

# CLIMATE SMART VILLAGES OF NORTH EASTERN HILL STATES OF INDIA



ICAR- Agricultural Technology Application Research Institute  
Umiam, Meghalaya-793103

# Climate Smart Villages of North Eastern Hill States of India



**ICAR- Agricultural Technology Application Research Institute**  
Umiam, Meghalaya –793103  
(An ISO 9001:2015 certified organization)

## **Climate Smart Villages of North Eastern Hill States of India**

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### **Published by**

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November, 2019

### **Printed at**

Rumi-Jumi Printers

6<sup>th</sup> Mile, Guwahati

Ph. No: 9864075734



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## **FOREWORD**

Climate change leading to increase in temperature and heavy/ erratic rainfall events has been observed all over India including Northeast India in last few years. North Eastern region of India is much more vulnerable to hydro-meteorological natural disasters compared to other parts of the country. Keeping these facts in view, Indian council of Agricultural Research (ICAR) had launched a project: National Innovations in Climate Resilient Agriculture (NICRA) so as to enhance resilience in Indian agriculture to climate change. As a part of this initiative technology demonstrations on location-specific climate resilient technologies are being demonstrated in 14 vulnerable districts of NEH States *Viz.*, Manipur, Meghalaya, Mizoram, Nagaland and Tripura through Krishi Vigyan Kendras under ICAR-ATARI, Umiam. Demonstration of appropriate practices and technologies with a climate focus has been taken up in farmer participatory mode in NICRA villages.

I am happy that ICAR-ATARI, Umiam as a part of NICRA Project has taken an initiative to bring out a publication entitled “Climate Resilient Villages of North Eastern Hill States of India” highlighting the impacts of the climate resilient technologies. I hope this publication will be helpful to those involved in planning and promoting climate resilient agriculture. I compliment the Director, ICRA-ATARI, Umiam and the entire team for their effort to bring out this valuable publication.

Dated : 15.11.2019

**(A.K. Singh)**

## Preface



### Greetings from Team ICAR-ATARI, Umiam!

Global climate change leading to increase in temperature and heavy rainfall events and decrease in low and medium rainfall events has been observed all over India including Northeast India in last few years. This situation has therefore, attracted the attention of the scientists and policy makers of the country. North Eastern region of India is much more vulnerable to hydro-meteorological natural disasters compared to other parts of the country. Keeping these facts in view, ICAR decided to initiate NICRA activities in selected KVKs of the country.

Technology demonstration is a key component of NICRA and is being implemented in 14 KVKs under ICAR-ATARI, Umiam representing different agro-climatic conditions in 5 North Eastern States *viz.* Manipur, Meghalaya, Mizoram, Nagaland and Tripura. Drought, floods, soil erosion *etc.* are the major climatic vulnerabilities in the region. Various climate proofing technologies available in the technology basket of NARS system were put-forth by KVKs in order to overcome the adverse effect of climate change events in the region. Efforts were made to spread the resilient practices to all the households in the NICRA villages and adjoining villages. Rehabilitation of shifting cultivation areas by way of terraced rice cultivation, adoption of climate resilient cultivation practices, implementation of resource conservation technology like micro-irrigation and rain water harvesting system, strengthening of the water storage infrastructure, soil conservation measures, integrated farming system, introduction of climate resilient breeds of plants and livestock, community based interventions *etc.* were some of the activities initiated in the identified climate vulnerable villages of various districts of the region.

This publication emphasizes the most significant achievements of the KVKs in the selected NICRA villages by depicting the weather profile of the last decade with a special focus on the climate resilient interventions under the four modules, *viz.*, NRM, crop production, Livestock and fisheries, institutional interventions. We take this opportunity to gratefully acknowledge the constant guidance and support from Dr. Trilochan Mohapatra, Secretary (DARE) & Director General (ICAR), A.K.Singh, DDG (AE), Director, CRIDA, Hyderabad, the Chairman and members of the High Level Monitoring Committee. I sincerely acknowledge the contribution of Mrs. Divya Parisa, Scientist, ICAR-ATARI, Umiam and her team and the KVKs for execution of the project and bringing out this publication.

Dated : 15.11.2019

  
 (Bidyut C. Deka)  
 Director

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## INTRODUCTION

National Innovations on Climate Resilient Agriculture (NICRA), a network project of the Indian Council of Agricultural Research (ICAR) was launched in February, 2011 with an aim to enhance resilience of Indian agriculture to climate change and climate vulnerability through strategic research and technology demonstration. The research on adaptation and mitigation covers crops, livestock, fisheries and natural resource management.

The main objectives of the project are:

- To enhance the resilience of Indian agriculture covering crops, livestock and fisheries to climatic variability and climate change through development and application of improved production and risk management technologies.
- To demonstrate site specific technology packages on farmers' fields for adapting to current climate risks.
- To enhance the capacity building of scientists and other stakeholders in climate resilient agricultural research and its application.

The project is comprised of four components.

- Strategic research on adaptation and mitigation
- Technology demonstration on farmers' fields to cope up with current climate variability
- Sponsored and competitive research grants to fill critical research gaps
- Capacity building of different stake holders

The Technology Demonstration Component (TDC) deals with demonstrating proven technologies in crop and livestock production systems to climate variability. This component is implemented in selected vulnerable districts of the country through location specific interventions by Krishi Vigyan Kendras (KVKs) in a participatory mode. The project is being implemented in farmers' field through 14 KVKs under ICAR-ATARI, Umiam representing different agro-climatic conditions in 5 North Eastern States *viz.* Manipur, Meghalaya, Mizoram, Nagaland and Tripura. Various interventions and adaptation measures were put forth to address the change in climate and its implications on agriculture, food security and livelihood of the agricultural communities.



**Table: State wise details of NICRA KVKs along with their climatic vulnerability**

State	District	Agro-climate	Vulnerability
Manipur	Senapati	Sub Tropical Plain Zone	Drought/water stress
	Imphal East	Mild Tropical Hill Zone	
	Ukhrul	Sub Tropical Hill Zone	Frost /Soil Erosion
Mizoram	Lunglei	Sub Tropical Hill Zone	Water stress
	Serchipp	Mid Tropical Plain Zone	Drought
Meghalaya	Ri-bhoi	Mid Tropical Hill Zone	Drought/water stress
	West Garo Hills	Sub Tropical Hill Zone	
	Jaintia Hills	Sub Tropical Hill Zone	Drought/ Flood
Nagaland	Phek	High hill Zone	Drought/water stress
	Dimapur	Mid Tropical Plain Zone	
	Mokokchung	Mild Hill Zone	
	Mon	Upper Brahmaputra Valley Zone	Drought/ Soil erosion
Tripura	Dhalai	Mid Tropical Plain Zone	Flood/ Soil erosion
	Khowai	Mid Tropical Plain Zone	Drought like situation

These districts were selected based on the following criteria:

- Drought proneness based on 30 years rainfall data
- Cyclone proneness based on frequency as recorded by IMD/State Disaster Management agencies.
- Flood proneness based on IMD data and NDMA maps.
- Vulnerability to heat wave and cold wave based on IMD grid data on temperatures.
- Actual incidence of floods and drought as recorded by AICRPAM centres
- Strength of the KVKs

The interventions in the village panchayats after the base line survey and PRA were finalized following a participatory approach through the Village Climate Risk Management Committee (VCRMC). The program was launched formally in all the villages by involving the state line department functionaries and leaders of the panchayats so as to ensure local ownership of the project.

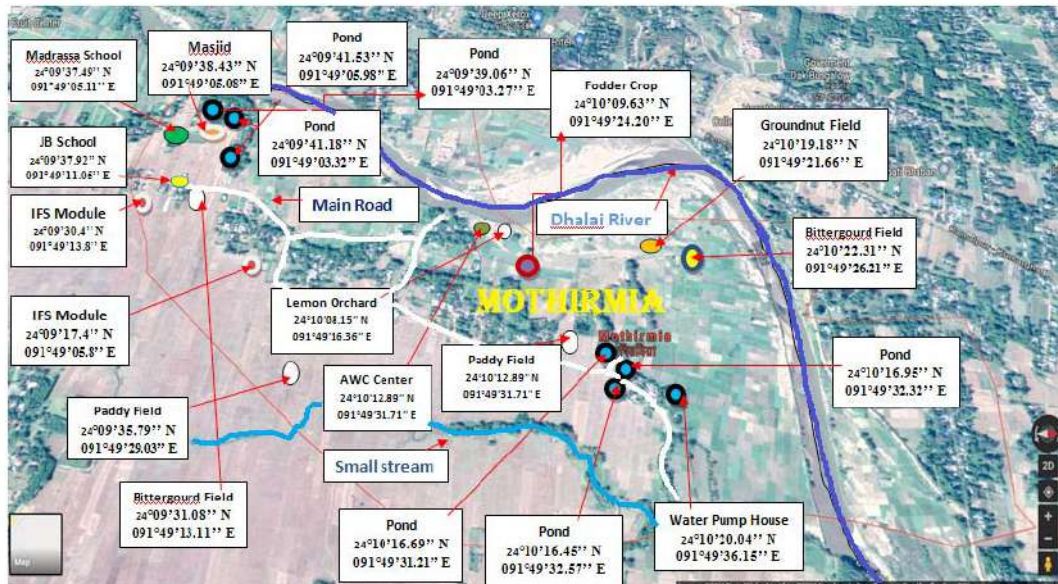
**Table: Villages adopted by NICRA-KVKs under ICAR-ATARI, Umiam**

<b>S. No.</b>	<b>Name of KVK</b>	<b>Name of village</b>
1	Imphal East	Andro, Top Chingtha and Yambem
2	Senapati	Hengbung-I, Mayangkhang and Makhan Village
3	Ukhrul	Ramva Village
4	Jaintia Hills	Umjalasiaw
5	Ri-Bhoi	Kyrdem
6	West Garo Hills	Marapara, Sananggre, Rongbokgre, Bagugre, Rim-rangpara
7	Lunglei	Hnahthial
8	Serchipp	N. Vanlaiphai
9	Dimapur	Dhansiripar
10	Mokokchung	Aliba
11	Mon	Ngangching
12	Phek	Thipuzumi
13	Dhalai	Salema
14	Khowai	North Pulinpur ADC Village

## Building climate smart village: KVK-Dhalai



The project was formally launched in 2015 at Methirmia village of West Kuchainala G/P, Dhalai. The village was selected because of its prevailing climatic vulnerability like soil erosion, flood and drought like situation.



Digital map of NICRA village depicting the climate smart interventions

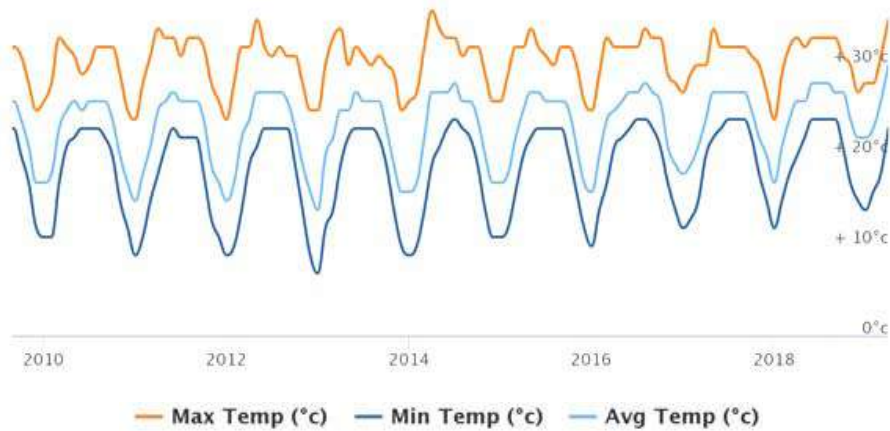


Fig. Weather graph showing minimum and maximum temperature trends in Dhalai District

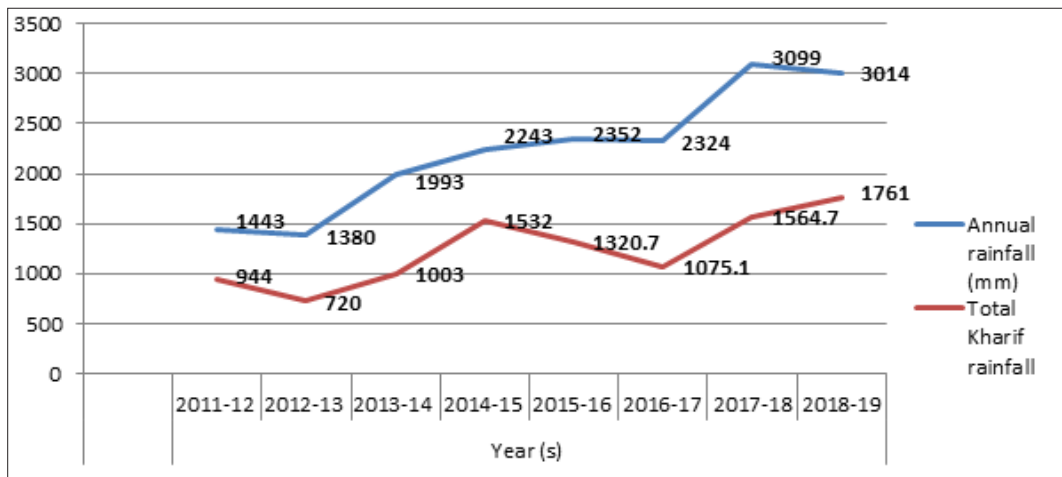


Fig. Weather graph showing annual rainfall pattern along with number of rainy days in Dhalai District

### Natural Resource Management

During September to December the crop encounters a massive moisture stress and crop losses accounts to 15-20% due to moisture stress and therefore, most of the farmers of different villages are not interested to grow second crops in paddy fallow. To overcome this situation, emphasis was given towards soil moisture conservation practices like in-situ moisture conservation by utilizing paddy straw as mulching in Bitter gourd cultivation in rice-vegetable cropping System. So far, 120 no. of farmers are benefitted with area coverage of 72 ha. with an average yield of 27t/ha having the BCR of 2.7. The most significant achievements since the inception of the project are depicted in the figure as follows.

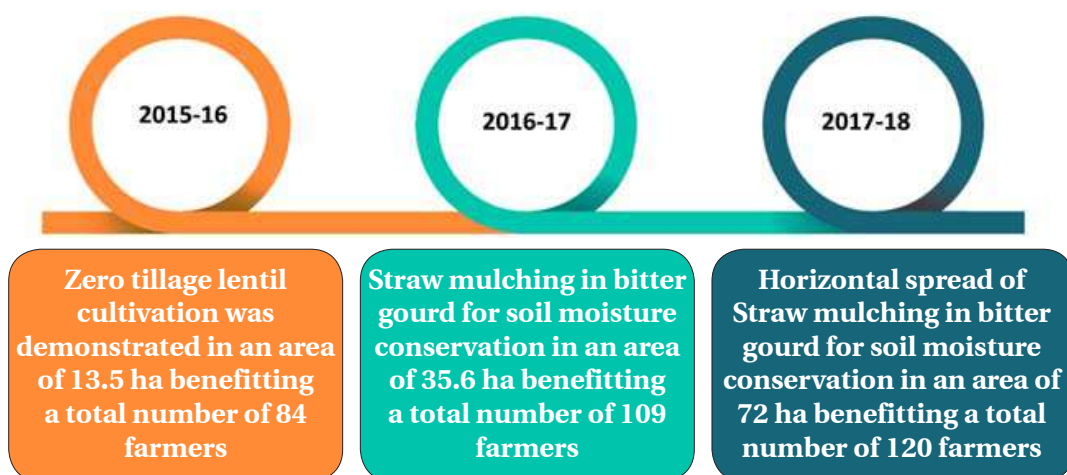


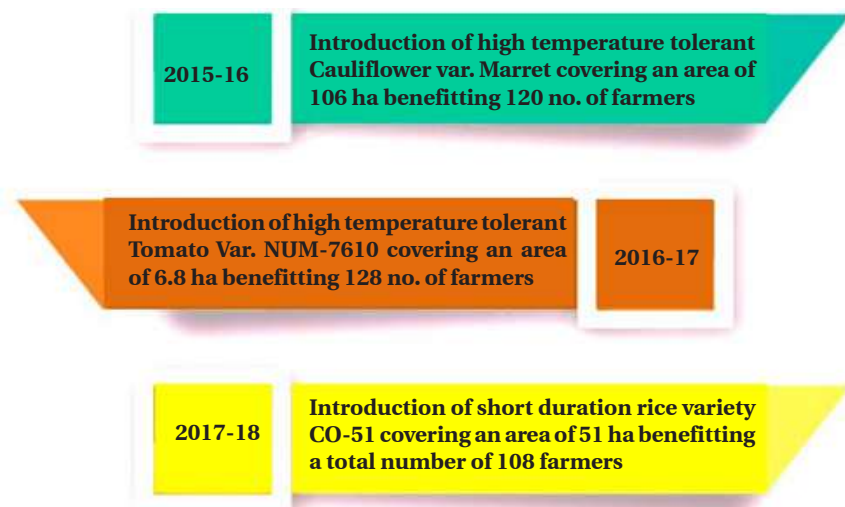
Fig. Significant achievements under Natural Resource Management

### Crop Production

The impact of climate change is being felt with a resultant decrease in crop yields. The warmer temperatures, erratic rainfall and extreme weather events are deleterious for the crop yields. Prolonged periods of drought, floods and shifting climatic zones are endangering development. Climate resilient varieties (CRVs) play a significant role in bringing about a stable crop yields. As the district is predominantly a rice growing belt, short duration variety of rice CO-51 was demonstrated in an area of 51 ha which recorded an increase in yield by 29% over local (Check). Many CRVs of vegetables were also demonstrated in an area of 29.78 ha benefitting 234 farmers.



Fig. SRI in paddy var. CO-51



**Fig. Salient achievements in crop production**

### **Livestock and Fisheries**

Use of community lands for fodder production during drought / floods by growing Congo Signal, oat and maize, and construction of low cost pig shelters were the most significant achievements.



**Fig. Interventions in livestock and fisheries**

### **Institutional Interventions**

The prominent interventions like seed bank, fodder bank and establishment of custom hiring centres benefitted the farmers to overcome the adverse conditions of changing climate.

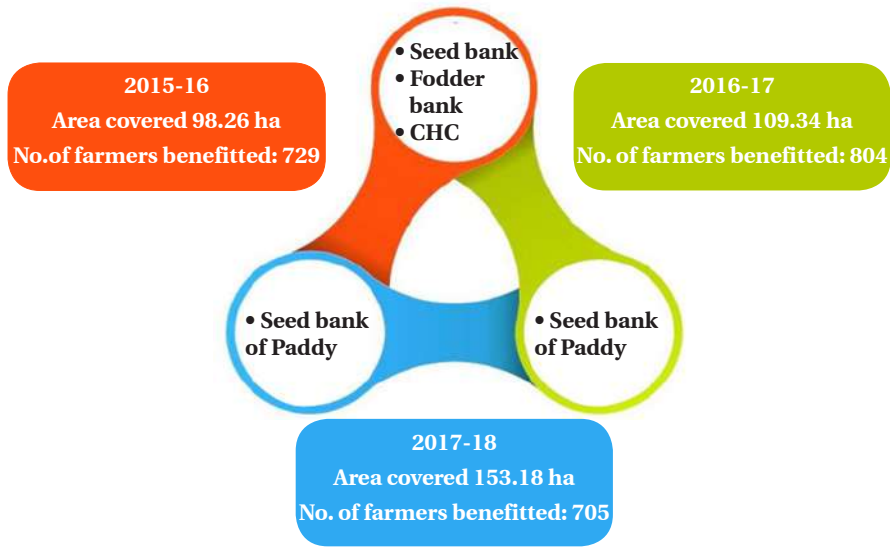


Fig. Institutional interventions at a Glance

### Capacity Building

A total number of 522 farmers were trained through 10 different training courses in several thematic areas related to crop, livestock *etc.*

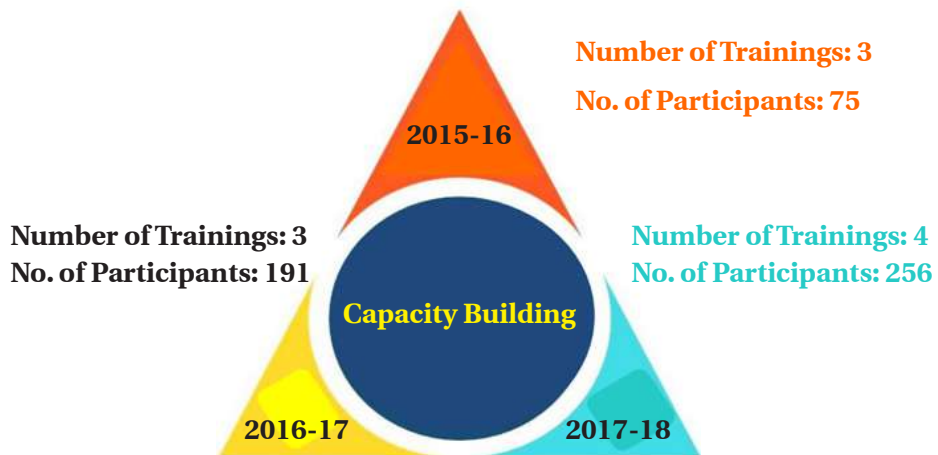


Fig. An overview of capacity building activities

### Successful Intervention

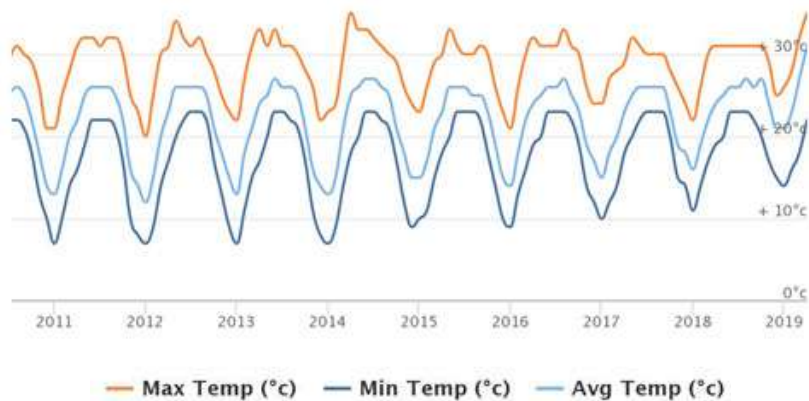
In situ moisture conservation was done by utilizing paddy straw as mulching in Bitter gourd cultivation in rice-vegetable cropping System. As during September to December; the crop encountered a massive moisture stress and crop loss occurred 15-20% due to moisture stress. So far, 60 farmers have benefitted with area coverage of 6 ha. The average yield of the crop is 27 t/ha with BC ratio 2.7.

## Climate smart interventions in Drought prone District of Nagaland: KVK- Dimapur



The project was formally launched at Dhansiripar village, Dimapur district of Nagaland in the year 2011. The village was declared as a drought prone area by Government of India during the year 2009. Around 10,000 ha area of paddy field could not be cultivated due to drought-like situation, out of which 4000 ha area belong to Dhansiripar block. Considering this fact, Dhansiripar village was adopted for implementing NICRA project by KVK Dimapur, ICAR Nagaland Centre.

With the implementation of the project, the farming community of the village were introduced to drought resilient and livelihood improvement technologies which in turn helped them to combat with the farming problems associated with the prevailing drought like situations.



Graph showing trends in temperature of last decade in Dimapur district



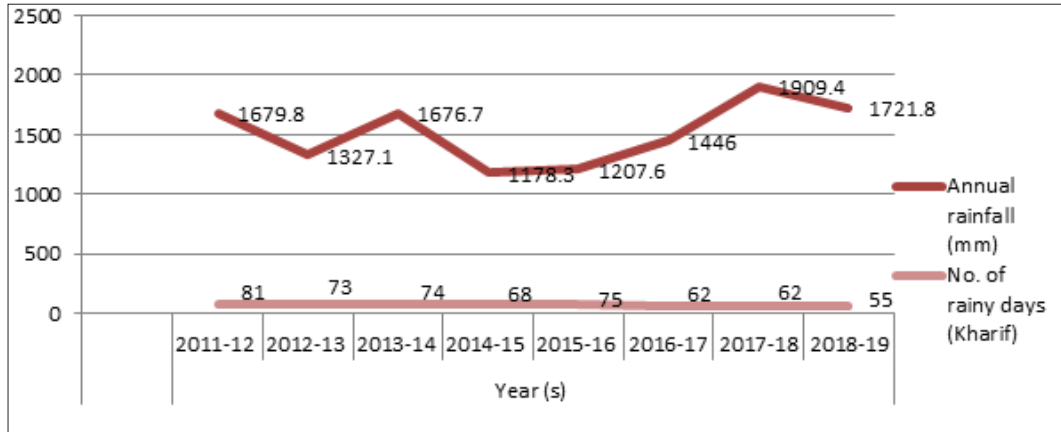
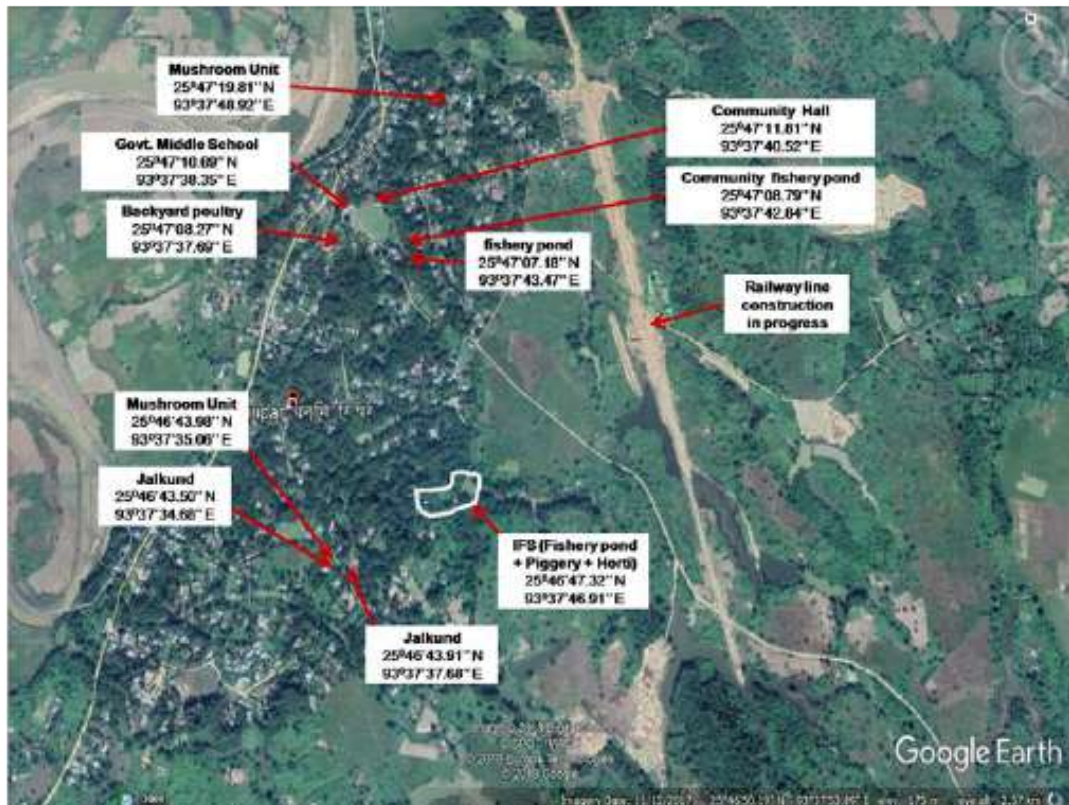


Fig. Graph depicting Annual Rainfall pattern of last decade in Dimapur district



Digital map of NICRA village highlighting the major interventions by KVK Dimapur

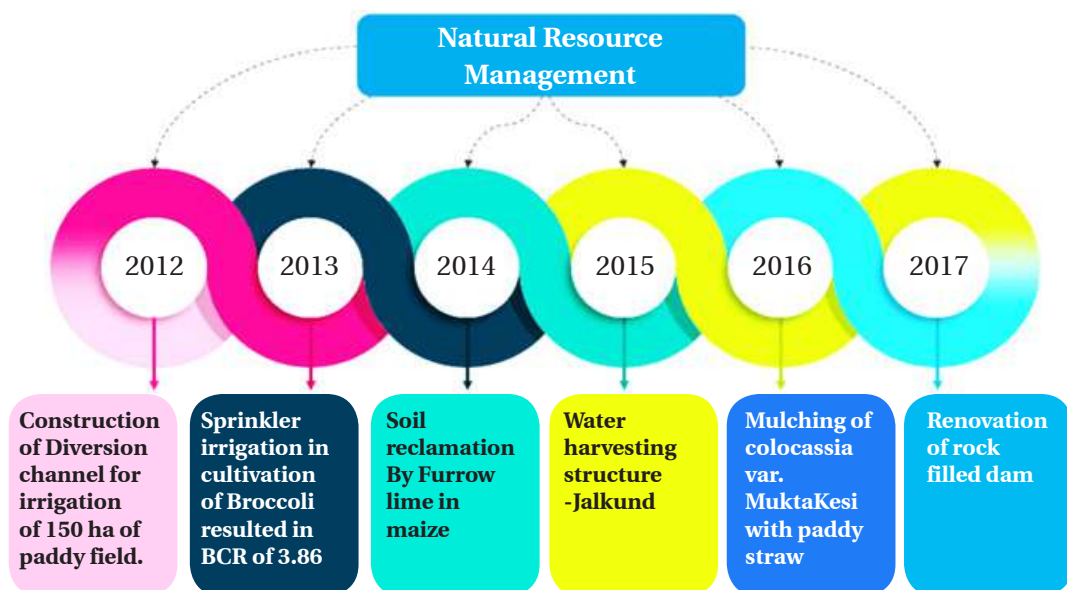
## Natural Resource Management

Seasonal floods are a common occurrence in river basins. During the rainy season, excess runoff in large volumes from the upstream parts of the basin often causes great damage downstream. On the other hand, some of the regions face shortage of water due to year round agriculture production which is largely dependent on ground water. Large quantities of water pumped for agriculture, especially in the dry season when surface water is limited, can exceed the amount that is recharged by rainfall. This causes falling of ground water levels. In order to tackle the problem, an existing rock fill dam was renovated to reduce the climate related vulnerability and risks and by exploiting floodwaters to reduce drought risks. This intervention has aided the farmers to cultivate paddy during off-season in an area of 180 ha and it has benefitted 80 numbers of farmers. The productivity of the crop increased to 30q/ha with a cropping intensity of 150 % compared to 24.5q/ha and 116 % of productivity prior to this intervention.

Other interventions like Diversion channel/ Construction of concrete irrigation channel for diverting water from nearby stream to water harvesting pond and for irrigating 150 ha of paddy field, Water harvesting structure (Jalkund), Sprinkler irrigation in the cultivation of Broccoli, soil reclamation by furrow application of lime in maize, in-situ moisture conservation by mulching of colocassia with paddy straw are the most significant interventions.

**Table: Influence of rock fill dam on cropping intensity**

Sl. No.	Particulars	Before Renovation of Rock Fill dam	After Renovation of Rock Fill dam
1.	Area under summer rice (ha)	100.32	180
2.	Productivity (q/ha)	24.5	30.50
3.	Cropping intensity (%)	116	150



**Fig. Rock fill dam construction: Converting the hazards into opportunities**

## Crop Production

Selection of appropriate crops, varieties and cropping systems is important for minimising the impact of climate variability. In addition, management practices that can reduce the yield variability or increase in agricultural production under variable climate and extreme events can contribute to resilience.

Crop diversification is important strategy for climate resilience. Hence, diversification with sesame in an area of 89 ha, where paddy could not be cultivated due to severe drought during July, benefitted a total number of 150 farmers and

recorded BCR of 3.13. Cultivation of improved varieties mustard/Toria var. TS-36, TS-38, TS-67 as second crop after rice for utilizing residual soil moisture and INM in vegetable crops was some of the important climate resilient practices.



**Crop diversification for intensive cropping**

## **Livestock and Fisheries**

Climate change has posed new challenges to the sustainability of livestock production systems with serious implications to small holders. The availability of natural resources that support livestock is highly sensitive to climate change, thus impacting the productivity of livestock. The resilient practices demonstrated and their impact is presented here.

### **Breed improvement for higher resilience in poultry and piggery**

Resilient and high productive poultry breeds like Vanaraja and Grampriya were introduced for egg production in the village, thereby increasing farmers' income. The improved breed of piggery like Hampshire cross was also introduced.

Interventions like Composite fish culture, management of fish ponds / tanks during water scarcity and excess water and 36,000 fish fingerlings were distributed to farmers for composite fish farming.

### **Popularization of Rabbitry as a subsidiary income source**

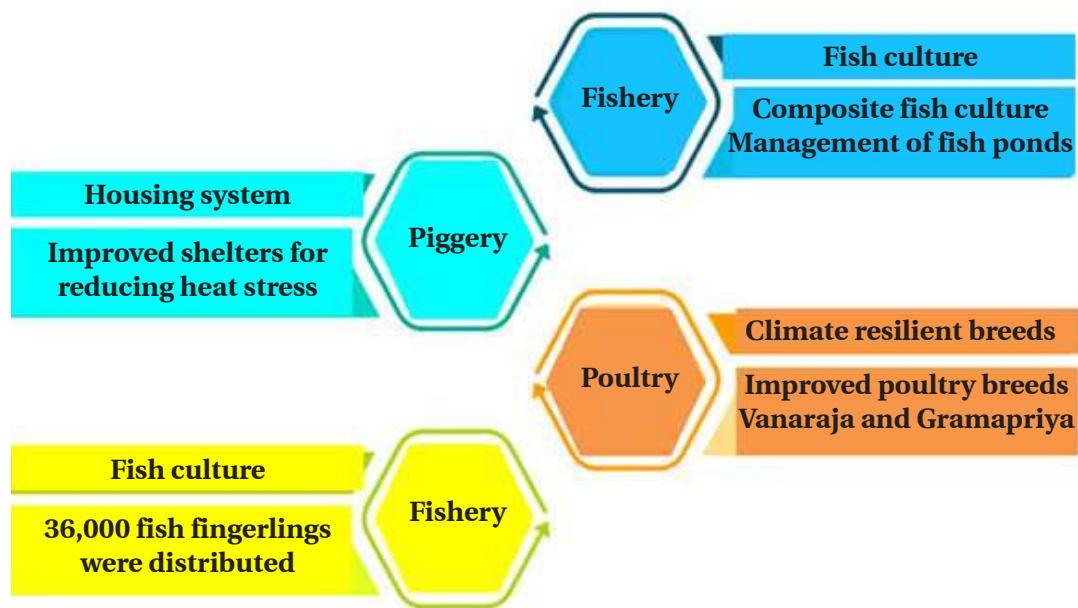
At recent times, rabbitry has come up as a successful farming venture in Nagaland. The people of Nagaland are mainly non-vegetarian and relish meat from pigs, cattle, buffaloes, goat, poultry birds and some other wild animals along with some insects. So, rabbit farming has been popularized in Dhansiripar village to solve the problems of low meat production and unemployment of the region. Two exotic breeds of rabbit, Soviet Chinchilla and New Zealand White were introduced as they are fast growers and have high reproductive potential besides good quality meat.

**Table: Rabbit rearing**

Technology Demonstrated	Variety	No. of farmer/No. of rabbits	Measurable indicators of output		% increase
			Demo	Local	
Rabbitry	Soviet Chinchilla & New Zealand White	15/40	Average adult weigh 4 kg with average litter size of 7	Average adult weigh 3 kg with average litter size of 5	33.33 % in body weight and 40 % in litter size

**Table: Economics of rabbit rearing**

Economics of demo (Rs./ ha)				Economics of local (Rs./ ha)			
Gross Cost (Rs.)	Gross return (Rs.)	Net Return (Rs.)	BCR	Gross Cost (Rs.)	Gross return (Rs.)	Net Return (Rs.)	BCR
650	2600	1950	4:1	600	2000	1400	3.3:1

**Fig: Significant Achievements in Livestock and Fisheries**



**Rabbit rearing a profitable venture**

### **Institutional Interventions**

Institutional structures were established at the village level to guide the implementation, continuation or interventions and for their long lasting impact. Custom hiring centre is one such initiative taken up by the KVK-Dimpaur.

### **Capacity Building**

Capacity building initiative is framed in broad terms for knowledge generation through training programmes. So far 77 training programmes were imparted to the farming communities in a span of seven years which has benefited 1518 number of farmers.

### **Successful Interventions**

The most successful intervention so far by KVK Dimapur is the construction of the rock fill dam using sausage wire and other locally available inputs. This intervention have greatly benefitted the farmers of the village and neighbouring villages as well because of the fact that water can be diverted to the farmers' field directly from the dam. Over 180 ha of farm land was irrigated from this intervention and profiting over 80 farming households. Farmers could now cultivate more crops and especially paddy in their fields because of the availability of irrigation water.

**Table:**

<b>Sl. No.</b>	<b>Particulars</b>	<b>Before Renovation of Rock Fill dam</b>	<b>After Renovation of Rock Fill dam</b>
1.	Area under summer rice (ha)	100.32	180
2.	Productivity (q/ha)	24.5	30.50
3.	Cropping intensity (%)	116	150

Another intervention is growing of toria/mustard in rice fallows. Usually, lands are left fallow after harvesting paddy in the village and one of the reasons behind this is unavailability of water for irrigation during the dry period. With the intervention of the KVK the farmers have now adopted various in-situ soil moisture conservation techniques such as; zero tillage, mulching of crops using paddy straw, other crop residues which were otherwise burnt and plastic mulch for growing crops during dry season. This made it possible for farmers to grow their crops during dry seasons and thereby gaining additional income in return.

## Reducing Agrarian Distress: KVK-Imphal East



NICRA Project in Imphal East District, Manipur was initiated during the year 2011 and villages' viz. Top Chingtha, Yambem and Andro were adopted for undertaking different Climate Resilient interventions. Later on, another village, Nongbrang was adopted which is part of the project's criteria to spread the practice of climate resilient agriculture to neighboring villages. There are 2270 number of households in the villages and total cultivable area is about 1063 ha. The major type of soil is Clayey and Sandy loam types of soil. The district experiences severe flood during the monsoon season which destroys large acreage of cropping lands.

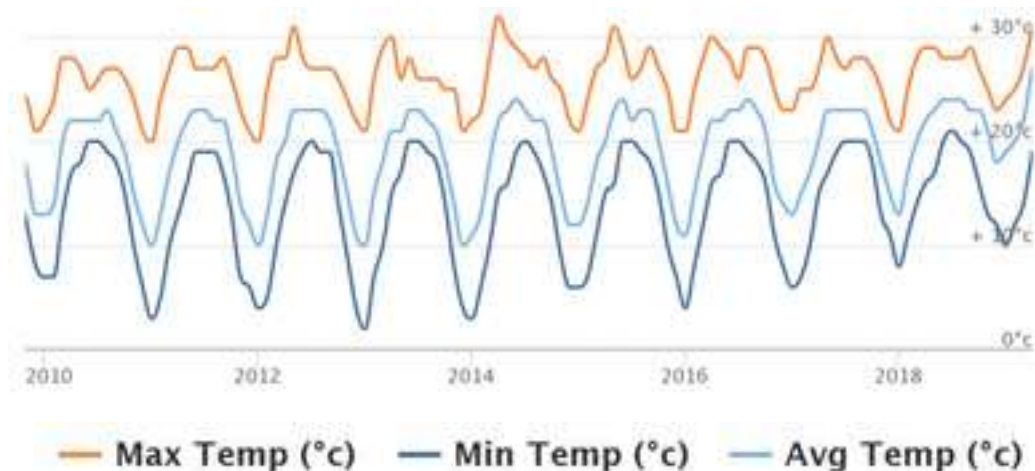


Fig. Graph showing temperature trends in the district during the last decade



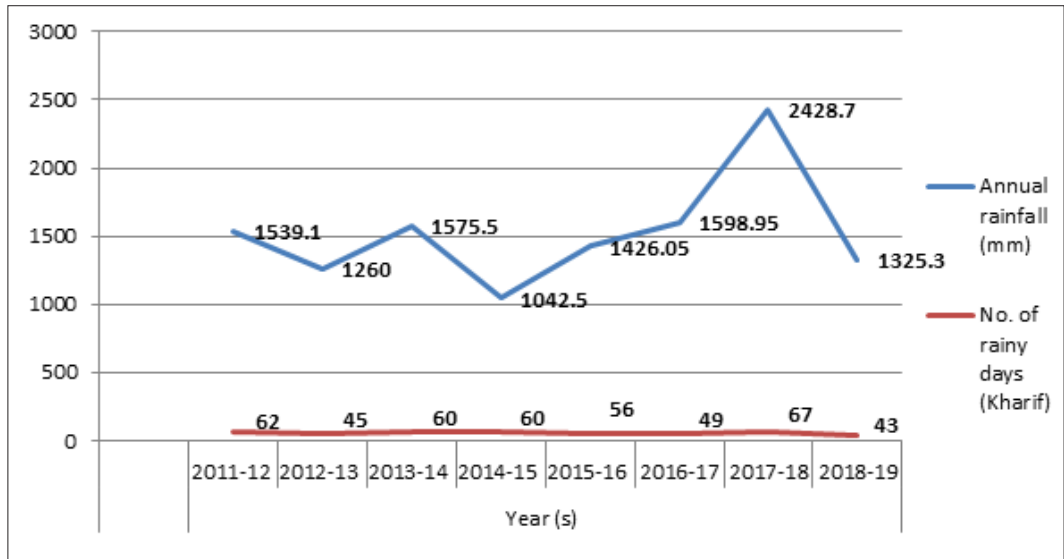


Fig. Rainfall pattern in the District during the last decade with number of rainy days



Andro Village



Top Chingtha Village

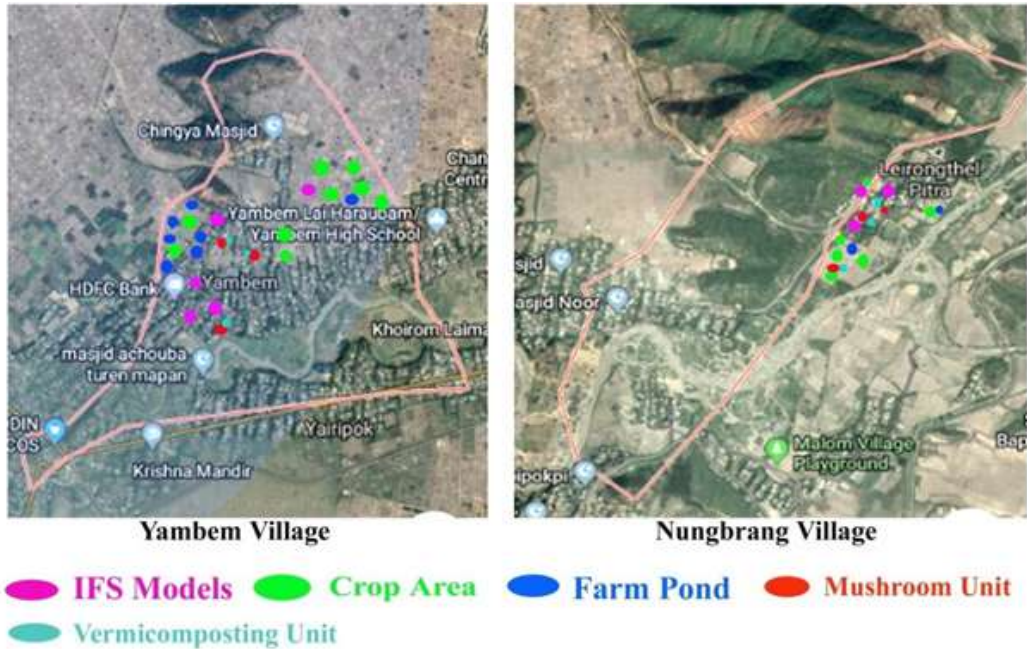


Fig. Digital map of NICRA village highlighting the major interventions by KVK Imphal East

### Natural Resource Management

The model Jalkund developed during the month of September, 2012 served various agricultural and allied activities with 30 cu. m volume of water available throughout the year irrespective of rainy/dry period.



Fig. Jalkund for live saving irrigation

The Scientific staff of Krishi Vigyan Kendra sensitized the farmer for effective and economic use of the harvested water. The participating farmer Mr. Th.Lukhoi Singh term the Jalkund as boon for him as the same could help him to generate an income upto Rs.1,73,08.00 within 3½ years period apart from household consumption. One remarkable achievement with the Jalkund during the dry spell of 2013-14 was that the household water requirement was also met by the Jalkund for at least 15 household of Maringthel during December to March. Had the Jalkund not been there, these 15 families had to suffer by walking upto 150m for fetching water from the main source in the difficult terrain. The family member of the fifteen households also expressed that the Jalkund is a boon for them during March-April, when the nearby river dries up.

### Crop Production

Under this module introduction of short duration varieties of rice (CAU R3) with duration of 100 days, promotion of cultivation of pulses and oilseeds in rice fallows, introduction of high yielding varieties and vegetable production under polyhouse *etc.* were some of the major activities.

**Table: Significant achievements of KVK Imphal East under crop production module**

Intervention	Technology demonstrated	No. of farmer/ Area (Ha)/Yield	Gross cost (Rs/ha)	Gross return (Rs/Ha)	B:C
Introducing flood tolerant varieties	Cultivation of deep water local paddy Taothabi	13/9/5.16 t/ha	42000	75,600	1.8
Water saving paddy cultivation methods (SRI, aerobic, direct seeding)	SRI in rice var. CAU R1	16/11/.25 t/ha	57,500	97,800	1.7
Integrated crop management	ICM in Rice var. CAU R1	7/3.50/6.24 t/ha	57,000	93,600	1.64
Contingent Crop	Cultivation of Short Duration (100 days) rice var. CAU R3	12/6.5/5.2 t/ha	53,500	79,050	1.48
Zero tillage cultivation of Rapeseed	Zero tillage cultivation in rapeseed	2 farmers /35 ha/680 kg/ha	12,000	30625	2.5
Crop intensification in Rice mono-cropped areas	Scientific cultivation of field pea var Rachana	16/9.0/0.75 t/ha	19,800	33,300	1.68
Crop intensification in Rice mono-cropped areas	Scientific cultivation of Lathyrus var Boi L 212	04/1.0/0.66 t/ha	19,500	29,700	1.52



**Fig. Straw mulching in Pea**

### **Livestock and Fisheries**

In North eastern region most extensive system of livestock rearing is practiced. In this system of livestock rearing, the effect of heat stress on livestock production is inevitable. However, in changing climate scenario, apart from the usual suspect heat stress there are numerous other environmental stresses which hamper livestock production. Lack of proper housing, proper care are the main causes of stress in animals. Hence, KVK had conducted various Animal check-up camps, Preventive vaccination against Swine flu *etc.* Improved shelters for reducing heat stress in pig sty using thatched roof recorded upto 20% increase in body mass as compared to free range intervention. The details of the system are given in the following table.

**Table: Low cost thatch roof pig sty with wallowing tank**

No of animals	Type of housing	Type of material used (Locally available)	Cost of housing	Economic impact (% increase in milk production/ weight gain)	
				With Intervention	Without intervention
4	Pig sty with wallowing tank	Pucca with thatch roof	Rs.55,000/-	Control heat stress in pregnant sow Birth Rate 8-12piglets	Birth rate 5-7 piglet



**Fig. Livestock interventions**

### **Institutional Interventions**

Initiation of seed bank, mini village weather station, provision of tools and implements to the farming community of the village by establishing a custom hiring centre *etc.* are some of the major initiatives taken up by the KVK. Discussion on use of mini portable weather station, Disease/Insect-pest as per weather situation and their management were frequently organised in the villages. Utilization of solar nano water pump for life saving irrigation was another important activity in the villages.

### **Capacity Building**

A total number of 118 training programmes were conducted covering various aspects of crop production, natural resource management, piggery, poultry and fisheries. Capacity building activities benefitted a total number of 2516 numbers of farmers over last seven years. Moreover, a total number of 549 extension activities like field days, field visits, and diagnostic visits were conducted by the KVK Imphal East.

### **Major Achievement**

One of the major achievements by the KVK under this project is the water reed cultivation cum fish farming. This method aims at utilizing the floods to the maximum profit with additional income from fish.

The intervention was undertaken in the land of an enthusiastic and progressive farmer named Mr. Maibam Nabakishor Dong of Yairipok Top Chingtha, Imphal East district. The area covered is about 0.25 ha in a low productive part of his field. The main reason to why the farmer chose this intervention is because of low income from paddy alone. The technology in these proposed IFS is *Periphyton* based aquaculture for enhancing fish productivity using water reed as a substrate in addition to the income from water reed and it was estimated to fetch an income of Rs. 2.5 lakh/ha/year. Mr. M. Nabakishore Singh started the activity as a participating farmer in KVK, Imphal East's technology demonstration programme under the project "National

Initiatives on Climate Resilient Agriculture - Technology Demonstration Component” during the month of April, 2012.

**Table: Details of the intervention**

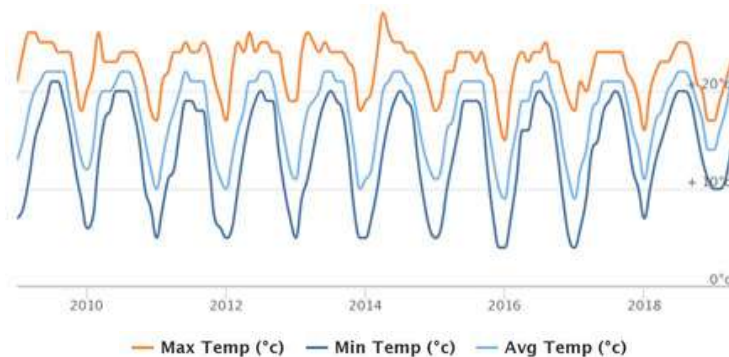
<b>Plot Area</b>	0.25 ha
<b>Number of water reed plants</b>	6000
<b>Spacing of water reed</b>	2' x 2'
<b>Fish stocking density</b>	1500 yearling
<b>Ratio of the fish species stocked</b>	Common carp : Mirgal : Rohu = 50:30:20
<b>Period of fish culture</b>	6 months (2 times in a year)

The net return from the first year was reported to be over Rs. 70,000. However, from the second year onwards the cost of land preparation is excluded and hence the net return was reported to be over Rs. 95,000 from the 0.25 ha area of land.

## Climate smart farming in hills: KVK-Jaintia Hills



NICRA Project was adopted in the Umjalasiaw village under KVK-Jaintia Hills district during the year 2015. The total number of households in the village is 117, which covers a total area of 300 ha. Total cultivable area is about 110 ha which is rainfed. The major types of soil in the area are silty clay loam and Sandy loam. The climatic vulnerabilities that the village experiences mostly are drought and water stress during winter season as well as erratic rainfall, which make it very difficult for farmers to grow their crops.



**Fig. Graph showing temperature trends in the district during the last decade**

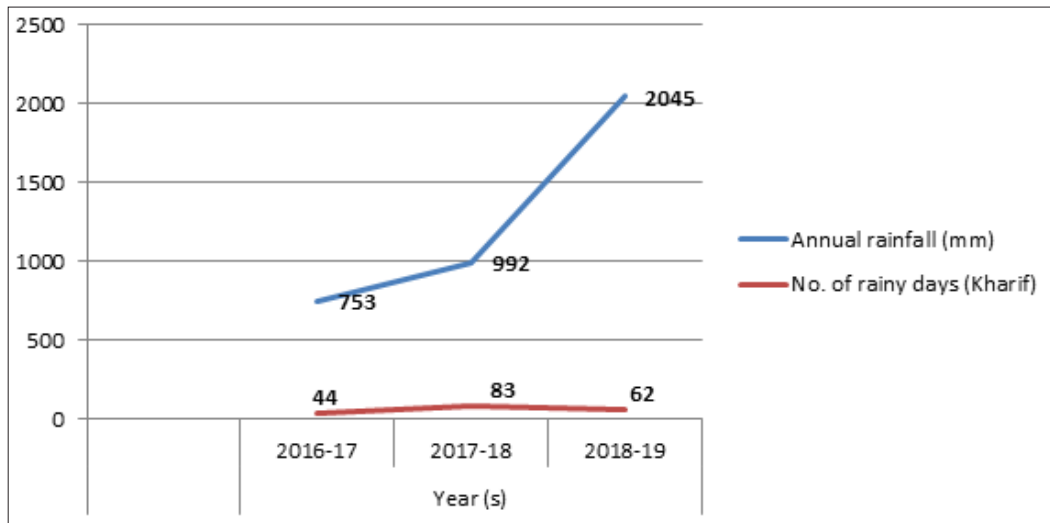


Fig. Graph showing rainfall pattern in the district during the last three years of NICRA intervention

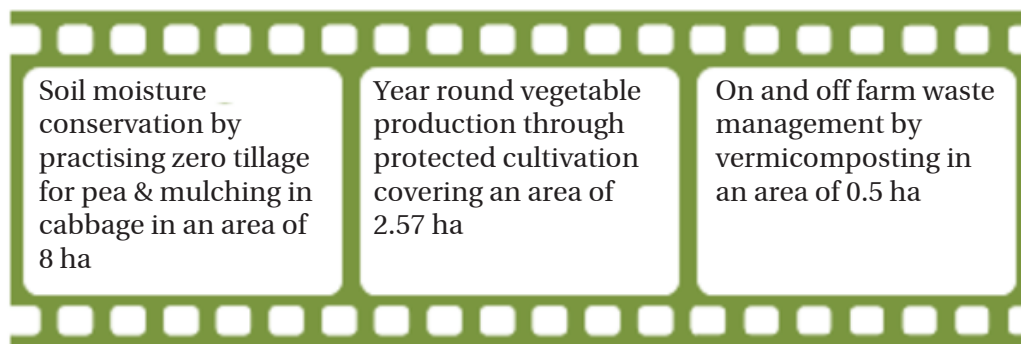


Digital map of NICRA village highlighting the major interventions by KVK, Jaintia Hills



## Natural Resource Management

The interventions like soil moisture conservation and residue management were put forth by the KVK. The activities in the NICRA villages undertaken are depicted in the following figure.



**Fig. The activities under Natural Resource Management**

## Crop Production

Climatic factors serve as direct input to agriculture, any change in climatic factors is bound to have a significant impact on crop yield and production. Rainfed agriculture will be the most impacted sector by climate change. Temperature is an important weather parameter, which affect productivity of rainfed crops. Hence, The KVK has taken an initiative and introduced temperature tolerant varieties like cabbage var. Rare ball, baby corn Vivek hybrid 9, pea var. Arkel. All these varieties resulted higher yield compared to check varieties. Intercropping of maize with French bean and cabbage with legume crops like pea also resulted in high returns to the farming community. Apart from CRV's interventions like SRI for cultivation of paddy, grafting techniques in kiwi, intercropping maize with French bean and use of bio-fertilizer have increased the production of the crop plants.

**Table: Cost economics of Intercropping in Maize with French bean**

No. of farmers benefitted	Area (ha)		Yields (q/ha)		BCR
	After intervention	Before intervention	Demo	Local practice	
3	1.21	NIL	Maize= 25.30 French bean= 43.2	Maize= 19.38	2.37:1



**Fig. Intercropping**

**Table: Cost economics of Intercropping in cabbage with Pea**

No. of farmers benefitted	Area (ha)		Yields*(q/ha)		BCR
	After intervention	Before intervention	Demo	Local practice	
3	1.21	NIL	Cabbage=121.8 Pea= 45.2	No crops are taken after maize	3.56

### **Institutional Interventions**

With the intervention of the KVK through NICRA project in the adopted village, it paved way to the creation custom hiring centre in the village whereby the farmers are able to cultivate crops using the machinery available in the CHC. Its existence has benefitted the whole farming community in the adopted village. Cropping intensity has indeed with the interventions through the CHC. The table below shows the details about the intervention in the adopted village.

**Table: Institutional Interventions**

Year	Technology Demo	Number of Farmers Benefitted	Area covered before (ha) / Units	Area covered After (ha) / Units	Notable achievements during the year
2015-16	1	NIL	NIL	NIL	Initiation of CHC
2016-17	1	22	0	15	Utilization of tools and implements of the CHC by the farmers in the village
2017-18	1	28	15	21	Utilization of tools and implements of the CHC by the farmers in the village

### Other interventions

Feeding management in composite fish culture, initiation of custom hiring centre, and various capacity building programmes were conducted by the KVK like trainings, method demonstrations, exposure visits *etc.* A total number of 39 training programmes were conducted by the KVK which has benefitted a total number of 820 participants.

### Major Achievements

One intervention that stands out is the cultivation of paddy using the System of Rice Intensification method or SRI. Before NICRA intervention in the village, the farmers usually broadcast their seeds and the fields are generally flooded. But with this intervention, the farmers were able to utilize water properly as fields does not require flooding and seedlings were also spaced properly, thereby reducing the requirement of seeds per unit area. The area for adoption this method of planting is about 3 ha in all and 10 farmers were involved. The yield during the year 2017-18 was reported to be 52.3 q/ha and local practice only yielded around 30.6 q/ha and the BC ratio from the demonstration was recorded to be 3.30.



## Scaling out a Climate Smart village in Tripura: KVK-Khowai

The project has been implemented in North Pulinpur village of Khowai district, which is about 50 km from the state capital Agartala. The village consists of 5 wards and 806 families with a total population of over 3600. The total geographical area of the village is 950 ha with 250 ha of cultivated land. There are no perennial streams or rivers in the village. The soils of the area are classified as hill red loamy to plain sandy loam soil. Annual rainfall ranges from 2050 to 2550 mm. Crops grown includes rice, other crops like chilli, cowpea, potato, maize, yam, pea, mustard, colocasia, cucurbits and fruits like mango, pineapple, citrus, banana *etc.* The villagers rear a wide range of livestock and fishery contributes a large share of income to the farming families. The scope of integrated farming system is tremendous in the area and if it could be tapped properly, it will play a major role in livelihood improvement of the farmers and ultimately contribute to the agricultural development of the state.

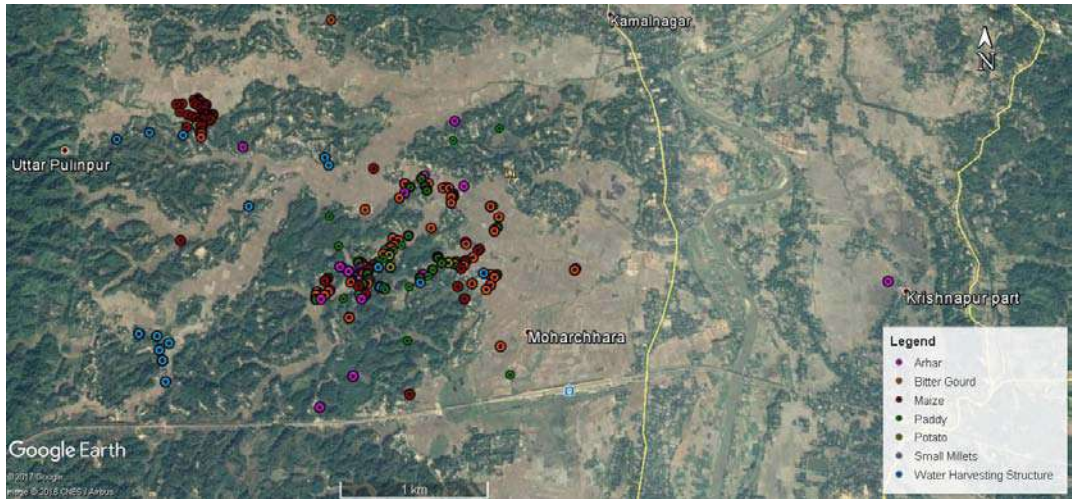


Fig. Digital map showing the interventions in NICRA Village

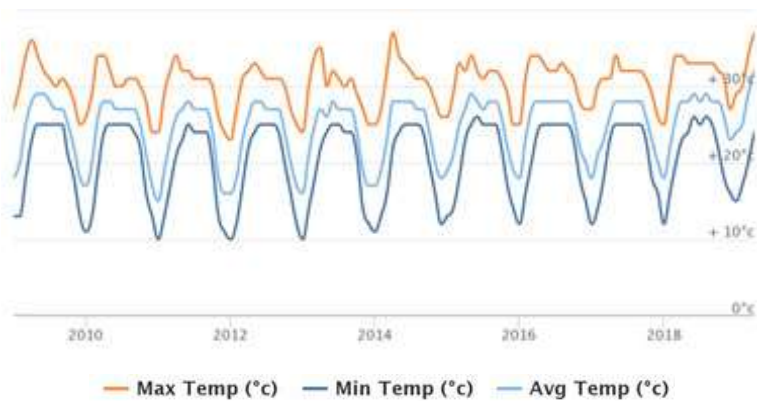


Fig. Graph showing temperature trends in the district during the last decade

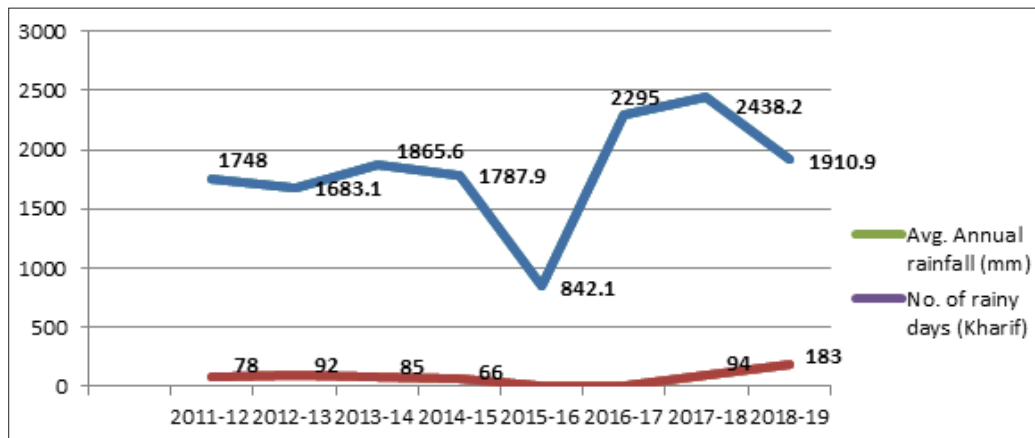


Fig: Rainfall pattern in the District during the last decade

## Natural Resource Management

The judicious use of natural resources will not only benefit the soil and the environment, but will also be able to sustain farming practises over a long period of time. The interventions and technologies that the KVK-Khowai demonstrated and popularized in the adopted village so as to attain better utilization and preservation of natural resources are IMC through paddy straw mulching in bitter gourd, zero to minimum tillage for the cultivation of lentil and Field Pea and raised bed with furrow irrigation in maize; water harvesting in catchment areas through *Jalkund* and recycling of irrigation water for supplemental irrigation.

**IMC through paddy straw mulching in Bitter gourd:** One of the major achievements is the mulching of bitter gourd with paddy straw in rice fallows. Bitter gourd variety Jyoti Bolder was used in the intervention. The time of planting was during December-January. Use of straw mulching to cope up with the adverse climatic condition was special practice. It helped to reduce soil moisture loss as well as for easy trailing of the bitter gourd vines on the ground. Before this particular intervention, total area under bitter gourd cultivation was 1.2 ha and area expanded to 25 ha within two years which otherwise remained fallow. The net profit from bitter gourd alone in 2017-18 was Rs. 2, 53,600.00 with BC ratio of 2.78.



**Fig. Activities undertaken for Natural Resource Management**

**Table: Year wise Economics of the successful in situ moisture conservation technologies**

Technology	Year	Seed yield (Kg/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
Water saving paddy cultivation method(SRI)	2012-13	4556 Kg	54672	14822	1.44
	2013-14	5250 kg	63000.00	15000.00	1.31
	2014-15	6500 kg	78000.00	27000	1.52
	2016-17	7000 kg	84000.00	36000.00	1.75
Integrated crop management in TPS (True potato Seed)	2011-12	9500 kg	380000.00	250000.00	1.92
	2015-16	12550 kg	502000.00	372000.00	2.8
	2016-17	11850 kg	474000.00	314000.00	2.6

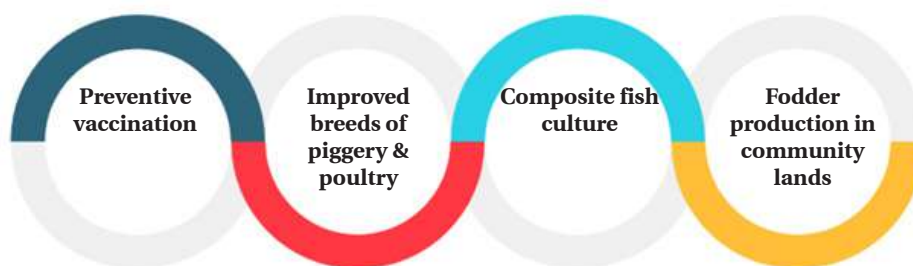
### Crop Production

Crop production methods for combating the fluctuations in climate were demonstrated in the adopted village was demonstration on row planting technology for HYV of paddy var. Ranjit, Gomati *etc.* Green manuring with Dhaincha in Paddy Var. Gomati and production of tuberlets by using true potato seed (TPS) var. HPS-11/67 were some of the major interventions by KVK Khowai.

### Livestock and Fisheries

Popularization of cross breed pigs suitable for dry areas, introduction of improved poultry breeds for backyard farming, composite fish culture, Preventive vaccination of livestock against different diseases *etc.* were some of the interventions that were made during last 5 years in the NICRA village. These interventions had benefitted over 270 farmers in the village with technology, information and inputs as well.

**Composite culture of fish:** Fish farming through composite culture was introduced to the village as most of the farmers were practising mono culture of fish. The fish species introduced in this system were Rohu, Mrigal, Common Carp, Tilapia and *C. Reba*. So far, 5 beneficiaries were benefitted from this intervention.



**Fig. Significant interventions under livestock and fisheries**

**Table: Cost Economics of the successful Interventions under the module Livestock and Fisheries**

Technology	Gross Cost(Rs/unit)	Gross returns (Rs/unit)	Net returns (Rs/unit)	B:C ratio
Popularizing of Cross Breed pigs suitable for dry prone areas in semi intensive condition	20000.00/sow/year	37000.00/sow/year	17000.00/sow/year	1.85
Introduction of Backyard poultry birds	560.00/5 bird	1100.00/5 bird	540.00/5 bird	1.96
Composite Fish Culture	109000.00	262000.00	153000.00	2.4

### Institutional Interventions

Interventions such as custom hiring centre (CHC) and seed banks were established in the NICRA village. The CHC is being jointly managed by the village climate risk management committee (VCRMC) and the KVK. Various farm implements *viz.*, Power Tiller, Knapsack Sprayer, Nano pump, wheel hoe, weed cutter, pump set, sprinkler irrigation set and other small implements like sickles, rakes *etc.* are made available in the custom hiring centre.





## Capacity Building

Capacity building activities such as training on the importance of integrated farming system model (IFS), training on Holistic approaches of livestock management for sustainable income, Training on Package and practice of true potato seed (TPS), Brain Storming Session for VCRMC Members, group meetings and others were conducted by the KVK. So far 89 of such activities were conducted and benefitted almost 2000 farmers in the village.

## Extension Activities

Activities such as field days, diagnostic visits, soil health camps and animal health camps were conducted by the KVK in the adopted village. Some of the activities were jointly conducted in convergence with other departments and divisions also. A total of 172 training activities were conducted and benefitted a total number of 3300 farmers.

## Extent of adoption of successful interventions

Successful interventions achieved so far in terms of extent of adoption under NICRA in the adopted village are shown in the table below:

**Table: Extent of adoption of successful interventions under NICRA**

Successful Interventions	Extent of adoption in the village in ha.					
	2012	2013	2014	2015	2016	2017
Mulching in bitter gourd	Nil	Nil	1.12	8	18.5	28.5
SRI in Paddy	0.8	Nil	2.32	50	80	120
Furrow irrigation in Maize	Nil	Nil	3.5	9	16.3	26.8

## Enhancing Farmers Capacities for Adaptation to Climate Change: KVK, Lunglei



### Introduction

The name of the adopted NICRA village is Hnahthial. The population of the village is around 7041 with 1643 number of households. Total cultivated area of the village has been worked out to be 344.70 ha. The location falls under Humid Sub-tropical Hill Zone with soil types being Red, Laterite and Alluvial Soil. Major crops grown are Rice, Maize, Mustard and vegetable crops.



Digital map of NICRA village highlighting the major interventions by KVK Lunglei

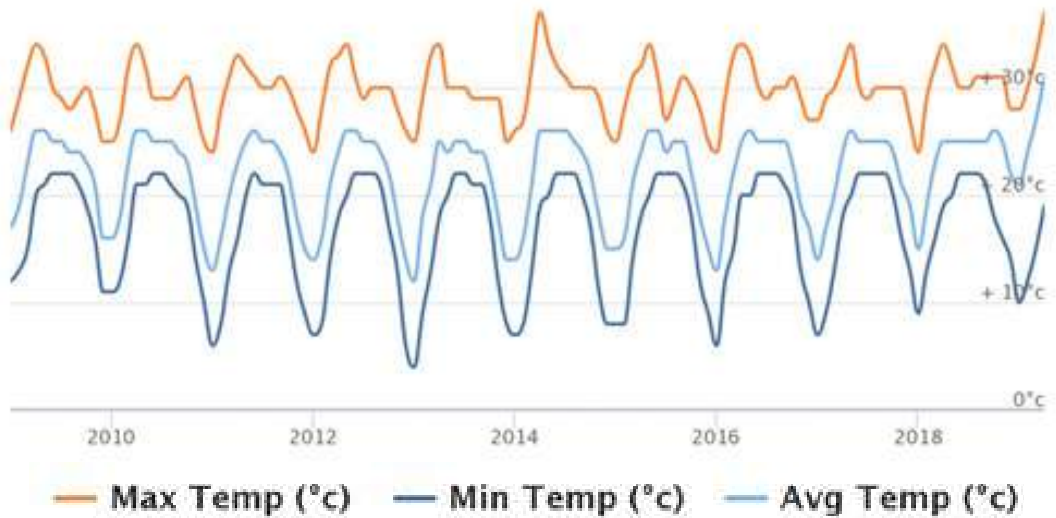
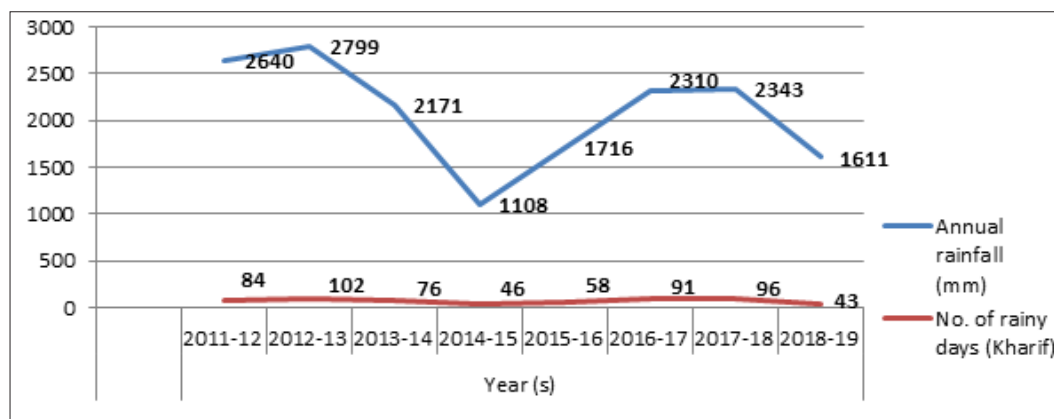


Fig. Graph showing temperature trends in the district during the last decade



**Fig: Rainfall pattern in the District during the last decade**

### Natural Resource Management

Different management practises which mainly aim at conservation of natural resources; water and soil, so as to minimize the impact of severe climatic aberrations and to lessen the impact of farming on the environment have been adopted by the KVK in the NICRA village and neighbouring villages as well. Interventions on water conservation such as micro irrigation systems in vegetable crops, in-situ moisture conservation through mulching in vegetable crops, construction and renovation of water catchment areas and drainage channels so as to check the run-off and conservation of irrigation water for application during unfavourable conditions, raised bed and furrow irrigation of onion; interventions on soil reclamation through the process of liming in acidic soils and soil health management practises through various natural composting methods such as vermicomposting for soil application are some of the prominent achievements under this module.

**Vermicompost production:** One of the major problems in the village is injudicious use of organic wastes and chemical load in the soil. In order to combat this problem, the KVK has demonstrated vermicomposting in the village so that the use of chemical substrates in the soil may be reduced and in turn promote the health of the soil in the farms. Also, maximum utilization of farm waste is realized from this intervention. Initially, four units were constructed for demonstration purpose. On seeing the impact of the technology several other farmers have adopted it. The production of vermicompost per unit of size 1m x 4m x 0.8m is about 2.5 quintals per harvest.



Fig. One of the Vermicomposting units in the village

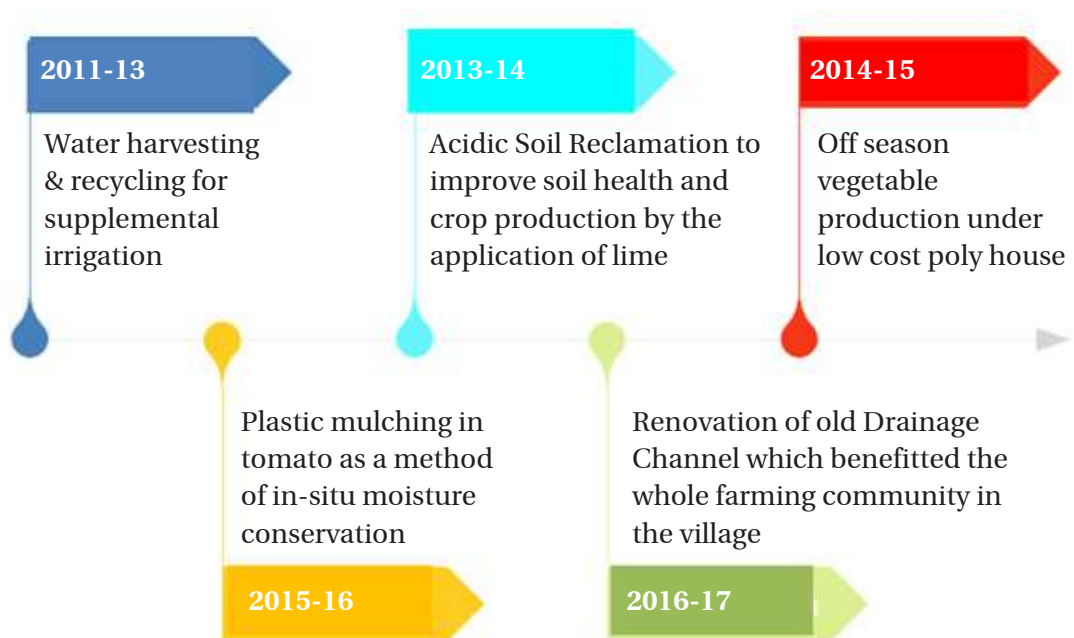


Fig. Salient achievements under Natural Resource Management module

## Crop Production

In order to enhance the production of crops in areas affected by climate change various interventions and technologies were adopted in the NICRA village. These interventions include introduction of improved crop varieties like maize var. HQPM-1, paddy var. Gomati, CAU R1, cabbage var. NS 22, mustard var. TS-36 and others. Other interventions such as establishment of community nurseries for delayed monsoon or occurrence of flood for the cultivation of different field and vegetable crops and improved technology on location specific intercropping systems have played a great positive impact on the lives of the farmers in the adopted village. High value crops like dragon fruit was also introduced in the farmer's field.



**Location Specific Intercropping System:** Intercropping of cabbage var. NS 22 and mustard var. TS-36 in an area covering 2.5 ha was taken up which benefitted 5 farmers of the adopted village. The yield of the crops obtained from this system was 30 q/ha for cabbage and 0.9 q/ha for mustard. The B:C ratio from the system was recorded to be 2.6.

### Paddy based cropping system

Field pea and soya bean were grown after paddy which has resulted in high economic return to the farmers. The details of the two cropping sequences are presented below in the following table

**Table: Performance of Paddy based cropping system**

Intervention	Variety	Area (ha)	No. of farmers	Yield (q/ha)	Economics ( Rs./ha)			
					Gross cost	Gross return	Net return	BCR
Sequence Paddy- Field pea cropping	Paddy-Gomati dhan Field Pea-HUDP-15	1.5	3	Paddy-33.40	28000	50100	22100	1.78
				Field pea-30.28 (pod yield)				
Mono crop paddy Farmers practice	Local	1	2	Paddy-22.78	24200	34170	9970	1.41

**Table: Performance of Paddy field pea based cropping system**

Intervention	Variety	Area (ha)	No. of farmers	Yield (q/ha)	Economics (Rs./ha)			
					Gross cost	Gross return	Net return	BCR
Cropping sequence	Paddy-CAU-R1	0.5 ha	3	Paddy-31.54	28200	47310	19110	1.67
Paddy-Soybean	Soybean-JS-335			Soybean-12.45				

### Livestock and Fisheries

The major interventions under this module are introduction of improved breeds of livestock like Hampshire cross, Gungroo x Hampshire cross breeds in case of piggery; Srinidhi, Vanaraja and Kuroiler in case of poultry, khaki capmbell in case of duckery. Other interventions like timely check-up of animals, application of preventive vaccination especially during monsoon season as there is excessive outbreak of diseases during the period and periodic de-worming of animals, construction of scientific housing systems for animals such as deep litter housing for poultry and piggery so as to reduce the heat stress or cold stress in animals, feed management interventions such as compound feeding schedule in Gramapriya, demonstration on concentrated feeding in breed sow cross breed (hampshire). Introduction of quail farming along with hatchery for multiplication of quails have profoundly influenced the livestock sector in the village.

**Breed introduction of Vanaraja birds:** Vanaraja breed of poultry is a dual-purpose chicken breed. It can be reared in back yards on natural, scavenged food with minimal supplementation. Important features of this breed are multi coloured feather pattern, immunity to disease; performs well with less nutritional needs; faster growth rate and produce more eggs; produce brown eggs like local hens. The hens produce up to 150 eggs per year, and weigh 1.0 to 1.2 kilograms at age 6 to 6 1/2 months. However, excessive weight of the chickens result in poor egg production.

**Table: Production performance of Vanaraja as compared to Local Birds**

Characters	Vanaraja	Local Birds
Weight at 8 weeks	1600-1750 g	600-800 g
Annual egg production	150-170 nos.	80 nos.
Weight of the Body (gm)	55-65	45-50
Adult Male	4.5-5.5 kg	3.5-4.0 kg

Adult Female	2-2.5 kg	1.3-1.6 kg
Deficiency disease (%)	Nil	40
Mortality (%)	10%	50 %

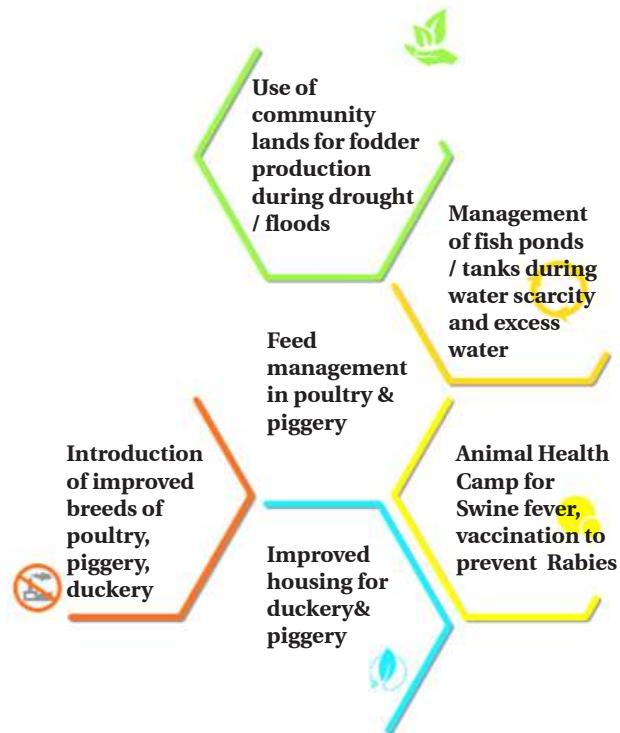


Fig. Significant achievements under the module Livestock and fisheries



## Quail production and management technology

Quail is a good source of egg and meat. The meat of the quail is most tender, delicious and nutritious. The birds are resistant to most of the poultry diseases. Hence, KVK has promoted quail farming in the NICRA village. The performance of the quails is given in the following table.

**Table: Performance of different economic traits of quails**

Characters	Parameters
Age at first laying	6-7 weeks
Annual egg production	220-180 eggs
Carcass weight	Male- 180 gm and Female- 250 gm
Mortality %	20 %

## Institutional Intervention

Institutional interventions like the establishment of seed banks for safe storage of seeds and timely availability of seeds, along with the establishment of Custom Hiring Centres for reducing drudgery and provision of farm implements on hired basis at low cost, raising of community nurseries during unfavourable conditions, livelihood improvement of farmers through utilization of agro-wastes for mushroom cultivation and composting, apiculture *etc.*, has benefitted the villagers of the adopted village. With these interventions, there has been an increase in the cropping intensity in the farm lands and most importantly enabling the farmers to attain much better returns.

**Livelihood improvement through oyster mushroom cultivation:** Popularization of mushroom cultivation through utilization of paddy straw has been a great success in the NICRA Village. Its cultivation requires only initial hard work and investment and the farmer can reap the profit for a long period of time. It is also very important as it encourages 'Zero Burning' of paddy straw. There are over 50 mushroom bags per unit and each unit yields about 110 kg of fresh mushroom. Fresh mushroom is sold at about Rs. 150.00 per kg in the area; the net profit from each unit is about Rs. 9250.00 and the B:C ratio of 2.42 is recorded.

**Table: Economics of Mushroom cultivation**

Unit	Av. Yield	Gross Cost (Rs/ha)	Gross Return	Net Return	B:C
50 bags/ unit	105 kg/unit (1 <sup>st</sup> harvest: 55 kg 2 <sup>nd</sup> harvest: 50 kg)	6500	15750	9250	2.42

## Capacity Building

Capacity building activities like training on natural resource Management, farm implements and machinery, crop management, crop production, resource conservation technology, seed production, nursery management, vermicompost units, pest and diseases management, Integrated Farming System, Soil health management, Post Harvest technology, Mushroom Cultivation, Protected cultivation and so on were undertaken in the NICRA village since its inception. So far, about 138 training programmes were conducted by the KVK and over 2560 farmers, farm women and rural youth have benefitted from these programmes.

## Extension Activities

Extension activities like field visits were organized so as to help the farming community in attaining firsthand knowledge on the practise of improved methods of farming. Apart from this, the farmers are also able to interact with experts from different fields, other farmers from different places and share their indigenous practises and knowledge. Since the inception of the project in the village, the KVK have conducted over 180 such activities and demonstrations and over 1700 farmers were benefitted.

## Major Impacts of the Project in the NICRA Village

- Crop diversification through introduction of exotic vegetable crops, high yielding varieties (HYV) of mustard and rapeseed
- Introduction of quality breeds of poultry and livestock increases the annual income for small farmers
- Promotion and capacity building for mushroom and bee keeping technology as a source of livelihood
- In-situ moisture conservation system reduces the soil moisture loss
- Introduction of farm implements and drudgery management
- Crop rotation for soil health
- Prophylaxis and mitigation of mineral deficiencies in livestock
- Improvement of irrigation facilities and water harvesting technology increases the cropping intensity

## Progressing Towards Climate Resilient Agriculture: KVK Mon



### Introduction:

NICRA Project is implemented in Nangching village under KVK, Mon. Total area of the village is about 1347 ha and total cultivated area is 273 ha. Maximum land under cultivation is about 255 ha which is rainfed. The area experiences an annual average rainfall of about 1952.17 mm and the major soil types are sandy loam and loamy soils.

The total population of the village is about 1022 with 194 numbers of households. The farmers of the village grow a wide variety of crops especially vegetable crops and the major livestock are poultry and piggery. The major problems faced by the farmers of the village are drought and soil erosion.

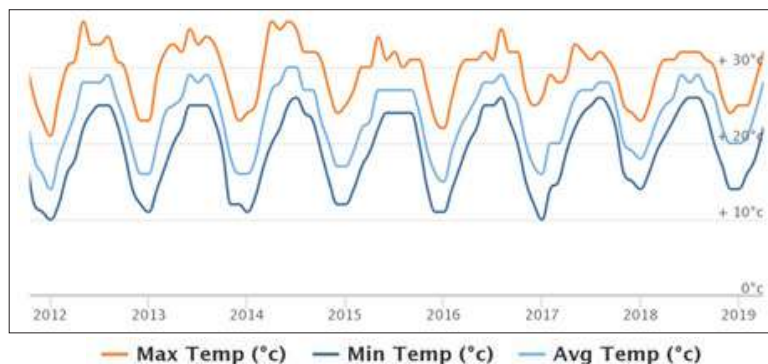


Fig. Graph showing temperature trends in the district during the last decade



Fig: Digital map of NICRA Village of KVK Mon

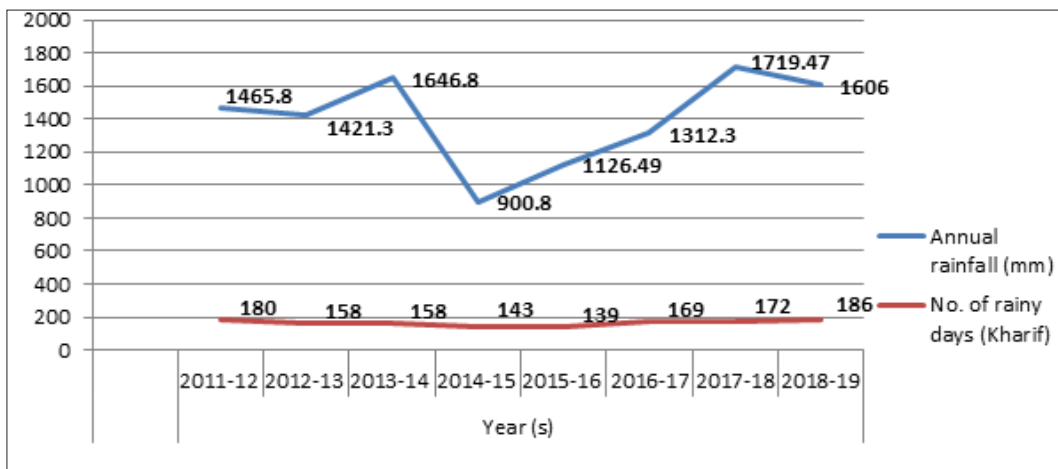
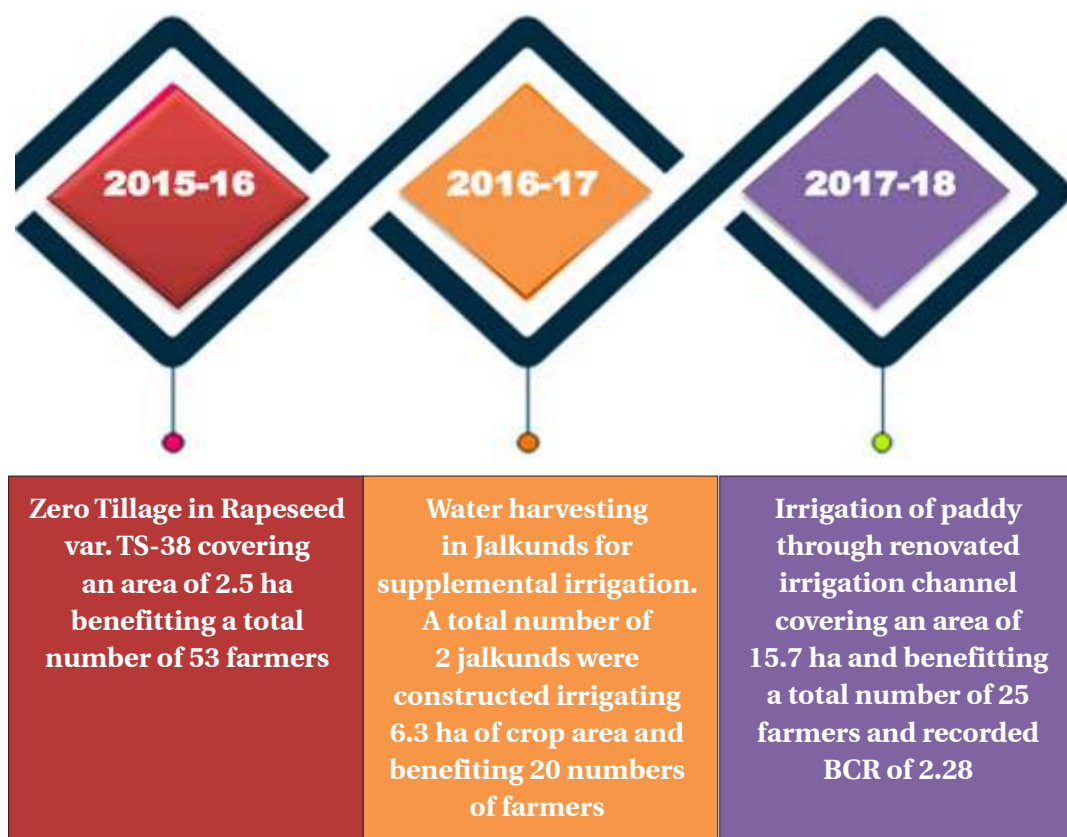


Fig. Graph showing rainfall pattern in the district during the last decade

## Natural Resource Management

Since most of the farmers rely on rains for growing their crops, the KVK has intervened on this matter by suggesting farmers to construct in-situ water harvesting structures. With this intervention, the farmers were able to irrigate their crops whenever required *i.e.*, life-saving irrigation of crops was achieved. Cropping intensity also increased because of available irrigation water which is one of the main accomplishments of the project. The farmers were also able to rear fishes in these ponds and thereby gaining additional income, which in turn improving their income and most probably their livelihood. At present, 10 such structures are proposed to be adopted and replicated at the village.



**Fig. Significant achievements under Natural Resource Management**

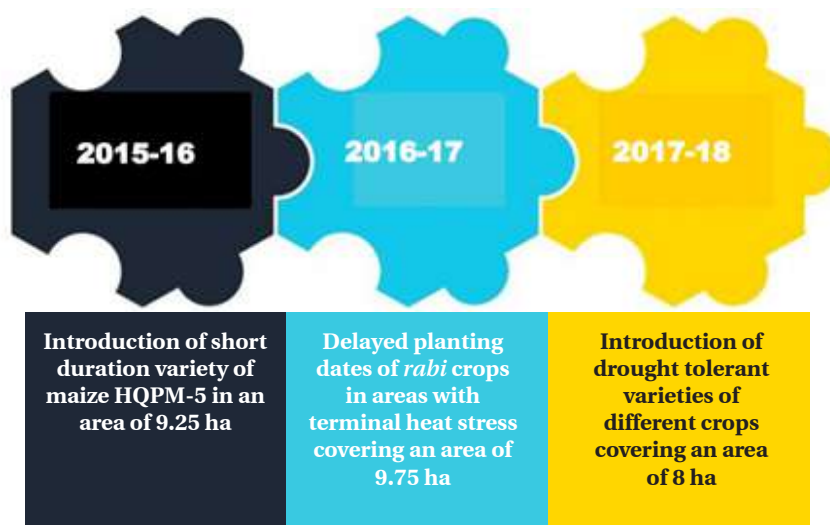
Interventions since 2015 onwards for NRM along with notable achievements during each year can be observed in the table below:

**Table: NRM details**

Year	Technology Demos	Farmers Benefitted	Area (ha) Before	Area (ha) After	Units constructed	Notable achievements during the year
2015-16	4	53	0	2.5	4	Zero tillage in Rapeseed var. TS-38
2016-17	4	20	0	6.3	2	Water harvesting in Jalkunds for supplemental irrigation
2017-18	5	25	0	15.7	0	Irrigation of paddy through renovated irrigation channel and recorded BCR of 2.28

### Crop Production

The climate change has imposed serious implications for natural resources like water availability and quality. They will also have an influence on the frequency and magnitude of natural disasters like drought; hence heat and drought tolerant varieties were introduced in different crops to combat the effects of ever changing climate. The significant achievements were depicted in the figure.



**Table: Performance indicators of short duration varieties**

Interventions	Technology demonstrated/critical inputs	Area (ha)	Measurable indicators of yield* (q/ha)		% increase in yield
			Demo	Local	
Introduction of short duration varieties	Soybean (Birsa Soya 1) with bio-fertilizer	01	13.50	6.50	51.85
	Pearl millet (PC 612)	01	7.10	-	-
	Maize (HQPM-1) with chemical fertilizer	01	17.80	13.50	24.14

**Fig. Demonstration of short duration varieties of maize HQPM-1****Table: Demonstration of Delayed planting dates of rabi crops for climate resilience**

Intervention	Technology demonstrated	No. of farmers benefitted	Area (ha)	Measurable indicators of yield* (q/ha)		% increase in yield
				Demo	Local	
Delayed planting dates of rabi crops in areas with terminal heat stress	Cabbage (Golden Acre)	10	0.25	510	-	-
	Pea (Prakash)	07	01	10.70	6.80	36.45

## Livestock and Fisheries

Livestock is an integral part of farming systems that supports the livelihood of small and marginal farmers. The resilient practices like breed improvement for higher resilience in poultry and piggery and low cost poultry sheds for rearing poultry birds increased the net income of the farmers. Apart from which 741 animals were distributed to the farmers.

Introduction of improved poultry breed Kuroiler benefitted a total number of 23 farmers. A total number of 455 improved breeds were distributed



A total number of 11 Low cost improved Poultry housing structures were constructed. A total number of 280 animals were distributed benefitting 46 nos. of farmers.

Introduction of improved piggery breed Hampshire cross breed that benefitted 3 farmers

**Table: Interventions under Livestock**

Interventions	Technology demonstrated	No. of farmers	Unit/ No. / Area (ha)	Measurable indicators of output		% increase
				Demo	Local	
Introduction of improved breeds	Poultry (Kroiler)	10	10 units	Body wt. gain at 12 weeks- 2490 g	450-550 g	79.69
Improved shelters for reducing heat stress in livestock	Low cost pig sty	10	2 units	Newly constructed (Ongoing demonstration)		



### Institutional Interventions

The most significant achievements are depicted in the figure below:

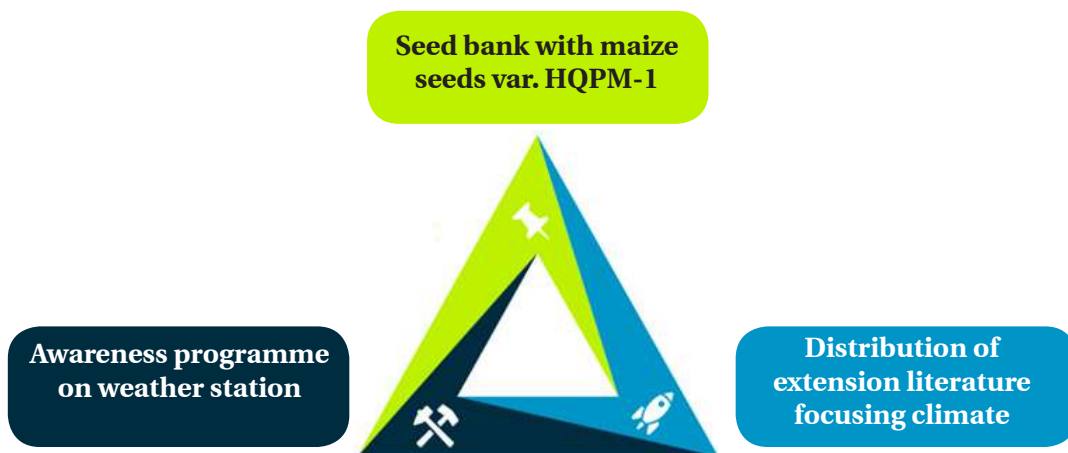


Fig. Significant achievements under Institutional interventions

### Capacity building

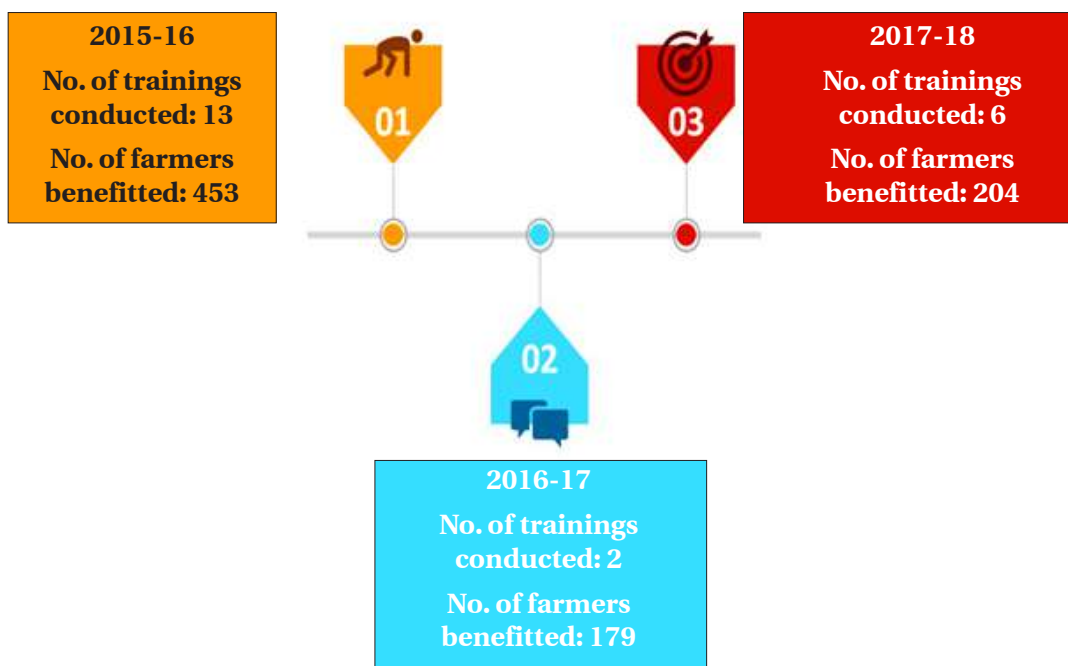


Fig. Capacity building activities from 2015 to 2018

## Major Achievements

Since most of the farmers rely on rains for growing their crops, the KVK have intervened on this matter by suggesting farmers to construct water harvesting structures on their field itself. With this intervention, the farmers were able to irrigate their crops whenever required *i.e.*, life saving irrigation of crops was achieved. Cropping intensity also increased because of available irrigation water which is one of the main accomplishments of the project. The farmers were also able to rear fishes in these ponds and thereby gaining additional income, which in turn improving their income and most probably their livelihood. At present, 10 such structures are proposed to be adopted and replicated at the village. The details of the intervention are as under:

**Table: Water harvesting structure**

Sl. No.	Particulars	Remarks
1	Name of the technology	Water harvesting and its utilization for Rabi crop in middle high land
2	Objectives of the study	To increase the cropping intensity of the area by providing supplemental irrigation during the long dry spells.
3	Problem diagnosis	Lack of source of irrigation water during long dry spells in Rabi and summer season
4	Comparisons/treatments a) Farmers practice	Farmers have no farm ponds but rely solely on rainfall.
	b) Improved technology	Water harvesting farm pond (25 m x 25 m x 2 m); 1250 cum; 1 ha command area Farm pond used for 1. Fish rearing. 2. Irrigation of vegetable crops throughout the year on 0.25 ha and rice followed by water melon on 0.75 ha
5	Nos. of unit to be replicated	10

## Enhancing Resilience to Climate Variability: KVK, Mokokchung



### Introduction

KVK, Mokokchung adopted Aliba village for this programme. The total cultivated area of the village is about 47,350 ha. The total population of the village is 1053 with 262 numbers of households. Major problems faced by the farmers are floods during monsoon and drought like situation during winter October-December. Of the total cultivated area only about 7,220 ha is irrigated and the rest is rainfed. Major crops grown are paddy, maize, cucumber, beans, pea and fruits like orange and banana. The villagers also rear only local breeds of piggery and poultry before the start of the project.

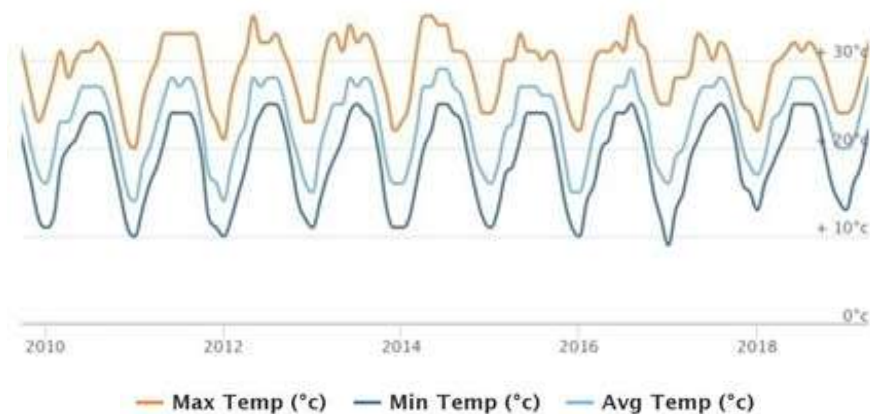


Fig. Graph showing temperature trends in the district during the last decade

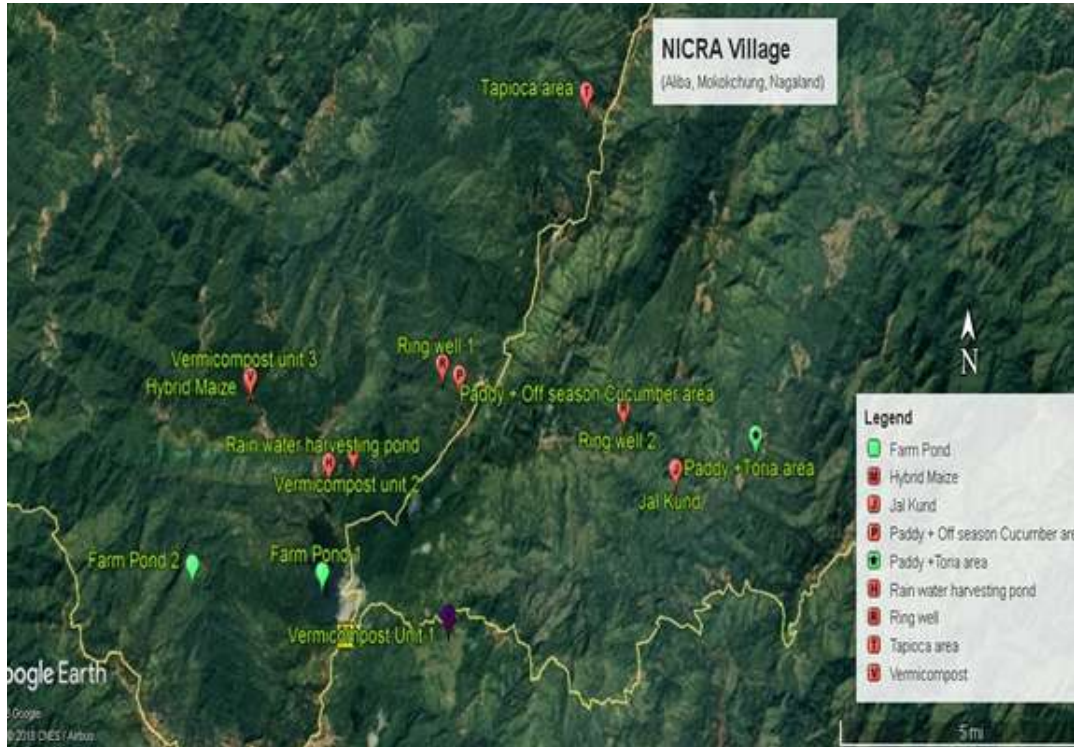


Fig: Satellite view of the project site depicting major interventions

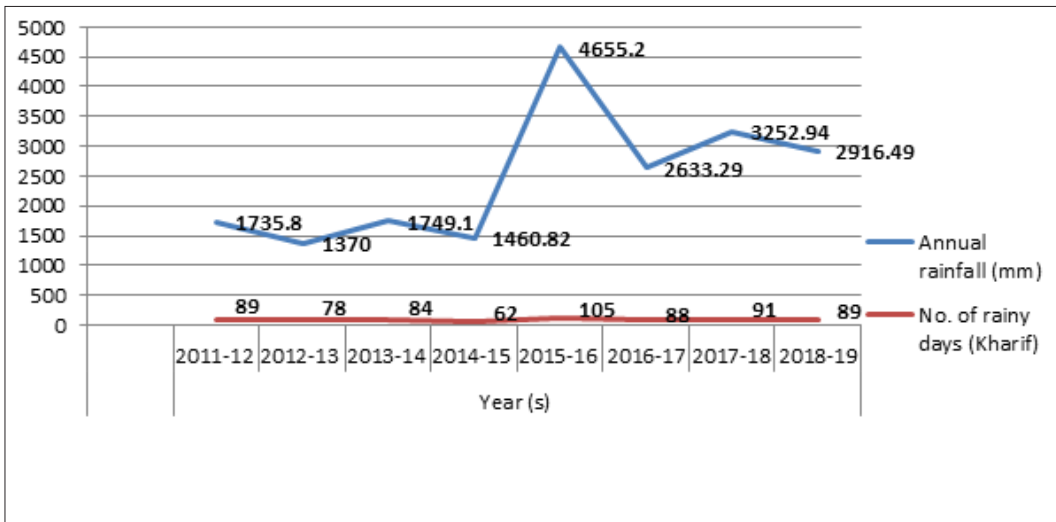


Fig: Rainfall pattern in the District during the last decade

## Natural Resource Management

One of the major achievements under this module is the construction of water harvesting structures or '*Jalkunds*' and ring well in the adopted village. This is so because of the fact that the village experiences drought after the monsoon and most of the farm lands are under rainfed farming. The collected rain water is then utilized for irrigating vegetable crops like capsicum, chilli *etc.* Other interventions undertaken under this module are renovation of irrigation channels using sausage wire, improved drainage in low lying areas, IMC through paddy straw mulching, promotion and popularization of vermicomposting, which in turn discourages the burning of agricultural wastes and so on.

***IMC through Straw Mulching and promoting Zero Burning:*** Intervention of in-situ moisture conservation through paddy straw mulching for the cultivation of broccoli var. Green Magic was done in the adopted village. The total area under this intervention was 2 ha involving 6 farmers.

**Table: Demonstration on Ring well for irrigation of winter vegetables and off-season cucumber**

Crops	No. of farmers	Area (ha)	Yield (q/ha)	Economics of demonstration (Rs./ha)			
				Gross Cost	Gross Return	Net Return	BCR
Off season cucumber	7	2 units	87.1 q/ha	85000	217750	132750	1:2.6

## Crop Production

Crop production interventions for combating climatic aberrations undertaken by the KVK in the adopted village include water saving paddy cultivation methods like SRI, introduction of improved crop varieties like tomato var. Megha 1 & 10, Swaraksha, Toria var. TS-38, cabbage var. Summer Queen, Rare ball, broccoli var. Green Magic, knolkhol var. White Vienna, pea var. Azad, maize var. HQPM-1, paddy var. CAU R-1, wheat var. DBW-107 and others. Short duration varieties of maize (RCM-76) were also introduced. Other technologies demonstrated and practised include staggered community nurseries for growing paddy, broccoli and King Chilli, sequential cropping after harvesting of paddy so as to utilize fallow lands and crop diversification are some of the significant achievements under the module.



**Fig. Demonstration on ring well**

**Table: Performance of medium duration maize (RCM-76) variety**

Measurable indicators Yield (q/ha)	% increase in yield		Economics of demonstration (Rs./ha)			
	Demo	Local	Gross Cost	Gross Return	Net Return	BCR
35.5	30.7	-	49700	101250	51550	2.4

### Utilization of fallow lands after harvesting paddy

In this system, Toria var. TS-38 was cultivated in the paddy fields which were usually left fallow after harvesting paddy. This intervention enables the farmers to gain additional income and also provides employment to unemployed rural youth. Total seed yield from this intervention was recorded at 580 kg/ha and net return of Rs. 14700.00 with B:C ratio of 2.3.

Crop	Variety	Seed yield (kg/ha)	Gross return (Rs./ha)	Net return (Rs./ha)	Benefit cost ratio
Toria	TS-38	580	23200	14700	2.3

### Livestock and Fisheries

Under this module, the KVK have introduced interventions like introduction of improved breeds of livestock and fisheries, construction of scientific housing for livestock to reduce heat and cold stress, preventive vaccination to livestock against

diseases like FMD, swine fever, Ranikhet disease *etc.* and utilization of community lands for production of animal feed (tapioca). Since the inception of the project, the KVK has demonstrated 28 such demonstrations in the adopted village. Over 500 numbers of livestock were distributed to about 300 farmers and over 800 animals were treated/ vaccinated.

### Institutional Interventions

Institutional interventions organised and demonstrated by the KVK in the adopted village includes establishment of seed bank, fodder bank, CHC, establishment of community nurseries and installation of solar nano-pumps for supplemental irrigation. The account for the CHC is jointly held by the KVK and the VCMRC (Village Climate Risk Management Committee). The implements in the CHC are available on hired basis at very low rate of hire.



**Fig. Solar Nano Pump Demonstration**

### Capacity Building

Capacity building activities organised by the KVK in the adopted village includes nursery management programme for training on nursery raising of vegetable crops, programme on scientific pea cultivation, water management of crops, programme on nutritional gardening for meeting the nutritional security needs and training of the self-help groups in maintenance and record keeping. A total of 54 such activities have been completed so far involving a total of 1329 farmers of the village.

## Extension Activities

Activities conducted by the KVK in the adopted village include strengthening of self-help groups, method demonstrations, awareness programmes, diagnostic visits, group discussions, farmer-scientist interactions, field days and so on. The total number of programmes conducted so far is 222 involving a total of 2209 farmers of the village.

## Significant Achievements in the NICRA Village

One of the interventions by the KVK is the cultivation of crops in slope areas by erecting embankments. During the monsoon period, most of the rain water flows through the slopes as run-off, leading to soil erosion. For combating this problem, the KVK demonstrated construction of embankments across the slopes and shaping the slope along the contours. This intervention has led to the use of such lands which were unused prior to the intervention for cultivation of crops, especially vegetable crops and gaining an additional income of up to Rs.32,000 per hectare.

Another important intervention is the promotion of Community nursery for Paddy, Broccoli and Naga King Chili so as to make the seedlings available during drought or flood in the NICRA adopted village. The seedlings are utilized for transplanting at the time of climatic uncertainties. The number of farmers benefitted and area covered through this intervention during the year 2018 is given in the table below:

**Table: Farmers benefitted from community nurseries with area covered**

Crop	No. of Farmers	Area (Ha)
Paddy (var. CAU-R1)	21	0.25
Broccoli (var. Green Magic)	11	0.10
Naga King Chili (Local)	7	0.01



## Climate Smart Interventions for Ecological Sustainability: KVK - Phek, Nagaland



### Introduction

KVK Phek is located at the northern side of the state of Nagaland. The region experiences severe drought especially in winter season. Initially, the KVK adopted Thipuzumi village which has a total area of 3300 ha with 421 total numbers of households. Presently, the KVK has adopted three other villages' viz., K. Basa, Phusachadu and Kikruma village with a total area of 2200 ha, 1600 ha and 8700 ha respectively. The total numbers of households are 310, 900 and 1190, respectively.

NICRA Project in KVK Phek started since the year 2011-12 and is still active till date where the farming community of the adopted villages has greatly benefitted in terms of different improved farming technologies.



Fig. Digital map of Thipuzu Village of KVK Phek, Nagaland

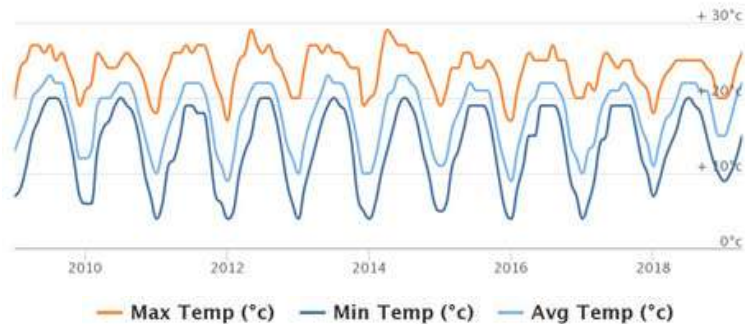


Fig. Graph showing temperature trends in the district during the last decade

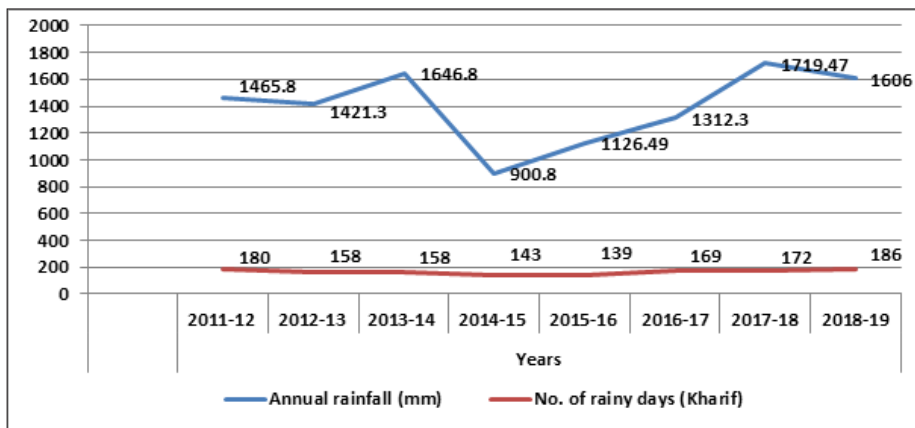
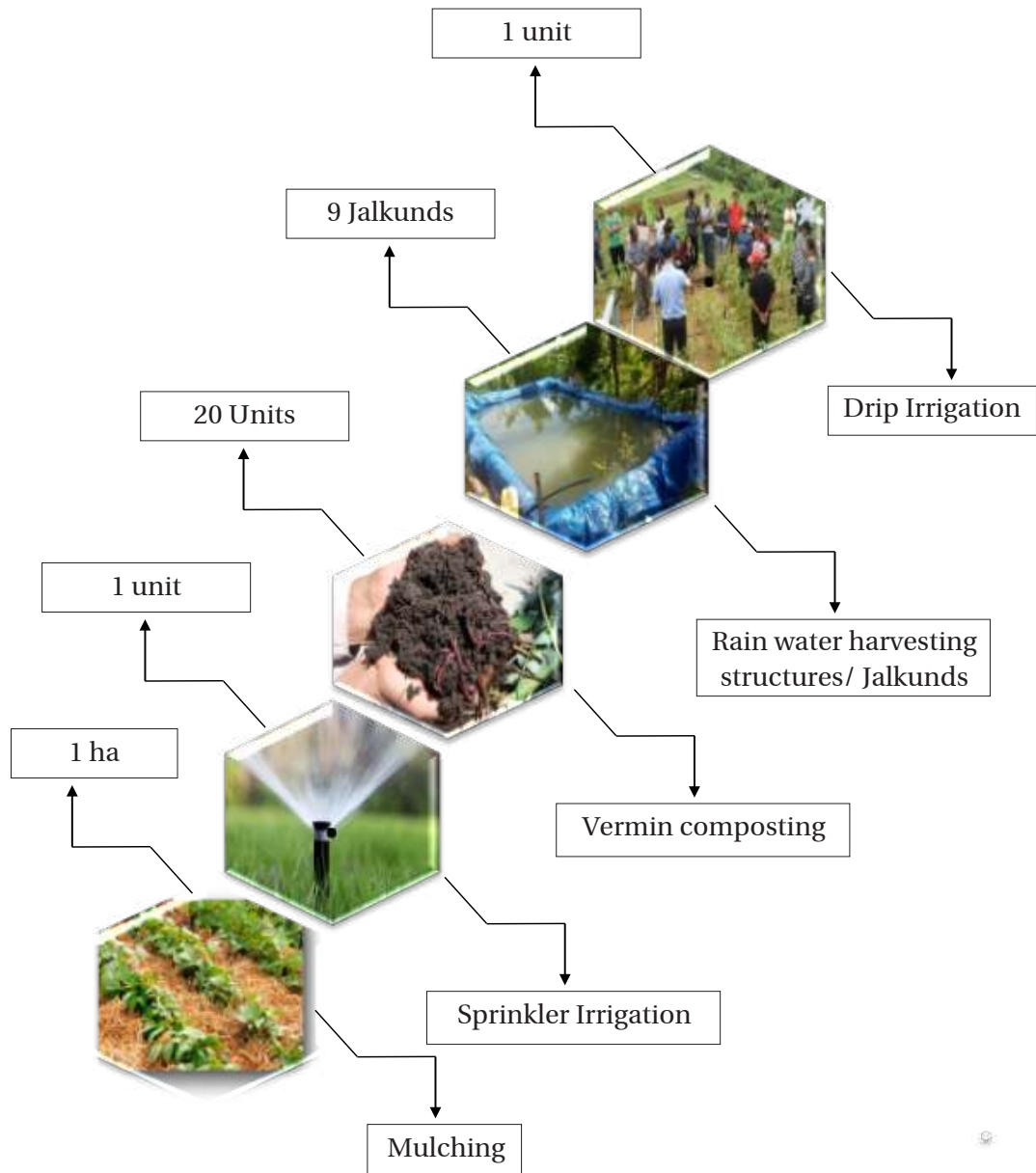


Fig: Rainfall pattern in the District during the last decade

## Natural Resource Management

Interventions like harvesting of rain water through storage tanks/special structures called '*Jalkunds*', soil moisture conservation through mulching using paddy straw and other crop residues, micro irrigation like drip and sprinkler irrigation and others were demonstrated and practised in the farmers' field.



**Fig. Prominent achievements under natural resource management**

## Crop Production

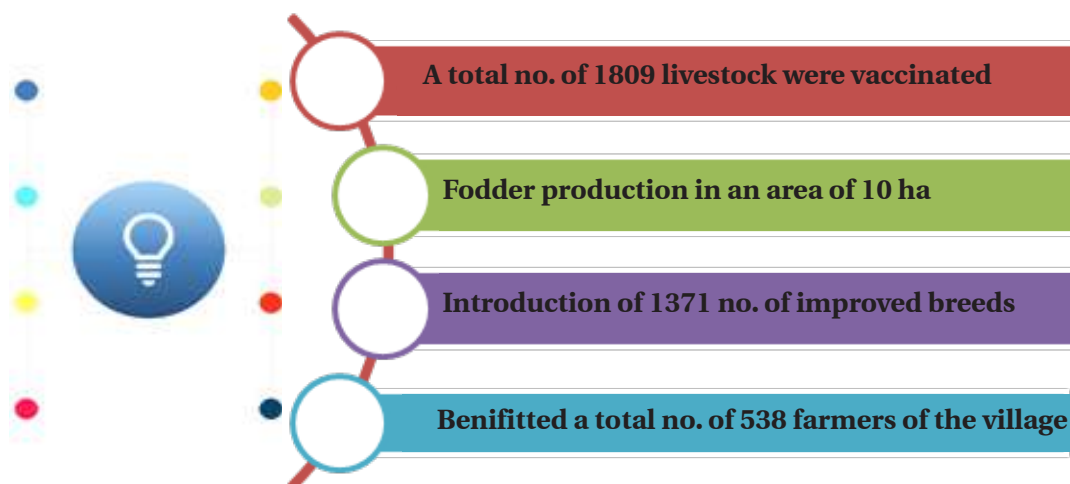
Climate resilient varieties like Arkel, AP-3 (pea) CAU R-1 (Paddy) Rare ball (Cabbage) were identified as most potential varieties. This particular intervention had a great impact on the farming community. Use of paddy straw as a substrate for mushroom cultivation resulted in social wellbeing, economic prosperity and environmental protection by addition of residues back to the soil. These interventions enabled the conditions that enhanced the feasibility of adaptation and mitigation options with sustainable development.

**Table: Performance indicators of high temperature tolerant pea varieties**

Variety	Measurable indicators of yield		% increase in yield	Economics of demonstration (Rs./ha)			
	Demo	Local		Gross Cost	Gross Return	Net Return	BCR
Prakash	1.9 t/ha	1.3t/ha	23.07	10050	39460	29410	3.9
Arkel	8.30t/ha	7.65t/ha	8.49	213000	489600	276600	2.29

## Livestock and Fisheries

Introduction of improved breeds of livestock *viz.*, Vanaraja and Srinidhi in poultry, Khaki Campbell in duckery, broiler rabbit breed Newzealand White *etc.* were the interventions to diversify the livelihoods in the village.



**Fig. NICRA Activities under the module Livestock and Fisheries**

### No. of farmers benefitted

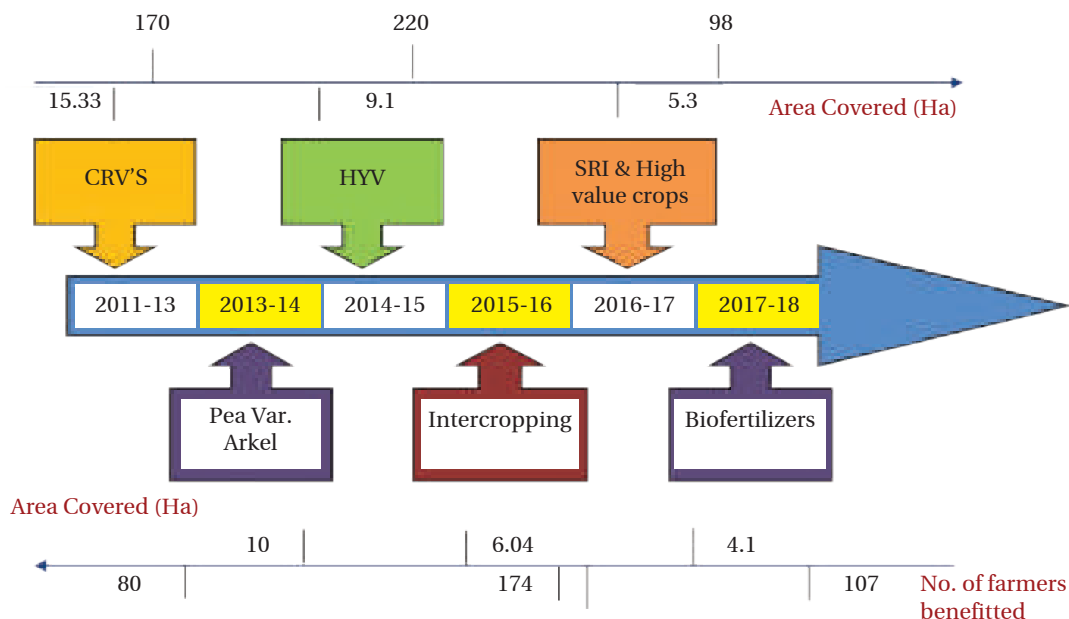


Fig. Impact of NICRA interventions on crop production

### Institutional Interventions



Fig. The significant interventions of KVK Phek Under NICRA

### Capacity Building Interventions

The Capacity Building activities conducted in the NICRA villages by the KVK includes; Exposure visits to Regional meteorological centre, Guwahati, NRC on Pig Guwahati, CVSC AAU, Khanapara, Goat research Station, Meghalaya; trainings and

demonstrations on different agriculture related enterprise like nursery management of paddy and vegetable crops, production technology of fruit crops like kiwi and persimmon, package and practises of vegetables like pea, farming systems, mushroom cultivation, scientific rearing of farm animals, proper management and housing of farm animals, micro irrigation techniques and other such enterprises. With these training activities and demonstrations, the farmers in the villages have gained more knowledge about modern agriculture, which is more sustainable to the environment and more profitable to the farmers as well.

### Extension Activities

The different extension activities conducted by the KVK includes field days, diagnostic visits where farmers were able to witness different type of farming systems in structured farms, group discussions. A total number of 31 extension programmes benefitting 696 farmers were conducted in the NICRA village since inception of the project.

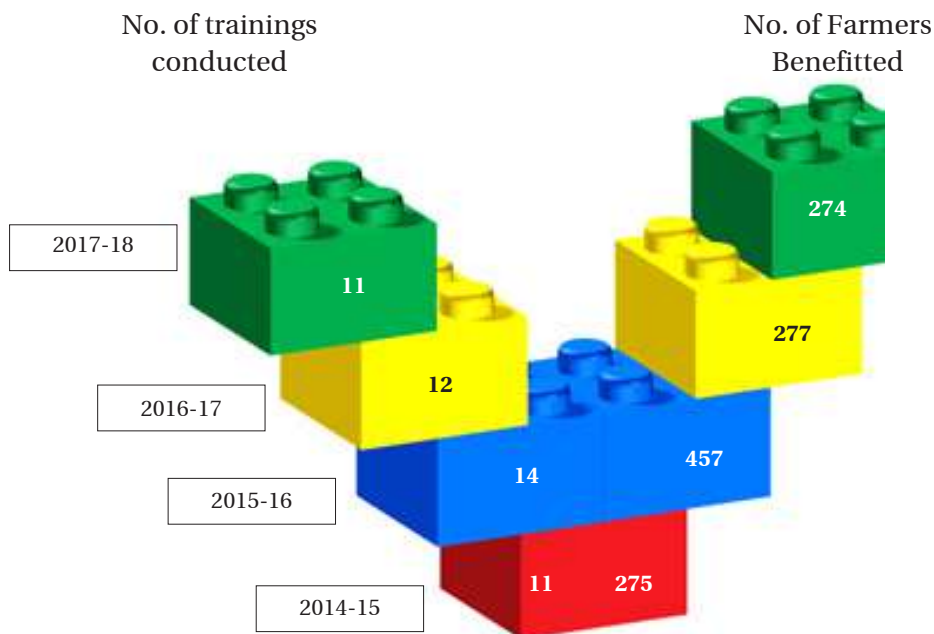


Fig. Capacity building activities of last five years

### Major Achievement

**Cultivation of Kiwi in Jhum land:** One of the major achievements by the KVK is the conversion of jhum lands to kiwi orchards. The orchard was started in the year 2012 where 100 kiwi saplings vars. Hayward and Allison, were planted in an area of around 0.25 ha. Timely pruning was done and grafting was also regularly done. During

the year 2017-18, it was recorded that over 500 kg of kiwi fruit was harvested from 80 plants, which benefitted the farmer in terms of income. Under the guidance of the KVK, the farmers have also started post harvest practises of kiwi where sorting, grading, packaging and labelling of fruits in packets and marketing of the fruits was accomplished.



**Kiwi Orchard**



**Kiwi Nursery for Propagation**



**Pruning in Kiwi**



**Packaging and marketing of Kiwi**

## The climate smart interventions in Meghalaya: KVK Ri Bhoi



### Introduction

NICRA project has been under implementation in village Kyrdem since 2011. Since its beginning, NICRA project demonstrated and supported to adopt a wide-range of technologies and improved practices for mitigating climate change to provoke farming as business especially in hills. Various technologies were demonstrated under NICRA and some of the technologies demonstrated for socio-economic impact are highlighted below.

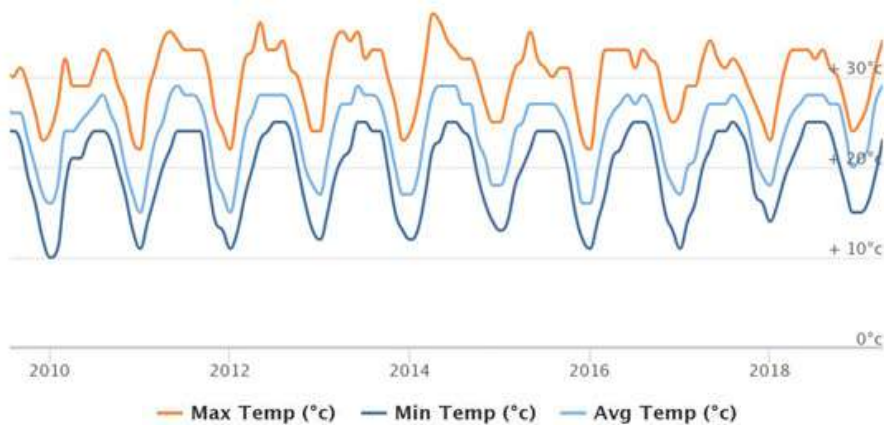


Fig. Graph showing temperature trends in the district during the last decade



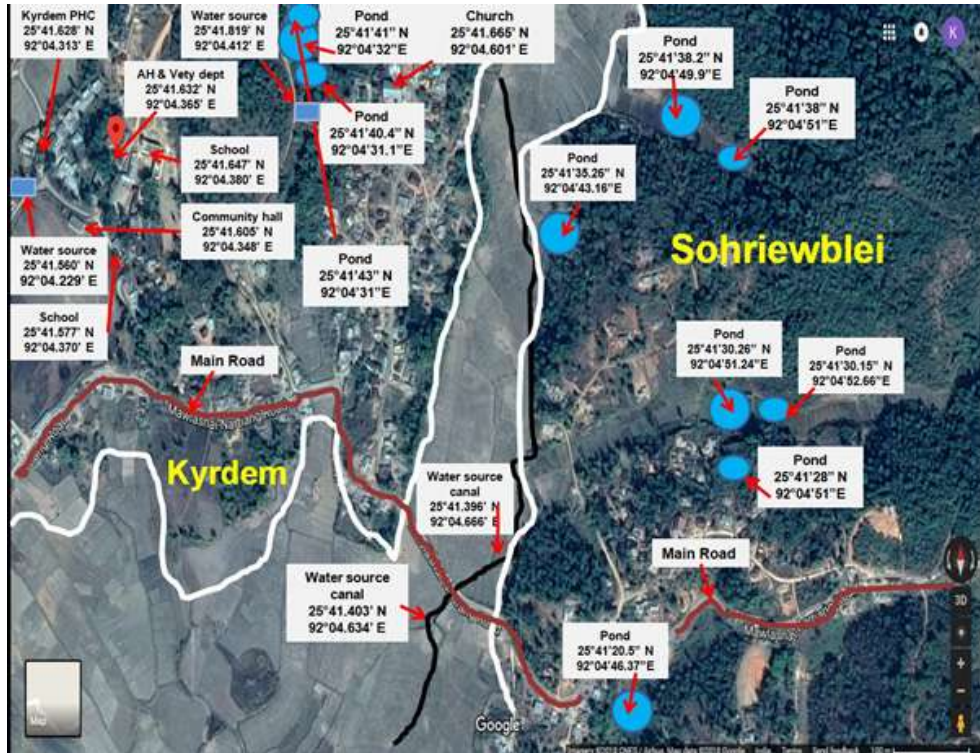


Fig. Digital map of NICRA village highlighting the major interventions by KVK Ri Bhoi

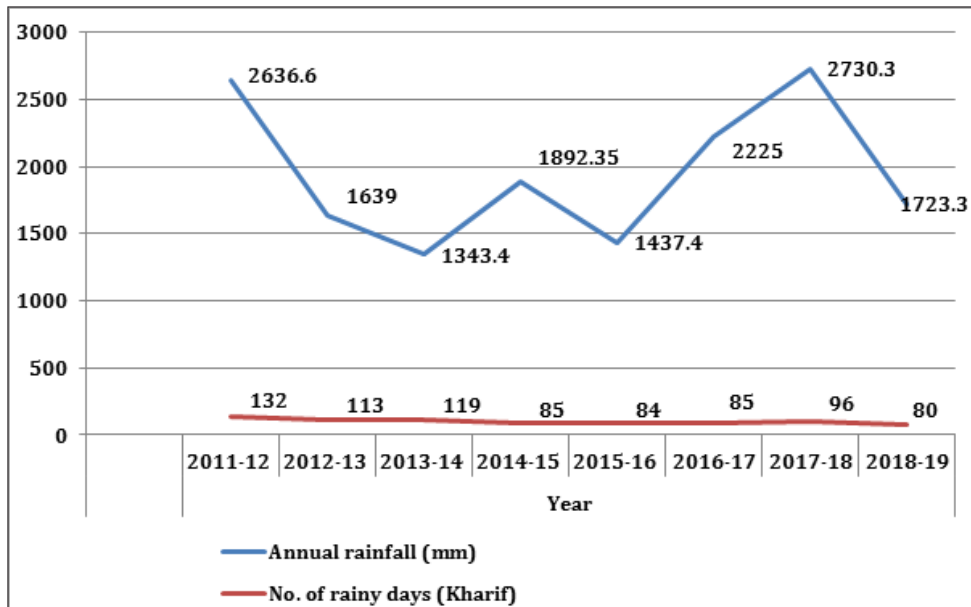
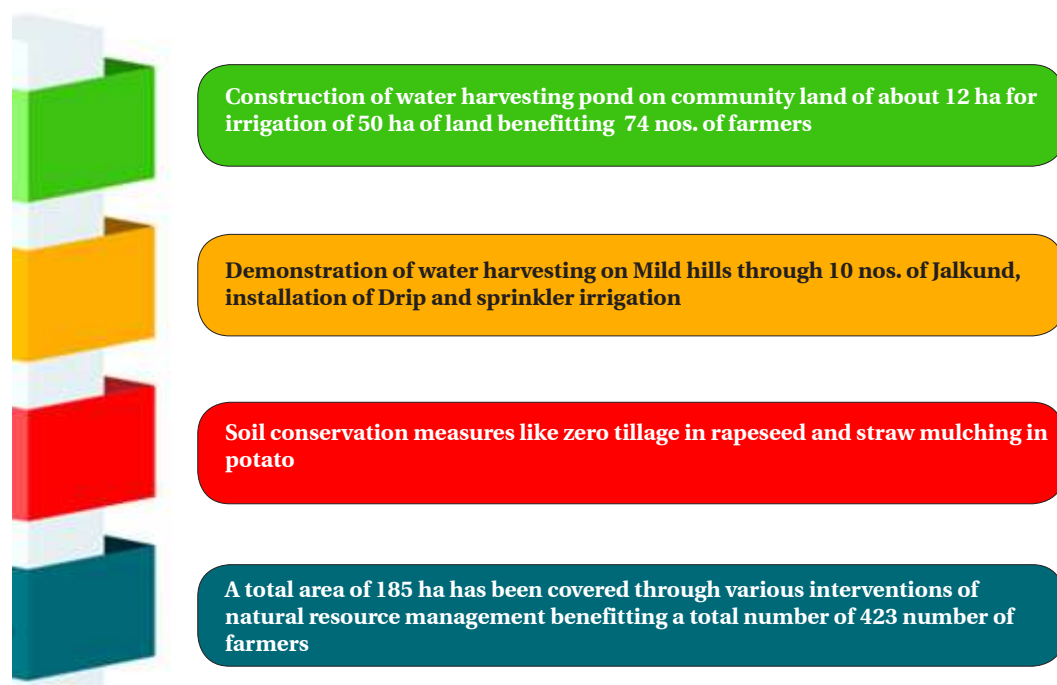


Fig: Rainfall pattern in the District during the last decade

## Natural Resource Management

So far, various interventions in response to adaptation to climate change have been identified which include efficient water management through construction of jalkunds, micro irrigation system through sprinkler and rain gun, ring bund constructed for demonstration of paddy cum fish farming, drip irrigation in tomato var. Suraksha, moisture conservation practices like Straw mulching in Potato var. Kufri Jyoti *etc.*



**Fig. Depicting the various activities under NRM module**

**Zero Residue burning:** Total 12 vermicompost units have been demonstrated benefiting 47 farmer's field with average net return of Rs. 16,940/unit/year having B:C ratio of 2.25. It has also added in improvement of soil health and enrichment of soil nutrients (VC: N-1.9%, P<sub>2</sub>O<sub>5</sub>-4.48%, K<sub>2</sub>O-0.85%) making it cost effective method. There were no vermicompost units in Kyrдем village prior to implementation of this programme.

**Table: Performance parameters/indicators of vermicomposting**

Production/harvest (q)	No. of harvest/yr	Total harvest (q/yr/unit)	Earthworm production (No.)
10.6	3	30.6	5250



**Fig: AAU Low cost storage structure demonstrated in the adopted village**

## Crop Production

Crop production measures are essential prerequisite and framework for enhancing the adaptive capacity of agricultural crops. The significant interventions that contributed towards the increase in production are introduction of rabi pulses in rice fallows like Lentil var. L-4076, Lathyrus var. bio-L-212, Watermelon Var. Madhuri 64 F1 and Field pea var. Rachna. Demonstration on nursery preparation in poly-house by raising seedlings of Cabbage (Rare ball, green Hero, golden acre), Cauliflower (Snowball-16 K and Swart), Tomato (Suraksha and Amitab-003), onion (Prema and N-53) and King chilli (Local) were conducted in the village.

**Paddy-pea cropping system under raised bed:** Forty two farmers were imparted demonstrations by KVK Ri Bhoi on paddy-pea cropping system covering 5.5 ha of area. A substantial increase in yield was recorded by 73.5%, system productivity by 98.47% and cropping intensity to 207% from 110%.

**Table: Comparison of yield of Paddy and ginger along with system productivity**

Crop yield	Yield before intervention (q/ha)	Yield after intervention (q/ha)	Income before intervention (Rs/ ha)	Income after intervention (Rs/ ha)	B:C ratio
Paddy (var. RCM 10)	20.3	40.52	14830	35823	2.36
Pea (Vikash)	0	13.33	NIL	33470	2.58
System productivity	20.3	67.18	14830	69293	2.47

## Maize-black gram cropping system

Training was provided to 15 farmers along with demonstration in 1 ha of land under maize-black gram cropping system. An average MEY was recorded to be 59.23q/ha with average additional net return of Rs. 47,722 (Profitability ratio 2.37). After following the maize-black gram cropping system cropping intensity changed from 113% to 200%.

## Livestock and Fisheries

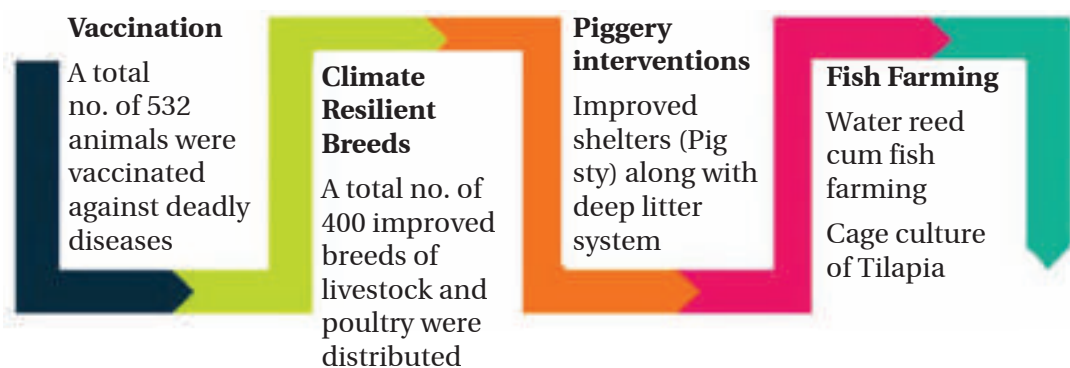
Various interventions like preventive vaccination, Animal check-up camp, introduction of improved breeds of livestock Giriraja breed for poultry and Hampshire cross breed for piggery, improved shelters for reducing heat stress in 3 piggery units; water reed cum fish farming and management of fish ponds were brought into light, out of which deep litter housing system for pigs and fish cum pig integrated farming system were most successful.

## Fish cum pig integrated farming system

KVK, Ri Bhoi demonstrated 2 IFS units with pig breed Hampshire cross. Fingerlings of Catla, Rohu and Mrigal was provided with stocking density of 8000 fingerlings per ha. Yearly fish yield was found out to be 108 kg/0.1 ha after integration of pig along with 8 piglets for starting another unit of IFS helping the poor and marginal farmer to earn extra revenue with good dividend. Farmers were able to earn an average annual return of Rs. 34,570/unit/yr with B: C ratio of 2.05.

**Table: Performance of Fish cum pig integrated farming system**

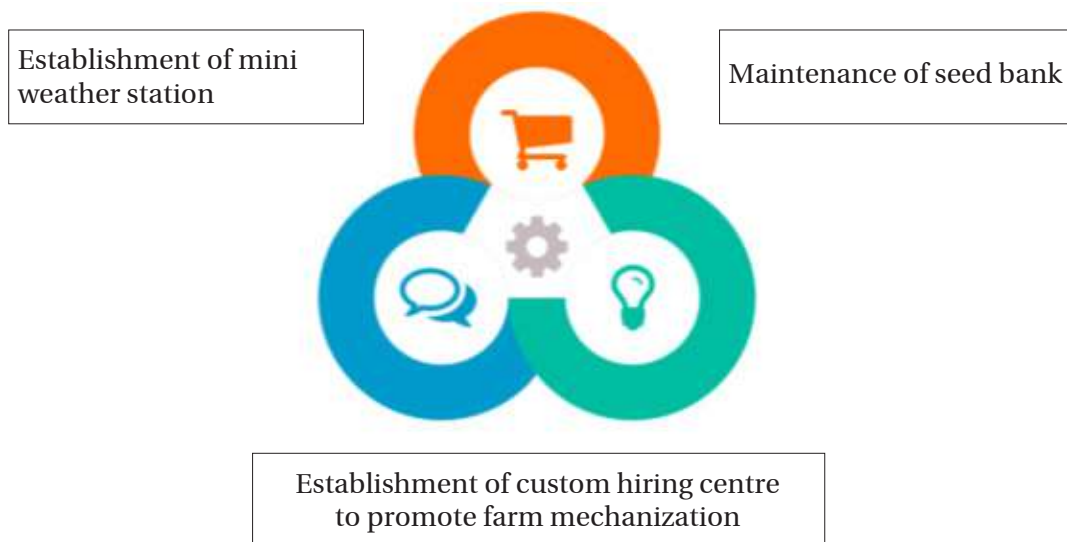
Before intervention	After intervention
Fish Production: 65kg/ 0.1 ha/yr (without integration of pig)	Body weight gain :148g/pig/day Fish production: 108 kg/0.1ha/yr



**Fig. Achievements under Livestock and Fisheries module**

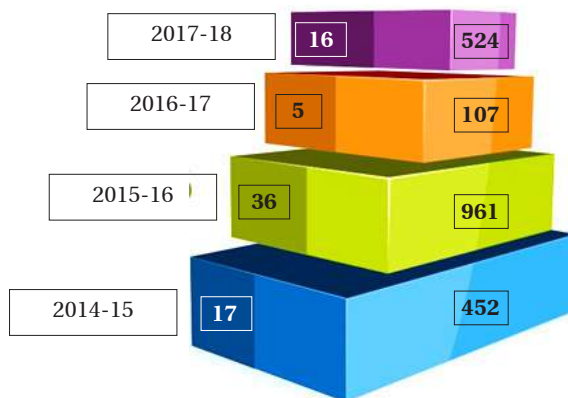
## Institutional Interventions

Many community-based initiatives like seed bank and establishment of custom hiring centres address the issue of vulnerability towards a changing climate. There are 28 different types of farm machinery stocked in CHCs; the most popular are power tiller, knapsack sprayer, paddy thrasher, maize sheller and small water pump.



**Fig. Interventions of KVK, Ri Bhoi**

Capacity Building conducting stakeholder consultations, training, workshops and demonstration exercises helped the farming communities for sharing and dissemination of agro-climatic information. A total number of 118 training programmes were conducted over the past few years which benefitted a total number of 2516 farmers in a span of seven consecutive years.



**Fig. Capacity building programmes at a glance**

## Successful Interventions

One of the major achievements in terms of overall satisfaction from the KVK will have to be the Poultry cum fish Integrated Farming System. Presently, two such units are being run by two separate self help groups and the total area of 0.01 ha. The breed of poultry reared is Vanaraja, which is a dual purpose breed (for meat and egg) and Indian Major Carps (Rohu, Catla and Mrigal) are reared in the ponds. About 15,000 numbers of fish fingerlings and 30 numbers of poultry birds are raised in a single unit. Apart from these crops like maize, bottle gourd, pumpkin, black gram, chilli and ginger are also grown in the area which enables the farmers to gain additional income. As reported by the KVK, over Rs. 35,000/- can be achieved from poultry alone from this system and about Rs. 7,000/- as additional income from vegetables. The gross income from fisheries alone is expected to be over Rs. 2,00,000/- from this year's harvest.

Another important intervention that has been adopted widely by the farmers of the NICRA village is the growing of crops, particularly vegetables in low-cost protected structures. Crops like Cabbage var. Wonderball, Capsicum var. Royal wonder, Broccoli var. Green Star *etc.*, are grown in these protected structures. The performance of vegetables grown in these structures is very high compared to the ones grown in open conditions. It has been reported that the farmer gains a net income of about Rs. 2,000/- from each growing period from a single unit.

## Climate smart interventions in Serchhip of Mizoram



### Introduction

The adopted village North Vanlaiphai under KVK, Serchhip falls under East Lungdar, Mizoram. The total population of the village is about 3582 with 777 numbers of households. Total cultivable area is about 518 ha.

The agriculture in the village is by and large rainfed and there was no proper irrigation method. Farmers grow rice only and usually leave the land fallow after harvesting. Paddy straw is also burnt on the field and is not utilized for anything else. In terms of climate, the area is prone to severe frost, especially during the months of December and January and water stress as well. However, during monsoon several cropping areas gets flooded and the water remains stagnant in many pockets of land which may damage and destroy crops completely.

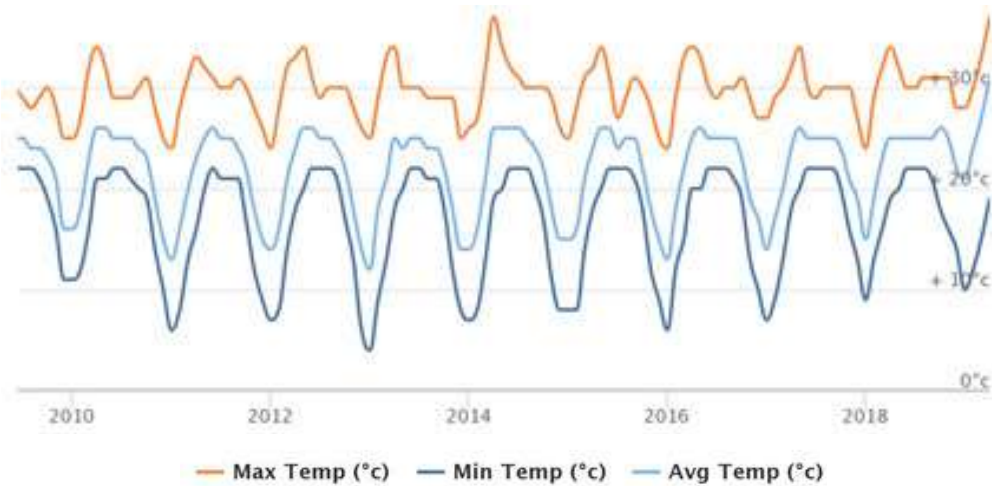


Fig. Graph showing temperature trends in the district during the last decade

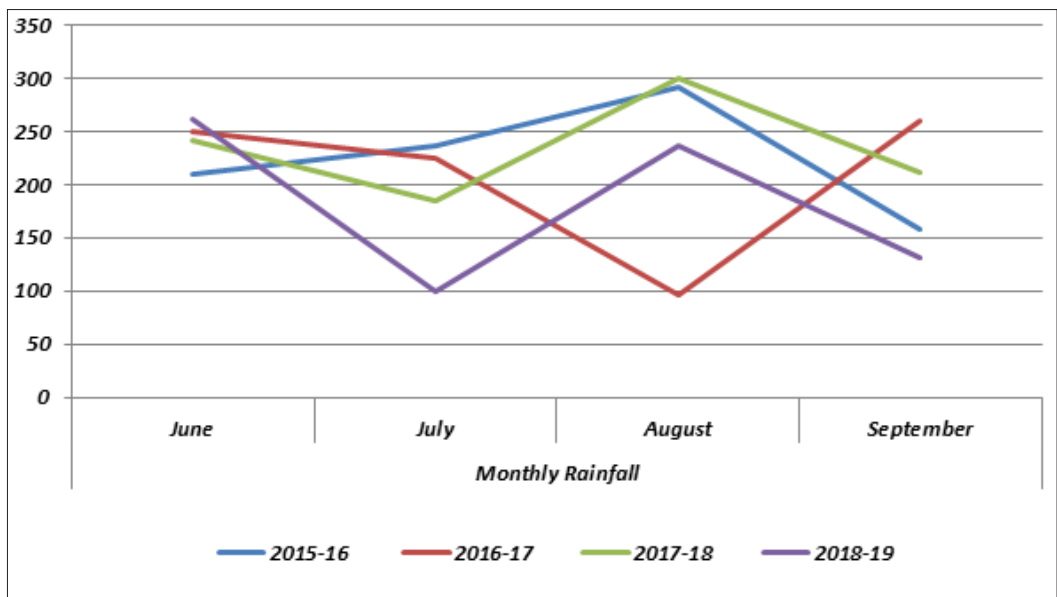
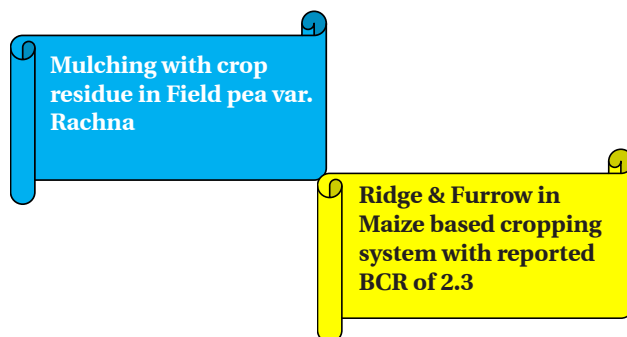


Fig: Rainfall pattern in the District during the last decade

### Natural Resource Management

To overcome the problem of water stagnation the farmers were advised to grow their crops using ridge and furrow method which was adapted in an area of 15 ha and benefitted a total number of 23 farmers so as to minimize the impact of water stagnation. Another promising intervention is the cultivation of crops, particularly horticultural crops in protected structures and use of drip irrigation system.





**Fig. Depicting the interventions under NRM module**

### **Crop Production**

Farmers of N. Vanlaiphai village have been cultivating more than one hundred year old local varieties of Paddy which are low yielding, tall stature, and sensitive to lodging and long duration (160 days maturity). These characteristics of old varieties do not permit timely land preparation and sowing of rabi crops due to which the fields remain fallow after paddy. Paddy is generally transplanted during 1<sup>st</sup> week of June and harvested during last week of November. The main reason for introduction of CAU R1 is to increase paddy production as well as timely sowing of rabi crops after harvesting paddy.

KVK, Serchipp introduced CAU- R1 through OFT and FLD in the district with an aim to popularize double cropping by utilizing the residual moisture of paddy after harvesting. Good quality seeds were provided with hands on training for raising of nursery and line transplanting. With the adoption of medium duration HYV of Paddy (var. CAU – R 1), the average productivity recorded was 3 t/ha with a net return of Rs. 49,050/- per ha compared to local variety having the yield of 2.0 t/ha with a net return of Rs. 26,550/-

Apart from introduction of climate resilient varieties protected cultivation was also given major emphasis and various protected structures were constructed in convergence mode.

**Table: Performance indicators of Paddy (CAU-R 1)**

<b>Crop</b>	<b>Paddy (CAU-R 1)</b>
Yield	3.2 t/Ha.
Net Return (Rs.)	50,210/-
B:C	2.4
State Avg. yield	2.1 t/Ha
District Avg. yield	2.23 t/Ha.



Fig. The cluster of protected structures constructed in the village under crop production module

### Livestock and Fisheries

When exposed to climatic stress the different stress might prove detrimental to the livestock. Such a response is attributed to animal's inability to cope up with the combined effects of different stress simultaneously. In such case the animal's body reserves are not sufficient to effectively counter multiple environmental stresses. As a result their adaptive capabilities are hampered and the animals struggle to maintain normal homothermy. Hence, improved shelters for reducing heat stress in poultry were initiated by KVK Serchhip to overcome the climatic aberrations. Also, improved breeds of poultry like Vanaraja were introduced to increase the production

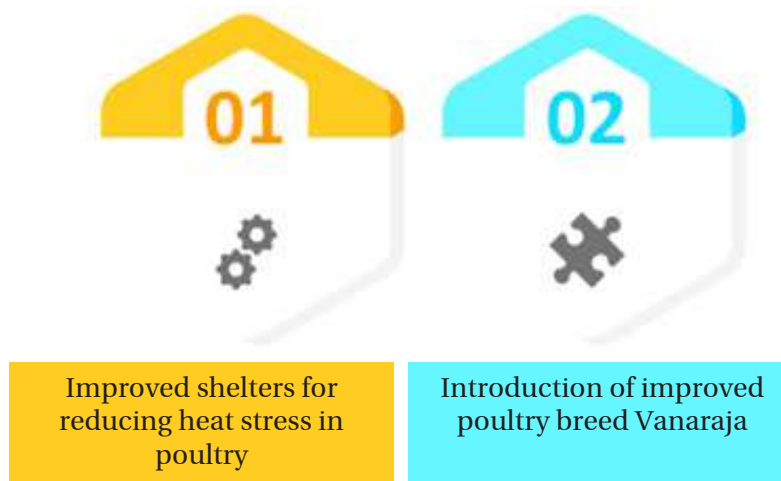


Fig. Interventions of KVK Serchhip under Livestock and Fisheries module

**Table: Performance of Vanaraja in Machang type housing system**

Breed	Average mature Body weight	Average age at 1 <sup>st</sup> Egg	Average egg Prod/year/ Bird	Net Return (Rs.)	B:C ratio
Vanaraja	3400g	4 months 27 days	124	6,680	3.72 : 1
Local	2900g	6months 4 days	77	3,490	2.16 : 1

### Institutional Interventions

KVK has taken an initiative to promote custom hiring centre to promote such small scale infrastructure through the local farmer associations. In addition, custom hiring centre is more viable and provides gainful employment and livelihood to the rural poor. The village has also developed a proper unit for storage of seeds. Seeds of many crops could be stored at a time and the seeds are distributed to farmers as and when required.

**Fig. Institutional interventions**

### Capacity Building

A total number of 17 training programmes were conducted benefiting a total number of 759 farmers. A total number of 15 extension activities were conducted benefiting a total number of 570 farmers.

# Combating climate change: KVK, Senapati



## Introduction

NICRA intervention started in KVK Senapati in the year 2011. The villages adopted by the KVK are Hengbung, Hengbung-I and Mayangkhang which collectively covers a total area of 232 ha. These villages face climatic vulnerabilities such as drought, moisture stress, cold wave, frost bites, erratic rainfall, flash rain, early withdrawal of rainfall and long dry spell during dry *Rabi* season.

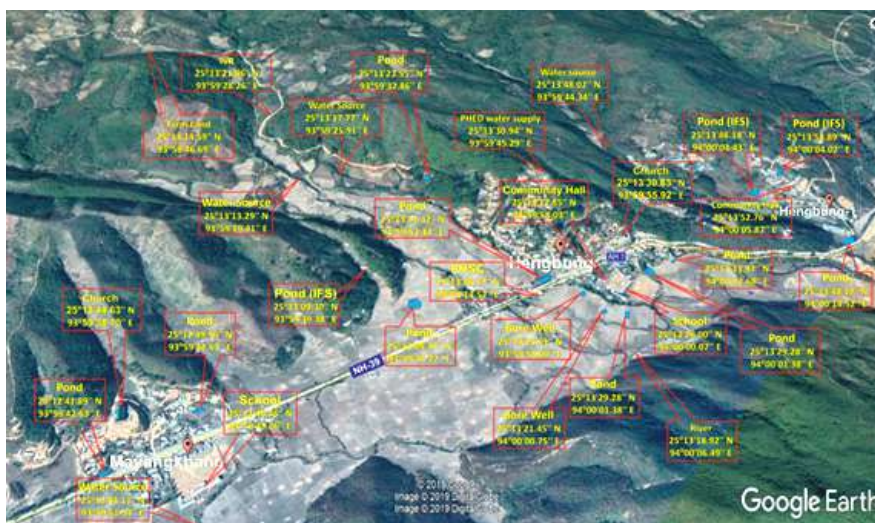


Fig. Digital map of NICRA Villages of KVK Senapati

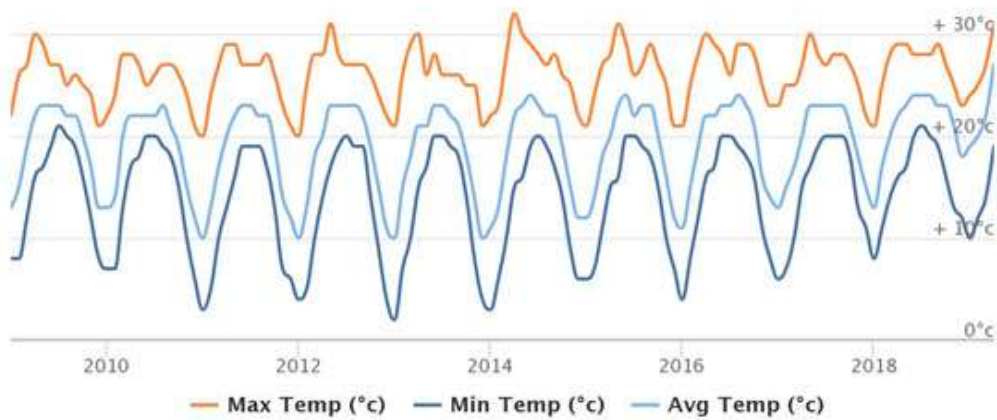


Fig. Graph showing temperature trends in the district during the last decade

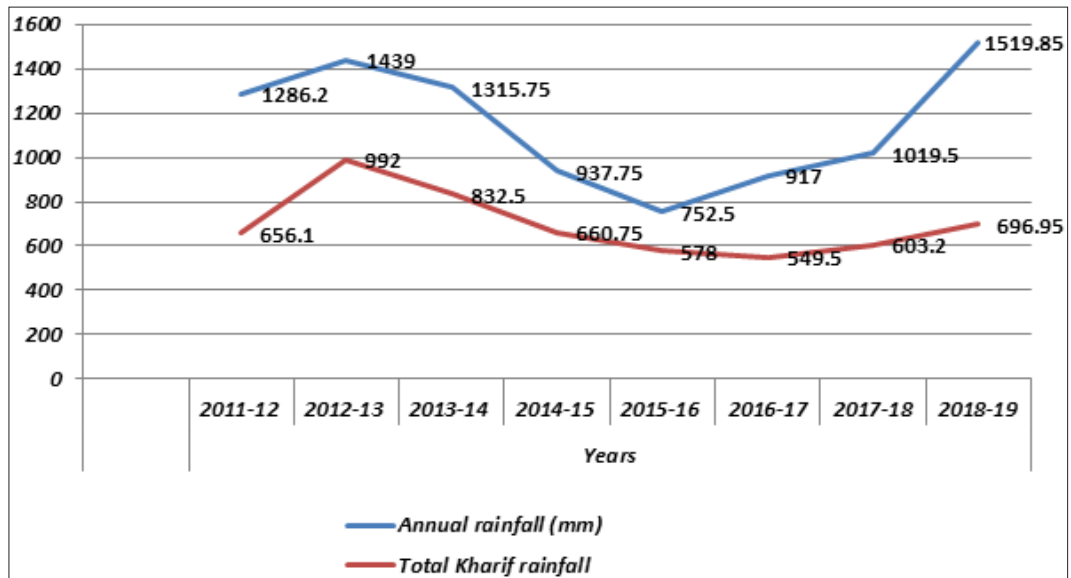


Fig: Rainfall pattern in the District during the last decade

## Natural Resource Management

Interventions covered by the KVK in the adopted village to counter the effects of climate change includes IMC through mulching in broccoli var. Aishwarya, practising of zero tillage cultivation in Rapeseed var. TS-36, popularization of micro irrigation systems like drip and sprinkler irrigation systems, soil conservation through bamboo cultivation (var. D. Hamilton), water conservation techniques like construction of check dams and other water harvesting structures for utilization during unfavourable conditions and so on.

**Minimum tillage in Pea:** This intervention was taken-up during 2017 and involves 6 farmers covering a cropped area of 1 ha. This intervention was taken up due to the unavailability of irrigation water and occurrence of drought like situation after the monsoon resides. The practise of this method of planting enables the crop to utilize the residual moisture from the paddy fields to the maximum, especially during growth stages of the plant and thereby promising better crop growth.

**Table: Economics of minimum tillage in Pea**

Intervention	Yield	Gross cost	Net income	BCR
Demo	6.3	26870	17230	1.64
Local	5.2	26225	10175	1.38

### Crop Production

The prominent interventions under the crop production module implemented by the KVK in the adopted village includes technologies like DSR paddy with line sowing to overcome water scarcity problem, advancement of planting dates of crops like broccoli var. Aishwarya so as to escape the terminal heat stress, bunding of pineapple in two row system as a method of improved cultivation practises in hilly areas, growing of improved crop varieties like cabbage var. Green hero and Rare ball, garden pea var. Arkel, Rapeseed var. M 27 and T9.

**Introduction of temperature tolerant cabbage var. Rareball:** The cultivation of cabbage var. Rareball is mainly because of the fluctuations in temperature during its growth period as there were incidences of rise in temperature during certain period of time. 15 numbers of farmers were involved in its cultivation covering a total area of 3 ha during 2017. The comparison between the performance of the improved and local cultivars are mentioned in the table below.

**Table: Economics of minimum tillage in Pea**

Intervention	Yield (q)	Gross cost	Net income	BCR
Demo	165.3	67355	97945	2.45:1
Local	147.5	65320	82180	2.25:1

### Livestock and Fisheries

Interventions conducted by the KVK in the NICRA village to improve the conditions of livestock and fisheries enterprises of the farmers includes introduction of improved breeds of livestock like Hampshire cross in the case of piggery, Gramapriya breed of

poultry, White Pekin ducks and so on. Due to heat wave during the summer months, there have been reports of heat stress on poultry birds and the mortality rate during such periods was also high. In order to solve this problem, the KVK demonstrated raising of poultry in improved shelters such as deep litter housing so as to reduce the heat stress and also to reduce the occurrence of diseases. Another intervention that was introduced to the farmers is the farm raising using Integrated Farming Systems (IFS) like duck cum fish farming, poultry cum fish farming, integration between animal husbandry, crop husbandry and fisheries in which to minimize the waste and input cost in the farm.

***Fish cum Duck IFS:*** Feeding livestock with concentrated feed in case of fishery and duckery has resulted in an additional weight gain apart from providing balanced nutrition and enhancing the productivity. One of the most successful interventions under this KVK so far is the Integrated Farming System of duck and fish. 5 farmers were chosen for this intervention and they were chosen based on the availability of farm pond and promising infrastructure. For this intervention, improved duck breeds (White Pekin) were reared in a free range manner and are fed with concentrated feed and in terms of fishes, Indian Major Carps were used. For one of the farmers, the net return from these IFS during the year 2017-18 was about Rs. 50,000.00 with BC Ratio of 2.9.

**Table: Economics of demonstration (Fish cum duck)**

Component	Yield (q)	Gross cost	Net income	BCR
Duck (Demo)	3.2 kg/duck/8 months	13792	15008	2.08
Duck (Local)	2.6 kg/duck/8 month	13255	10145	1.76
Fish (Demo)	0.40 kg/fish/8 months	11470	21530	2.87
Fish (Local)	0.32 kg/fish/8 month	10470	15930	2.52

### **Institutional Interventions**

Under this module, interventions such as establishment of seed banks and Custom Hiring Centre were incorporated in the adopted village. The seed bank was constructed using locally available bamboo. The outer line of the seed bin was lined with hessian cloth, charcoal and silica gel pack and seeds of rice, groundnut, black gram and rice bean were stored. Community nurseries were also raised for growing different vegetable crops during unfavourable conditions. These interventions, no doubt, have benefited the whole farming community of the village. Since the inception of the project in the village, the total number of technologies demonstrated under this module so far is 11 and benefitted almost the whole farming community in the village.

**Table: Details of the CHC with income generated during 2017-18**

<b>Implement</b>	<b>Area/ hrs</b>	<b>Beneficiaries</b>	<b>Income generated</b>
Power tiller	4.25 ha	11	9920
Knapsack sprayer	3 ha	3	600
Seed treatment drum	9 ha	12	375
Cono weeder	1 ha	3	225
SRI marker	1 ha	2	50
Chaff cutter	10 hrs	2	250
Maize sheller	3 hrs	2	300
Dal mill	2 hrs	1	40
Multipurpose pulverizer	12 hrs	8	240
<b>Total</b>	<b>18.25 ha 27 hrs</b>	<b>44</b>	<b>12000</b>

### Capacity Building

Capacity building activities such as proper feeding management of livestock, pest and disease management of crops, precautionary measures from diseases in livestock and fisheries and others were conducted by the KVK to better equip the farmers of the village. So far, 46 such trainings were conducted by the KVK and benefitted a total of 992 farmers, farm women and rural youth as well. Exposure visits to research centres and institutes, field days, different awareness programmes, method demonstrations, group discussions, agro-advisory services, diagnostic visits etc were also conducted benefiting 1400 personnel through 242 such activities.

### Successful Intervention

One of the most successful interventions under this KVK so far is the Integrated Farming System of duck and fish. 5 farmers were chosen for this intervention and they were chosen based on the availability of farm pond and promising infrastructure. For this intervention, improved duck breeds (White Pekin) are reared in a free range manner and are fed with concentrated feed and in terms of fishes, Indian Major Carps were used. For one of the farmers, the net return from this IFS during the year 2017-18 was about Rs. 50,000/- and in terms of BC Ratio it was 2.9.



## Climate smart pathways for sustainable farming: KVK Ukhrul



### Introduction

NICRA project started in village Ramva under KVK, Ukhrul in the year 2015. The adopted village receives an average annual rainfall of about 1616 mm and temperature Max, 30°C and Min 2.8° C. The major types of soil in the area are Alluvium, Lateritic black and red ferrous soils. The village falls under sub-tropical monsoon type of climate and the climatic vulnerability faced is moisture stress during both Kharif and Rabi seasons. Soil erosion is also a problem which is prevailing in the area because of the terrain and jhum cultivation.

The total population in the village is about 1380 with 280 numbers of households. Major crops grown are Rice, Maize, Mustard and other vegetables. The village is largely affected by soil erosion, high seepage loss and surface runoff; it has dual effect of water in the form of heavy rainfall during monsoon and severe scarcity during winter season. The rain water received during monsoon is either lost as surface runoff or sub surface runoff since most of the areas in the village are hilly terrains coupled with sandy loam soils. Further, in the recent years the area has witnessed erratic rainfall with increase intensity and prolong dry spell which results in low crop productivity and low cropping intensity. For combating the problem of soil erosion, the farmers have been advised to grow cover crops and to utilize log bunding in areas with steep slope.



Fig. Digital map of NICRA village highlighting the major interventions by KVK Dimapur

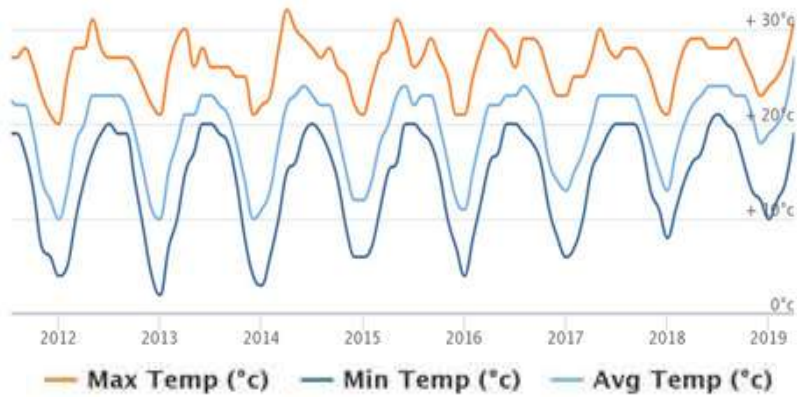


Fig: Graph showing temperature trends in the district during the last decade

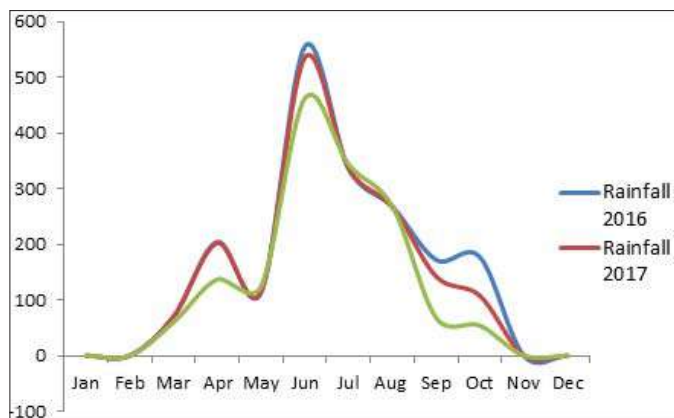


Fig: Rainfall pattern in the District during the last three years

## Natural Resource Management

Efficient management of natural resources is key for enhancing the adaptive capacity and contributes towards the resilience of communities. Location specific in-situ moisture conservation measures, harvesting of excess water, efficient use of harvested water, efficient irrigation methods, supplemental irrigation, enhancing the cropping intensity with the harvested water are the important approaches and the proven technologies on these aspects were demonstrated. The most significant achievements under NRM are depicted as follows.

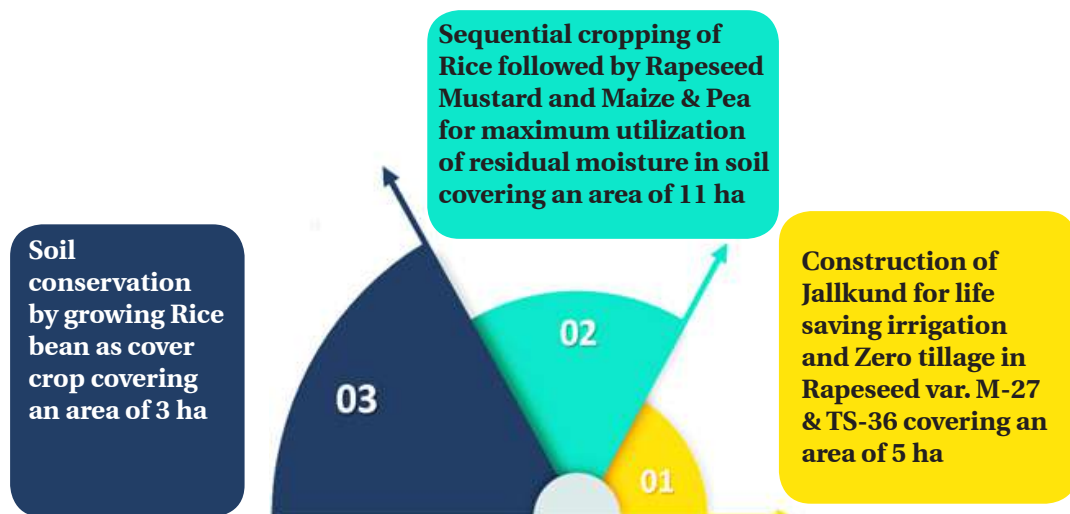


Fig. Interventions under the NRM module

**Cultivation of cover crops in Jhum lands:** Shifting cultivation practices lead to deforestation and soil erosion on hill slopes. Hence, KVK has taken an initiative for Jhum improvement through introduction of perennial crops (Kachai lemon, Orange and Tree Bean) and cover crop under wood log bunding.

**Table: Performance of cover crop in Jhum lands**

Variety	Area (Ha)/ No. of farmer	Measurable indicators of output		% increase
		Demo	Local practice	
Rice bean	3 ha/8	1200kg/ha	850 kg	40%

**Table: Economics of cultivation of cover crops in Jhum lands**

Economics of demo (Rs./ ha)			Economics of local(Rs./ ha)		
Gross Cost (Rs.)	Net Return (Rs.)	BCR	Gross Cost (Rs.)	Net Return (Rs.)	BCR
30000	32500	1:2.1	42500	25000	1:1.7

## Crop production

One major intervention by the KVK is the practice of advancing the planting date of crops especially garden pea so as to escape the moisture stress during maturity stage. This intervention has enabled the farmers to attain better crop yield as compared to planting of crops during normal time. Another significant achievement is the planting of improved varieties of crops especially in case of paddy. Farmers of the village usually grow local rice varieties which take more time to mature. With the introduction of short duration varieties like rice variety RCM-13 that takes only about 120-130 days to harvest, has enabled the farmers to take up second crop for cultivation; such as toria and other winter vegetables in the paddy fields, thereby attaining additional income.



**Fig. Mid-duration paddy var. RCM-13**

Introduction of drought tolerant Groundnut var. ICGS -76 in an area of 22 ha, Cultivation of Toria var. TS-38 after paddy in fallow lands in an area of 6 ha and SRI in paddy for water saving paddy cultivation method in an area of 8.5 ha are some other interventions put forth by KVK Ukhrul in the village.

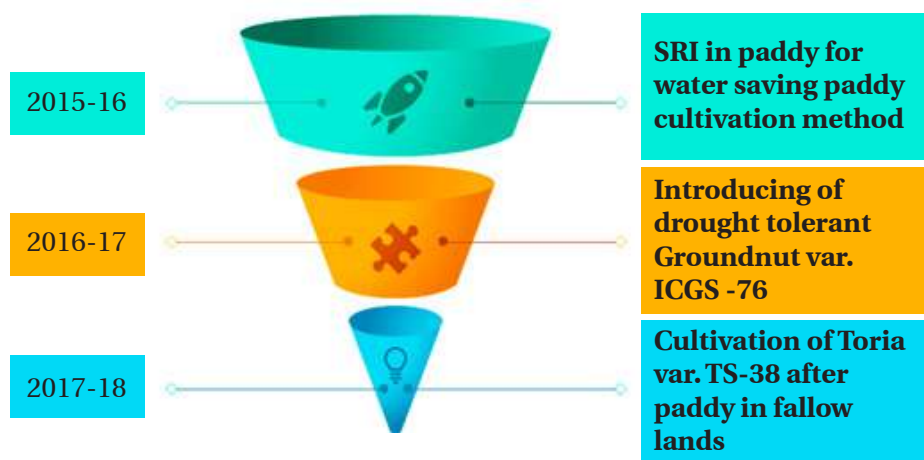


Fig. Crop production module

**Table: Performance of Toria Variety TS-38 over local variety**

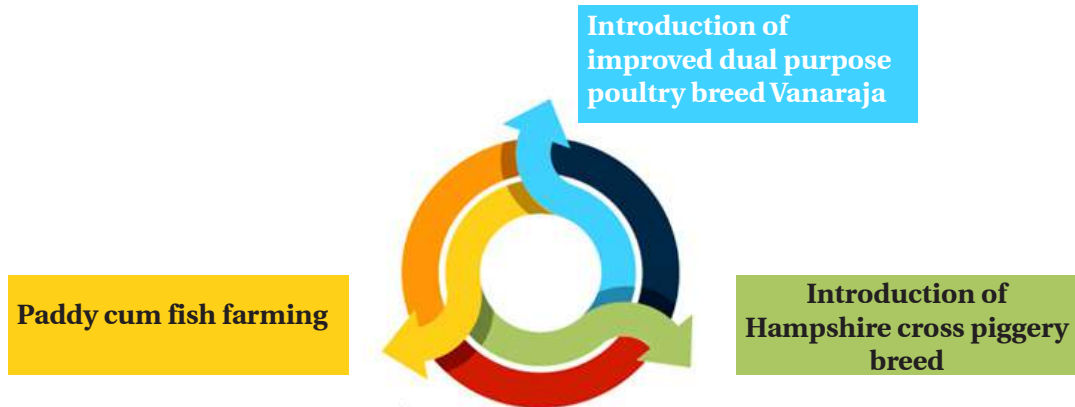
Variety	Area(ha)/ No. of farmer	Measurable indicators of output		% increase
		Demo	Local	
TS-38	2 ha (4 Farmers )	6.9	5.6 (M-27)	23.2

**Table: Economics of Toria variety TS-38**

Cultivation Cost (Rs.)	Net Return (Rs.)	BCR	Gross Cost (Rs.)	Net Return (Rs.)	BCR
12800	13600	2.1:1	12800	8650	1.7:1

### Livestock and Fisheries

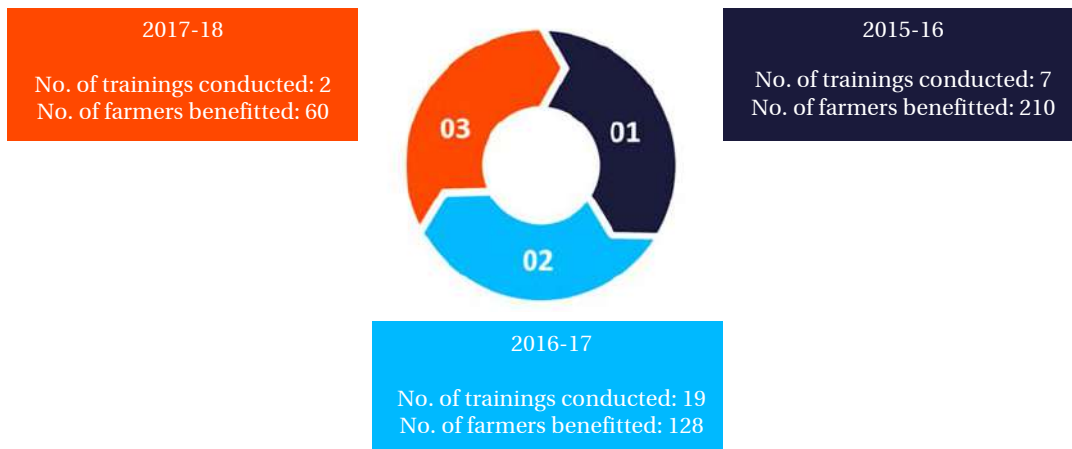
Improved dual purpose poultry breed vanaraja, which can be reared in backyards on natural, scavenged food with minimal supplementation that produces eggs and meat was introduced in the NICRA village for increasing income of farmers and to minimize the risk from variable climate. Hampshire cross piggery breed which has faster growth, lower maintenance costs, better feed conversion rate and reproductive performance, higher survivability, disease resistance and ecological adaptability was introduced in the NICRA village.



**Fig. Interventions in Livestock and Fisheries**

### **Institutional Interventions**

Mechanization of farm operations for rice production has necessitated the use of appropriate implements for timeliness in field operations and effective application of production inputs by optimizing the output of mechanical sources. Custom hiring centre has reduced the drudgery and improved the efficiency of field operations.



**Fig. Capacity building programmes since the inception of the project**

### **Capacity Building**

Capacity building fulfils the need of participatory approaches to agricultural research and development. Thus, innovative climate resilient technologies identified and found suitable for the region are popularized by training, publication, documentation and dissemination of success stories. A total number of 28 training programmes were conducted benefitting a total number of 398 farmers.

## Adaptation to climate change: KVK West Garo Hills



Krishi Vigyan Kendra, West Garo Hills under NICRA Project selected five villages namely, Marapara, Sananggre, Rongbokgre, Bagugre and Rimrangpara for implementation of the project. There are total 825 households in the villages. Total cultivated area consists of 161.2 ha. Major source of irrigation are streams.

**Major crops grown:** Cashew nut, areca nut, rubber, teak, pumpkin, maize, vegetables (vegetable mustard, radish), Paddy (local variety *viz.*, Kochu Gipok, Kochu Gisim, pumpkin, maize (local variety like badal, minil), ginger, turmeric *etc.*

**Climate vulnerability:** All the adopted villages suffer from climate vulnerabilities like

- Uneven distribution of rainfall
- Terminal drought
- Cyclonic storm
- High incidence of insects' pests and diseases

**Problems Diagnosed:** PRA report of all the five selected villages revealed that farmers who are small and marginal type had no knowledge about scientific cultivation of crops coupled with unscientific rearing of livestock. Lack of knowledge to deal with climatic vulnerabilities like flood; drought resulting in complete crop loss and low income is also a great concern. The farmers also had no knowledge about post-harvest management of locally available resources to generate additional income. Although the selected villages had immense organic inputs but they were completely unaware that it can be converted into rich organic manure for enhancing fertility status of the crop.

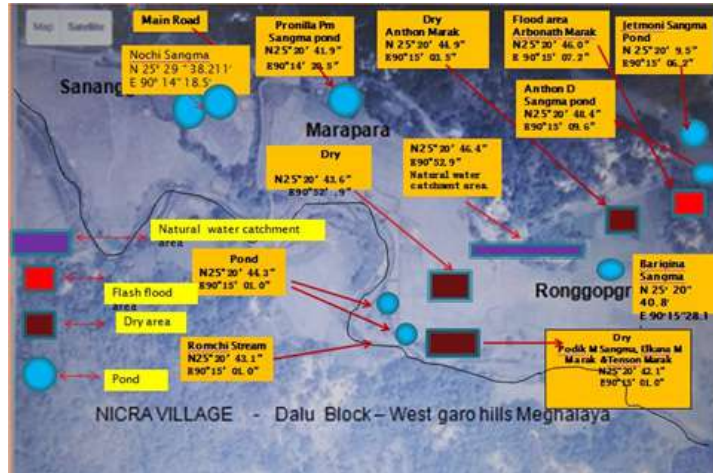


Fig. Digital map of NICRA village of WestGaro Hills Meghalaya

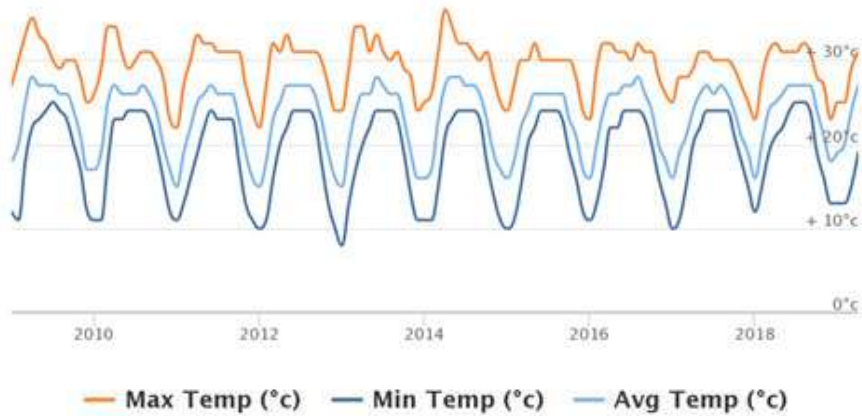


Fig: Temperature data of last decade in West Garo Hills

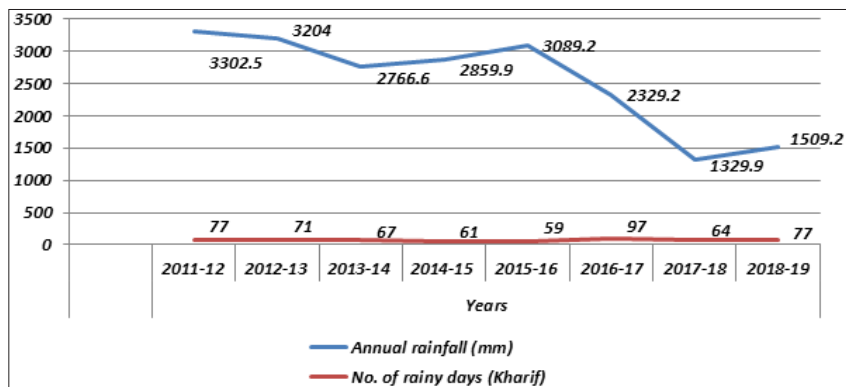


Fig: Rainfall data of last decade in West Garo Hills



## Natural Resource Management

As a result of intensive cropping the health of the soil in terms of fertility and property of most paddy fields have degraded which have rendered in low productivity as years go by. In order to fix this, the KVK have advised the farmers to take up green manuring through the cultivation of Dhaincha (*Sesbania bispinosa*) in the paddy fields. The soil health has also been reported to have improved drastically and the conservation of soil moisture has also been achieved. The B:C ratio recorded was reported to be 3.64 as result of the intervention.

**Table: Result of moisture conservation techniques in Horticultural crops**

Crop	No. of irrigation	Yield (q/ha)	Average Net return (Rs./ha)	B:C ratio
Cabbage	7	281	168420	2.49
Cauliflower	7	234	121420	2.07
Tomato	7	173	173850	3.02

**Potential use of paddy straw through mushroom cultivation:** Paddy straw after harvesting of paddy is mostly burnt or left on the field without realizing the potential it has for other agricultural enterprises. Paddy straw is used as a substrate for growing mushroom for generating additional income. Form the intervention; the farmers of the village are benefitted by a net return of over Rs. 8,000 per unit and in terms of BC ratio the value is 4.6.

## Crop Production

Under this module, the KVK have made significant achievements such as year round production of vegetables such as tomato, capsicum *etc.* in polyhouse, utilization of improved crop varieties such as paddy var. Gitesh, which could withstand extreme flooding conditions as compared to local, non-descript varieties, advancement of planting dates of mustard var. TS-36 in areas with terminal heat stress, location specific intercropping system through pre *Kharif* maize – pulse cultivation and the utilization of bio-pesticides for managing pests and diseases in the cultivation of pumpkin. Overall, over 55 technologies in total were demonstrated in which over 600 farmers have benefitted.

**Growing of local pumpkin using bio-pesticides:** The practice of this intervention in which seed and soil treatment was done with *Trichoderma harzianum* @10g/kg of seed and 500g/1 quintal of FYM and need based spraying with neem oil @2ml/litre of water. It was undertaken in two different farmers' fields which covers an area of about 0.5 ha. The yield in the demonstrated plot was recorded at 16 tonnes/ha and that of the farmer's practice was just about 11.2 tonnes/ha.

**Table: Comparison between yield from demo and farmer's practise with % difference**

Yield from Farmer's Practice	Yield from Demonstration	% Difference
11.2 t/ha	16 t/ha	43%

### Livestock and Fisheries

Interventions such as introduction of improved animal breeds like Hampshire, Ghungroo cross breeds in piggery, Srinidhi, Vanaraja and Kuroiler in poultry, preventive vaccination of farm animals, incorporation of mineral mixture to livestock for better growth performance, Integrated Farming Systems such as pond based systems which includes fishery, piggery, poultry, duckery, horticulture crops, field crops *etc.*, cultivation and proper storage of fodder and other feeds were all demonstrated. The introduction of improved Kuroiler breed of poultry was very successful.



**Fig. Vaccination of animals against diseases**

**Introduction of improved Kuroiler breed of poultry:** About 250 number of such poultry breeds were distributed to 25 farmers. The body weight of the Kuroiler breeds at 4-6 weeks averages about 705g as compared to local which were an average of 347 g at the same time. The number of eggs laid annually for the Kuroiler breeds was about 105 numbers and that of local breed was only about 40 numbers. In terms of profit, the B:C ratio for the Kuroiler breed and local breed was 2.9 and 1.3 respectively.

**Table: Comparison between Kuroiler and local breeds of poultry**

S. No.	Parameter	Result	
		Kuroiler chicken	Local chicken
1	Body wt (4-6 weeks)	705g	347g
2	Body wt (20 weeks)	Male 1.9kg Female 1.6kg	0.9 kg 0.6 kg
3	Body wt (40 weeks)	Male 2.55kg Female 2.0kg	1.3kg 1.05kg
4	Annual egg production	105 nos.	40 nos.
5	Egg wt (40 weeks)	50g	30g
6	Survivability	90%	95%
7	B:Cratio	2.89	1.28

### Institutional Interventions

Institutional interventions such as establishment of Custom Hiring Centre, Seed bank, portable weather station for the purpose of generating information about crop selection and pattern have been incorporated in the NICRA village so far. Utilization of farm implements on hired basis from the CHC by the farmers have led to increase in cropping intensity in the adopted village as well as neighbouring villages, as the rate of hiring is highly manageable by the farmers of the village.

### Capacity Building

Capacity building activities like various training programmes, workshops, demonstrations comprising of scientific raising of nursery seedlings, natural resource management to mitigate climate change impacts, integrated pest and disease management of field and horticultural crops using bio-pesticides *etc.*, were undertaken in the NICRA village and these have helped the farming communities to gain extensive knowledge and information in terms of better understanding of the farming related to climate change. Since the implementation of NICRA project in the district, a total of 60 numbers of different training programmes and demonstrations were conducted and have benefitted over 1,787 numbers of famers, farm women and youth as well.

### Extension Activities

Activities such as awareness programmes, exposure visits to different institutes, method demonstrations, diagnostic visits and other such activities were conducted by the KVK for the purpose of broadening the minds and equipping the farmers of the village with valuable knowledge relating to agro-climatic changes. So far, about 130 of such activities were conducted by the KVK and have benefitted over 2,091 farmers, farm women and rural youth.

**Significant climate smart interventions**  
**The pathways to prosperity**



## Water Reed cum Fish Farming



One of the major achievements by KVK, Imphal East under this project is the water reed cultivation cum fish farming. This method aims at utilizing the floods to the maximum profit with additional income from fish.

The intervention was undertaken in the land of an enthusiastic and progressive farmer named Mr. Maibam Nabakishor Dong of Yairipok Top Chingtha, Imphal East district. The area covered is about 0.25 ha in a low productive part of his field. The main reason behind this intervention is low income generation from paddy alone. The technology in these proposed IFS is *Periphyton* based aquaculture for enhancing fish productivity using water reed as a substrate in addition to the income from water reed and it was estimated to fetch an income of Rs. 2.5 lakh/ha/year. Mr. M. Nabakishore Singh started the activity as a participating farmer in KVK, Imphal East's technology demonstration programme under the project "National Initiatives on Climate Resilient Agriculture - Technology Demonstration Component" during the month of April, 2012.

**Table: Details of the intervention**

Plot Area	0.25 ha
Number of water reed plants	6000
Spacing of water reed	2' x 2'
Fish stocking density	1500 yearling
Ratio of the fish species stocked	Common carp : Mirgal : Rohu = 50:30:20
Period of fish culture	6 months (2 times in a year)

The net return from the first year was reported to be over Rs. 70,000. However, from the second year onwards the cost of land preparation is excluded and hence the net return was reported to be over Rs. 95,000 from the 0.25 ha area of land.

### **IMPACT**

Water reed cum fish farming is a high income earning agro practice. Cultivation and promotion of such farming not only boost the economy and enhance employment opportunity, but also help in conservation of wetlands and paddy fields unsuitable for taking up paddy cultivation. Having unexpected harvest of water reed and fish, Mr. Maibam Nabakishore Singh was very happy by raising his income from his small landholding of 0.9 ha and appreciated the technological support and the information given by Krishi Vigyan Kendra, Andro, Imphal East. The farmers from different parts of the district and also from the state have shown keen interest for taking up such farming system and horizontal spread of the technology has taken place at least 07 no. of farmers and many more are in the process.

## Cage culture of *Tilapia (Oreochromis niloticus)*



Fish production in cages increases as the stocking rate is increased. However, there is a density at which fish become too crowded and water quality within the cage deteriorates to a point that causes a decline in growth rate. For maximum turnover of marketable fish, it is better to limit production to levels that do not depress growth.

### **Output and outcome:**

A cage with a size of 12ft x 12ft x 6ft is installed in the canal on 13<sup>th</sup> July, 2017 at Nungbrung village with 6 (six) nos of participating farmers who were imparted skill by KrishiVigyan Kendra, Imphal East in terms of cage fabrication/construction, scientific culture techniques through training and exposure visit. Tilapia with an average size of 85 gm was stocked with a stocking density of 40 nos fingerling per cubic meter. Feeding was done twice daily @ 3% body weight with floating pellet feed. The culture was carried out for 4 months. A production of 502 kg with an average weight of 620 gm/fishes was achieved from an unutilized existing canals located at Nungbrung Village of Imphal East District, Manipur.

### **Impact**

The production achieved by adopting such technology in water bodies which remain unutilized for so many years could be an important way-out for doubling



farmers' income. Such practices could be brought under large area of water bodies for income generation and to uplift the socio economic status of the farmers of the district and state of Manipur.



**Fig Fabrication of cage for cage culture demonstration at Nungbrung Village, Imphal East District**



**Fig: Observation of growth of fishes in cage at Nungbrung Village**

# Income Generation Through Nursery Raising And Off Season Vegetable Production Under Low Cost Poly House



## Introduction

KVK Ri Bhoi has introduced low cost polyhouse technology for off season production of vegetables in Kyrdem village. Kong Biona Lymphuid and Kong Daialin Lamare, two women farmers from Kyrdem village were very successful in their endeavour. In the past, the nursery of different crops were raised in open fields. Thus, the nurseries were under risk of damage from heavy rainfall and hailstorm. There were times when the farmers had to raise nursery for the second time if the first one fails. This leads to loss of time, money and other resources. But under polyhouse, the nurseries were being protected from all weather aberrations as well as from infestation of insect pests.

### **KVK intervention**

Low cost polyhouse was constructed using locally available bamboo, metallic wire for developing the frame. UV stabilized film of 200  $\mu$  (800 gauge) used for covering the roof and 75 per cent shade net on the side walls. The estimated cost of construction of a 100 m<sup>2</sup> size poly house varies between Rs. 15,000 to Rs. 18,000 *i.e.* the construction cost per square meter may range from Rs. 150 to Rs. 180. While constructing the polyhouse the height at the center was kept about 2m and 1.5m at the side. In case of tomato and cucumber, proper staking was done with bamboo sticks and tying with rope.

### **Output and outcome**

During tomato cultivation, prevalence of low temperature and high humidity causes severe infestation of diseases. Under polyhouse cultivation high yielding variety Cheeranjivi was cultivated and seedlings were transplanted in the month of September. Cucumber, capsicum, broccoli, lettuce and tomato were remunerative crops for polyhouse cultivation in this area. Capsicum and broccoli were also high value crops and thus they helped the farmers in getting additional income. The nurseries of crops like tomato, cabbage, cauliflower, chilli were also being raised in polyhouse.

### **Impact**

The farmers were very happy with the technology as their crops were being protected especially during the nursery stage. The off season vegetables provided good prices to the farmer.

## Reclamation of degraded jhum lands- A boon to farmers of Nagaland



*Jhum*, known as shifting cultivation, a practice involving the slash-and-burn of felled trees in a forest patch followed by farming, is home to India's northeast. Taking into the detrimental effects of shifting cultivation, KVKs under ATARI Umiam have taken an initiative to reclamation of jhum lands and interventions like Horticulture, agro-forestry plantations and soil and water conservation measures have been demonstrated.

### Impact

Soil erosion rate has decreased and aid in Income generation from *jhum* fields. Certain local concerns like the burning of patch, which heated the land and killed soil microorganisms, harming its productivity, were also addressed this way. The attempt has been to improve upon and make the practice of *jhum* as eco-friendly as possible. One such attempt is cultivation of high value crops like kiwi in jhum lands.

### Cultivation of Kiwi in *Jhum* land

One of the major achievements by the KVK, Phek is the conversion of jhum lands to kiwi orchards. The orchard was started in the year 2012 where 100 kiwi saplings vars. Hayward and Allison, were planted in an area of around 0.25 ha. Timely pruning was done and grafting was also regularly done. During the year 2017-18, it was

recorded that over 500 kg of kiwi fruit was harvested from 80 plants, which benefitted the farmer in terms of income. Under the guidance of the KVK, the farmers have also started post harvest practises of kiwi where sorting, grading, packaging and labelling of fruits in packets and marketing of the fruits was accomplished.

***Reclamation of Jhum lands:*** This is done through land shaping and land embankment of hill slopes using locally available bamboo and timber. Cultivation of vegetables in these lands during *Kharif* and *Rabi* seasons have enabled the farming community to attain additional income of up to Rs. 32,000/ha. Moreover, these have helped in creating additional job opportunities to unemployed rural youth and have greatly reduced the seasonal migration of the rural population to urban areas. This intervention also restricts the carbon emission from the land and also increases the cropping intensity. This intervention has been followed to different parts of the adopted village.



## Mini weather station: A citizen science approach



The need of smallholder farmers in the Northeastern region for accurate weather forecasts is made greater by the dependency on rain-fed agriculture, and by the global impact of climate change. To date, smallholder farmers largely rely on national meteorological agencies with low capacity for the provision of weather services that are distributed over radio, TV and mobile. Establishment of mini



weather stations and training the local farmers to obtain data from the mini weather stations can play a key role not only in disseminating weather forecasts but also in improving weather services by catalysing new content and technology providers. As a dynamic service component, weather forecasting presents an opportunity to drive

stickiness of the overall mobile agriculture (mAgri) proposition, provided that services are of high quality and locally relevant. To exploit the potential of weather services, KVKs established the unique strategic assets, primarily the network intelligence which in the absence of smart phones equipped with Global Positioning System (GPS) allows the provision of localised services.



## Climate resilient housing system in Livestock



In north eastern region most extensive system of livestock rearing is practiced. In changing climatic scenario numerous environmental stresses like heat, floods, drought, cold *etc.* hampers the livestock production. The unfavorable climatic factors impose enormous stress in animals that need to be counteracted. Hence, KVKs have given much emphasis for improved housing system in poultry, piggery and rabbitry. Improved housing system for the livestock contributes to counteract the detrimental effect of environment.

### Deep litter housing of pigs

The cost of production is lower than for conventional systems, depending on bedding and feed costs. This system aids in improvement of animal health through the use of 'all in, all out' (AIAO) management. Improved performance results from a higher health status and increased feed intakes. Management strategies such as split-sex feeding and phase feeding can be used with DLH systems. There is little or no liquid effluent, and odour is reduced provided adequate litter is used for each batch. Used litter is suitable for composting, with the potential to be used as fertiliser or for sale off-farm.

KVK Ri Bhoi popularized the idea of climate resilient deep litter piggery among the NICRA farmers by demonstrating 6 units with 2 piglets of Hampshire cross per unit and floor space of 3sq.m/pig. After adopting the technique the growth rate of pig was increased by 33.64% and mortality was reduced by 6.5%.



**Table: Performance indicators body growth rate & mortality rate in pigs**

<b>Before intervention</b>	<b>After intervention</b>
Body weight gain 110g/day/pig	Body weight gain 152g/day/pig
Mortality- 12.5%	Mortality-6%

**Table: Influence of deep litter system on Income generation**

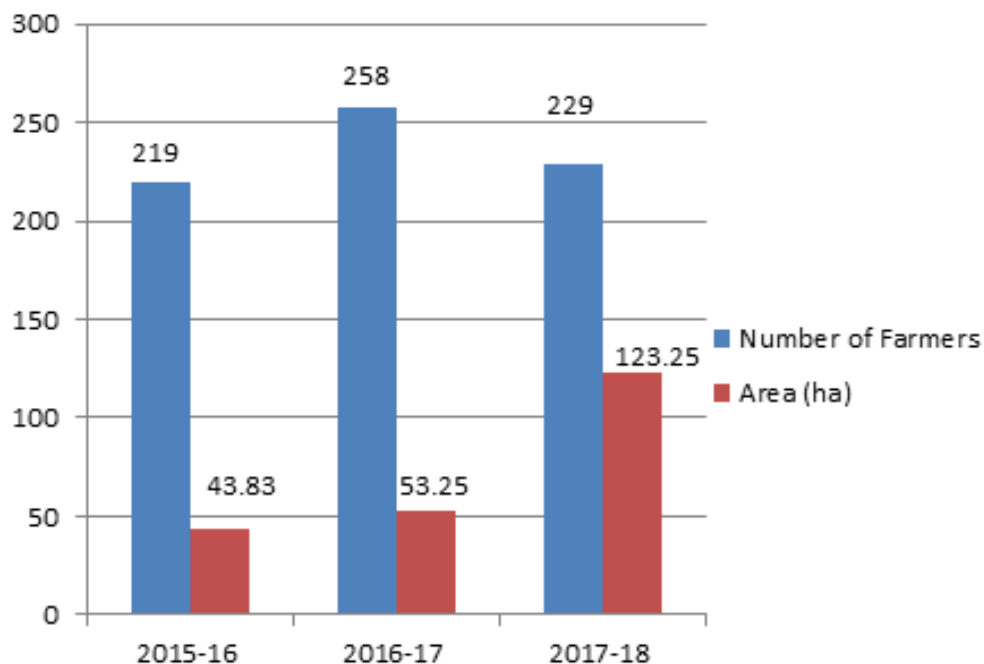
<b>Change in income (Rs/Yr.)</b>		<b>% change in income</b>
<b>Before</b>	<b>After</b>	<b>125%</b>
13200	<b>29700</b>	

## Moisture conservation measures in NICRA villages build the adaptive capacity of farmers to climate



Efficient management of resources is key for enhancing the adaptive capacity and building climate resilience of farming communities. Drought and flood are major climatic vulnerabilities of the region that affect the crop production which has brought out the need for effective management of deficit rainfall, excessive rainfall and retention of soil moisture for longer periods. Location specific in-situ moisture conservation measures, harvesting of excess rainwater and efficient use of harvested water, efficient irrigation methods, and supplemental irrigation are some of the major interventions in NICRA villages for enhancing the cropping intensity. Some of the salient achievements like construction of rock fill dam, construction of jalkunds, mulching using paddy straw and drip irrigation using indigenous methods like bamboo based drip irrigation are widely accepted measures for water conservation.

## In-situ Moisture Conservation



**Table: Intervention of In-situ moisture conservation in various crops**

Interventions	Crop
In-situ moisture conservation	Pulse crop-Black gram Green gram Pea Oilseeds crop- Rapeseed , Vegetables crop– Broccoli, Cabbage, Cauliflower, Capsicum colocasia, Potato Spice crops- Ginger , Turmeric Fruit- Strawberry and Pineapple

**Table: Utilization of Jalkund water for irrigation**

Crops benefitted	Area covered during 2017-18
Vegetables, Off season cucumber	84.5 ha

## Crop diversification: An intensive cropping system

Sesame is one of the emerging crop for farmers of Dhansiripar (NICRA village) of Dimapur district, Nagaland. Sesame was successfully demonstrated as an alternate crop with an objective to combat the problems of late onset of monsoon and low rainfall for cultivation of paddy in lowlands. The varieties that performed well in the prevalent drought-



like situation in the village were AST-1 and Kaliabor Til-1. The farmers in the village have adapted the cultivation of sesame depending on season and land suitability and the area covered is up to 50 ha since 2011. They could get the average net return of Rs.45,000-50,000 per ha which was compensated for low production of rice crop.

**Table: Improvement in yield of improved variety of Sesamum**

Variety	Measurable indicators of output (q/ha)		% increase in yield
	Demo	Local	
AST-1	7.00	6.00	16.66
Kaliabor Til-1	7.15	6.00	16.68

**Table: Cost economics of Sesamum**

Variety	Economics of demo (Rs./ ha)			Economics of local (Rs./ ha)		
	Gross Cost (Rs.)	Net Return (Rs.)	BCR	Gross Cost (Rs.)	Net Return (Rs.)	BCR
AST-1	21000	48000	2.88:1	21000	35000	2.40:1
Koliabor Til-1	21000	45000	2.85:1	21000	35000	2.40:1

## A Special Focus on Climate Resilient Varieties (CRVs)



The development and identification of climate resilient crop varieties, with enhanced tolerance to heat, drought, flooding are essential in order to sustain and improve crop yields to cope up with the challenges of climate change. It is essential to bridge the yield gaps, enhance the productivity and profitability, minimize risk and improve the livelihood of millions of people dependent on agriculture

Under NICRA Project, climate resilient crop varieties are one of the most important resources. Improved and stress tolerant crop varieties along with proper management practices can enhance the coping ability through risk reduction in vulnerable environment. Details of crop yields of various crops are described below

The need for stress, heat tolerant varieties has become paramount importance in the present context of climate change apart from various adaptation and mitigation strategies to feed the ever increasing population in the country. Concerted efforts of the National Agricultural Research System (NARS) during the last decades resulted in development of stress tolerant varieties in several crops and efforts are further being strengthened to develop varieties tolerant to various stresses individually as well as those with multiple stress tolerance. These stress tolerant cultivars can play an important role in coping with climate variability as well as enhancing the productivity

**Table: Improved crop varieties used for cultivation in NICRA villages**

S.No	Crop	Variety	Remarks
1	Paddy	Swarna sub 1	Flood tolerant variety
2	Paddy	Gitesh	Suitable for staggered planting
3	Maize	HQPM 1	A high yielding variety of maize
4	Vegetables	Tomato (Arka Rakshak)	Triple disease resistant variety
		Pea (Arka Priya)	High temperature tolerant variety
		Broccoli (Harumi )	High temperature tolerant variety
		Cabbage (Rareball and wonder ball)	High temperature tolerant varieties
5	Oilseeds	Mustard(TS 67) Groundnut (ICGS-76) Sesame (AST-1 Koliabor Til-1) Soybean (JS 335)	High yielding varieties  Ashort duration variety of soyabean
6	Pulses	Arhar (Pusa 992)	High yielding variety

**Table: Performance of soyabean variety JS335 over Local variety in KVK Mon Nagaland**

Variety	Yield	% Increase In Yield	Net returns	B:C ratio
JS 335	11.98	37 % over the local variety	29960	2.66
Local	7.5		17500	1.5

**Table: Yield economics of temperature tolerant varieties of Vegetables at KVK Senapati, Manipur**

Variety	Yield (q/ha)	Gross returns	Net returns	B:C ratio
Cabbage (Local)	147.5	147500	82180	2.25
HYV (Rareball)	165.3	165300	97945	2.45
Broccoli (Local)	62.1	155250	77690	2.00
HYV (Harumi)	78.6	196500	116660	2.46

## Role of Institutions in adaptation to climate change



Institutions (KVKs) play a vital role in shaping adaptation to climate change to help the most vulnerable groups of farming communities. Adaptation to climate change is highly local, and its effectiveness depends on local and extra-local institutions through which incentives for individual and collective action are structured. KVKs played a vital role in mediating mechanisms that will translate the impact of external interventions to facilitate adaptation to climate change. Institutional arrangements structure facilitates or impedes individual and collective responses, and shapes the outcome of such responses to climate hazards.

Institutional interventions like custom hiring centre, seed banks and fodder banks established across the NICRA villages served the needs of the farming community.

**Table: Various institutional interventions in the NICRA villages of ATARI Zone VII**

Interventions	No. of farmers Involved	Area (ha)
Seed Bank	202	42.91
Fodder Bank	98	15.86
Custom hiring centre	4449	866.1
Climate literacy through a village level weather station	301	-
Others	475	17.5
<b>TOTAL</b>	<b>5525</b>	<b>942.37</b>

## Doubling Farmers Income: IFS models



Integrated Farming System models covering crop-livestock- aquaculture were planned and demonstrated in the NICRA villages, considering the overall need of the area, available technological options, market accessibility both for input and produce *etc.* Intensification and diversification of agricultural activity through integrated farming system approach comprising crop, livestock and aquaculture components benefitted the farmers of the NICRA villages in a climate changing scenario. Around 18 numbers of IFS units were established in the NICRA villages with various components which are given below

**Table: IFS models in NICRA Villages**

Name of the KVK	IFS model
Jaintia hills	Fish + Pig + Vegetable based IFS
Dhalai	Paddy + Duck + Fish
Ribhoi	Pig cum fish based IFS Duck cum fish based IFS Poultry cum fish based IFS
Khowai	Duck cum fish based IFS (5 No)
West Garo hills	Fish + Duck + Banana based IFS (5 No.s)
Senapati	Duck cum fish based IFS
Ukhrul	Duck cum fish based IFS Paddy cum fish based IFS



### **Integrated rice fish vegetable based farming system**

KVK, Jaintia hills demonstrated the Rice+Fish+vegetable based farming system. The intervention has resulted in yield of fish of about 0.5 quintal, Pig meat 0.70q/unit, Cabbage about 63q in an area of 0.15 ha. The intervention resulted in a gross income of 59600 and a net return of 28200. The benefit cost ratio is 1.89:1.

### **Fish - Duck -Banana based IFS model:**

KVK, West Garo hills demonstrated the Fish + Duck + Banana based IFS. The dimension of the model is 16 x 14 x 2.5 cubic metres. It consists of 8500 fish fingerlings per pond 10 numbers of ducks and 20 bananas (G-9) in each model. The yield obtained from banana is 82 tons/ha, fish yield was 3.72q/ IFS/year, duck eggs of about 715 no's/IFS/year. This particular model has given a net return of Rs. 25,345/IFS/year with a B:C ratio: 3.82

### **Fish cum pig integrated farming system:**

KVK, Ri Bhoi demonstrated 2 IFS units with pig breed Hampshire cross. Fingerlings of catla, rohu and mrigal were provided with stocking density of 8000 fingerlings per ha. Yearly fish yield was found out to be 108 kg/0.1 ha after integration of pig along with 8 piglets for starting another unit of IFS helping the poor and marginal farmer to earn extra revenue with good dividend. Farmers were able to earn an average annual return of Rs. 34,570/unit/yr with B:C ratio of 2.05.

**Table: Enhancement of growth parameters in fish cum pig IFS Model**

<b>Before intervention</b>	<b>After intervention</b>
Fish Production: 65kg/ 0.1 ha/yr (without integration of pig)	Body weight gain: 148g/pig/day Fish production: 108 kg/0.1ha/yr



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