National Innovations in Climate Resilient Agriculture
Technology Demonstration Component

Annual Report 2025-26

(Attached Good quality photographs in jpg format only)

Name of KVK: **KVK, Kalahandi**

Nature of Climatic Vulnerability: **Drought**
Name of Adopted Villages: **Indramal, Khairbhadi, Pipalpadar**
Brief description of the villages:
Under the National Innovations on Climate Resilient Agriculture (NICRA) project by KVK, Kalahandi, three villages—Indramal, Khairbhadi, and Pipalpadar—have been selected for implementing climate-resilient agricultural interventions. Indramal and Khairbhadi have been covered under NICRA since 2021–22, while Pipalpadar was newly included during 2025–26.
The villages are predominantly characterized by rainfed farming systems with limited irrigation facilities. The cultivated area in Indramal, Khairbhadi, and Pipalpadar is 121.4 ha, 97.5 ha, and 72.2 ha respectively, of which the major portion (97.4 ha, 79 ha, and 68 ha respectively) is rainfed. Irrigated areas are relatively small, indicating a high dependence on monsoon rainfall and greater vulnerability to climatic variability.
These villages also experience drought conditions, with about 29 ha in Indramal, 22.6 ha in Khairbhadi, and 21 ha in Pipalpadar categorized as drought-prone areas, while no flood-prone areas have been reported. The villages consist of 71, 62, and 93 households respectively, mainly comprising small and marginal farmers. Considering the climatic risks, location-specific Farming System Technologies (FSTs) have been identified and promoted to strengthen climate resilience and improve the adaptive capacity of the farming systems.
Name of PI/Co-PI/Associated Scientist/SRF:
PI- Dr. Amitabh Panda, Co-PI- Dr. Binod Kumar Jena, SRF- Mr. Swaraj Meher

I. Module I: NRM

Table. Performances of demonstration of in-situ moisture conservation technologies

Technology demonstrated	No. of farmers	Area (ha)	Yield (q/ha)	Economics of demonstration (Rs/ha)		
				Gross Cost	Net Return	BCR
Green manuaring (dhaincha) in rice (Swarna Samriddhi)	5	2	42.2	52300	44760	1.85
Brown manuaring in rice						
Summer Ploughing in rice						
Azolla in Paddy						
Zero Tillage in wheat / Maize/ Others crops						
Repair of bund						
Horticultural production through land embankment development						
Organic mulching in vegetables						
Mulching in tomato (Arka Apeksha)	5	1	212.2q/ha tomato	109605	198145	2.8
Any intervention not covered in above						
Total	**10**	**3**				

Mention the variety and Enclosed 2/3 photos

DEMONSTRATION ON GREEN MANURING WITH DHAINCHA IN RICE CULTIVATION

Table. Performances of water harvesting and recycling for supplemental irrigation

Technology demonstrated	No. of farmers	Area (ha)/Unit	Output (q/ha)	Economics of demonstration (Rs/ha)

				Gross Cost	Net Return	BCR
Renovation of pond for fish production and irrigation						
Renovation of canal						
5% Model						
Bora bandh						
Renovation of Well for irrigation						
Bund making leveling in paddy field						
New water harvesting structure						
Raising of land embankment						
Ground water recharge						
Desiltation of defunct water harvesting structures						
Renovation of irrigation channel						
Newly Check dam						
Renovation of common pond						
Any intervention not covered in above						
Total						

Enclosed 2/3 photos

Table. Performance of artificial ground water recharge technologies demonstrated

Technology demonstrated	No. of farmers	Area (ha)	Output (q/ha)	Economics of demonstration (Rs./ha)		
				Gross Cost	Net Return	BCR
Field bunding for rice						
Water management through bunding of rice						
Ground water recharge through SRI by sub-soiler						
Any intervention not covered in above						
Total						

Enclosed 2/3 Photos

Table. Performance of different water saving irrigation methods

Technology demonstrated	No. of farmers	Area (ha)	Output (q/ha)	Economics of demonstration (Rs./ha)		
				Gross Cost	Net Return	BCR
Irrigation system (micro Irrigation system)						
Application of biofertilizer in rice/crops						
Vermi-compost from biodegradable wastes	4	4 beds	13.1q/bed/Yr	7780	24970	4.2
Production of crops on farm bund						
RBF in crops						
LEWA in crops						
Sprinkler irrigation in crops						
Any intervention not covered in above						

Total							

Mention the variety and Enclosed 2/3 photos

DEMONSTRATION ON VERMI-COMPOST FROM BIODEGRADABLE WASTES

Table. Performance of other demonstrations

Technology demonstrated	No. of farmers	Area (ha)	Output (q/ha)	Economics of demonstration (Rs./ha)		
				Gross Cost	Net Return	BCR
Demo 1						
Demo 2						
Demo 3						
Others if any						
Total						

Enclosed 2/3 photos

Table: KVK wise rainwater harvesting structures developed

RWH structures	No.	Storage capacity (cu.m)	No. of farmers	Protective irrigation potential (ha)	Increase in cropping intensity (%)

Desilting Pond					
New Pond created					
Pond Renovation					
Canal					
Checkdam					
5% model					
Pyne					
Well					
Inlet Channel					
Desiliting drainage channel					
Bora bandh (Temporary check dam)					
Repaired well					
Jalkund					
Small ditches for jute retting					
Landshaping and rain water harvesting structure					
Others if any					
Total					

Enclosed 2/3 photos

II. Module II: Crop Production

Table. Performance of different drought tolerant varieties

Technology demonstrated Crops with varieties	**No. of farmers**	**Area (ha)**	**Yield(q/ha)**		**% increase**	**Economics of demonstration (Rs./ha)**		
			Demo	**Local**		**Gross Cost**	**Net Return**	**BCR**
Demonstration on Drought Tolerant Rice (Swarna Samriddhi)	14	14	46.1	40.9	12.71	51810	54220	2.04
Demonstration on Heat tolerant tomato (Arka Apeksha)	11	0.51	211.5	173.2	22.11	109243	197491	2.80
More if any								
Total								

Mention the variety and Enclosed 2/3 photos

DEMONSTRATION ON DROUGHT TOLERANT RICE (SWARNA SAMRIDDHI)

Table. Performance of different salt tolerant paddy varieties

Technology demonstrated (Crops with varieties)	**No. of farmers**	**Area (ha)**	**Yield (q/ha)**		**% increase**	**Economics of demonstration (Rs./ha)**		
			Demo	**Local**		**Gross Cost**	**Net Return**	**BCR**
Crop I								
Crop 2								
Crop 3								
More if any								
Total								

Enclosed 2/3 photos

Table. Performance of different flood tolerant varieties

Technology demonstrated (Crops with varieties)	**No. of farmers**	**Area (ha)**	**Yield (q/ha)**	**% increase**	**Economics of demonstration (Rs./ha)**

			Demo	Local		Gross Cost	Net Return	BCR
Crop I								
Crop 2								
Crop 3								
More if any								
Total								

Mention the variety and Enclosed 2/3 photos

Table. Performance of advancement of planting dates in different crops

Technology demonstrated	No. of farmers	Area (ha)	Yield (q/ha)		% increase	Economics of demonstration (Rs./ha)		
			Demo	Local		Gross Cost	Net Return	BCR
Crop I								
Crop 2								
Crop 3								
More if any								
Total								

Mention the variety and Enclosed 2/3 photos

Table. Performances of water saving technologies

Technology demonstrated	No. of farmers	Area (ha)	Yield (q/ha)		% increase	Economics of demonstration (Rs./ha)		
			Demo	Local		Gross Cost	Net Return	BCR
Water saving technology through SRI								
Aerobic Rice								
Direct seeded brown manured rice								
DSR								
Sowing of rice / wheat / Maize with ZTD machine								
Others if any								
Total								

Mention the variety and Enclosed 2/3 photos

Performance of Community nurseries

Technology demonstrated	No. of farmers	Area (ha)	Yield (q/ha)	% increase	Economics of demonstration (Rs./ha)

			Demo	Local		Gross Cost	Net Return	BCR
Crop I								
Crop 2								
Crop 3								
More if any								
Total								

Mention the variety and Enclosed 2/3 photos

Table. Performance of different location specific intercropping systems

Technology demonstrated	No. of farmers	Area (ha)	Yield (q/ha)		% increase	Economics of demonstration (Rs./ha)		
			Demo	Local		Gross Cost	Net Return	BCR
Crop I + Crop 2								
Crop 3 + Crop 4								
More if any								
Total								

Mention the variety and Enclosed 2/3 photos

Table. Performance of different crop diversification in NICRA villages

Technology demonstrated	No. of farmers	Area (ha)	Yield (q/ha)		% increase	Economics of demonstration (Rs./ha)		
			Demo	Local		Gross Cost	Net Return	BCR
Crop I								
Crop 2								
Crop 3								
More if any								
Total								

Mention the variety and Enclosed 2/3 photos

Table. Performance of other demonstration under crop production module

Technology demonstrated	No. of farmers	Area (ha)	Yield(q/ha)		% increase	Economics of demonstration (Rs./ha)		
			Demo	Local		Gross Cost	Net Return	BCR
Demonstration on Grafted Tomato for tolerance against moisture stress	21	0.18	219.8	177.6	23.76	119570	210130	2.75
Demonstration on Foliar application of Glycine Betaine on cotton to promote drought resilience	8	2.2	16.8	14.5	15.9	46000	71600	2.56
Demonstration on cultivation of paddy straw mushroom	30	30 beds	3 kg/bed	2.17 kg/bed	38.25	100/bed	260/bed	3.6
Total								

Mention the variety and Enclosed 2/3 photos

DEMONSTRATION ON GRAFTED TOMATO FOR TOLERANCE AGAINST MOISTURE STRESS

DEMONSTRATION ON FOLIAR APPLICATION OF GLYCINE BETAINE ON COTTON TO PROMOTE DROUGHT RESILIENCE

DEMONSTRATION ON CULTIVATION OF PADDY STRAW MUSHROOM

III. Module III : Livestocks and Fisheries

Table. Performance of different fodder demonstration in community lands

Technology demonstrated	No. of farmers	Unit/ Area (ha)	Output (q/ha)		% increase	Economics of demonstration (Rs/ha)		
			Demo	Local		Gross Cost	Net Return	BCR
Fodder 1								
Fodder 2								
Total								

Mention the variety and Enclosed 2/3 photos

Table. Performance of improved fodder

Technology demonstrated	No. of farmers	Unit/ Area (ha)	Yield (q/ha)		% increase	Economics of demonstration (Rs./ha)		
			Demo	Local		Gross Cost	Net Return	BCR
Fodder 1								
Fodder 2								
Total								

Mention the variety and Enclosed 2/3 photos

Table. Performance of various vaccination camps organized

Technology demonstrated	No. of farmers	Unit/ No./ Area (ha)	Measurable indicators of output* (q/ha)		% increase	Economics of demonstration (Rs./ha)		
			Demo	Local		Gross Cost	Net Return	BCR
Vaccination camp against FMD Cattle & PPR against goat, Deworming, other diseases	50	-	18	14.5	25	4200	12000	2.8
Vaccination for PPR in goat and Ranikhet in Poultry.								
Deworming								
Mineral mixture								
Proper De-worming								
Vaccination camp against other diseases								
Others if any								
Total								

Enclosed 2/3 photo

Table. Performance of composite and cat fish in the renovated ponds

Technology demonstrated	No. of farmers	Unit/ No. / Area (ha)	Measurable indicators of output* (q/ha)		% increase	Economics of demonstration (Rs./ha)		
			Demo	Local		Gross Cost	Net Return	BCR
Cat Fish 1								
Cat Fish 2								
More if any								
Total								

Enclosed 2/3 photo

Table. Performance of livestock demonstration in NICRA adopted villages

Technology demonstrated	No. of farmers	Unit/ No. / Area (ha)	Measurable indicators of output* (q/ha)		% increase	Economics of demonstration (Rs./ha)		
			Demo	Local		Gross Cost	Net Return	BCR
Demonstration on Backyard rearing of improved poultry bird (RIR)	40	200 chicks	1.6 Kg/bird	1.3 kg/bird	23.08	200/bird	680/bird	4.4
Breed 2								
If any more								
Total								

Enclosed 2/3 photo

Table. Performance of improved shelters for poultry and dairy animals

Technology demonstrated	No. of farmers	Unit/ No. / Area (ha)	Measurable indicators of output (q/ha)		% increase	Economics of demonstration (Rs./ha)			
			Demo	Local		Gross Cost	Gross Return	Net Return	BCR

Shelter 2									
Others if any									
Total									

Enclosed 2/3 photo

IV. Module IV: Institutional Intervention

Table. Details of the various institutional interventions

Interventions	**No.of KVKs**	**Details of activity**			**No. of farmers**	**Unit/ No. /Area (ha)**
		Name of crops / Commodity groups / Implements	**Quantity(q) / Number / Rent / Charges**	**Technology used in seed / fodder bank & function of groups**		
Seed bank						
Fodder bank						
Commodity groups						
Custom hiring centre	1	Paddy Transplanter, Reaper, Sprayer, Thresher	Rs. 15750/-	Implements hired through rental basis and the amount generated from rent used for maintenance of implements and savings	31	-
Collective marketing						
Climate literacy through a village level weather station						
More if any						
Total						

Enclosed 2/3 photo

V. Village Climate Risk Management Committee (VCRMC)

Under the NICRA-TDC Project, the Village Climate Resilience Management Committee (VCRMC) was duly constituted to strengthen participatory decision-making and ensure effective implementation of climate-resilient interventions at the village level.

During the year 2025–26, a total of seven (07) VCRMC meetings were successfully organized. These meetings witnessed active participation from KVK officials, VCRMC President, VCRMC Secretary, and a large number of farmers, ensuring inclusive and community-driven planning.

The meetings served as a platform for discussion, planning, and execution of various project activities. Key decisions and outcomes of these meetings include:

- Conducting an introductory meeting to deliberate on the annual action plan and overall project objectives.
- Selection of beneficiaries for various demonstrations, ensuring transparency and consensus among stakeholders.
- Finalization of demonstrations such as:

    - Green manuring through *Dhaincha*
    - Drought-tolerant rice variety (*Swarna Samriddhi*)
    - Application of glycine betaine in cotton for drought tolerance
    - Cultivation of grafted tomato
    - Demonstration on heat-tolerant tomato (Arka Apeksha)
    - Paddy straw mushroom cultivation, with priority to farmwomen
    - Backyard rearing of improved poultry birds (RIR)
- Planning and operational decisions regarding the Custom Hiring Centre (CHC).
- Organization of animal vaccination camps to improve livestock health.
- Conducting climate resilience awareness programmes to enhance farmers' adaptive capacity.
- Implementation of Farmers & Farm Women (F&FW) trainings and Farmer–Scientist interactions.

The beneficiary selection process was carried out with maximum participation and consensus of the members present, ensuring fairness and transparency. Detailed discussions were held on activity planning, resource allocation, and execution strategies, aligned with the objectives of the NICRA project.

Overall, the VCRMC meetings played a crucial role in strengthening community participation, improving awareness on climate-resilient practices, and ensuring effective implementation of interventions at the grassroots level.

VI. Custom Hiring Centres:

Photographs of Farm implements and Machinery at NICRA Adopted villages

Table. Revenue generated through Custom hiring Centres (CHCs) and VCRMC in KVKs

Name of KVK	Revenue generated (Rs.)	
	From CHC during the year	Total fund under VCRMC as on 31.03.2026
KVK, Kalahandi	15750/-	21335/-

VII. Capacity Building

Theme	Title of training programme	No. of Courses	No. of participants		Total
			Male	Female	
Crop Production & Management	Integrated Farming System for Resource Optimization	1	26	4	30
	Farm Mechanization for climate resilience and labour efficiency	1	0	30	30
	Climate resilient Agronomic practice for rainfed cropping system	1	30	0	30
	Soil Moisture conservation techniques through Mulching and Ridge-Furrow system	1	0	30	30
	Enhancing soil health and productivity through Green manuring with Dhaincha	1	0	30	30
	Seasonal Mushroom Cultivation and Income diversification strategies under climate vulnerability	1	0	30	30
Natural Resource Management	Preparation and use of Organic compost and Vermicompost at Farm level	1	0	30	30
	Soil Health Management and use of organic input	1	0	30	30
	Crop residue Management and Soil carbon enhancement technique	1	29	1	30
Horticulture	Nutritional Kitchen Gardening for Household food security	1	0	30	30
	Seedling Production techniques and nursery management in vegetables	1	23	7	30
	Water Management and Micro-irrigation in vegetable cultivation	1	26	4	30
		TOTAL			**27000/-**


TRAINING FOR
FARMERS & FARM WOMEN
Under NICRA - TDC Project
Year - 2025-26
Latitude: 20.087903
Longitude: 83.387343
Elevation: 239.14±4.41 m
Accuracy: 7.052 m
Time: 09-15-2025 14:20
Note: F&FW Training, NICRA Project
Powered by NoteCam


TRAINING FOR
FARMERS & FARM WOMEN
Under NICRA - TDC Project
Year - 2025-26
GPS Map Camera
Khairbhadi, Odisha, India
X7pf+55, K, Khairbhadi, Khairmal, Odisha
Lat 19.985427° Long 83.273013°
12/09/25 02:46 PM GMT +05:30
Google


Under NICRA - TDC Project
Latitude: 20.087878
Longitude: 83.387255
Elevation: 229.57±6.97 m
Accuracy: 14.57 m
Time: 08-16-2025 13:48
Note: Mushroom Demonstration, NICRA Project


TRAINING FOR
FARMERS & FARM WOMEN
Under NICRA - TDC Project
Year - 2025-26
GPS Map Camera
Odisha, India
khairbadi,kalahandi,Odisha
Lat 19.929202°
Long 83.239847°
04/08/25 12:20 PM GMT +05:30
Google


TRAINING FOR
Year - 2025-26
Latitude: 19.985487
Longitude: 83.273016
Altitude: 184.64±8.26 m
Accuracy: 4.996 m
Time: 11-06-2025 13:53
Note: NICRA PROJECT


TRAINING FOR
FARMERS & FARM WOMEN
Under NICRA - TDC Project
Year - 2025-26
Latitude: 19.985487
Longitude: 83.273016
Altitude: 184.64±8.26 m
Accuracy: 4.996 m
Time: 11-06-2025 13:56
Note: NICRA PROJECT


TRAINING FOR
Year - 2025-2
Latitude: 20.087905
Longitude: 83.387255
Elevation: 222.1±5.26 m
Accuracy: 4.502 m
Time: 12-11-2025 13:51
Note: NICRA-TDC PROJECT
Powered by NoteCam

VIII. Extension Activities

Name of the activity	Number of Programmes	No. of beneficiaries		
		Male	Female	Total
Animal Health Camp	1	34	16	50

IX. Soil Health Card Prepared and Distributed

Table- SHC card distribution at NICRA adopted villages

KVK	Year	No of soil samples collected	No. of samples analysed	SHC issued	No of Farmers involved
KVK, Kalahandi	2025-26	15	15	37	42

X. Convergence with Other Ongoing Development Progrmmmes

Table: Convergence of Ongoing Development Programmes/Schemes in NICRA implementing KVKs

KVK	Technology	Development Scheme/Programme	Nature of work	Amount (Rs.) Mobilized
KVK, Kalahandi	Pond based IFS	Tata Steel Foundation	Construction of farm pond for fishery, irrigation and raising of crops on bunds	20000
	Backyard rearing of poultry birds	Dept. of Veterinary	Improved poultry breed for climate resilience	20000
	Grafted tomato cultivation for wilt tolerance	Dept. of Horticulture	Implementation and technical supervision of grafted tomato cultivation for wilt tolerance	20000
	Animal Health & Vaccination Camp	Dept. of Veterinary	Vaccination and health care support provided to 981 livestock animals	15000

Pond based IFS in convergence with TATA steel Foundation

Grafted tomato cultivation for wilt tolerance

XI. Dignitaries visited NICRA Villages during 2025-26

Name of visitors	Date	Remarks
Prof. Dr. Rabi Ratna Das, Joint Director (Monitoring), DEE, OUAT, Bhubaneswar, Odisha	26.12.2025	Appreciated the climate resilience technologies like, Grafted tomato cultivation in ridge and furrow method wit drip irrigation, Polymulchig for soil moisture conservation, Vermicomposting and others. Encouraged the team and farmers for upscaling of effective climate-resilient practices.

Enclosed 2/3 Photographs

XII. Success stories of NICRA Village Farmers with photographs

KVK, KALAHANDI
Success stories of NICRA Village Farmers
Year -2025

Name of the State : **Odisha**

Name of the KVK : **KVK, Kalahandi**

Theme : **Drought resilience and stress mitigation in cotton**

Name of the farmer	**Ratnakara Padhan**
Village	**Khairbhadi**
Address	**Block-Bhawanipatna, Dist-Kalahandi**
Contact details(Phone, mobile, email Id)	**+91-8260111246**
Education	Intermediate (+2)
Landholding (in acre)	5
Irrigated (in acre)	1
Un-irrigated (in acre)	4
Family size (Number)	6
Agricultural and non-agricultural activities of the family	Cotton, paddy & vegetable cultivation
Source of income of the family	From Agriculture sector
Daily family expenses for food purpose	₹180/-
Monthly expenses other than food cost	₹5200/-
Background before intervention (not more than 150 words)	Ratnakara Padhan is a hardworking farmer of Indramal village who primarily cultivates cotton under rainfed conditions. Due to erratic monsoon, long dry spells, and high temperature stress, his cotton yield had significantly declined over the years. The plants frequently showed symptoms of leaf wilting, reduced boll formation, and premature boll drop. His traditional practice involved only basal fertilizer application without any stress-mitigating sprays. During drought periods, his fields suffered heavy moisture stress, leading to 25–30% yield loss, pushing his family toward financial instability. He was selected as a NICRA beneficiary based on his vulnerability to climate-induced drought. Under the project, he was introduced to the foliar application of **glycine betaine**, a proven osmoprotectant that helps cotton withstand moisture stress. This marked a turning point in improving the health, productivity, and climate resilience of his cotton crop.

Brief description of technical interventions and justification including innovation, if any (not more than 150 words)	Under the NICRA Project, foliar application of **glycine betaine @ 2%** was demonstrated in Ratnakara's cotton field during critical stress stages (squaring, flowering, and boll formation). Glycine betaine acts as an osmoprotectant, enabling the plant to maintain cellular water balance, reduce heat damage, and sustain physiological activities during moisture stress. The innovation lies in its **rapid anti-stress action**, which enhances stomatal regulation, chlorophyll stability, and boll retention even during dry spells. After the intervention, his cotton plants exhibited reduced leaf wilting, higher boll number, and uniform growth compared to untreated fields. The technology proved highly effective during intermittent droughts and resulted in higher yield with minimal cost. Overall, the intervention significantly enhanced cotton resilience, stabilized yields, and improved his livelihood under climate-vulnerable conditions.
Technological benefits after intervention	After adopting glycine betaine spray, Ratnakara observed notable improvements in his cotton crop. The plants remained visibly greener with delayed leaf senescence, and boll retention increased by 15–20%. Wilting symptoms during dry spells were significantly reduced. The technology enhanced photosynthetic efficiency, resulting in better boll weight and overall yield. Higher drought tolerance also reduced the risk of seasonal crop failure. As a low-cost input, glycine betaine offered high returns by improving plant vigor and reducing dependency on irrigation. This intervention proved valuable for rainfed cotton farmers facing frequent moisture stress.

Social impact	The successful demonstration motivated several farmers in Indramal and nearby villages to adopt glycine betaine in cotton and other field crops. Ratnakara's improved income strengthened his family's financial security and boosted his confidence. His success created awareness about climate-resilient practices and encouraged peer-to-peer learning. The community now recognizes him as a progressive farmer who adopted scientific solutions to overcome drought stress. This intervention also contributed to wider acceptance of climate-smart agriculture in the village.

Role of KVK in intervention	KVK, Kalahandi played a key role in implementing this intervention by providing glycine betaine, technical guidance, and regular field monitoring. Scientists trained Ratnakara on the timing, dosage, and preparation of the foliar solution. Field visits were conducted during critical growth stages to assess stress conditions and guide optimal spray application. KVK ensured continuous advisory support and helped him evaluate the impact on crop growth and yield. Through this intervention, KVK strengthened his adaptive capacity to climate-related stress and promoted scientific crop management in the village.	
Horizontal/Vertical spread	Farmers from within and outside the NICRA village visited Ratnakara's field to observe the visible difference between sprayed and unsprayed cotton. Many farmers in Indramal and nearby villages have started using glycine betaine during dry spells, making the technology widely accepted under rainfed cotton systems.	
Impact factor	**Before Adoption**	**After Adoption**
Farmer Practice	No stress mitigation practice; high risk of yield loss	Glycine betaine spray @2% improved drought tolerance; ensured stable yield
Yield of Product	Cotton suffered severe wilting and flower drop during dry spells; average yield only **6.5 q/acre**	Wilting reduced, boll retention increased; yield increased to **9.8 q/acre**
Gross Income	₹32,500/acre	₹49,000/acre
Total Expenditure	₹18,000/acre	₹20,500/acre
Net Profit	₹14,500/acre	₹28,500/acre
Dissemination of knowledge in the locality	Before the intervention, no farmers practiced anti-stress foliar solutions for cotton.	After witnessing Ratnakara's success, several farmers adopted glycine betaine spray and other climate-resilient practices. Awareness meetings and farmer-to-farmer interactions facilitated rapid spread of the technology.
Knowledge gain based on1-5scale*	1	5

Feeling of economic security based on 1-5 scale*	1	4
Ability to understand and solve problems based on 1- 5 scale*	2	4
Self image in community based on 1-5scale*	1	4
Self confidence based on 1-5scale*	2	5

*1-5scaleindicates1=lowestand5=highest

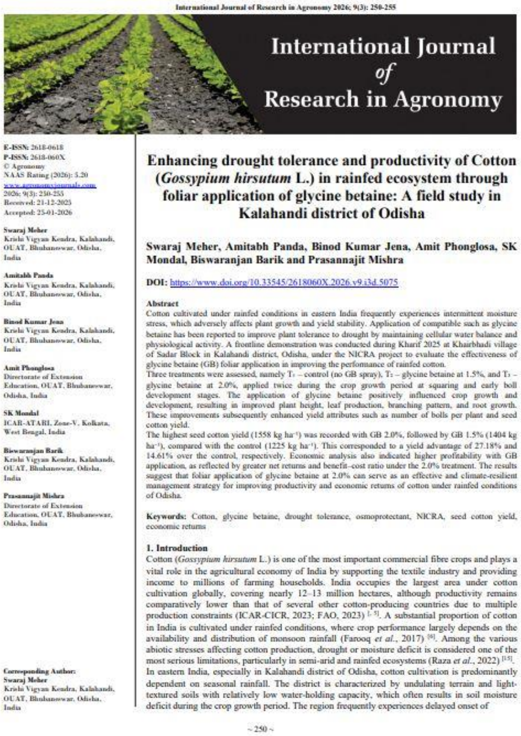
Photographs

Name of the PI: Dr. Amitabh Panda
Name of the Co-PI: Mr. Binod Kumar Jena
Name of the SRF: Mr. Swaraj Meher

XIII. Newspaper coverage

XIV. Publication

Description (nature of publication)	**Citation of the publication**	**Name of the Authors**
Original Research Paper	Enhancing drought tolerance and productivity of Cotton (Gossypium hirsutum L.) in rainfed ecosystem through foliar application of glycine betaine: A field study in Kalahandi district of Odisha, International Journal of Research in Agronomy 2026; 9(3): 250-255, DOI: https://www.doi.org/10.33545/2618060X.2026.v9.i3d.5075	Swaraj Meher, Amitabh Panda, Binod Kumar Jena, Amit Phonglosa, SK Mondal, Biswaranjan Barik and Prasannajit Mishra
Original Research Paper	Evaluation of tomato (*Solanum lycopersicum* L.) varieties for heat tolerance under high temperature conditions in Kalahandi District of Odisha, India, International Journal of Horticulture and Food Science 2026; 8(3): 61-67, DOI: https://www.doi.org/10.33545/26631067.2026.v8.i3a.495	Amitabh Panda, Binod Kumar Jena, Swaraj Meher, Biswa Ranjan Barik, Amit Phonglosa, SK Mondal and Prasannajit Mishra
Original Research Paper	Evaluation of Drought-Tolerant Rice Variety (Swarna Samriddhi) under Rainfed Conditions in the Western Undulating Zone of Odisha, International Journal of Agriculture and Food Science 2026; 8(2): 442-449, DOI: https://www.doi.org/10.33545/2664844X.2026.v8.i3f.1278	Binod Kumar Jena, Swaraj Meher, Amitabh Panda, Biswaranjan Barik, Prasannajit Mishra, Amit Phonglosa and SK Mondal


International Journal of Research in Agronomy 2026; 9(3): 250-255

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Enhancing drought tolerance and productivity of Cotton (*Gossypium hirsutum* L.) in rainfed ecosystem through foliar application of glycine betaine: A field study in Kalahandi district of Odisha

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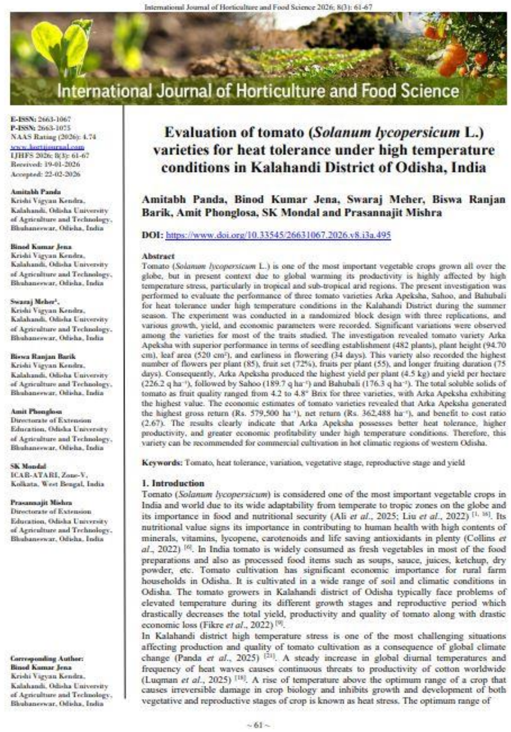
Abstract
Cotton cultivated under rainfed conditions in eastern India frequently experiences intermittent moisture stress, which adversely affects plant growth and yield stability. Application of compatible such as glycine betaine has been reported to improve plant tolerance to drought by maintaining cellular water balance and physiological activity. A frontline demonstration was conducted during Kharif 2025 at Khairbhadi village of Sadar Block in Kalahandi district, Odisha, under the NICRA project to evaluate the effectiveness of glycine betaine (GB) foliar application in improving the performance of rainfed cotton.
Three treatments were assessed, namely T_1 – control (no GB spray), T_2 – glycine betaine at 1.5%, and T_3 – glycine betaine at 2.0%, applied twice during the crop growth period at squaring and early boll development stages. The application of glycine betaine positively influenced crop growth and development, resulting in improved plant height, leaf production, branching pattern, and root growth. These improvements subsequently enhanced yield attributes such as number of bolls per plant and seed cotton yield.
The highest seed cotton yield (1558 kg ha^{-1}) was recorded with GB 2.0%, followed by GB 1.5% (1404 kg ha^{-1}), compared with the control (1225 kg ha^{-1}). This corresponded to a yield advantage of 27.18% and 14.61% over the control, respectively. Economic analysis also indicated higher profitability with GB application, as reflected by greater net returns and benefit–cost ratio under the 2.0% treatment. The results suggest that foliar application of glycine betaine at 2.0% can serve as an effective and climate-resilient management strategy for improving productivity and economic returns of cotton under rainfed conditions of Odisha.

Keywords: Cotton, glycine betaine, drought tolerance, osmoprotectant, NICRA, seed cotton yield, economic returns

1. Introduction
Cotton (*Gossypium hirsutum* L.) is one of the most important commercial fibre crops and plays a vital role in the agricultural economy of India by supporting the textile industry and providing income to millions of farming households. India occupies the largest area under cotton cultivation globally, covering nearly 12–13 million hectares, although productivity remains comparatively lower than that of several other cotton-producing countries due to multiple production constraints (ICAR-CICR, 2023; FAO, 2023) [1-5]. A substantial proportion of cotton in India is cultivated under rainfed conditions, where crop performance largely depends on the availability and distribution of monsoon rainfall (Farooq *et al.*, 2017) [6]. Among the various abiotic stresses affecting cotton production, drought or moisture deficit is considered one of the most serious limitations, particularly in semi-arid and rainfed ecosystems (Raza *et al.*, 2022) [15].
In eastern India, especially in Kalahandi district of Odisha, cotton cultivation is predominantly dependent on seasonal rainfall. The district is characterized by undulating terrain and light-textured soils with relatively low water-holding capacity, which often results in soil moisture deficit during the crop growth period. The region frequently experiences delayed onset of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Evaluation of tomato (*Solanum lycopersicum* L.) varieties for heat tolerance under high temperature conditions in Kalahandi District of Odisha, India

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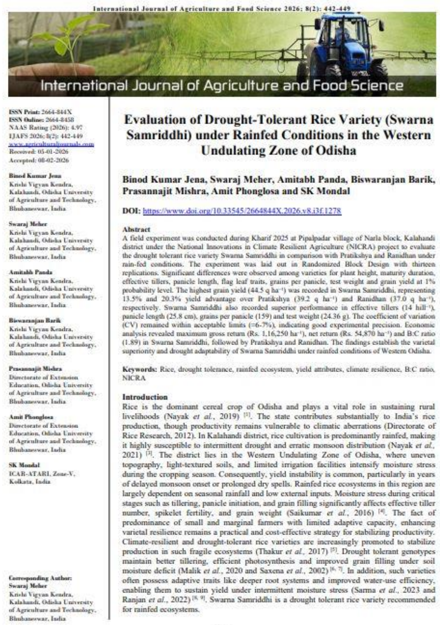
Abstract
Tomato (*Solanum lycopersicum* L.) is one of the most important vegetable crops grown all over the globe, but in present context due to global warming its productivity is highly affected by high temperature stress, particularly in tropical and sub-tropical arid regions. The present investigation was performed to evaluate the performance of three tomato varieties Arka Apeksha, Sahoo, and Bahubali for heat tolerance under high temperature conditions in the Kalahandi District during the summer season. The experiment was conducted in a randomized block design with three replications, and various growth, yield, and economic parameters were recorded. Significant variations were observed among the varieties for most of the traits studied. The investigation revealed tomato variety Arka Apeksha with superior performance in terms of seedling establishment (482 plants), plant height (94.70 cm), leaf area (520 cm^2), and earliness in flowering (34 days). This variety also recorded the highest number of flowers per plant (85), fruit set (72%), fruits per plant (55), and longer fruiting duration (75 days). Consequently, Arka Apeksha produced the highest yield per plant (4.5 kg) and yield per hectare (226.2 q ha^{-1}), followed by Sahoo (189.7 q ha^{-1}) and Bahubali (176.3 q ha^{-1}). The total soluble solids of tomato as fruit quality ranged from 4.2 to 4.8° Brix for three varieties, with Arka Apeksha exhibiting the highest value. The economic estimates of tomato varieties revealed that Arka Apeksha generated the highest gross return (Rs. 579,500 ha^{-1}), net return (Rs. 362,488 ha^{-1}), and benefit to cost ratio (2.67). The results clearly indicate that Arka Apeksha possesses better heat tolerance, higher productivity, and greater economic profitability under high temperature conditions. Therefore, this variety can be recommended for commercial cultivation in hot climatic regions of western Odisha.

Keywords: Tomato, heat tolerance, variation, vegetative stage, reproductive stage and yield

1. Introduction
Tomato (*Solanum lycopersicum*) is considered one of the most important vegetable crops in India and world due to its wide adaptability from temperate to tropic zones on the globe and its importance in food and nutritional security (Ali *et al.*, 2025; Liu *et al.*, 2022) [1, 16]. Its nutritional value signs its importance in contributing to human health with high contents of minerals, vitamins, lycopene, carotenoids and life saving antioxidants in plenty (Collins *et al.*, 2022) [6]. In India tomato is widely consumed as fresh vegetables in most of the food preparations and also as processed food items such as soups, sauce, juices, ketchup, dry powder, etc. Tomato cultivation has significant economic importance for rural farm households in Odisha. It is cultivated in a wide range of soil and climatic conditions in Odisha. The tomato growers in Kalahandi district of Odisha typically face problems of elevated temperature during its different growth stages and reproductive period which drastically decreases the total yield, productivity and quality of tomato along with drastic economic loss (Fikre *et al.*, 2022) [9].
In Kalahandi district high temperature stress is one of the most challenging situations affecting production and quality of tomato cultivation as a consequence of global climate change (Panda *et al.*, 2025) [21]. A steady increase in global diurnal temperatures and frequency of heat waves causes continuous threats to productivity of cotton worldwide (Luqman *et al.*, 2025) [18]. A rise of temperature above the optimum range of a crop that causes irreversible damage in crop biology and inhibits growth and development of both vegetative and reproductive stages of crop is known as heat stress. The optimum range of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Evaluation of Drought-Tolerant Rice Variety (Swarna Samriddhi) under Rainfed Conditions in the Western Undulating Zone of Odisha

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Abstract
A field experiment was conducted during Kharif 2025 at Pipalpadar village of Narla block, Kalahandi district under the National Innovations in Climate Resilient Agriculture (NICRA) project to evaluate the drought tolerant rice variety Swarna Samriddhi in comparison with Pratikshya and Ranidhan under rain-fed conditions. The experiment was laid out in Randomized Block Design with thirteen replications. Significant differences were observed among varieties for plant height, maturity duration, effective tillers, panicle length, flag leaf traits, grains per panicle, test weight and grain yield at 1% probability level. The highest grain yield (44.5 q ha^{-1}) was recorded in Swarna Samriddhi, representing 13.5% and 20.3% yield advantage over Pratikshya (39.2 q ha^{-1}) and Ranidhan (37.0 q ha^{-1}), respectively. Swarna Samriddhi also recorded superior performance in effective tillers (14 $hill^{-1}$), panicle length (25.8 cm), grains per panicle (159) and test weight (24.36 g). The coefficient of variation (CV) remained within acceptable limits (≈6-7%), indicating good experimental precision. Economic analysis revealed maximum gross return (Rs. 1,16,250 ha^{-1}), net return (Rs. 54,870 ha^{-1}) and B:C ratio (1.89) in Swarna Samriddhi, followed by Pratikshya and Ranidhan. The findings establish the varietal superiority and drought adaptability of Swarna Samriddhi under rainfed conditions of Western Odisha.

Keywords: Rice, drought tolerance, rainfed ecosystem, yield attributes, climate resilience, B:C ratio, NICRA

Introduction
Rice is the dominant cereal crop of Odisha and plays a vital role in sustaining rural livelihoods (Nayak *et al.*, 2019) [1]. The state contributes substantially to India's rice production, though productivity remains vulnerable to climatic aberrations (Directorate of Rice Research, 2012). In Kalahandi district, rice cultivation is predominantly rainfed, making it highly susceptible to intermittent drought and erratic monsoon distribution (Nayak *et al.*, 2021) [3]. The district lies in the Western Undulating Zone of Odisha, where uneven topography, light-textured soils, and limited irrigation facilities intensify moisture stress during the cropping season. Consequently, yield instability is common, particularly in years of delayed monsoon onset or prolonged dry spells. Rainfed rice ecosystems in this region are largely dependent on seasonal rainfall and low external inputs. Moisture stress during critical stages such as tillering, panicle initiation, and grain filling significantly affects effective tiller number, spikelet fertility, and grain weight (Saikumar *et al.*, 2016) [4]. The fact of predominance of small and marginal farmers with limited adaptive capacity, enhancing varietal resilience remains a practical and cost-effective strategy for stabilizing productivity. Climate-resilient and drought-tolerant rice varieties are increasingly promoted to stabilize production in such fragile ecosystems (Thakur *et al.*, 2017) [5]. Drought tolerant genotypes maintain better tillering, efficient photosynthesis and improved grain filling under soil moisture deficit (Malik *et al.*, 2020 and Saxena *et al.*, 2002) [6, 7]. In addition, such varieties often possess adaptive traits like deeper root systems and improved water-use efficiency, enabling them to sustain yield under intermittent moisture stress (Sarma *et al.*, 2023 and Ranjan *et al.*, 2022) [8, 9]. Swarna Samriddhi is a drought tolerant rice variety recommended for rainfed ecosystems.

XV. Expenditure Statement of NICRA-TDC Budget during 2025-26

Name of KVK	FINAL RE				Expenditure	Closing Balance 31.03.2026
	Contingencies	SCSP	NRC	Total		
KVK KALAHANDI	610000/-	165000/-	300000/-	1075000/-	1075000/-	Nil

XVI. Awards/Recognition etc. (with photos)

XVII. Any other activities (not covered above) (with photos)