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Agricultural systems by design

ENHANCING FARMING SYSTEMS IN VULNERABLE REGIONS OF MAHARASHTRA, INDIA: EVALUATING INNOVATION BUNDLES FOR SUSTAINABLE INTENSIFICATION

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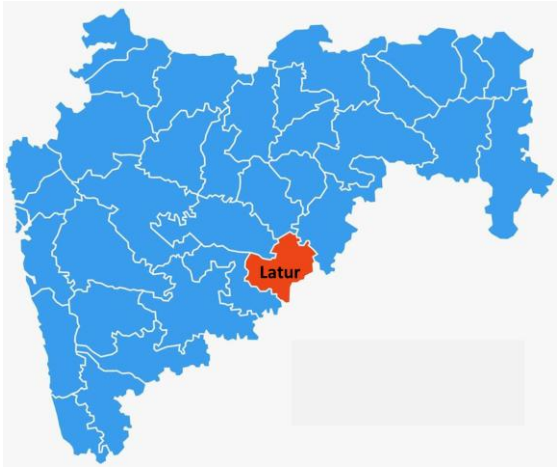
ICRISAT
INTERNATIONAL CROPS RESEARCH INSTITUTE FOR THE SEMI-ARID TROPICS

CGIAR

Background and Objectives

Region and Challenges in Rainfed Farming in vulnerable region of Latur



'Water Train' To Maharashtra's Drought-Hit Latur Completes 100 Trips

Indo-Asian News Service | All India | Jul 30, 2016 23:13 pm IST

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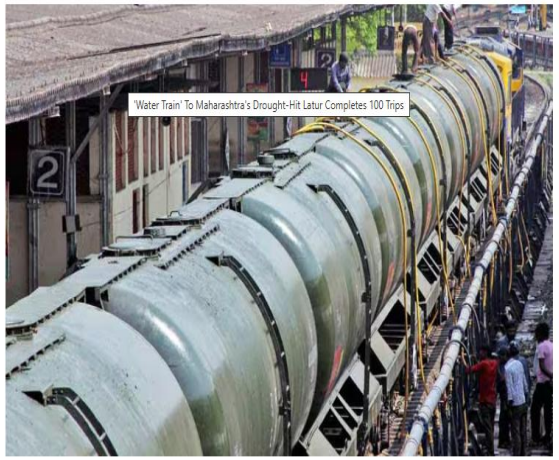


The first 'water train' started on April 11 from Miraj to Latur with 10 tanker wagons.

- **Increasing water scarcity and crop failure risk** due to increasing extreme weather events- droughts, heat waves, flash floods
- **Open well-** water is **drying up**
- **Land degradation, low SOC**, erosion, nutrient depletion
- **Resource limitation- low investments**
- Poor access to **technologies**
- **Poor access to market**- input and output
- **High risk, low productivity and income**
- **Disadvantaged** women, children- drudgery, water, nutrition, schooling, etc

➢ Scope of **optimizing water and land** resources is limited at the farm scale- landscape-watershed perspective

Study Objective

❑ Design and evaluate **socio-technical innovation bundles** for **rainfed mixed farming systems** in vulnerable regions of Maharashtra (Latur)

❑ **Targeting and evaluating impact on multidimensional sustainability:**

➢ Farm household **cashflows**

➢ **Environmental sustainability**

➢ **Economic sustainability**

➢ **Social sustainability (resilience)**

Integrated Systems Assessments for designing Bundled Solutions for Systems Transformation under Drylands: Optimizing resources and opportunities from *farm to landscape scale*

Community Driven Approach

MSAT

Evaluate Economic, Social, Environmental and productivity dimensions

LRI

Land Resource Inventory (LRI) assess soil characteristics, land use potential

Hydrological assessment

Identify water availability, recharge potential and vulnerabilities

Systems analysis and localized Insights to **identifying entry points** at landscape and HH level

Whole farm scenario analysis

for different farm types

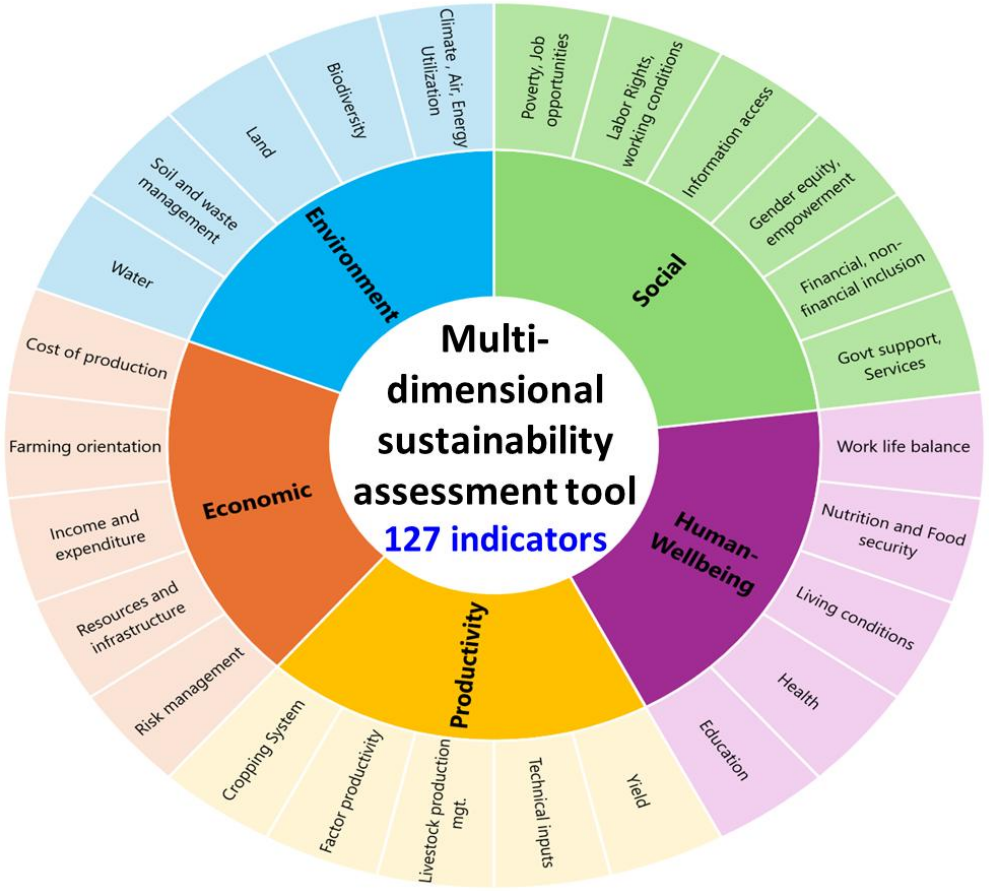
Contextualized bundled solutions

- Implementation of Landscape and Farm Type-Specific Holistic Solutions
- Higher Adoption
- Enhanced Economic, Social, Environmental Sustainability

Departments of Agriculture, Groundwater, Watershed onboarded and Village Panchayat led coordination with the community

Assessment Framework and Tools

Multidimensional sustainability assessment



MSAT framework

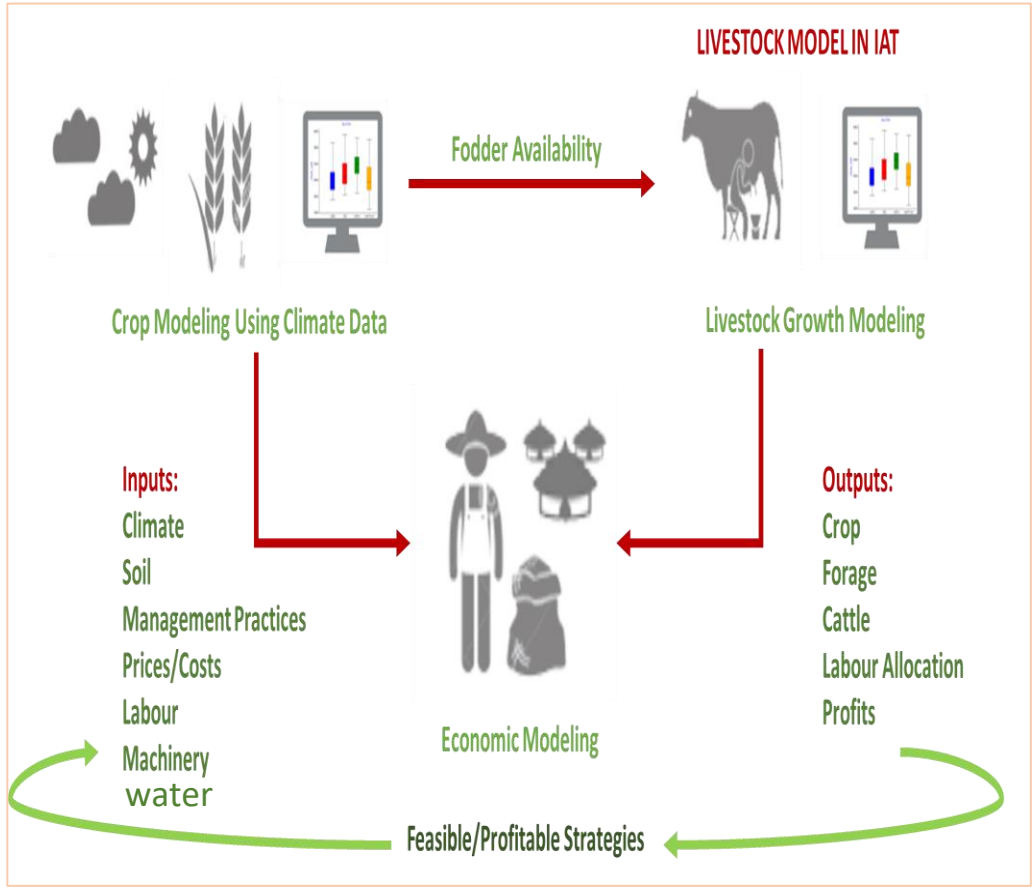
Land Resource Inventory

&

Hydrological Assessment

at the Landscape Scale

Whole-farm modeling: Crop-Livestock Enterprise Modelling



WHOLE FARM BIO-ECONOMIC MODELING

Entry points and interventions

🌍 Landscape and Community Scale Interventions

- **NRM interventions at watershed scale-** bunding, Check dams, Nala plugs, Farm pond (new/rejuvenation), Deepening and widening of drainage channels
- **Water budget-based** crop planning

- Community level **farm machinery** custom hiring center
- Awareness on regenerative agriculture, organics, kitchen gardening and nutrition

👥 Household Level Interventions

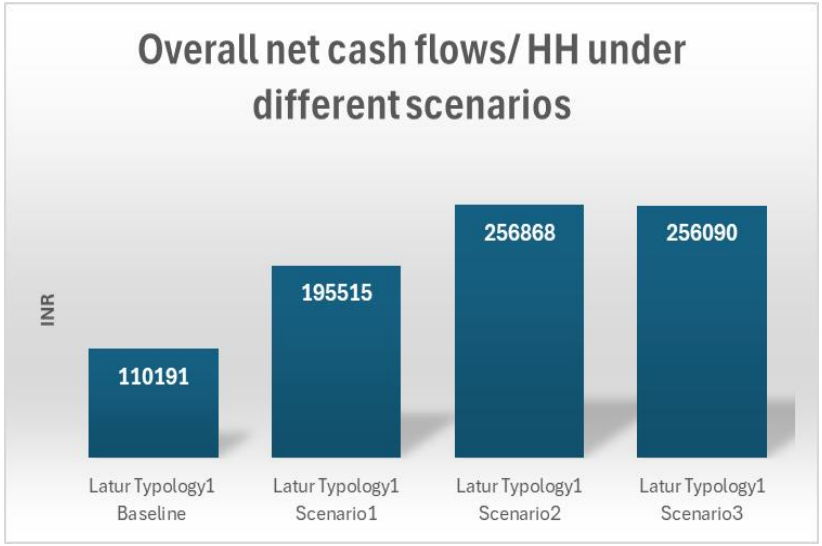
- **Improved crop varieties**
- **Soil test-based** application of nutrient and micronutrient
- Appropriate integration of **low-water-requiring crops**
- Livestock intensification through **quality fodder**
- Productive use of **fallow land** – increased production
- **Expanded livestock** ownership
- Fish farming in **farm ponds**
- Agroforestry- **fruit tree**

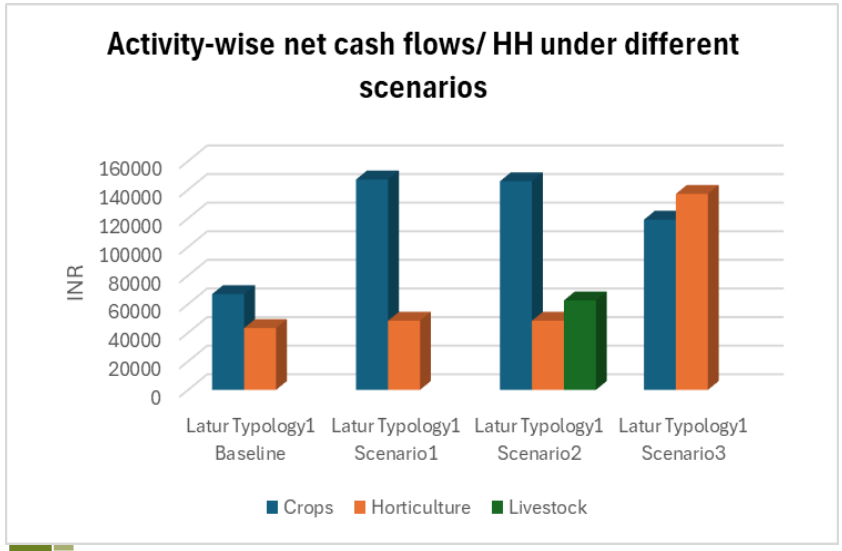
Innovations Bundles

Scenario	HH type 1 (Older age, smaller holder, less educated, mostly rainfed)	HH type 2 (Younger age, relatively large holding, more educated, partial irrigated, higher bank credit)
S 1	• Improved access to water • Access to small machinery • Improved varieties • Crop diversification • Fallow land under crops	• Improved access to water • Access to small machinery • Improved varieties • Crop diversification • **Sprinkler in Sugarcane** • Fallow land under crops
S 2	• Improved access to water • Access to small machinery • Improved varieties • **Adding 1 milch animal**	• Improved access to water • Access to small machinery • Improved varieties • **Sprinkler in Sugarcane** • **Introducing fodder crop** • **Adding 2 milch animal**
S 3	• Improved access to water • Access to small machinery • Improved varieties • Crop diversification • Fallow land under crops • **Sapota fruit production (increased)**	• Improved access to water • Access to small machinery • Improved varieties • Crop diversification • **Sprinkler in Sugarcane** • Fallow land under crops • **Sapota fruit production (increased)**

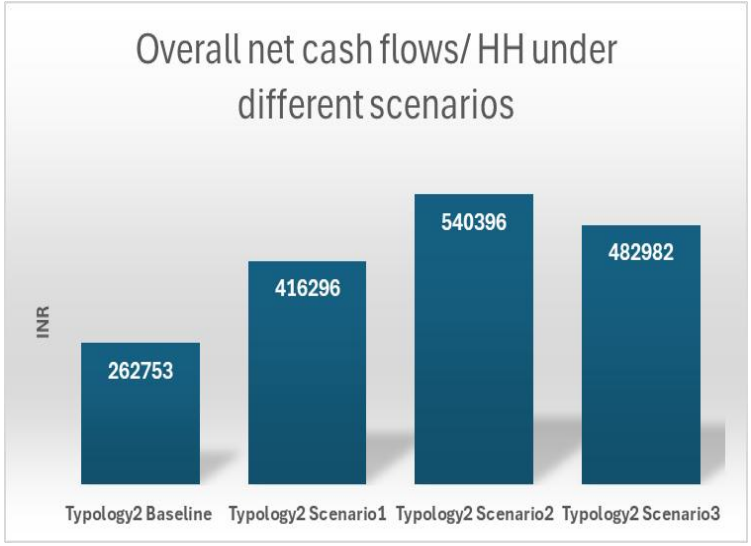
Whole Farm Modelling Scenarios: Impact of different innovation bundles on HH net returns

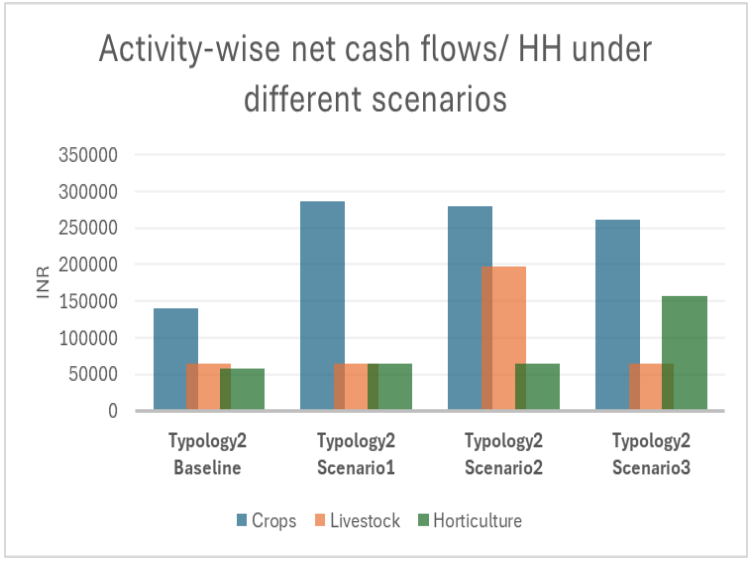
HH Typology 1





HH Typology 2





% increase in net returns across HH types

Scenarios	Farm type 1	Farm type 2
1. Scenario1	77%	58%
2. Scenario2	133%	106%
3. Scenario3	132%	84%

Water deficit

Baseline	After interventions
40%	14%

This can be addressed by shifting from the sugarcane crop to Soyabean-Chickpea or Soyabean-sorghum, Sapota, MIS

From Struggle to Sustainability: Improvement in multidimensional sustainability

Outcomes

Enhance agro-bio-diversity

Reduced women drudgery

Improved household food and nutrition security

Groundwater in open wells increased by 4 meters

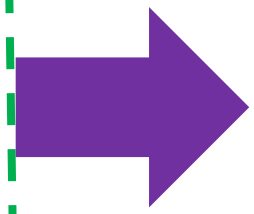
Productive use of fallow land leads to Increased production

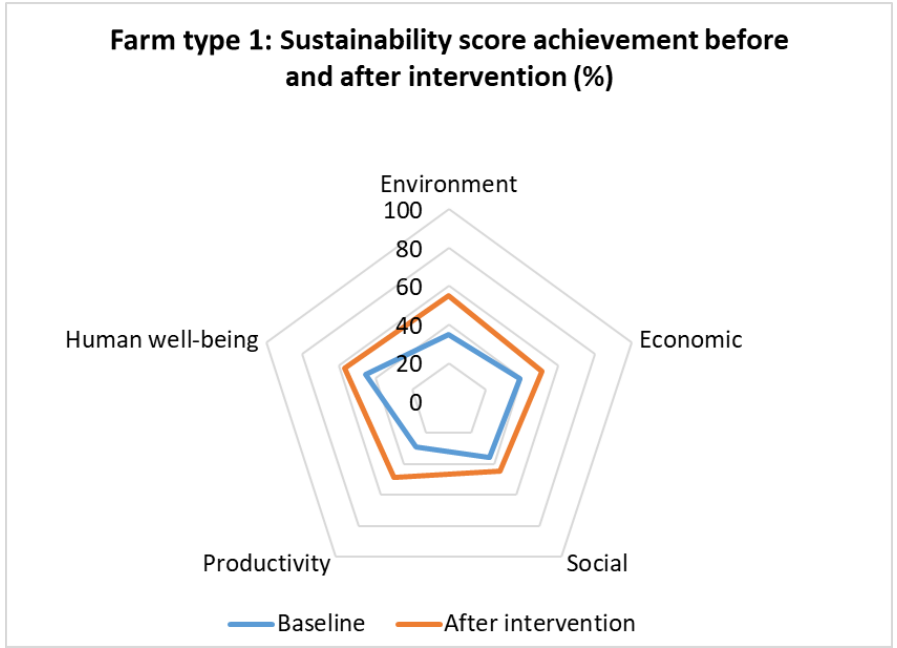
Crop yields increased by 25 -45%

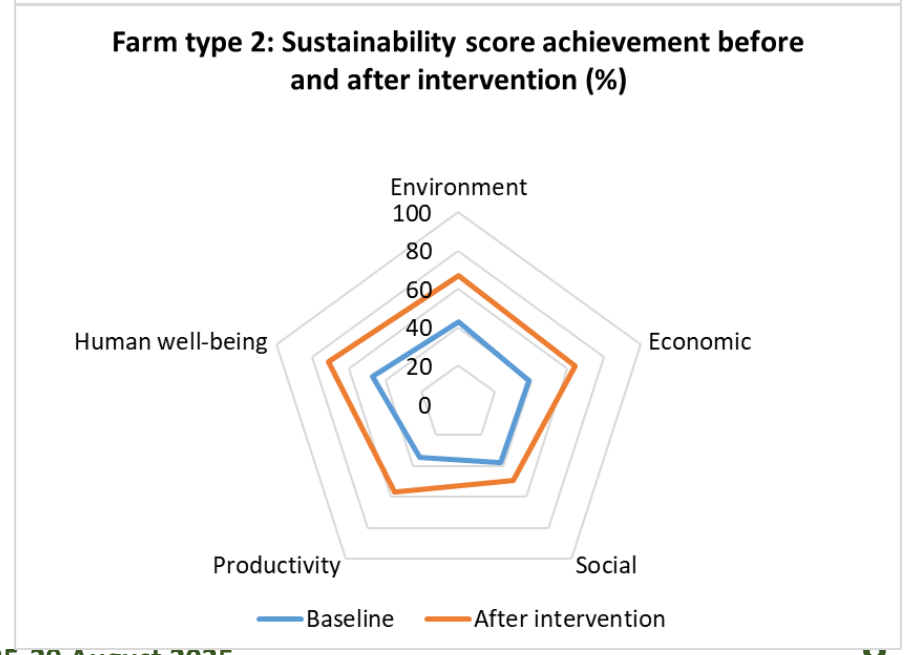
Improved access and quality of drinking water

Increased school attendance

Increased milch animals and milk yield by 10 – 25%







Way Forward

- Encouraging farmers to shift from sugarcane to soybean-based cropping systems or Sapota and micro-irrigation systems
- Based on this system science-driven approach and demonstrated success, the bundled innovations scenarios can be developed for other dryland landscapes for large-scale transformation of farming systems in vulnerable regions
- Develop a ‘Digital twin’ landscape model for suitability mapping to guide planning and investment towards sustainable farming systems on a large scale
- Integrating this system science approach with national programs and policies
- Capacity building of NARES through hands-on training and developing suitability maps

Thank You