DryArc – understanding complexity in smallholder farming systems for scaling impactful interventions

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ICRISAT

What is an Innovation Systems Approach?

The goal: In support of ICRISAT's vision, ISD creates and uses knowledge, methodologies and tools to create innovations, understand entry points/tradeoffs and leverage actors towards profitable resilient and sustainable agri-food systems at scale.

An **innovation systems** approach harnesses the conditions needed to create demand for technologies and creates the knowledge that may be used to bring about such changes…innovations most often emerge from a systems of actors **collaborating, communicating and learning**.

Agribusiness and Innovation Platform

Systems Analysis for CSA

(Incl. GIS/RS)

Digital Agri. & Youth

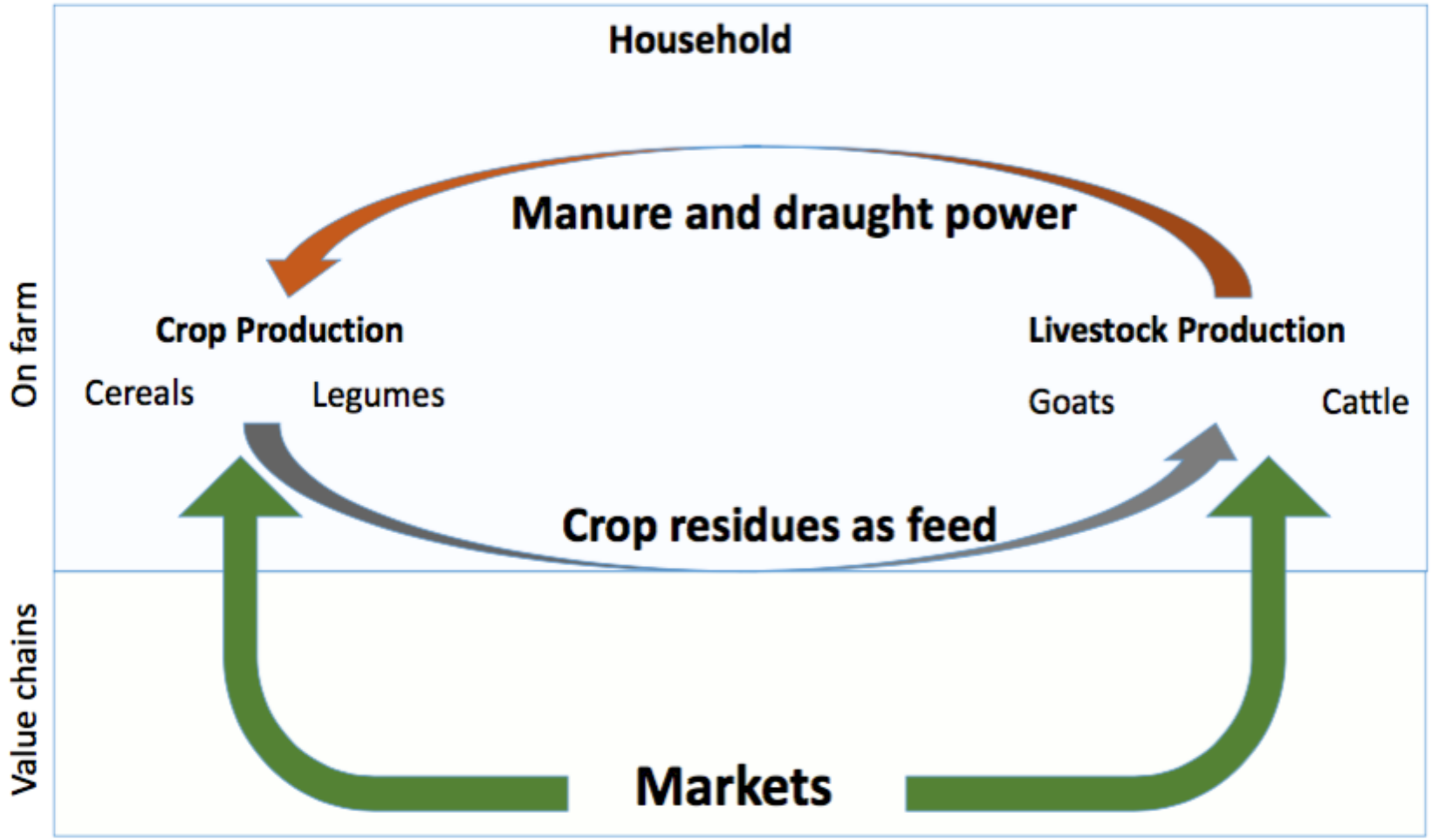
(incl. M&E)

Markets Institutions Nutrition & Diversity

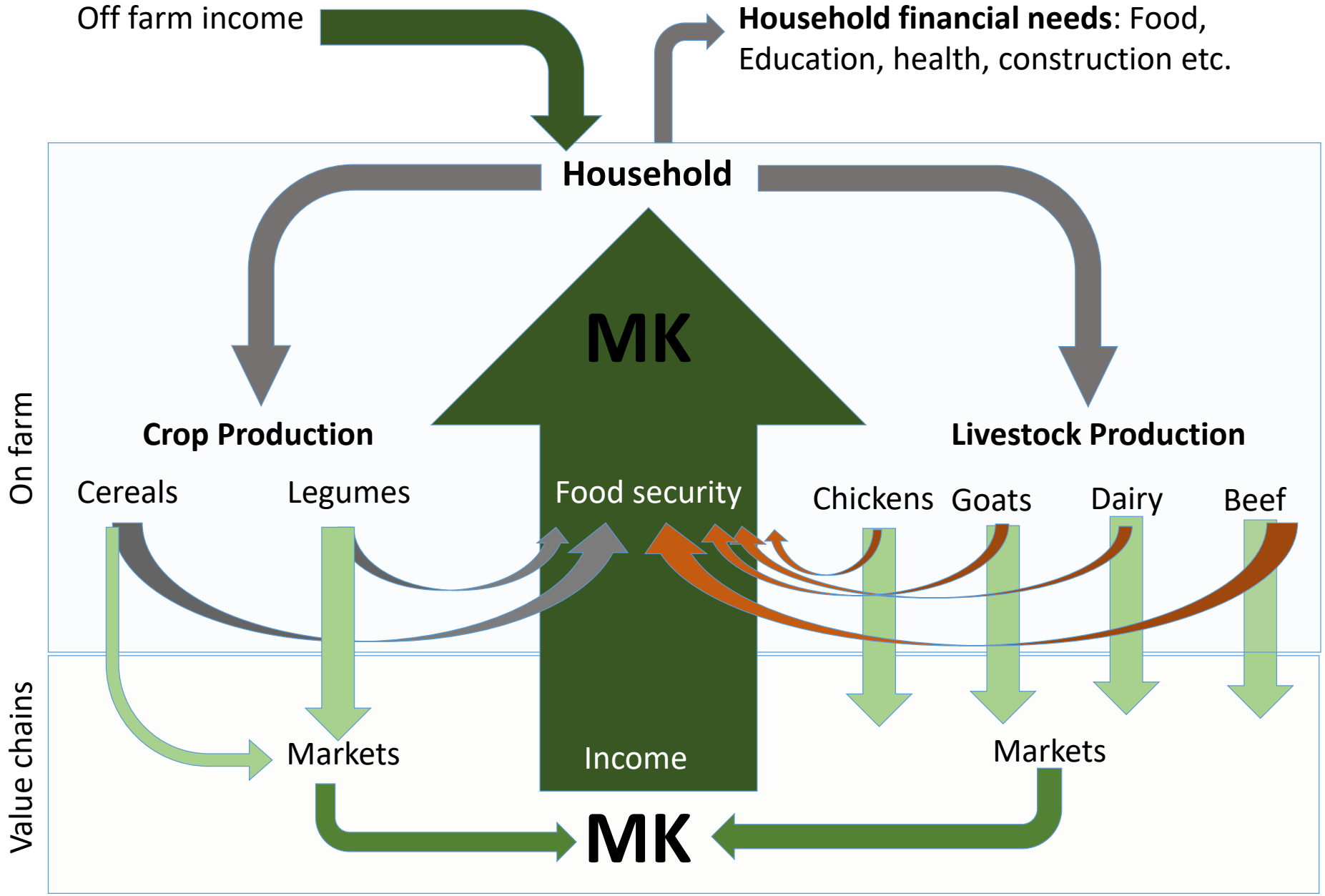
(incl. impact assessment)

Crop livestock systems:

Agro-ecological and economic interactions



Agro-ecological and economic interactions between crops, livestock and markets

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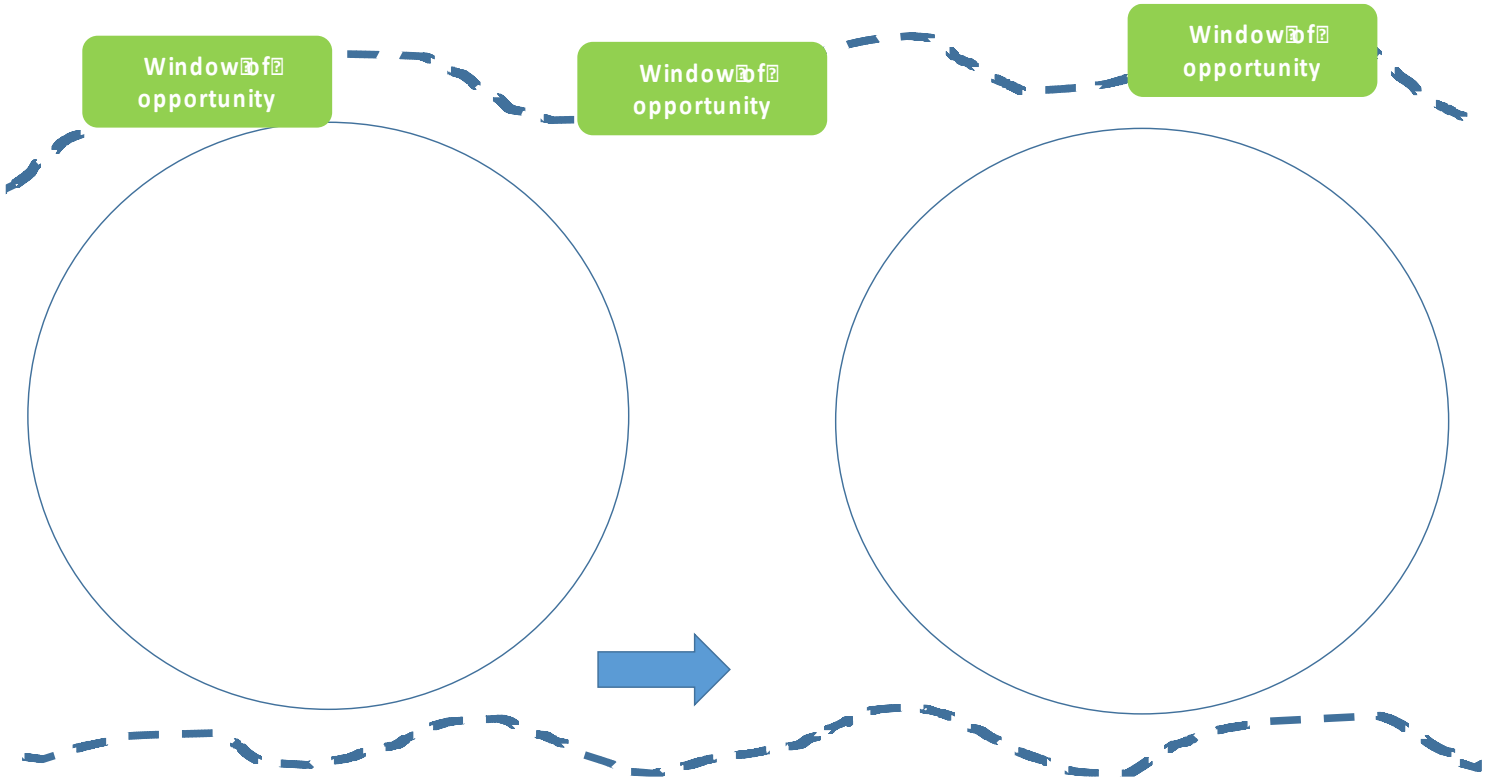
Innovation Platform approaches:

(1) developing functional networks to facilitate desirable change



Innovation Platform approaches:
(2) Visioning and road map

Resilient and profitable state

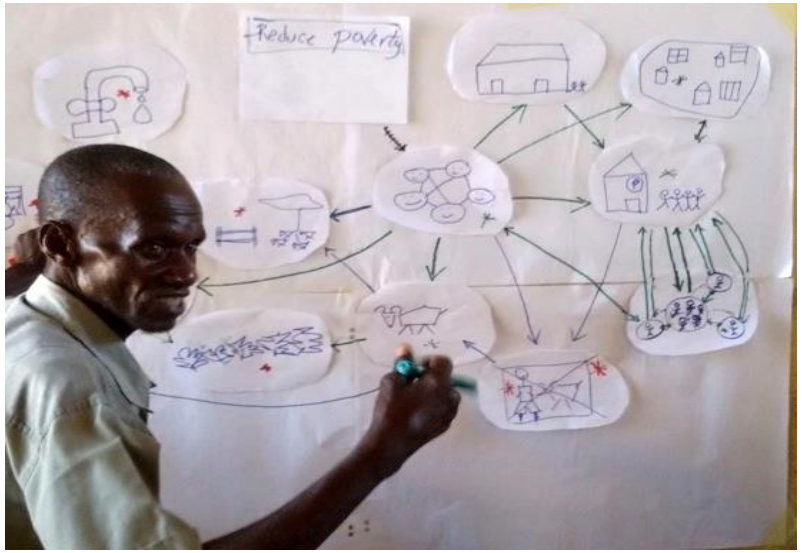
Barriers → Solutions

→ Lack of land ownership

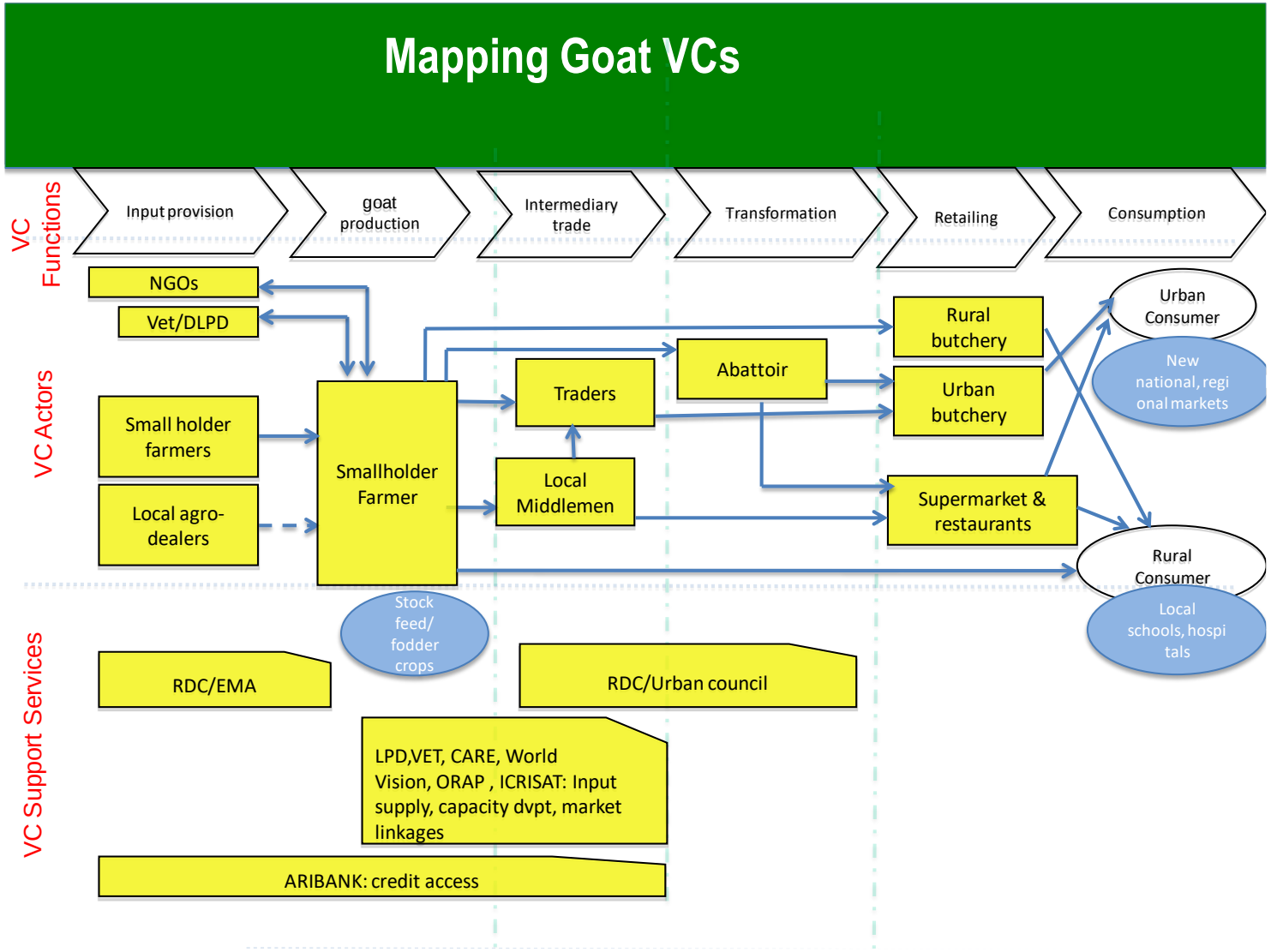
→ Weak social capital (internal/external)

→ Lack of knowledge on crop livestock technologies

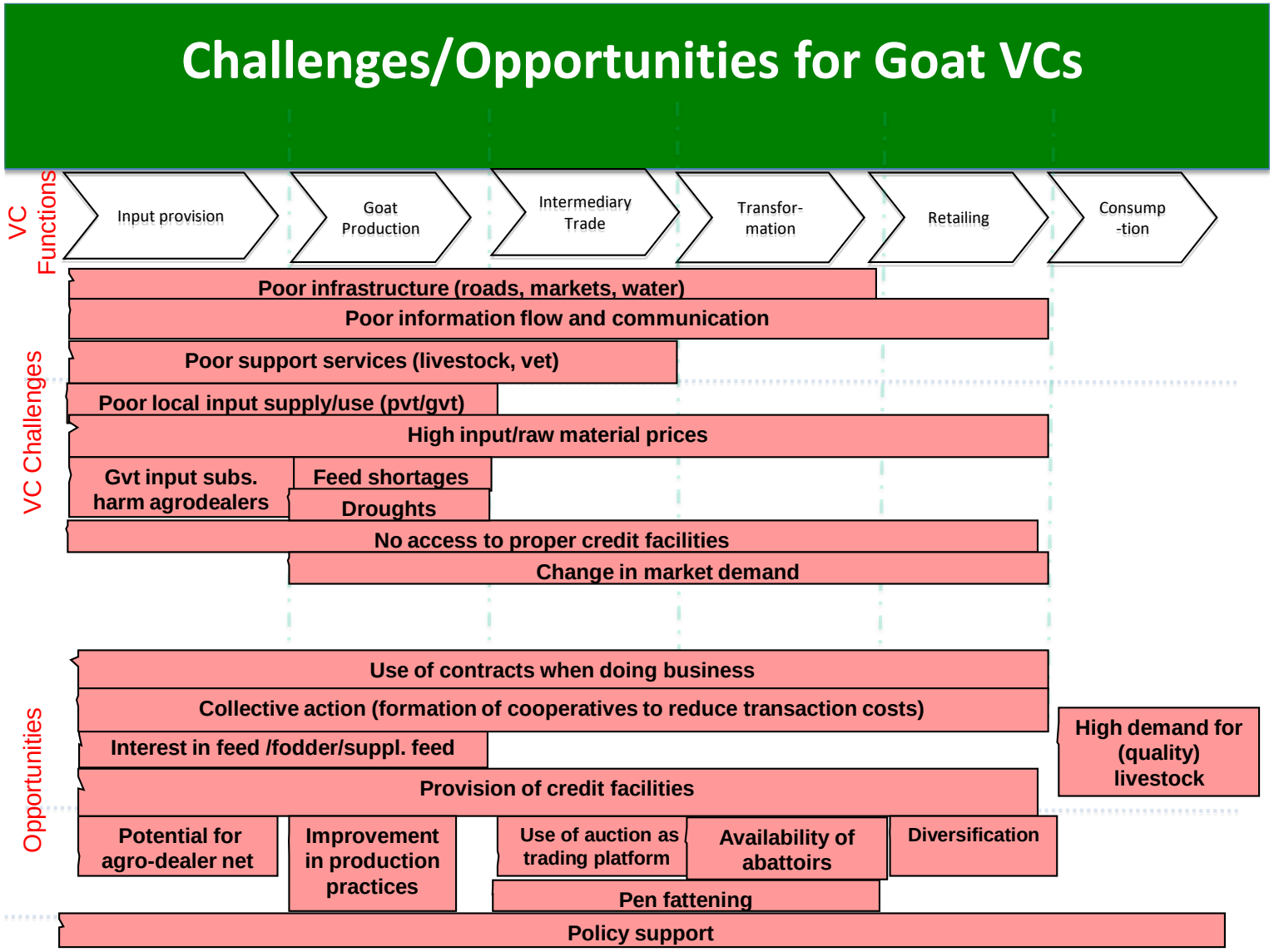
Vulnerable state



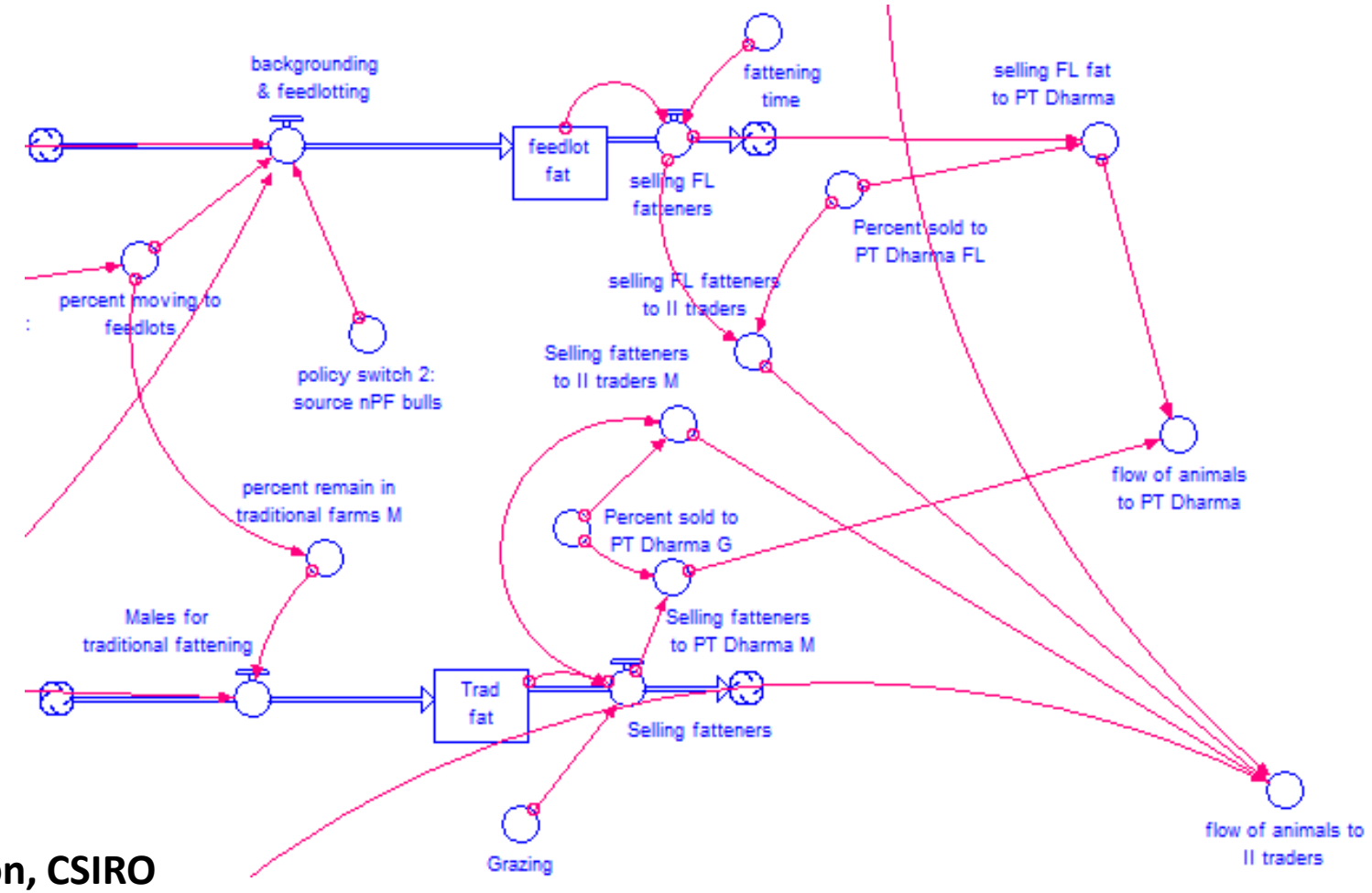
Innovation Platform approaches:
(3) Diagnoses



Innovation Platform approaches:
(3) Diagnoses

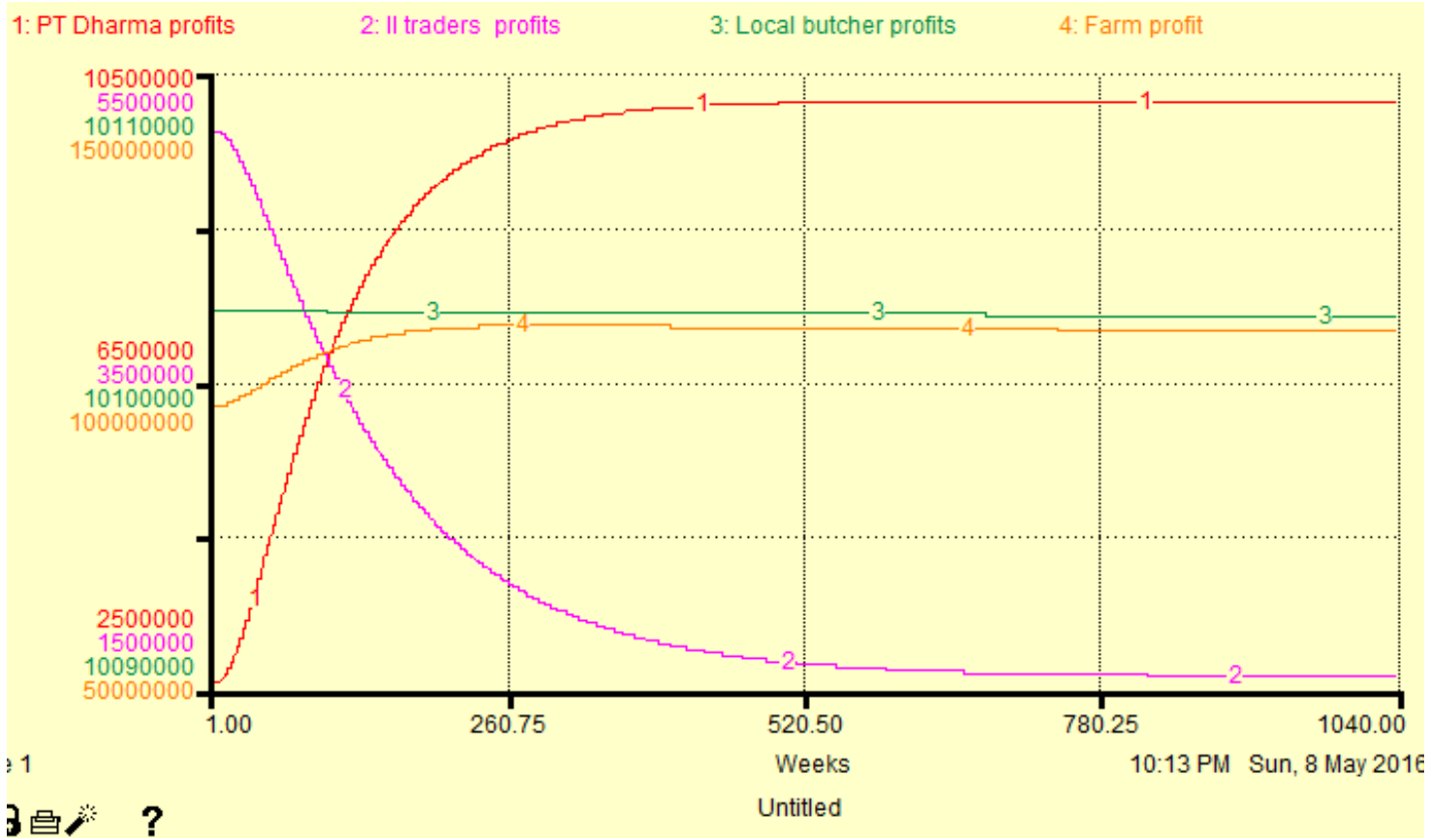


Value chain models – beef project, Sumbawa Indonesia – feed-lotting and improved processing



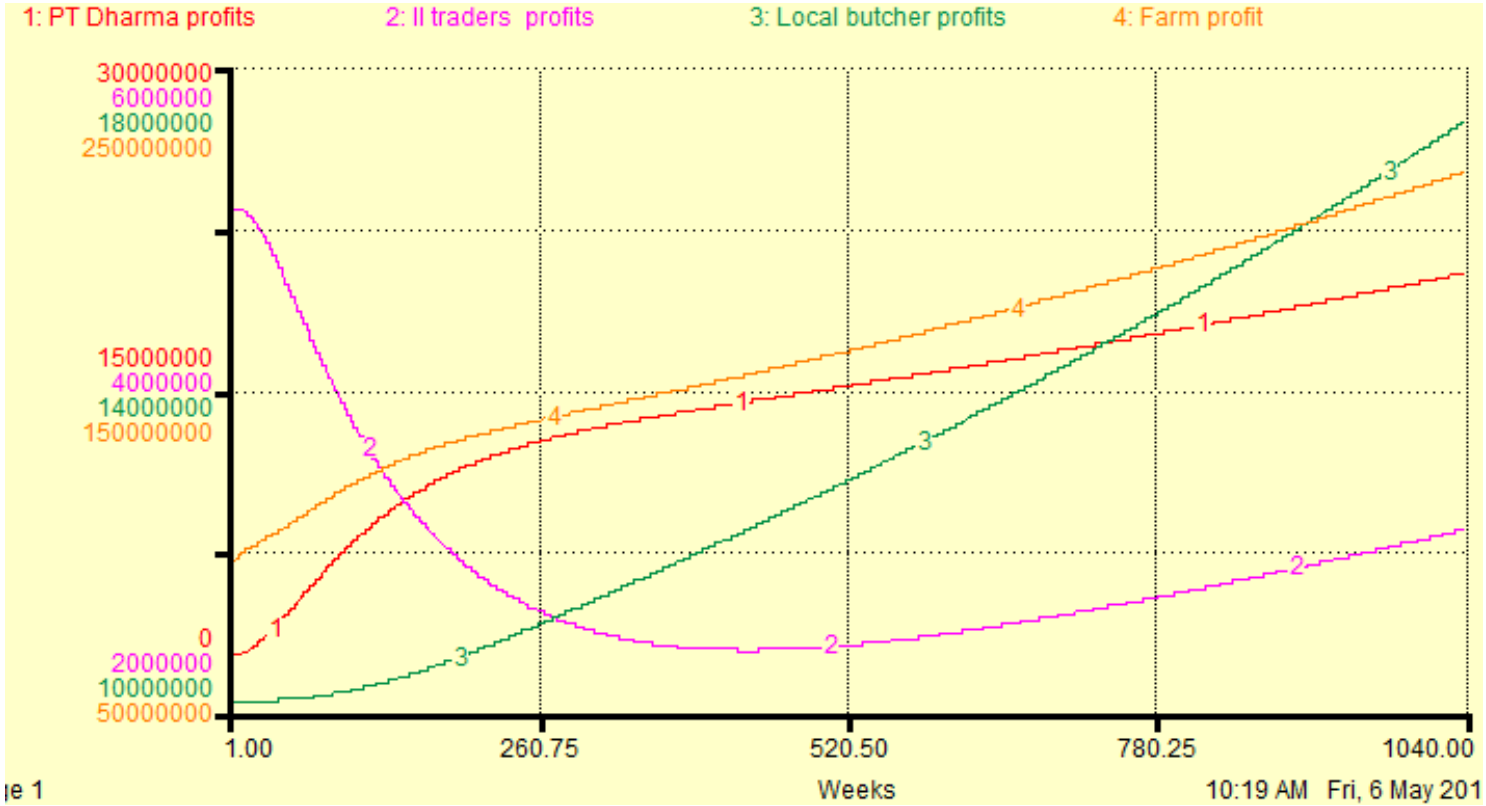
Source: Ben Henderson, CSIRO

Value chain models – beef project, Sumbawa Indonesia – feed-lotting and improved processing



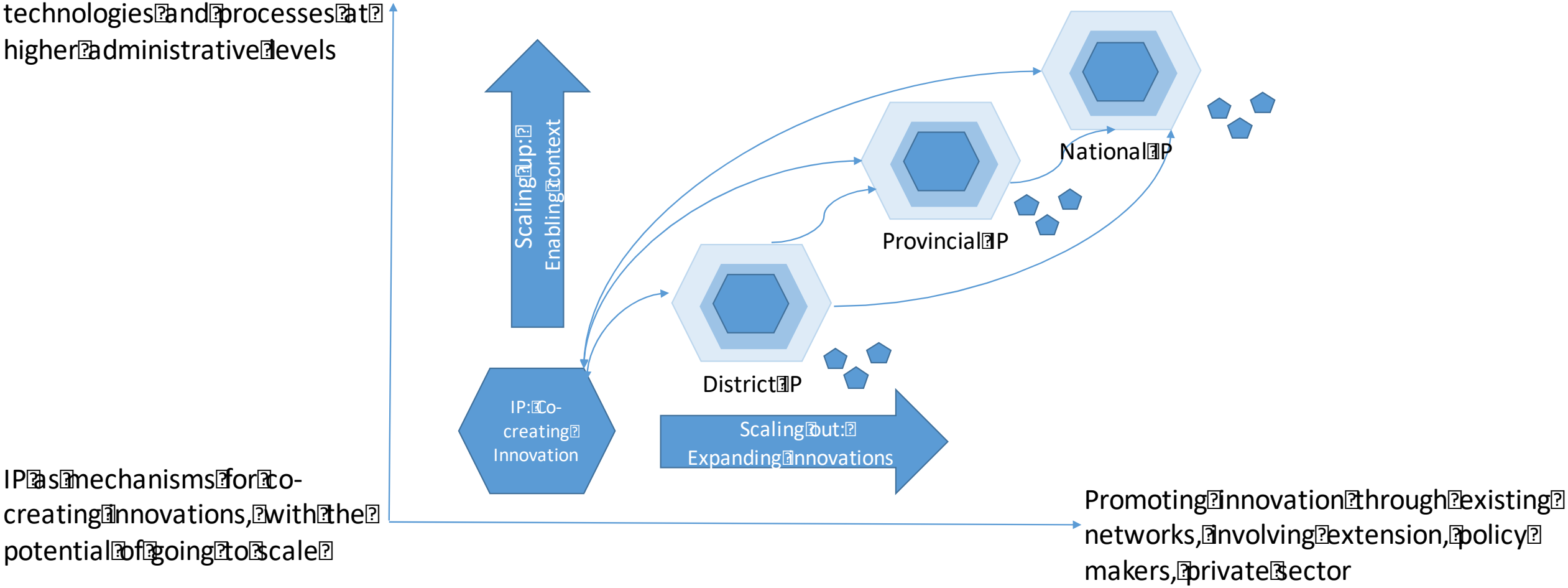
Source: Ben Henderson, CSIRO

Value chain models – feed-lotting, improved processing, breed herd improvement



Source: Ben Henderson, CSIRO

Innovation Platform approaches:
(4) Iterative process of prototyping, evaluation and scaling



Scaling through multi-disciplinary networks

Scaling as part of participatory technology development, engagement and visibility processes:

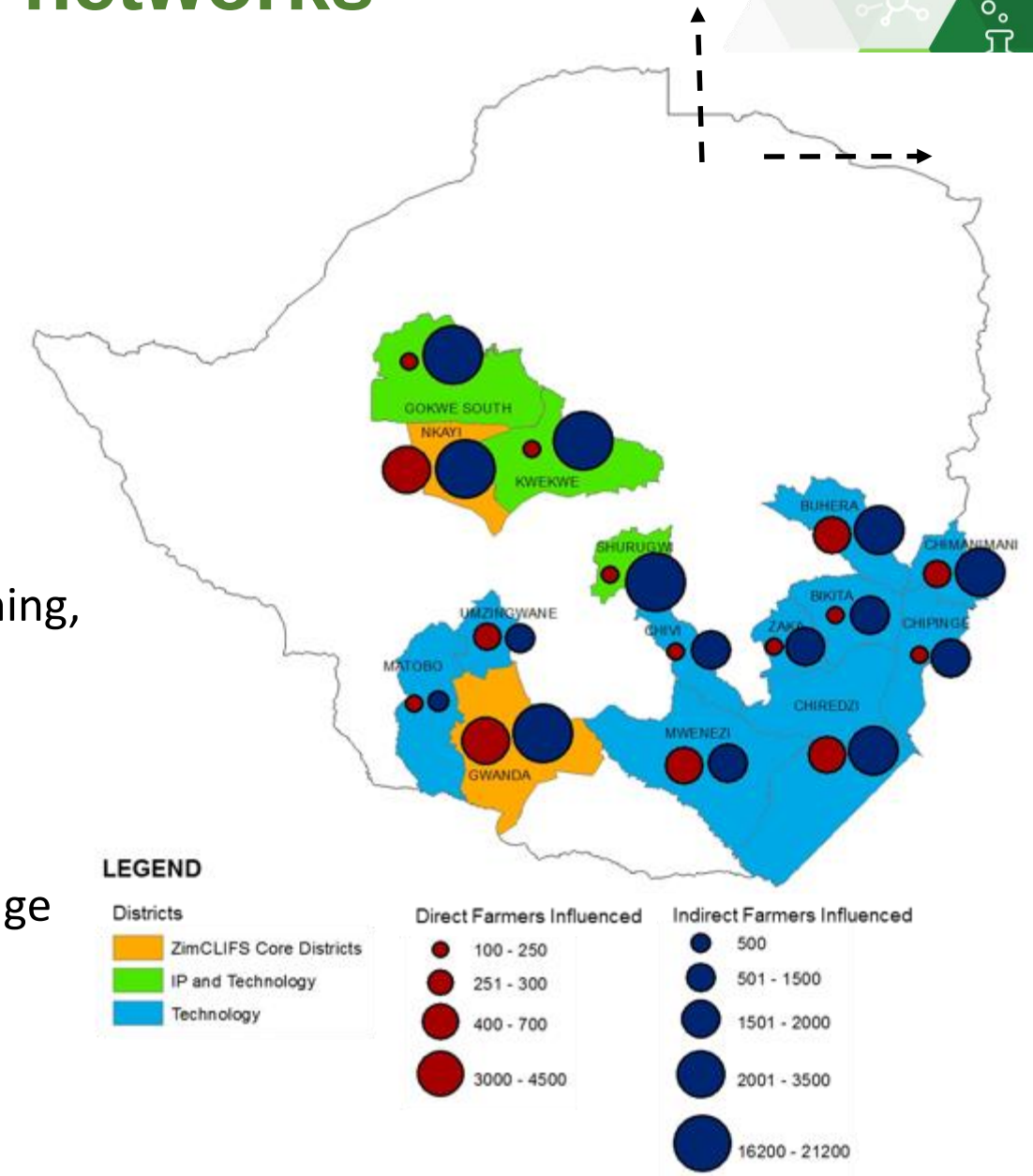
- IPs + innovations - in different contexts, similar mechanisms
- Innovations only - large uptake without IPs, where there is relevance

Open structures for experimentation and knowledge sharing

- Disseminate innovations in other areas and countries
- Integrate innovations with other components, e.g. pen fattening, goat/cattle market initiatives, goats for welfare groups
- Private sector responses, e.g. sale of mucuna seed, links to abattoirs

Lasting trustworthy networks of actors for accelerating knowledge diffusion, adaptation, uptake

At least 14 districts in Zim and expanding to Mozambique and Malawi



INTEGRATED ASSESSMENT- Bio-economic Modelling Tool

APSIM

Crop Modeling Using Climate Data

Fodder Availability

LIVESTOCK MODEL IN IAT

Livestock Growth Modeling

Inputs:
Climate
Soil
Management Practices
Prices/Costs
Labour
Machinery

Outputs:
Crop
Forage
Cattle
Labour Allocation
Profits

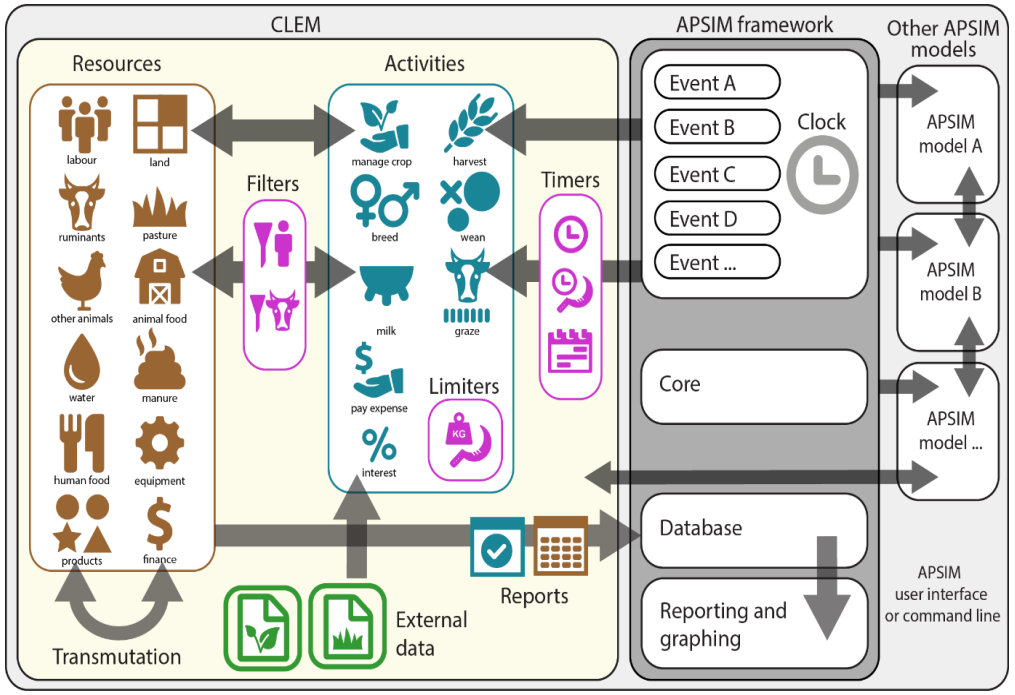
Economic Modeling

Feasible/Profitable Strategies


CLEM
CROP LIVESTOCK ENTERPRISE MODEL

What is CLEM?

- A whole farm enterprise model tracking all **Resources** (assets) used by farm **Activities**
  - **Resources** (e.g. animals, crops, fodder, labour, land, money, water)
  - **Activities** (e.g. grow crops, manage animals, feed animals, manage fodder, manage manure, feed household)
- CLEM can test a range of farm improvement strategies in a multitude of crop and livestock enterprises, while tracking impacts on nutrition, natural resources, and highly constrained resources (e.g. labour).

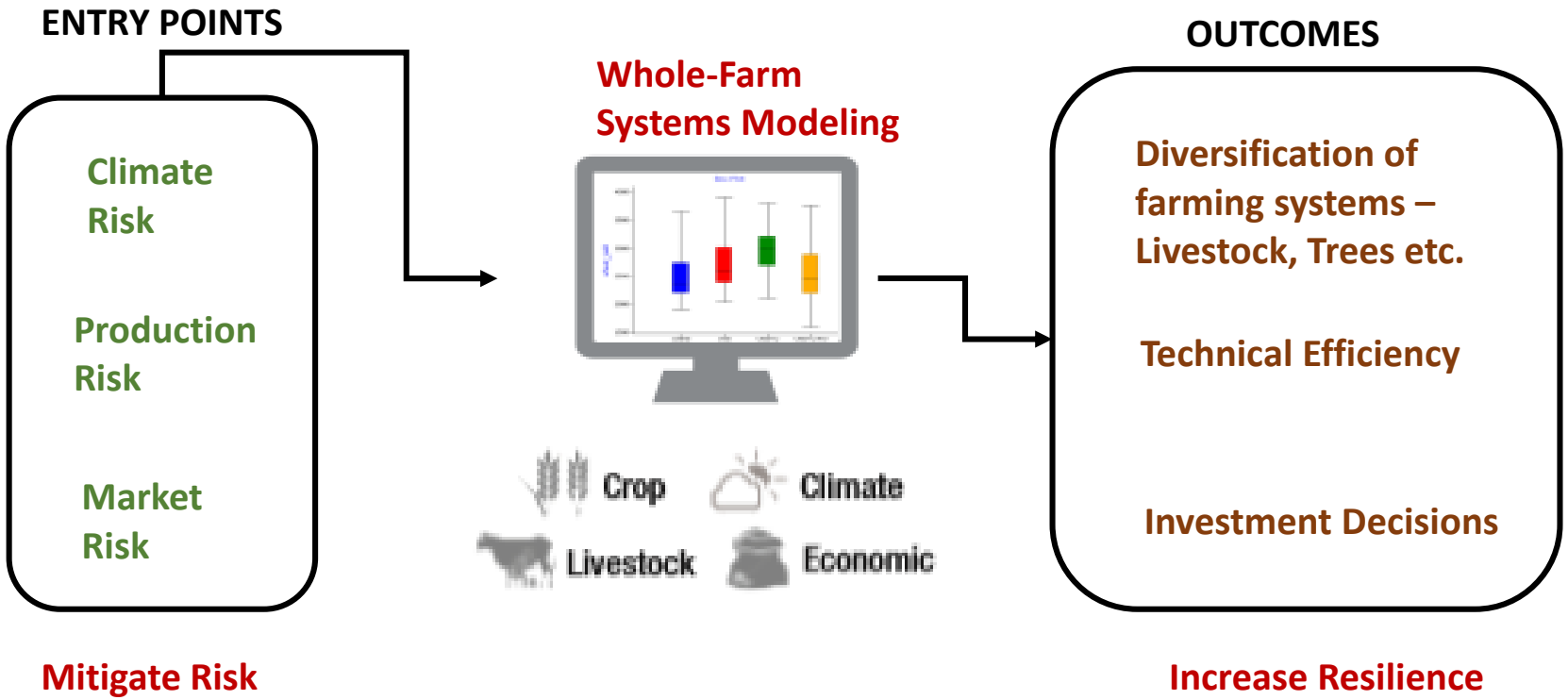


CLEM is in Beta release – undergoing final Validation and Documentation

Cereal Legume Livestock intensification and market integration

Nkayi	Baseline	Fertilize Crops & feed residues to livestock	.....	Cereal Legume Livestock & Markets
Crop GM	$ 22	$ 225		$ 263
Livestock GM	$ 188	$ 462		$ 1,051
Net Cash Income	$ 88	$ 362		$ 930
CVof HEI	25%	18%		14%
Efficiency metrics				
HEI/mm Rain	$0.62/mm	$1.15/mm		$2.05
HEI/Labor	$1/day	$1.86/day		$5.67/day
HEI/ha	$113/ha	$208/ha		$317/ha

Integrated Bio-Economic Modelling help evaluate ex-ante impact of various CSA options



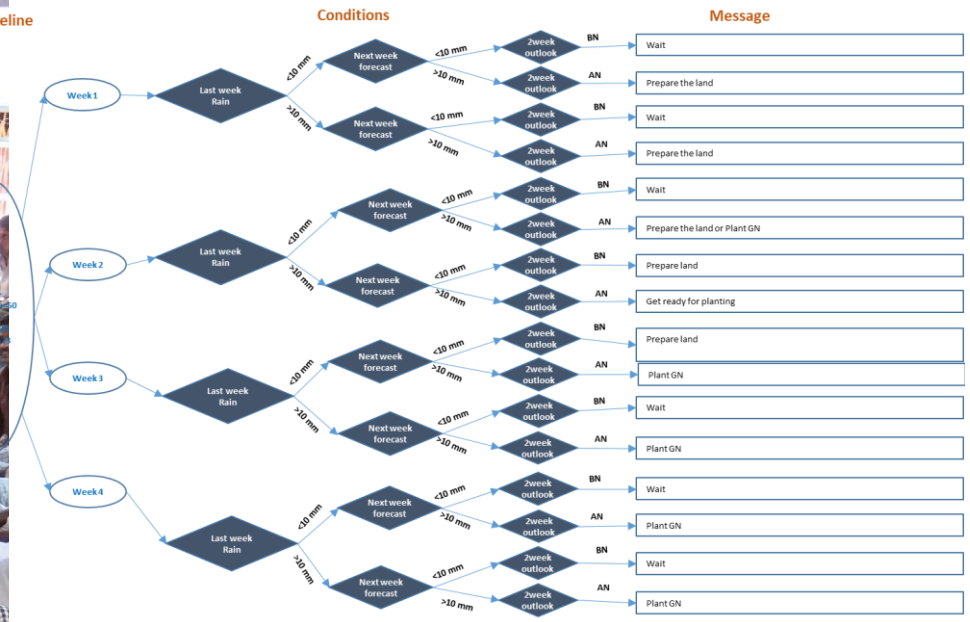
Integrated Bio-Economic Modelling to for Agricultural Risk Management: Case of Mahbubnagar district, TS (% net increase in returns)

	Insitu Moisture Conservation	Recommended Nitrogen Levels	Insitu+ Recomended Nitrogen	Farm Ponds	Farm Ponds+ Recommended Nitrogen	Fertilizer+Irrigation Interventions & Better Livestock Integration
Group 1	↑ 16	↑ 8	↑ 25			↑ 106
Group 2	↑ 8	↑ 8	↑ 17	↑ 6	↑ 14	↑ 39
Group 3	↑ 8	↑ 7	↑ 16	↑ 10	↑ 18	↑ 48

Integration of livestock and perennials proved more profitable and resilient

What have we learnt?

- Multi-stakeholder processes are effective in **facilitating change** through improved markets and social learning, and scaling.
- **Farmers respond to market signals** and invest in agricultural production when returns on investments are real.
- **Feed production is crucial** in increasing the production of high quality animal products, therefore to generate income
- Farmers **understand the role of legumes** in improving overall farm productivity (animal and soil) However, both legume and livestock **markets are crucial in driving technology adoption**
- Integrated systems **increase resilience and sustainability**


Timeline
Conditions
Message
Week1
Week2
Week3
Week4
Last week Rain
Next week forecast
2week outlook
<10 mm
>10 mm
BN
AN
Wait
Prepare the land
Prepare the land or Plant GN
Prepare land
Get ready for planting
Plant GN


SAMSUNG
G.parsivedl, G.venkataiah, G.krishna Re, G....
2:25 PM
Weather forecast for comming 5 days :
1)Rainfall: Light to moderare rains
2)Temperature: 29-33°C
3)Wind Speed: 10-16 km/hr
ACRC
ANGRAU-Hyderabad
9:57AM, 5 Sep
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160 / 1
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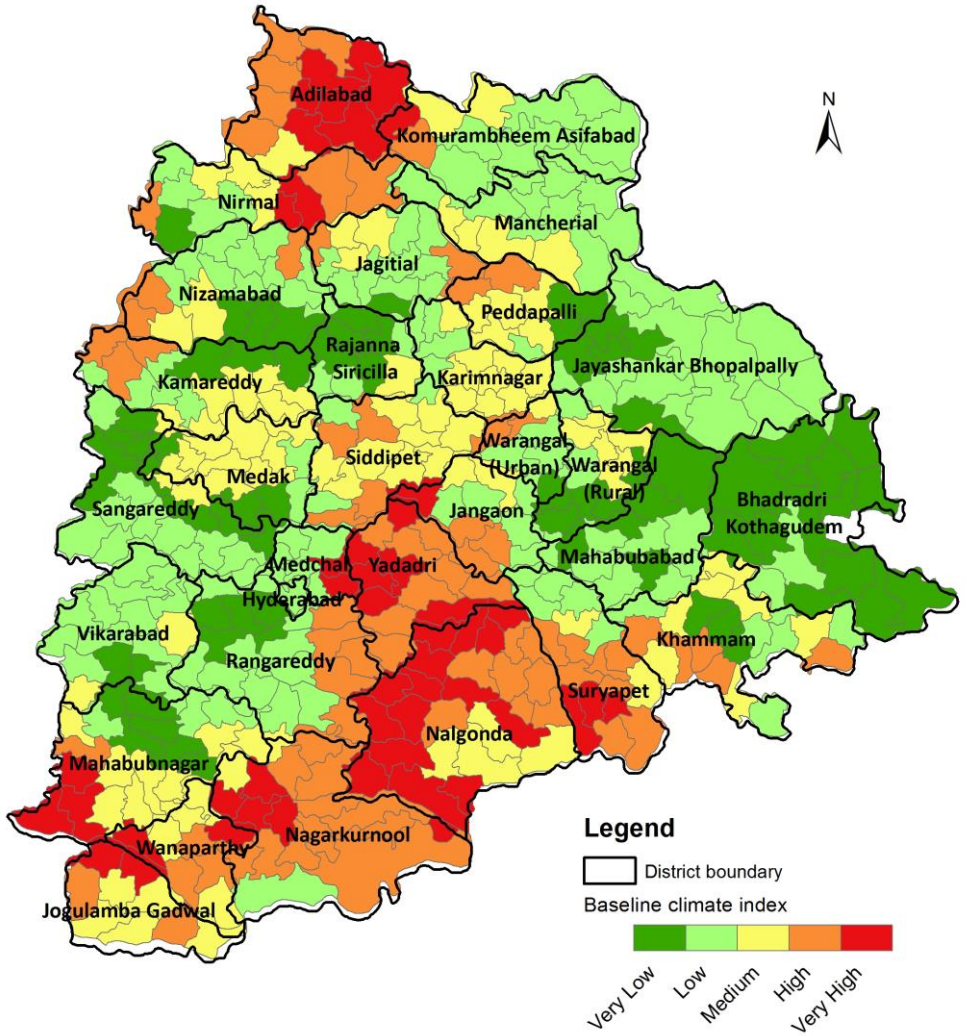
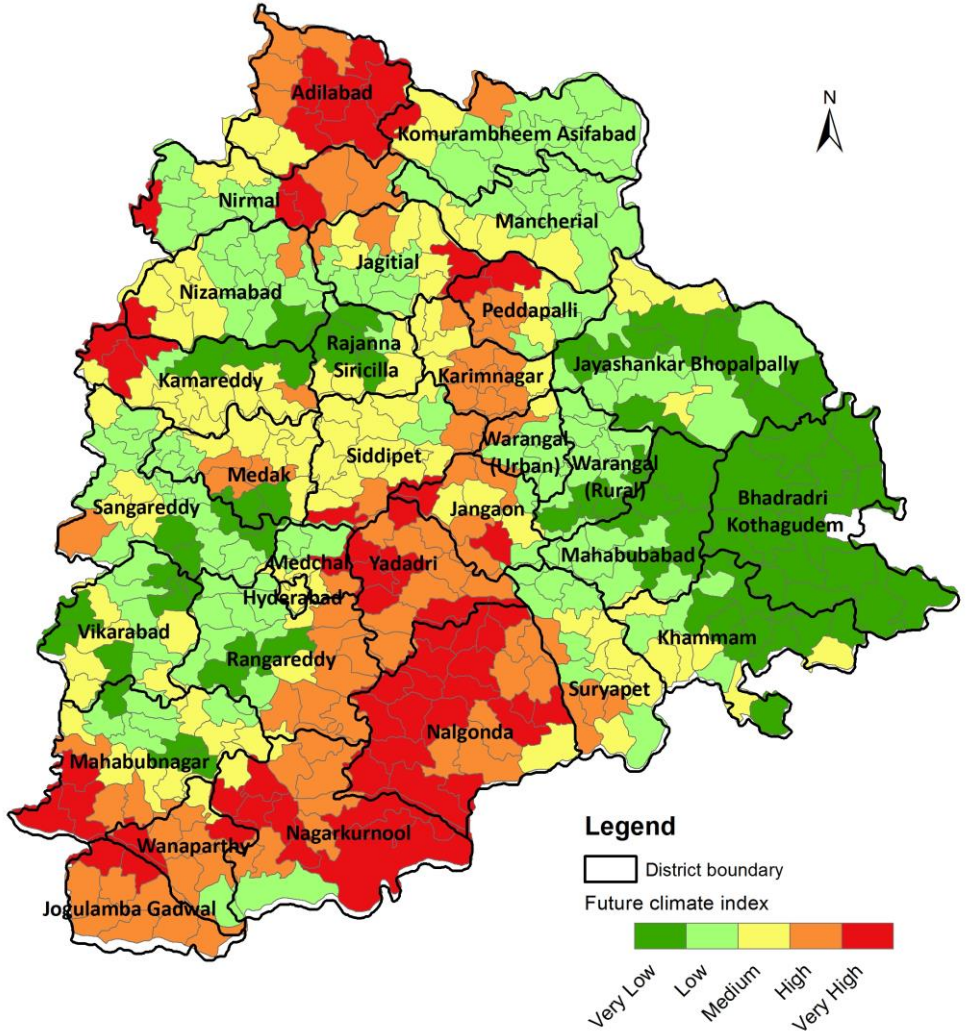
Climate Analysis – Exposure Index

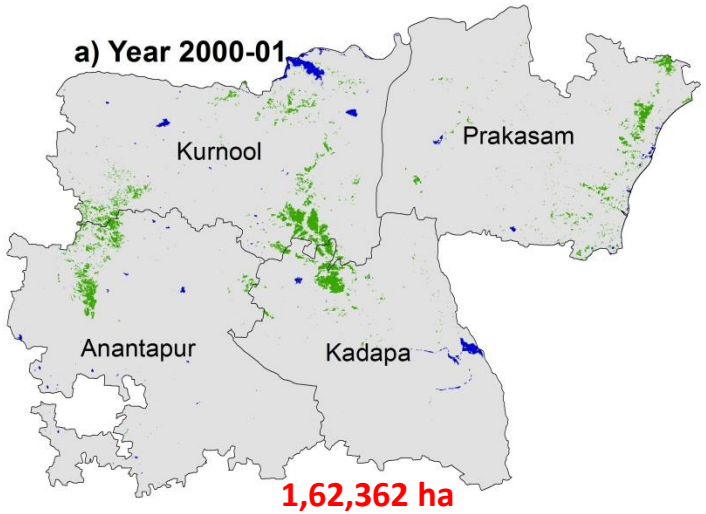


Mandal wise climate exposure index for baseline climate

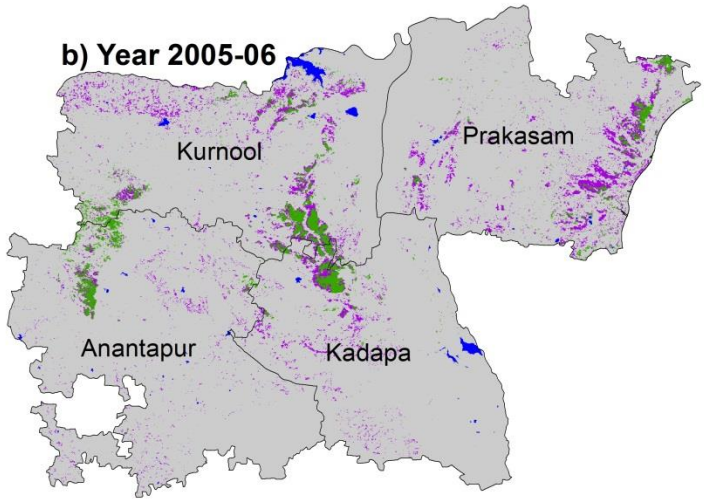


Mandal wise climate exposure index for Mid-century RCP 8.5

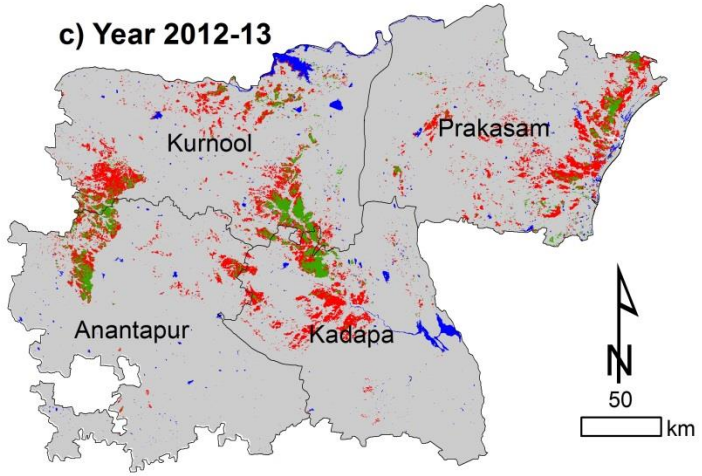
Tracking adoption of Chickpea: Andhra Pradesh



1,62,362 ha



3,89361 ha



5,58,713 ha

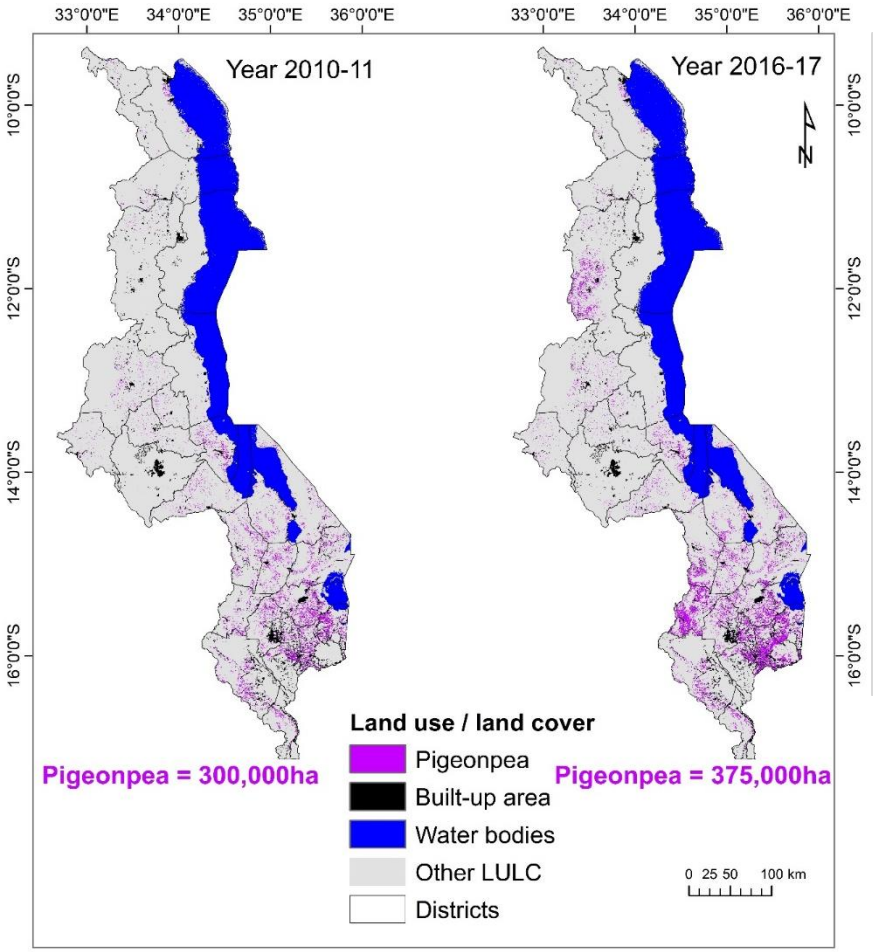
Legend

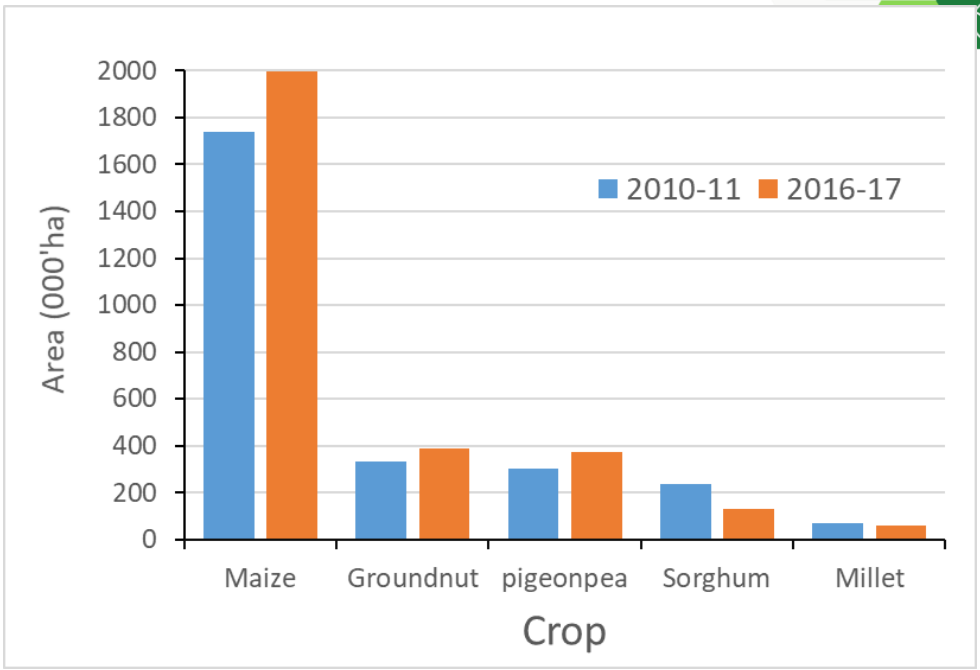
- 01. Water bodies
- 02. Chickpea (2000-01)
- 03. Chickpea expansion (2005-06)
- 04. Chickpea expansion (2012-13)

Districts	2012-13		
	2000-01	2005-06	2012-13
Anantapur	34,777	51,304	84,493
YSR (Kadapa)	30,343	69,258	117,903
Kurnool	68,113	140,511	196,793
Prakasam	35,129	128,288	159,524

Gumma et al., 2016. *Int'l Journal of Remote Sensing*. 37(8):1955-1972.

Tracking legume crops: Malawi





Gumma et al., 2019. Monitoring changes in the cultivation of pigeonpea and groundnut in Malawi using time series satellite imagery and its relationship to export and import dynamics. *(Prep)*.

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