increased significantly in all the identified double cropping systems as compared to the existing monocropping of rice. The maximum rice equivalent yield and net income of 19460 kg/ha and Rs. 158303/ha, respectively was recorded in Rice + Potato system (Table.5.2.3.2).

Table.5.2.3.2: Performance of double cropping or relay cropping at NICRA village Chamua during 2014-15 and 2015-16 (pooled data) .

Cropping system	Crops	REY (Kg/ha)	Net income (Rs)
	Rice + Maize	15050	110075
	Rice + Maize + Pumpkin**	-	-
	Rice + Rapeseed	7534	36893
	Rice + Potato	19460	158303
	Rice + pea**	-	-

**Yield of pea and Pumpkin is not available

5.2.4. Introduction of maize as a climate resilient crop:

As maize has coarse fibrous root system which spreads widely and penetrates deeply, it is considerably more water-efficient crop. Since the crop is C_4 plant, it has higher level of adaptation to elevated CO_2 concentration and drought environment. That is why this crop is identified as climate neutral or climate resilient crop. Under NICRA, efforts are being made to introduce the crop in the adopted village. It was observed that this crop can be sown in all types of land situation available in the village in the driest period (in terms of rainfall received) of the year (December to February) after the harvest of *Sali* rice as well as other *rabi* crops like potato and rapeseed. During the winter months of 2011-12, 2012-13, 2013-14 and 2014-15, village received very less rainfall (27, 46, and 16.5 mm) but the farmers of the village were able to harvest very good crop with average grain yield of 30.67 qt/ha and B: C ratio of 3.08.

Fig.5.2.3.1: Popularization of Maize as climate resilient crop under NICRA project

5.3. Rain water harvesting and recycling – a water based adaptation strategy:

Under NICRA the major thrust was given in rain water management through *in-situ* moisture conservation and rain water harvesting in farm ponds or in other water harvesting structures and efficient utilization either as supplemental/life saving irrigations to *kharif* or *rabi* crops. Both *in-situ* and *ex-situ* rain water management not only mitigate dry spells but increase crop yields, rain water use efficiency and B:C ratios. Under NICRA, rain water management technologies were demonstrated in the adopted villages.

5.3.1. *In-situ* rain water harvesting for management of dry spell:

Mulching cum manuring with locally available agricultural waste materials and weeds like rice straw, straw of rapeseed, water hyacinth etc proved to be useful for management of intermittent dry spells in both *kharif (Turmeric, ginger)* and *rabi* (Tomato and Potato) seasons. Under NICRA, famers of the village were encouraged to take up alternate crops like turmeric and ginger with proper organic mulching in upland areas of the village which was a better option for avoiding adverse effects of intermittent dry spells.

Mulching in Potato and Tomato resulted in higher tuber/fruits yield, RWUE and net returns, as it helps in better utilization of residual soil moisture by the crops. In potato, labour requirement was reduced considerably as intercultural operations like earthing up; weeding and irrigation need not to be performed in mulched crop. The yield of potato (Cultivar- K. Pokharaj) was increased by 114 % when the crop was grown with organic mulching as compared to non mulched crop. It was observed that in tomato mulching not only assist in better growth of the crop, but also considerably increased the length of fruiting (harvesting) period of the crop as compared to crop grown without mulching. Mulching gave higher tomato yield of 16081 kg ha^{-1} (110% increase) with a net return of Rs. 111460/ ha and B:C ratio of 3.25 (Table.5.3.1.1).

Table.5.3.1.1: Performance of Potato (Variety: Kufri Pokhraj) and tomato (Variety: MT-327) with mulch cum manuring.

Crop	Variety	Yield (kg ha-1)		% increase in yield	RWUE (kg ha-1-mm)	Net returns (Rs/ha)	B:C ratio
		With mulching	Without mulching				
Potato	Pokhraj	20625	14043	46.8	252.14	50475	1.69
Tomato	MT-3	16081	7750	110	196.59	111460	3.25

Fig.5.3.1.1: In-situ water harvesting for dry spell management with organic mulching in potato (Kufri pokhraj) and Tomato (MT-3)

5.3.2. *Ex-situ* rain water harvesting for management of dry spell:

The average annual PET at Biswanath chariali is 1138 mm, which is lesser by 887 mm as comapred to the normal annual rainfal (1925 mm). Therefore the annual rain water harvest potential of the staion is 887 mm. From March to last part of October there is surplus water (means rainfall –PET is positive) of 935 mm which is known as humid part of the year. It is also observed that during premonsoon months (March to May) a considerable amount of rainfall can be harvested in the farm ponds. The part of harvested rainwater can be effectively utilized for timely sowing of *Sali* rice (particulty long duration varieties like Ranjit) in absence of rainfall during first part of June due to delayed onset of monsoon. Timely sowing followed by early transplanting of rice seedlings facilitates better establishment, better growth and better yield of long duration cultivars and also save the crop from adverse impact of terminal dry spell.

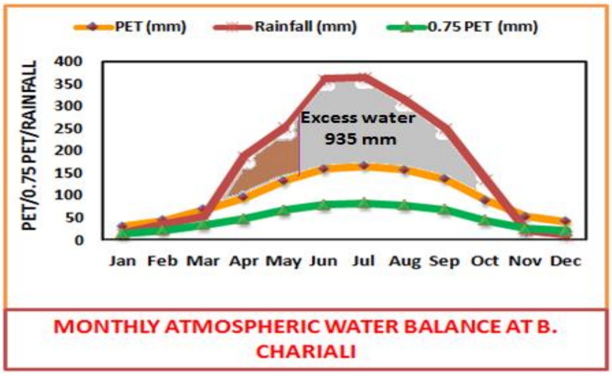

Fig.5.3.2.1: Rain water harvest potential and rain water harvested in farm pods during pre monsoon months at NBPZ of Assam.

From a field experiment conducted at BNCA during 2013, it was found that water collected from a catchment area of 224 m^2 (a roof area of 124 m^2 of a house + pond top surface area of 100 m^2) was sufficient to harvest rain water of 319 m^3 in a farm pond of same volume. The water collected in the pond was sufficient for providing two irrigations (0.06 m depth) in the potato crop cultivated in the area of 1840 m^2, resulting an increase in the tuber yield by 136% as compared to the rain fed potato crop (52.43 q/ha).

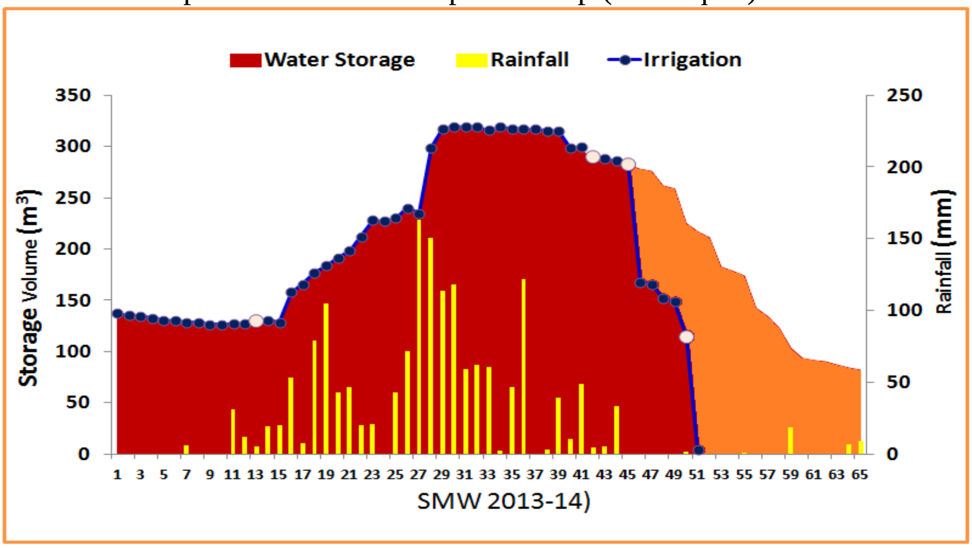

Fig.5.3.2.2: Rain water (collected from roof top) harvested at farm pond at the different SMWs during 2013 -14 at Biswanath Chariali

Thirteen farm ponds were renovated in the NICRA village during implementation of NICRA. Rain water harvested in these ponds during pre-monsoon months was used for sowing of *Sali* rice. During 2011-12, 2013-14 and 2014-15 onset of monsoon was delayed by 2-3 weeks, in such situation these farm ponds were very useful for completing sowing of long duration varietes before third week of June. In 2014-15, rain water harvested was used to sow *Sali* rice in a nursery area of 5.33 ha which covered an area of 53.3 ha in main field.

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Fig.5.3.2.3: Farm ponds renovated under NICRA

Rain water harvested in farm ponds during the monsoon months was efficiently utilized for providing 1-2 supplemental irrigation in *rabi* crops like potato and rapeseed. Supplemental irrigation gave higher yield of 14179 kg/ha (85.6% incraese) and 894 Kg/ha (107% incraese) in case of Potato (Kufri Jyoti) and rapeseed (TS-36), respectively (Table.5.3.2.1).

Table.5.3.2.1: Effective utilization of harvested rain water in potato and rapeseed during 2013-14

Crop	Variety	Yield(kg/ha)		Increase in yield (%)	Net return (Rs)	BC ratio
		With irrigation	Without irrigation			
Potato	Pokhraj	14179	9262	85.6	40153	2.13
Rapeseed	TS-36	894	463	107	17775	1.98
	TS 38	1170	-	-	28815	2.61

Fig.5.3.2.4: Performance of Potato and rapeseed with supplemental irrigation from the harvested rain water

5.4. Efficient energy Use and Management through establishment of custom hiring centre:

Efficient use of energy is important for increasing production, productivity and competitiveness of agriculture in general, and *rainfed* agriculture in particular. In the changing climatic environment, frequency of destructive weather aberrations (like heavy rainfall events, drought, flood, *etc.*) affects agriculture sector. In such situations, timely completion of farm operations is very important which could be accomplished through the use of improved implements and machines. Thus, mechanization is the key for building climate resilient agriculture in the country (Srinivasarao *et al*., 2013). Since resource poor farmers can't afford to purchase the costly farm implements/machines of their own, therefore, custom hiring centre with need based farm implements/machines (rotavator, cultivator, thresher, reaper, transplanter, water lifting pumps, duster, sprayers etc) was established under NICRA project. These implements were made available for hiring by the needy at cheaper rates fixed by the Village Management Committee. The income earned by the centre has been utilized in providing remuneration to the operators and repairing of the implements. Few youth of village were trained in FMTTI, Biswanath Chariali for operation and maintenance of the farm implements of the centre. Timely farm operations carried out with the help of custom hiring center facilitated the farmers to complete sowing or transplanting in time. It also helped them to take more than one crop or crop diversification. Farm implements were proved to be cost effective and saved the time to a large extent (Table.5.4.1).

Table.5.4.1: Farm implements made available through Custom Hiring Centre during 2014-15

Name implement used	Type of farm operation	No. of farmers and area covered (ha)	Time saved/ha compared to farmers practices	Saving in cost of operation/ha compared to farmers practice (Rs/ha)	Resource generated by hiring implements (Rs)
WLP	Nursery bed preparation of *Sali* paddy	80 (5.33) (Main field: 53.3 ha)	20.6 hrs	750.00	4000.00
Power tiller	Ploughing	75 (20)	41.2 hrs	750.00	30000.00
Cultivator	Ploughing	120 (56)	43.1 hrs	375.00	8400.00
Rotavator	Plouging	80(45)	94.5 hrs	2250.00	10125.00
Paddy Thresher	Threshing of paddy	145 (45.1)	56 hrs	1875.00	22330.00

A study conducted revealed that with increase in the level of mechanization, the human and animal hour requirement for paddy cultivation was reduced from 795 to 350 and 352.5 to 22.5 hr/ha, respectively (Fig 17). Thus mechanization helped in a substantial reduction of drudgery of human and animals. It was also found that total energy requirement for paddy cultivation in the studied six levels of energy input ranged from 5630 to 8448 MJ/ha. Thus energy used in paddy cultivation could be reduced by 8 to 23% by increasing the level of mechanization .

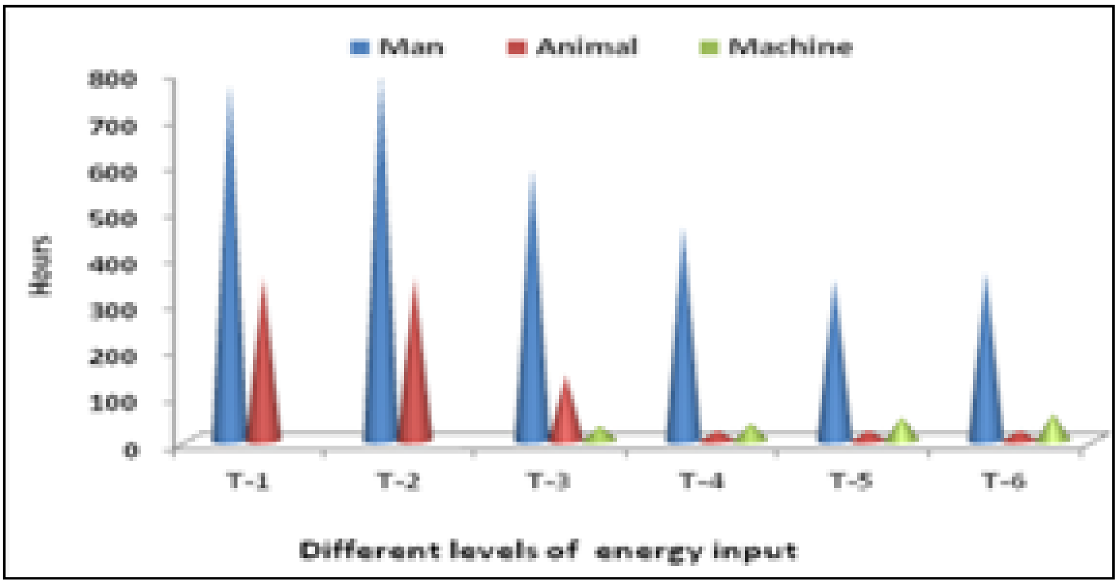

Fig.5.4.1: Human, animal and machines hours required for different farm operations in cultivation of *Sali* paddy under different levels of energy input

5.5. Integrated farming system and alternate land use:

Alternate land use and farming system can play a great role in building climate resilient agriculture. Therefore efforts are being made through NICRA project to strengthen our age old integrated farming system, rejuvenate traditional *bari* system, protected cultivation under low cost poly house, and promotion of vermicompost production *etc*.

5.5.1 *Bari* (homestead garden) development:

The *bari* system of Assam is a kind of farming system having animal (cow, goat, duck, poultry, pig *ect*), crop (vegetables, fruits species like arecanut, betel vine, coconut, banana, papaya, litchi, mango, guava *etc*) and fishery (farm pond) components with intense accommodation in surrounding area of their houses. *Bari* system is the most important component of agriculture in Assam, which significantly contributes towards the house hold income of the farmers. Very intensive, multistoried integrated *bari* system of Assam is identified as an important farming system which can contribute significantly in building climate resilient agriculture. All farm families of the NICRA village Chamua are having *bari* systems which are either inherited or developed by themselves. There is marvelous scope for increasing the productivity of the traditional *bari* system through scientific intervention and thereby bringing more resilience to agriculture in view of increasing weather variability due to climate change. An area of 15.51 hectares (11.7% of total area) of the village is under homestead farming with the average size of 0.12 ha per family. The major components of the bari *farming* system of the village comprises of plantation crops (like coconut, areca nut, black pepper etc) seasonal crops (vegetables), fishery and animal component (cow, goat, duck, poultry, pigeon and pig). Almost every house hold has a farm pond inside their *bari* system. The three major components of bari system of NICRA village *viz.*, fishery, plantation crops and vegetables occupy 34.2, 31.6 and 22.6 percent of total area of homestead garden, respectively (Table.5.5.1.1).

Table.5.5.1.1: Economic analysis of homestead components in NICRA village

Homestead component	Area (ha) or Number of livestock	Cost of cultivation (Rs)	Yield (Kg) or in Numbers	Gross income (Rs)	Net income (Rs)	BC Ratio
Plantation Crop						
Arecanut	3.4 ha	317000	35360 kg	884000	567000	2.8
Coconut		115600	3468 nos	693600	578000	6.0
Blackpepper		100000	1326 kg	397800	297800	4.0
Dairy						
Jersey Breed	30 nos	876000	55920 ltrs	2236800	1360800	2.6
Locai Breed	235 nos	1679000	49350 ltrs	1974000	295000	1.2
Fishery	5.3 ha	440264	12619 kg	2640509	2200245	6.0
Duckery	306 nos	30600	306 nos	122400	91800	4.0
Piggery	66 nos	132000	66 nos	396000	264000	3.0

The economic analysis of various components under the homestead farming shows that coconut, among the plantation crop, had the highest B: C ratio of 6.0 while among the livestock components fishery had the highest B: C ratio of 6.0.The lowest B: C ratio of 1.2 was found in case of local breed of cattle

5.5.2. Protected cultivation inside low cost poly house:

During 2014-15, seven low cost poly houses were erected in Chamua village under NICRA for demonstration of cultivation of high value off season vegetables and raising vegetables seedlings in advance for *rabi* season. Due to heavy rainfall up to mid of October, often it becomes difficult to raise seedlings of cole crops, tomato, brinjal, chili *etc*, which causes delay in planting of rabi vegetables. Thus low cost poly houses save the crop from heavy rainfall. Moreover high value crops and off season vegetables can be successfully grown in the poly house which is otherwise not possible due to heavy rainfall during rainy season.

5.5.2.1.Success story: 1

During 2014-15, a small farmer (*Mr. Ratul Mahanta*) with 0.03 ha of land used his poly house for raising seedlings of tree and fruit plant species as well as vegetables. The farmer grew seedlings/cuttings of various species of trees (forest tree), fruits, flowers, vegetables and medicinal plants. During the year 2015 he raised 31700 seedlings of 24 forest tree species, 3800 seedlings of 9 fruit tree species and 100 seedlings of other plant species. The farmer was able to earn a net income Rs. 24, 34,286.00/ha/year with B: C ratio of 5.82 from his small nursery.

Fig.5.5.2.1.1.: Poly house is used for raising seedlings of tree species

5.5.2.2.Success story –II:

Mr. Harendra Neog, a small farmer of NICRA village used his polyhouse for growing crops like – *Lata bih jalakia* (a species of hot chilli), unseasonal vegetables like tomato, Laisak (Brassica *spp*), Chinese cabbage, cucumber etc. The farmer earned Rs. 8080.00 (Rupees eight thousand eighty) from April to October, 2015 from the crops grown in the poly house. His earning from the polyhouse is expected to increase in future.

Fig.5.5.2.2.1: Performance of various crops in the low cost poly house during 2015-16

5.5.3. Production of vermicomopst:

Production and use of vermicompost was demonstrated among the farmers of the village. Vermicompost produced by the famers was utilized in their crop field. On an average vermicompost production was 1000 kg per tank per annum.

Fig.5.5.3.1: Vermicompost production in NICRA village Chamua

5.5.4. Integrated Farming System:

During 2015-16, a model farming system with different components (paddy + Fish + Duck + horticultural crops (citrus and banana)) was developed in an area of 0.65 ha in Chamua village with farm pond of size 6 m x 6 m x 2.5 m and a duck house (floor area of 25 m^2). The bunds created at the boarders was used for cultivating horticultural crops like *Assam lemon, banana* etc.

Fig.5.5.4.1: A model of farming system developed for small farmers of the NICRA village.

5.6. Other interventions undertaken for building climate resilient agriculture:

5.6.1. Village seed bank:

Maintaining a seed bank is one of the adaptation strategies to tackle the adverse situations arising due to occurrence of extreme weather events. Therefore, effort was made to establish a seed bank of paddy varieties of different duration which are suitable for overcoming adverse situations arising due to occurrence of aberrant weather conditions like flood and drought**.** Establishment of village seed bank helps the small and marginal famers of the village for self reliance for seed, an important input in agriculture. Farmers of the NICRA village were encouraged to produce seeds of different improved rice cultivars of different durations suitable for different land situations and two varieties of rapeseed (TS-36 and TS-38). Moreover more than 30 land races of rice were maintained by the farmers of the village. Records of availability of seed in the village were maintained in village office and seed availability is displayed in the village office. Seeds of different varieties /crops were exchanged among the farmers of the village. Moreover impact of village seed bank of Chamua was realized in nearby villages (horizontal expansion of the climate resilient technology).

Fig.5.6.1.1: Seed bank of NICRA village Chamua

Fig.5.6.1.2: Farmers of nearby villages are benefited from the seed bank of NICRA village

5.6.2. Agromet Advisory Services:

Any contingency measure, either technology related (land, soil, water, crop) or institutional and policy based, which is implemented based on real time weather pattern (including extreme events) in any crop growing season is considered as *real time contingency planning.* Agromet advisory services play very important role in preparedness and real response stage of the contingency crop planning in agriculture. Agromet advisory service helps the farmers in decision making process in preparedness stage of real time contingency planning such as land related (e.g. Land situation wise decision making, raise bed or flat bed etc), rain water harvesting (mulching, farm pond, micro irrigation system etc), crop related (selection of suitable crop/varieties), management related (management of insect-pest, diseases, nutrient, weed etc). The only way to address real time response to weather aberrations is through agromet advisory services. Thus this service plays a vital role in planning agricultural contingency. For example, entire North Bank Plains Zone of Assam was affected by intermittent flash flood during *kharif*, 2015 affecting standing crop of both *Ahu* and *Sali* rice. Early season and mid season floods caused not only submergence of the *Ahu/Sali* rice but also inundation of the vacant field for different periods of time. As a result, fields could not be used for sowing and/or transplanting of *Sali* paddy. As a real time response, different agromet advisories were prepared for different flood situations and weather related information were disseminated among the farmers of the agroclimatic zone.

Table.5.6.2.1: Agromet advisories issued as real time response to weather aberration during *kharif*, 2015-16

Sno.	Situation arising due to weather aberration	Advisory given
1	If sowing is possible within 30^{th} June,	Sowing of normal varieties (Ranjit, Bahadur, etc)
2	If sowing is not possible within 30 June due to stagnant water /recurrent flood	Sowing of medium duration varieties (Satyaranjan, basundhara, TTB-404 etc).
3	If sowing is not possible up to 15 July	Sowing of short duration varieties like *Lachit* and *Chilarai* .
4	If sowing is not possible up to 30 July	Sowing of very short duration varieties like Luit, Kapili, Kolong and Disang. Sowing can be continued up to first week of September

Weather forecast based agrometeorological advisories prepared by Agromet Advisory Services, Sonitpur are being regularly displayed in the NICRA village Chamua. There is no doubt that the farmers of the NICRA village are being immensely benefited from the advisories.

Fig.5.6.2.1: Mini weather station and *Agromet Advisories* dislapyed in NICRA village chamua

Two of the case studies showing usefulness of agromet advisories for managing weather aberration in real times basis by farmers of NICRA village are given below.

5.6.2.1.Case study I:

The NICRA village Chamua recoded exceptionally high rainfall during May 2015 (415 mm). The wet spell (50% excess rainfall) occurred in the village affected maize crop which was in grain filling stage.

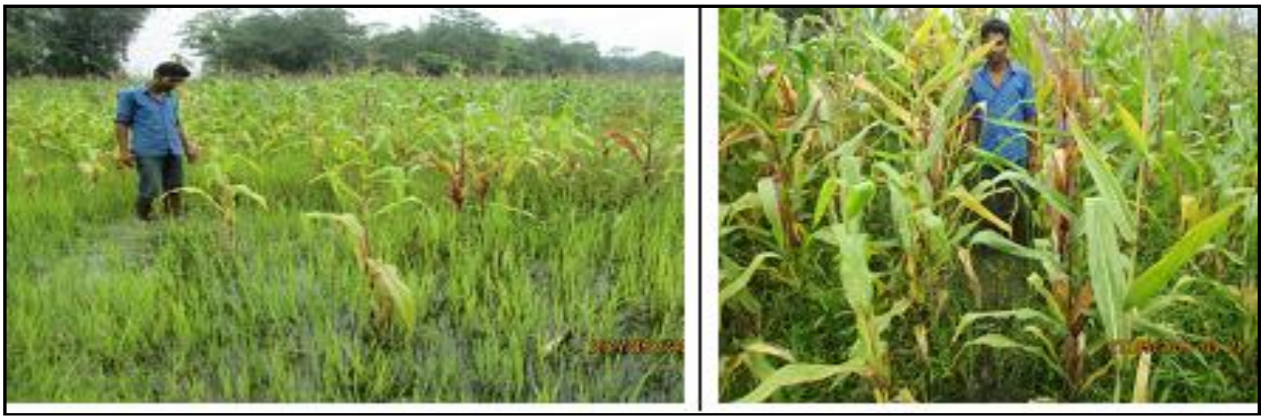

Fig.5.6.2.1.1: Heavy rainfall during May, 2015 affected the maize crop in NICRA village

Daily rainfall forecast (for Lakhimpur district) received from IMD almost matched with the actual daily rainfall recorded in the village during that period. The weather information (weather forecast) available at that time was very much useful in managing the situation arising due to the excess rainfall through real time agromet advisories. Farmers were benefited by the following advisories issued and displayed in the village.

- Drain out the water from the fields where maize was grown.
- Harvest the green cobs.
- If draining out of water from the field is not possible, harvest green cobs and harvest the crops for fodder

5.6.2.2. Case study II:

Weather of the NICRA village Chamua was exceptional in terms of cloudiness and relative humidity during the month of January, 2016. From 9 Jaunary to 31 January, 2016 (14 days) cloud was almost overcast and in most of the days evening relative humidity varied from 70 to 90%. High humidity and overcast sky along with four rainy days was very favourable for outbreak of late-blight disease of potato and tomato. Potato grown in 12 ha of land in the NICRA village was damaged and there was a yield reduction upto of 50%.

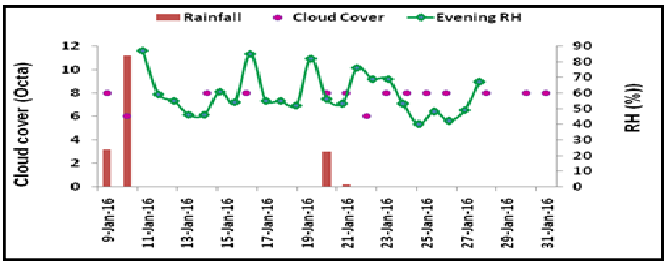

Fig.5.6.2.2.1: Daily rainfall, cloud cover, evening relative humidity recorded during Jan, 2016 at Chamua village

Based on weather forecast available (on overcast sky, high relative humidity and light rainfall) agromet advisories were prepared and displayed in the village. Farmers were benefited from agromet advisories because they achieved an increase in yield of potato by 127% (from 9490 to 21563 kg/ha).

Fig.5.6.2.2.2: Impact of Agromet Advisory Services on performance of potato at Chamua, during 2015-16

5.6.3. Village level institution:

Village level institution (known as Village Level Climate Risk Management Committee) played very important role in identifying and facilitating implementation of interventions and smooth functioning of NICRA project. It identified, innovated and implemented risk resilient interventions in a participatory mode and also helped in sensitizing and building the adaptive capacity of the farmers. Various climate resilient interventions like renovations or establishment of new farm ponds, crop, land and soil based interventions, establishing and efficient functioning of the custom hiring centre, creating village assets etc could be effectively implemented through village level institution. The Village Climate Risk Management Committee, Chamua, is headed by the president of the committee. The VLRMC, Chamua has been successfully managing various activities of NICRA project right from the beginning. Renovation or construction works related to the NICRA project like establishment of custom hiring centre, erecting training hall, renovation of farm ponds, erecting housing facilities of duck and pigs, erecting low cost poly houses, construction of vermicompost units *etc* were carried out with the help of the committee. It is worth mentioning that the VLRMC helps enormously in adopting climate resilient technologies not only in the NICRA village but also in nearby villages. For running the custom hiring centre a subcommittee was constituted under VLRMC of the village. The members of VLRMC of the village assemble regularly and discuss the progress of activities of the NICRA project implemented at their village and communicate the outcome of the meetings to the Chief Scientist, AICRPDA, BNCA.

Fig.5.6.3.1: Training hall and village office of NICRA village

5.6.4. Capacity building:

Training/ demonstration of operation of farm implements /exposure visits/ sensitization meetings/ animal vaccination camp/ awareness programme harvest festivals were organized from time to time under NICRA project.

Fig.5.6.4.1: (a) Visit of honourable Vice-Chancellor, AU, Jorhat,
(a) Glimpses of harvest festival and farmers' Fair, 27, 2015

Fig.5.6.4.2: Trainings/demonstration programme organized in the village.

Year	No. of trainings	Topic	Duration	No. of trainees	Funded by
2010-11	2	NICRA sensitization meeting	1	60	NICRA
		NICRA sensitization meeting	1	65	NICRA
2011-12	9	Scientific cultivation of turmeric, ginger and hybrid Napier (fodder crop) at the NICRA village.	1	30	NICRA
		Training on scientific cultivation of rice organized at the NICRA village.	1	30	NICRA
		Training programme on scientific cultivation of black gram, green gram, sesame (Sole and intercropping) organized at the NICRA village.	1	30	NICRA
		Training programme on scientific cultivation of potato, rapeseed and pea was conducted at the NICRA village.	1	30	NICRA
		Demonstration cum training programme on operations and use of farm implements at the NICRA village. (In collaboration with Farm Machinery Training and Testing Institute for NE Region, Biswanath Chariali, Assam.)	3	30	NICRA
		Training programme on production and use of vermicompost and other organic manures at NICRA village.	1	45	NICRA
		Training programme on scientific cultivation of Ahu rice, Maize and Colocasia.	1	80	NICRA
		Training programme on production and use of vermicompost and other organic manures at NICRA village.	1	100	NICRA
		Training on post harvest storage of fruits	1	100	NICRA

2012-13	1	Training on rice based rainfed production system under TSP, AICRPDA at Laxmi Multipurpose Agricultural Farm, Pavoi, Sonitpur,Assam	1	32	TSP
2013-14	25	Natural Resource Management	1	30	TSP
		Backyard poultry rearing- Vanraja	1	30	TSP
		Backyard poultry rearing- Vanraja	1	30	TSP
		Group dynamics	1	30	TSP
		Post harvest management	1	30	TSP
		INM on Sali paddy	1	30	TSP
		Fish-Livestock-Horticulture- IFS	1	30	TSP
		Management of Fish Pond	1	30	TSP
		Vocational training on broiler farming	1	30	TSP
		INM in paddy cultivation	1	30	TSP
		Scientific maize cultivation	1	30	TSP
		Training on “Agromet Advisory Services for Village Level Climate Managers” organized in collaboration with Agromet Advisory Services, Sonitpur and RMC, Guwahati at BN College of Agriculture.	1	23	NEH
		Training on “operation and maintenance of agricultural implements and machines” in collaboration with ‘North Eastern Region Farm Machinery Training and Testing Institute (FMTT for NER)’, Biswanath Chariali, Assam was organized at the NICRA village Chamua**,** Lakhimpur.	3	30	NICRA
		Backyard rearing of Dual Purpose Poultry breed “Vanraja”	1	40	TSP
		Breed up gradation of cattle through Artificial Insemination (AI)	1	41	TSP
		Training on Managing Group Dynamics	1	23	TSP
		Post –Harvest Management	1	20	TSP
		Vocational Training cum Demonstration on Broiler Farming	17	25	TSP
		IPM on Sali paddy cultivation	1	25	TSP
		Fish-Livestock-Horticulture farming as IFS model	1	28	TSP
		Year round management of Fish Pond	1	25	TSP
		INM in Paddy cultivation	1	33	TSP
		Scientific cultivation of Maize	1	33	TSP
		Natural Resource Management	1	18	TSP
		Exposure visit of Farmers of TSP village, Jalakiasuti to Biswanath Chariali College of Agriculture on 12-12-2013	1	30	TSP
2014-15	29	Crop diversification and farming system	1	69	NICRA
		Flash flood resilient agriculture	1	41	NICRA
		Demonstration of operation paddy transplanter	1	84	NICRA
		Training for village level Climate	1	20	NEH

		manager			
		Training for village level Climate manager	1	20	NEH
		Training for village level Climate manager	1	20	NEH
		Demonstration operation potato planter	1	80	NICRA
		Training on scientific cultivation of potato from TPS	1	60	NICRA
		Training on playhouse technology for cultivation of vegetables	1	56	NICRA
		Training on **“**Poly-house technology for cultivation of vegetables”	1	50	PFDC ,ICAR
		Training on “Poly-house technology for cultivation of vegetables” in collaboration with Precision Farming Development Centre, Horticultural Research Station (AAU), RARS Kahikuchi, at NICRA village Chamua.	1	52	PFDC ,ICAR
		Farmer’s Awareness Programme organized by Gramin Krishi Mausam Sewa(GKMS),Sonitpur(AMFU) in collaboration with AICRPDA,BNCA	1	30	GKMS
		Training programme for “Village Level Climate Manager” organized by AICRPDA, NICRA in collaboration with Gramin Krishi Mausam Sewa(GKMS),Sonitpur(AMFU)	3	30	GKMS
		One day training on nursery management and horticulture at NICRA upsacling village Nalbari	01	30	NEH
		One day training on nursery management and horticulture at NICRA upsacling village Nalbari	1	36	NEH
		Vegetable production inside poly house	1	34	NEH
		Training on field crop cultivation and seed production	2	29	NEH
		Training on fishery poultry and Animal husbandry	2	34	NEH
		Training on Improved cultivation practices of paddy	1	28	TSP
		Training on improved cultivation of potato	1	25	TSP
		Training on care and management of pigs	1	33	TSP
		Training on improved cultivation practices of banana	1	24	TSP
		Training on integrated farming system of livestock and fishery	1	21	TSP
		Training on preservation of seasonal vegetables by pickling	1	25	TSP
		Training on improved cultivation practices of Black gram	1	22	TSP
		Training on Improved cultivation of Oilseeds	1	25	TSP

		Training programme cum exposure visit to FMTTI, Biswanath Chariali on 05.05.2015 for 1 month	30	9	TSP
		Training cum exposure visit on " Certificate course in Textile, Dying and printing at Assam Agricultural University, Jorhat	30	4	TSP
		Training cum exposure visit on " Modern Agriculture practices at SIRD, Guwahati	21	4	TSP
2015-16	04	Farmers Field School at on Scientific rearing of broiler farming	21	20	TSP
		Vocational training programme on carpet making	7	30	TSP
		Exposure visit to Gingia, college of Agriculture, BNCA & Pabhoi Multipurpose Agricultural Project at Biswanath Chariali	1	25	TSP
		Techniques for preservation of fruits and vegetables	2	31	NICRA
2016-17	05	Scientific cultivation of sugarcane as alternate crop	1	30	NICRA
		Training on maintenance and operation farm implements at Chamua village	2	30	NICRA
		Awareness programme on arsenic contamination of ground water and health hazards at Chamua village Chamua	1	30	NEH
		Field day on seed production of rice	1	34	NEH
		Farmers'-scientists interaction on promoting medicinal plants cultivation as a tool of biodiversity conservation and livelihood enhancement in NICRA up-scaling village, Nalbari	1	50	NEH
Total	**75**		**205**	**2631**	

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OMPOST PRODUC ON
Unit No-2
NICRA AICRPDA
BN College of Agriculture(A


CUSTOM HIRING CENTRE
National Initiative on Climate Resilient Agriculture(NICRA)Project
AICRPDA, BN College of Agriculture, Assam Agricultural University
Chamua, Borbali-784163-Lakhimpur, Assam.


THANK YOU
ALTERNATE LAND USE AND FARMING SYSTEM
CROP DIVERSIFICATION
RAIN WATER HARVESTING AND RECYCLING
FARM POND
Cow Shed
MIXED FARMING
DUCK HOUSE
UP LAND
RABI SEASON
After Flood
TS- 36
TS- 38