

Towards Viksit Bharat@2047 Technological Innovations and Policy Options for Eastern Region



ICAR Research Complex for Eastern Region

ICAR Parisar, P.O. Bihar Veterinary College
Patna-800 014, Bihar

ISBN -978-81-954348-4-8

Towards Viksit Bharat@2047: Technological Innovations and Policy Options for Eastern Region

Editors: Abhay Kumar, Anup Das, PC Chandran, SS Mali, DK Singh, P Bhavana, Kumari Shubha, Arti kumari and Sarfaraj Ahmad

©2025 ICAR RCER All rights reserved.

Year of Publication: February, 2025

Citation:

Abhay Kumar, Anup Das, PC Chandran, SS Mali, DK Singh, P Bhavana, Kumari Shubha, Arti kumari and Sarfaraj Ahmad (2024). Towards Viksit Bharat@2047: Technological Innovations and Policy Options for Eastern Region. ICAR-Research Complex for Eastern Region, Patna, India. pp-195. ISBN -978-81-954348-4-8

Published by:

The Director,
ICAR-Research Complex for Eastern Region
ICAR Parisar, Patna- 800014, Bihar, India
Ph: +91-0612-2223962, FAX: +91-0612-2223956
E-mail: director.icar-rcer@icar.gov.in
Website: www.icarrcer.icar.gov.in

Printed at:

VIRTUE ENTERPRISES, Patna, Call : 9304410331, 9383836044

CONTENT

Introduction	1
Chapter-1: Technologies	
1. Crop Production and Protection	
1. Sustainable Intensification of Rice-Fallow System of Eastern India	5
2. Sustainable Intensification of Rice-Wheat Cropping System with Summer Green-gram using Resource Technologies in Eastern India	7
3. Improved Agro-techniques for Enhancing the Productivity of Millets in Eastern India	9
4. Innovative Millet-Based Climate Resilient Cropping System for Eastern India	11
5. Interspecific Grafting in Solanaceous Vegetables for Bacterial Wilt Management	13
6. Package of Practices for Upland Field Water Spinach	15
7. Rice-Legume System for Enhancing Productivity of Rainfed Uplands	17
8. Rejuvenation of Unproductive Mango Plants	19
9. Transforming Rice Straw into Eco-Friendly Growing Medium for Microgreens	21
10. Eco-Friendly Plantable Seedling Pot or Decorative Pot from Agricultural Residue	23
11. Conceptual Model for Integrated Organic Farming in an Acre farm plot	24
12. Air pollution Tolerance Index and Anticipated performance Index in Trees and Crops Across the Eastern Gangetic Plains India	26
13. Selecting Wheat Cultivars for Heat and Drought Stress Adaptation in the Middle Gangetic Plains	28
14. Optimizing soil c under different cover crops and irrigation systems	30
2. Farming System and Land Use Models	
1. Integrated Farming Systems for Different Ecologies of Eastern India	33
2. Multitier cropping system for Rainfed Uplands of Eastern India	35
3. Carbon stock quantification models for important fruit trees of Eastern India	37
4. Climate Resilient Agriculture Practice in Rice- Fallow Ecosystems of East India Plateau	39
5. Agroforestry Models for Rehabilitation of Coal mine affected Areas in Eastern Plateau & Hill Region	41

3. Soil and Water Conservation Measures

1. Modified drip fertigated mulched Planting System for commercial Cultivation of Vegetable in East India Plateau 44
2. Modified Drip Fertigation Technology for Vegetable Production in Eastern India 46
3. *Tephrosia* Biomass Mulching Technology for Improving Soil Health and Productivity of Fruit Orchard 48
4. Low-Cost Non-Weighing Lysimeter for Assessing Nutrient Leaching Loss 50
5. Fertilizer recommendation in mango using leaf nutrient standard 52
6. Doba Technology of Water Harvesting for Orchard Establishment in Uplands 54
7. Subsurface drip fertigation in vegetable crops 56
8. Drum Kit System for Drip Irrigation 58
9. Modified Non-weighing Paddy Lysimeter 60
10. Prioritized map for identifying drought susceptible zones in Sakri basin 62
11. Model Framework for Water Harvesting Planning using multivariate techniques 64
12. Mapping Flood Prone Areas of Bihar based on Frequency 66

4. Livestock & Fish Production and Protection

1. Serological Diagnosis (Indirect ELISA) of *Theileria annulata* using Recombinant spm² antigen 69
2. Identification of CCL8 and CXCL10 as Early Pregnancy Biomarker in Buffaloes 71
3. Spent Mahua Flower as Growth Promoting Pig Diet 73
4. Low-Cost Feed Formulation for T&D Pig 75
5. Sustainable Poultry Feed Formulation for Desi Chicken 77
6. Breeding, rearing and juvenile seed production of Magur fish (*Clarias magur*) 79
7. Optimization of Integrated Fish Farming Systems for Livelihood Improvement of Small and Marginal farmers of Eastern Region 81
8. Formulation of vitamin-mineral enriched diet for quality seed Production and survival of Rohu (*Labeo rohita*) 83
9. Grass Carp Cultivation Using Seasonal Forage and Aquatic Crops 85
10. Mitochondrial genome maps of duck germplasm inhabiting Eastern Region of India 87
11. HSP70 as marker for heat stress in *Murrah* buffalo 89
12. Effect of glucosamine supplementation on egg laying Performance of chicken 91
13. Identification of novel SNP marker within the PROP1 gene associated with growth characteristics in goat 93
14. Genetic effects of STAT3 gene polymorphism on body Size traits in Assam Hill goats 95

5. Farm Mechanization and Post-Harvest

1. Design and Development of Solar Operated hold-on type paddy thresher 98
2. Solar Irrigation Pump Sizing Tool 100

3. Custom Hiring Centre (CHC) for promotion of Climate Resilient Agriculture	102
4. Over the Plant (OTP) Manual Weeder for Row Crops	104
5. Manual Makhana Seed Grader	106
6. Peripatetic fish vending cart	108
7. Farm Machinery Hiring Calculator: a web Based tool	110
8. Solar Cabinet Dryer for Leafy Vegetables	112
9. Hybrid Solar Light-Pheromone Insect Trap	114
10. Mixed Para-Pheromone Fruit Fly Trap for Horticultural Crops	116
6. Socio-economic, Extension & Policy Measures	
1. Climate Resilient Model Villages Developed at Gaya and Buxar districts of Bihar	119
2. Model for structural and functional analysis of Makhana value chain	121
3. Strengthening Export Potential of Farmer Producer Organizations (FPO) through One District One Product (ODOP): A Conceptual Model	123
4. Seed based technology delivery model through Farmers Producer Organization (FPO)	125
5. Flood Prone Area Identified as Fruit Hub in Bihar: A Policy Framework	127
6. Nutrigarden Model Addressing Anemia and Hypovitaminosis Challenges of Eastern India	129
7. Policy Measures for Tenant farmers of Bihar	131
8. Socioeconomic status scale for farmers of Bihar and Jharkhand	133
9. Participatory Research Application for Year-Round Income and Agricultural Sustainability (PRAYAS): A process model for empowering weaker sections	135
10. Process Model for Developing Zero Hunger & Zero Technology Gap Village	139
11. Conceptual Model for Evaluation of Carbon Credit Projects	141
12. Forecasting Kharif Rice Production and Rainfall Assessment in Bihar : ARIMAX and Spatial Interpolation Models for Food Security in Easter India	143
13. Model-Based Resource Mapping and strategies for Rice Cultivars in Food Prone Ecosystems	145
Chapter-2: Climate Resilient Rice varieties	148-158
Chapter-3: Improved varieties of Vegetables	160-186
Chapter-4: High Yielding varieties of Fruits	188-190
Chapter-5: Other Improved varieties (Chickpea, Makhana & Faba bean)	192-195

Innovative Millet-Based Climate Resilient Cropping System for Eastern India

Period of development: 2016 - 2020

Developers:

Rakesh Kumar, JS Mishra, RS Pan, BP Bhatt, S Mondal, K Saurabh, R Shinde

Background:

Change in climate impose for identification of an eco-friendly production system that is more productive-cum-energy efficient & environmentally safer. Four-year study was conducted (2016-2019) to diversify dominant rice-wheat system through climate resilient cropping in eastern India. Ten diverse cropping system comprised of transplanted puddle rice-wheat-mung, conventional till-direct seeded rice (CTDSR)-wheat-mung, soybean-maize, CTDSR-mustard-urd, foxtail millet-lentil-fallow, pearl millet-chickpea-fallow, finger millet-toria-fallow, sorghum (grain)-chickpea -fallow, maize cob-pigeon pea & sorghum (fodder)-mustard-urd.

Description of the technology:

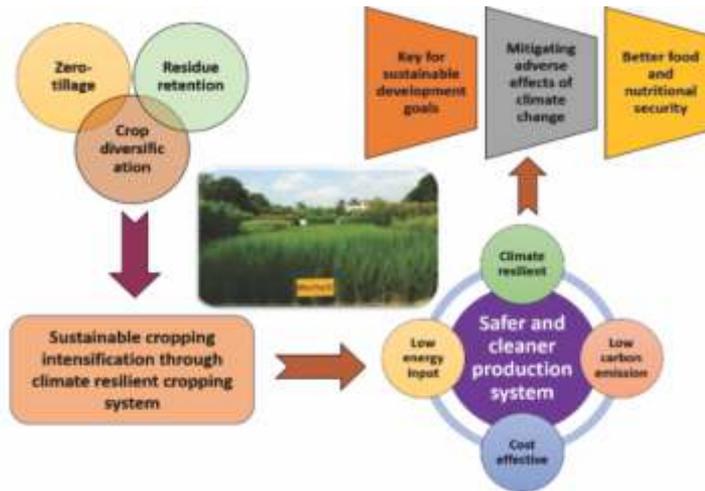
Ten millet based diverse cropping systems were evaluated for their adoption in eastern India. Millet-based systems reduced input cost (43-69%) and sometimes doubled the farmers' income. Most productive cropping system in terms of system rice equivalent yield (SREY) was noted with maize cob-pigeonpea (ZT) (22.3 t/ha) followed by sorghum fodder-mustard (ZT)-urd bean (ZT) system (18.5 t/ha). In terms of economics, most profitable cropping system was maize cob-pigeon pea (Rs.255272/ha) followed by sorghum fodder-mustard-urd bean system (Rs.178059/ha). Millet-based system helps in reducing C-input (172%) and improves energy ratio (61%) as compared to cereal-based production system. Inclusion of millets in the existing production system improved energy productivity, productivity, economic efficiency on diverse agro-ecological zone of eastern India.

Commercial potential:

The technology can be offered through consultancy services or outsourced to the State Agricultural Department, Development agencies like Millets Mission, RKVY, NGOs, and farmers' groups.

Impact:

Under CRA Program (GoB), ICAR RCER Patna has developed 10-Climate Smart Village (CSV) in Gaya (05) and Buxar (05) and covered more than 500 ha area with millet-based production system during last three years in drought prone district of Bihar. Thus, inclusion of millets in existing production system (rice-wheat) improved energy productivity and system productivity in diverse agro-ecological zone of eastern India.



Millet-Based Climate Resilient Cropping System strategies



Millet-Based Climate Resilient Cropping System

Agro-ecoregions suitability:

Rainfed ecosystem of Eastern states

Reference:

Kumar Rakesh, Mishra JS, Mondal S, Meena RS, Sundaram PK, Bhatt BP, Pan RS, Lal R, Saurabh K, Chandra N, Samal SK, Hans H, Raman RK. 2021. Designing an ecofriendly and carbon-cum-energy efficient production system for the diverse agroecosystem of South Asia. *Energy* 214:118860. <https://doi.org/10.1016/j.energy.2020.118860>