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Food losses in food value chains – analysing causes and identifying solutions

How to assess the causes, impacts and solutions?

Methodology

Food Loss Analysis: Causes and Solutions – Case studies in the Small-scale Agriculture and Fisheries Subsector

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Why case study?

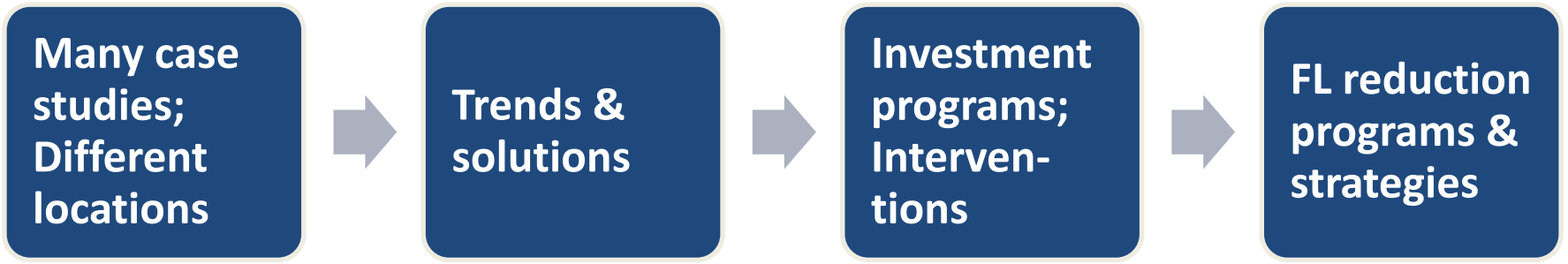
Literature review and statistical data

✓	Quantity estimation	
✓	Major causes	
✗	Exact causes	✓
✗	Most important losses in chain	✓
✗	Impact of solutions	✓

Case study

Characteristics

- One-moment recording
- Specific food supply chain, specific season
  - NOT a national subsector study
- Different time and location: different situation



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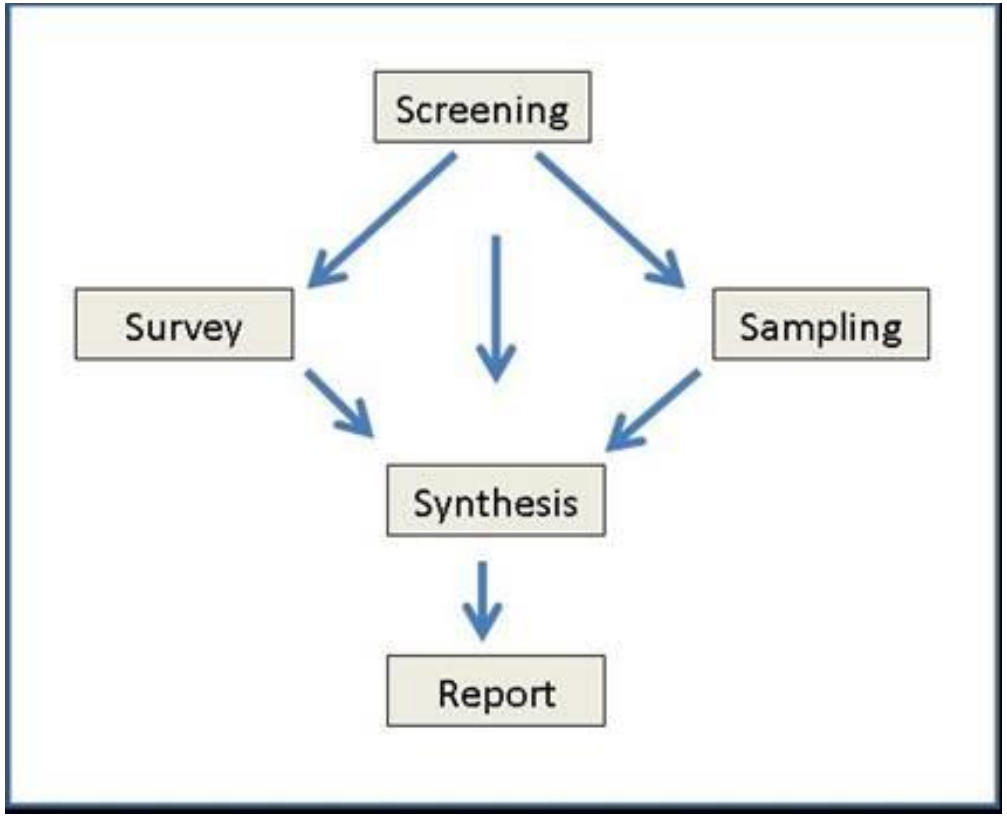
SAVE FOOD - STUDY TO A FOOD LOSS REDUCTION PLAN

Uniform Methodology

- identification of
  'Critical Loss Points'
- recognition of
  'Good Practices'

Strategy formulation

- National validation workshop
- National food loss reduction strategy



Screening

- Understanding the FVCs in the subsector
  - Qualitative understanding of the range of losses
  - Indicative, quantitative data for loss assessment
- Selection of FVCs for Surveying and Sampling

- Secondary data – sourced from reports, docs..
- Key informant interviews – experts

→Mapping the FVCs in the subsector and actors

Ranking the FVC – economic impact, food security, national development objectives

Survey / Sampling

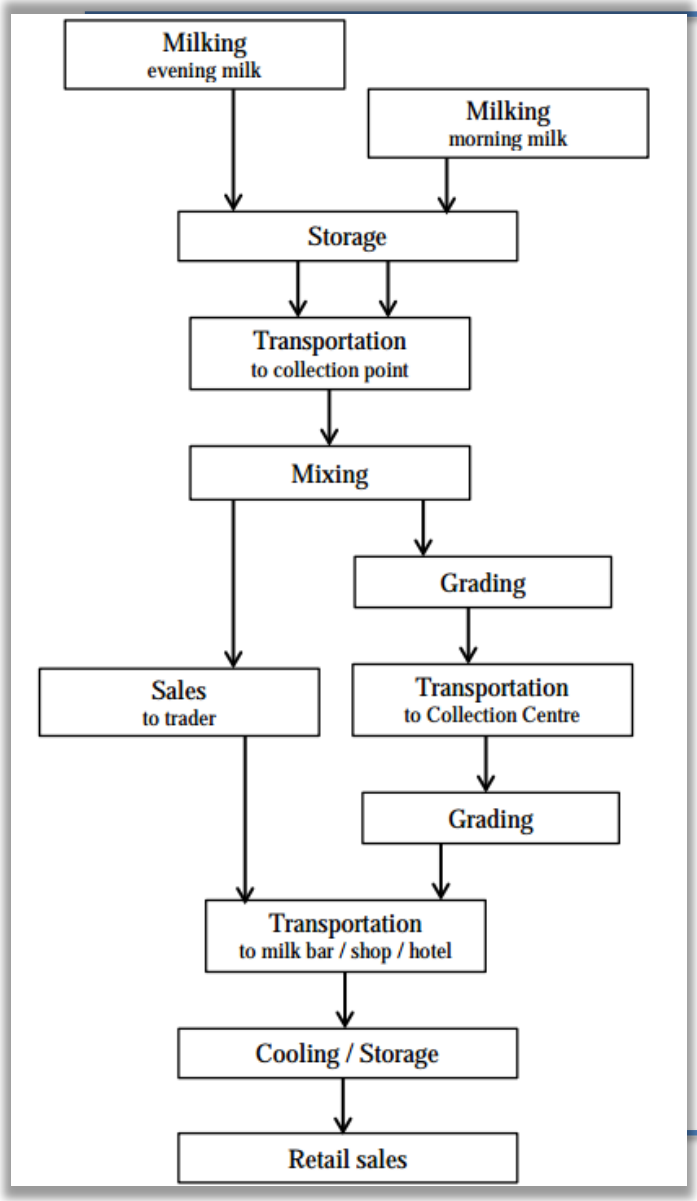
- Identify more and clearer quantitative and qualitative information → identify CLP

Survey

- Careful observations in the field
- Interview with the FVC actors
  - Semi-structured interview
  - Key informant interview

Sampling

- Actual measurements of losses along the chain
- Load tracking



Critical Loss Points

- Magnitude of food loss - production to retail
  - Qualitative and quantitative
- Major task and output of 3 S→ find and validate CLP
- CLP: What, why? → target for solutions
- Impact on food security
- Effect on the economic result of the FC

Low loss point

Kenya Case Study Report, FAO 2014.

Synthesis

- Cause finding – location and ID of causes in the FVC
- Solutions and feasibility assessment
  - Propose interventions and determine technical and financial feasibility
- Integration/context of national strategies

Photo 18. Tomatoes samples from the 25-kg plastic crates.

Considerations on Solutions

- Not be more **expensive** than food loss itself.
- Not place a higher burden on the **environment** and GHG emissions.
- Make more food available to the **people that need it most**.
- Be **socially and culturally** acceptable.

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Essential Dimensions

Environment and climate change	• Food production ↔ environment, supporting ecosystems, climate change • Adaptive capabilities • Energy access, technologies and use
Social and gender	• Access to resources and services between genders • Cultural practices • Social position in FVC • Female inclusion in studies
Food safety	• Regulatory and management system • Application of regulations • Common practices • Capacity of chain actors and regulatory agencies

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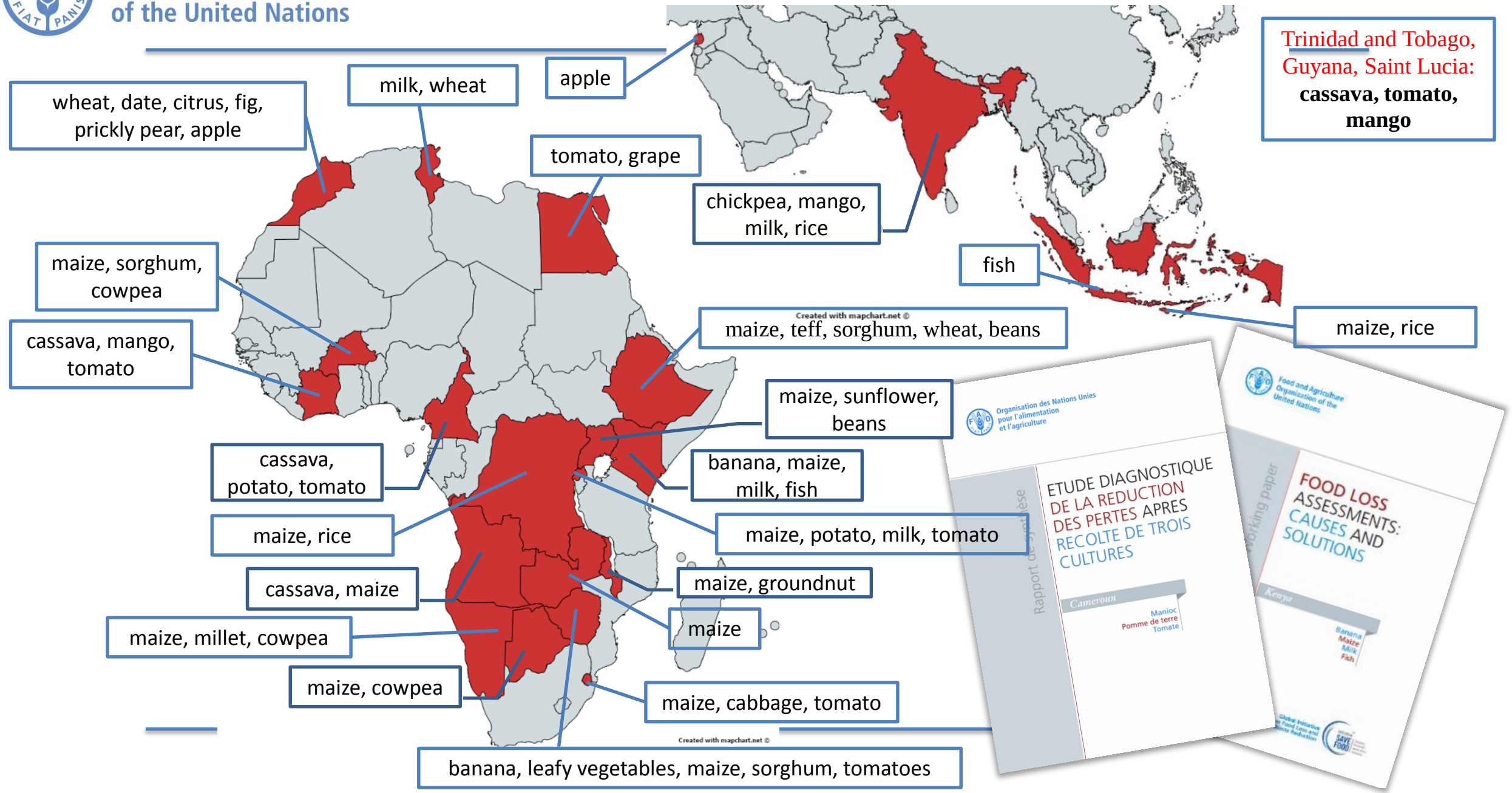

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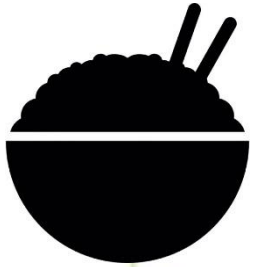
Subsector : Rice



PRODUCTION STATISTICS

India : 2nd Largest Producer

Andhra Pradesh : 3rd in India (Production) & 2nd in terms of productivity.

Contributes 7% of national and 1% of global production

Production= 8.4 Million Tons , Productivity = 3.4 T/ Ha

RICE

SUPPLY CHAIN

- Highly organized
- Two Channels :Public distribution system & Private market system
- Farmer->VLA->Miller->Warehouse->Distributor->Wholesaler->Retailer->Consumer

POLICY

- Decentralized Rice Procurement Policy
- CMR Policy

ENVIRONMENT

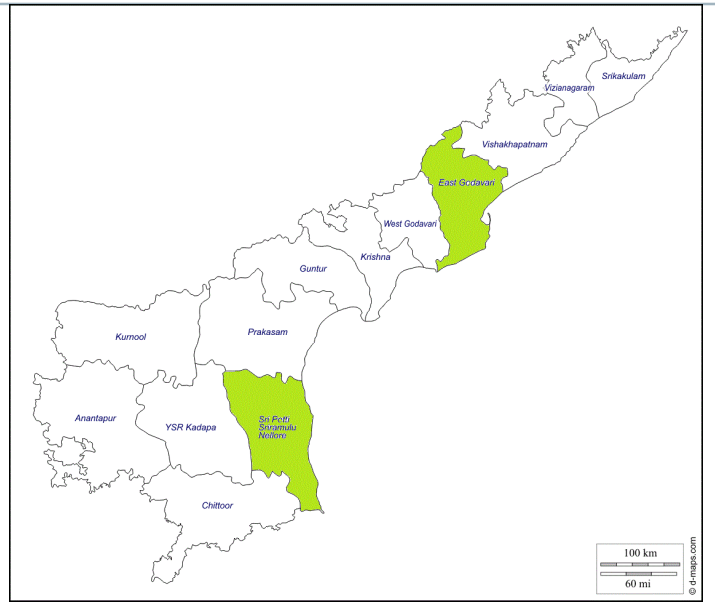
- Methane Emissions
- Pesticide Residue
- Water Consumption
- Ground Water Deterioration
- Energy Consumption

ECONOMIC IMPORTANCE

- Total value generated for milled rice produced in the state is 3,230 million USD contributing approximately 62.91% to the economy from rice products in AP

Selection Rationale

Geographies Selected		
Districts	**East Godavari**	**Nellore**
Rationale	• Pertains to different Zones in AP i.e. Godavari zone and South zone • Highest paddy production districts in the respective zones • Existence of the entire Value Chain • High density of rice mills	

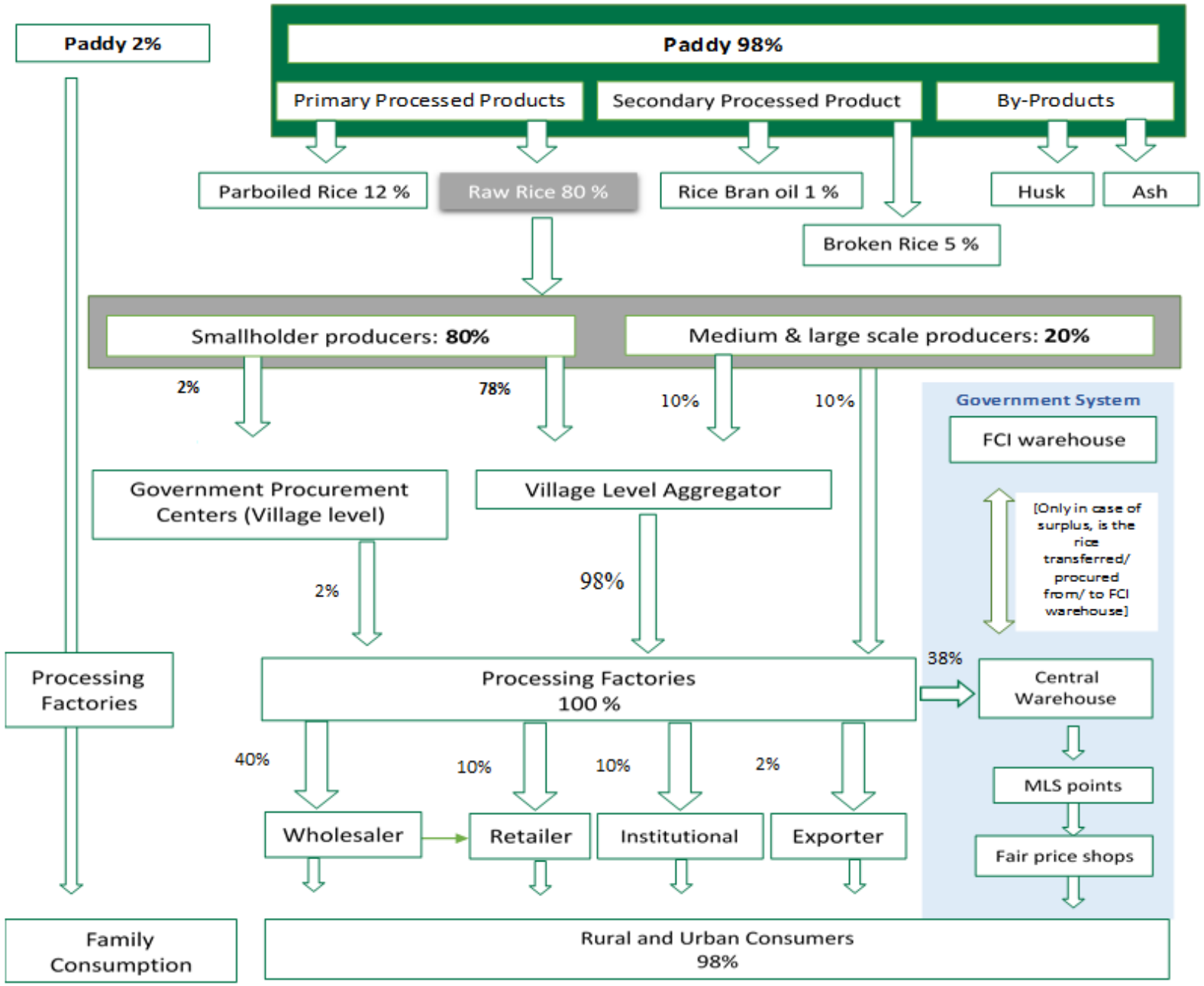


Food Supply chains in the Region		
VALUE CHAIN PRODUCT	**SYSTEM**	**SIGNIFICANCE OF PRODUCT**
Raw rice	Public Distribution System	Highest in Economic importance and Food consumption
	Private Market	
Parboiled Rice	Public Distribution System	Not significant in the selected study region as most of it is transferred to Tamil Nadu and Kerala markets
	Private Market	
Paddy (de-husked rice)	Informal Trade	Insignificant volumes(2%)

Food Value Chain selected and studied:

Raw rice in the Government system (Public Distribution System) and the Private Market

Flow Diagram



Steps in Value Chain

Production
Jul-Oct

Mechanical Harvesting & Threshing
(Nov)

Drying
(Nov)

Storage at Farmer Level
Nov-Dec

Transportation from Village to Miller
Dec 1st week

Quality Testing at Mill

Steps in Value Chain

Mill
Dec-Mar

Storage at Mills/ Private Godowns
Dec-Nov

Wholesaler

Retailer

Storage at Government Godowns
Dec-June

MLS Point

Distribution at Fair Price Shops

Consumer

Loss Points and Causes

Steps in the FSC	Quantitative	Qualitative	Root cause & Rationale
Harvesting & Threshing	**Quantitative CLP, 6 %**	Qualitative LLP <1%	Maximum losses are predicted to be during mechanical harvesting and threshing.
Drying	Quantitative LLP, 0.2%	–	Birds/ Animals feeding on the grains
Transportation	Quantitative LLP, 0.5%	–	Minimal losses during transportation of paddy from farm to mill & mill to warehouses / Pilferage
Quality Testing (Miller level)	–	LLP	Rejection of the selected lots if not meeting the moisture criteria
Milling	LLP ,<0.1%		Improper milling might lead to some minor losses.
Storage (At Mills)	LLP, 0.2-0.5 %	**Qualitative CLP , 3%**	Discoloration &breakage can lead to quality degrade., More than 6 months
Transportation	–	–	–
Storage @ CWC Godowns	–	**CLP,2-3%**	Breakage & moisture losses
Storage @ MLS points	–	–	–
Storage @ FCI Godown*	LLP, 0.2 %	–	Moisture loss
Distribution (Fair Price Shops)	LLP, 0.01-0.05 %	–	Pilferage
Distribution (Wholesale Shops)	–	–	–
Distribution (Retail Shops)	–	–	–

*According to the data provided by the FCI warehouse, primary research was not performed

Critical Loss Points

Mechanized Harvesting and Threshing

- Quantitative critical loss point and qualitative low loss point.
- Leads to higher losses than conventional manual harvesting.
- Mechanized harvesting accounts to 6% of food loss i.e. 85 thousand tons per year.
- Economic loss is around 4300 Cr ($ 64 million) per year.
- Causes
  - Low awareness about non-shattering varieties
  - Semi to unskilled combine harvester operator
  - High moisture content due to early harvesting

Unseparated Grain on field after threshing

Storage : Private Mill

Storage : CWC Warehouse

Storage

- Qualitative critical loss point and quantitative low loss point
- Food Loss due to improper storage at mills and CWC warehouse is 3.3 %.
- Economic loss is 2100 Cr ($32 million) per year.
- Causes
  - Poor storage management coupled with long term storage
  - Moisture loss
  - Discoloration
  - Attack by Pests
  - Physiological: Respiration

Loss Reduction Technologies

SILOS

- Erection cost of USD 90 -100 per MT
- Commissioning with 8-12 months
- Mechanical process for bulk handling
- Small land required
- Lower maintenance cost
- High degree of automation
- No requirement of multiple bagging
- Quality monitoring at all stages with minimum human interference

TRADITIONAL WAREHOUSING

- Erection cost of USD 50-120 per MT
- Completion time 1-2 years and more
- Huge manpower cost
- Land requirement 2-3 time that of silos
- Regular repair required
- No Automation
- Huge cost incurred in multiple bagging
- No such provisions

Projected Construction of Silos in Andhra Pradesh(Phase III)

Centre	Capacity in MTs
Srikakulam	100,000
East Godavari	100,000
West Godavari	100,000
Krishna	50,000
Total	**350,000**

Hermetic storage

Sealed or hermetic storage systems are a very effective means of controlling grain moisture content and insect activity.

Disadvantages

- Initial investment costs are higher than conventional storage

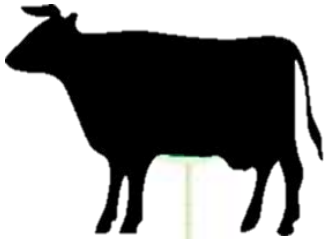
Advantages

- Reduce Qualitative loss by locking moisture content
- No oxygen transfer :Kills Pests
- No/Low chemical sprays :Food Safety & Environment friendly
- Suppresses aflatoxin and other grain-infecting molds

Food For Thought

Supply Chain Activity	Challenges	Potential Solutions
Primary Production	• Limited knowledge on good agriculture practices • Availability of non-shattering varieties • Injudicious use of Pesticides • Environmental impact :GHG production • Waterlogged Cultivation	• Capacity Building • Better Varieties for cultivation
Harvesting & Threshing	• Harvesting & Threshing Losses: Mechanized Vs Manual • Handling Losses	• Capacity building of farmers and combine harvester operator
Drying	• Sun drying leading to quantitative and quality loss • Over or under drying	• Moisture Meter • Community drying facilities
Milling	• Storage of Paddy • Qualitative Loss: Broken and Waste • Adverse Environmental impact : Power and Water consumption GHG • Gender disparity	• Better Storage facility • Modernization of processors (Rubber Hullers)
Storage	• Pest Attack • Rodents • Packaging technique :Jute Bags for paddy • Pilferage	• Storage at village level :Community warehouses • Hermetic Storage • Silos
Transportation	• Spillage Loss • Handling Loss	• Utilization of covered vehicles for transportation

Subsector: Milk



PRODUCTION STATISTICS

- India : Largest Producer of milk in world, 18.5% of world production.
- Andhra Pradesh : 5th in milk production in country
- AP Production : 9.6 Million MT

SUPPLY CHAIN

Four main channels

- Government cooperative
- Mutually Aided Cooperative Societies
- Private formal sector
- Informal sector, including direct marketing

Milk

POLICY

- National Plan for Dairy Development
- Calf rearing programme (NSP)
- Integrated livestock management (SCSP)

ENVIRONMENT

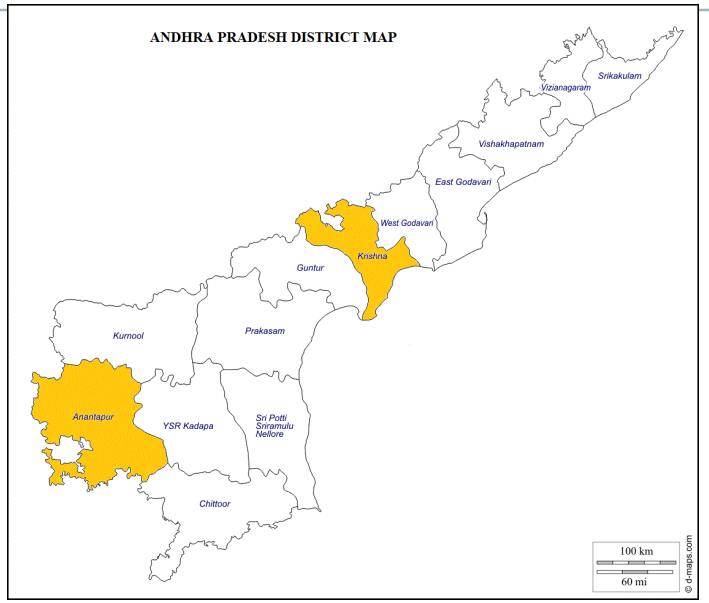
- Methane emission
- High Water Footprint
- Refrigeration : GHG emissions

ECONOMIC IMPORTANCE

- Important source of secondary income for over 80-90 million milk producers,
- Significant role in alleviation of rural income and employment.
- The livestock sector contributes to 4 per cent of India's GDP and the dairy sector comprises a king's share of it.

Selection Rationale

Geographies Selected		
Districts	Krishna District	Ananthapur District
Rationale	• Krishna district is the first district to have a proper implementation of operation flood program in Andhra Pradesh with a proper cooperative structure and has high milk productivity and also have a commercialized and organized market structure. • Ananthapur district has low milk productivity, low market access and is highly dominated by unorganized market	



Food Supply chains in the Region	
VALUE CHAIN PRODUCT	**SYSTEM**
Liquid Milk	Organized sector
	Unorganized sector
Chilled Chain Products like yoghurt, paneer, sweets, Ice cream	Organized sector
Shelf stable products like butter, ghee, Milk powder	Organized sector
	Unorganized sector

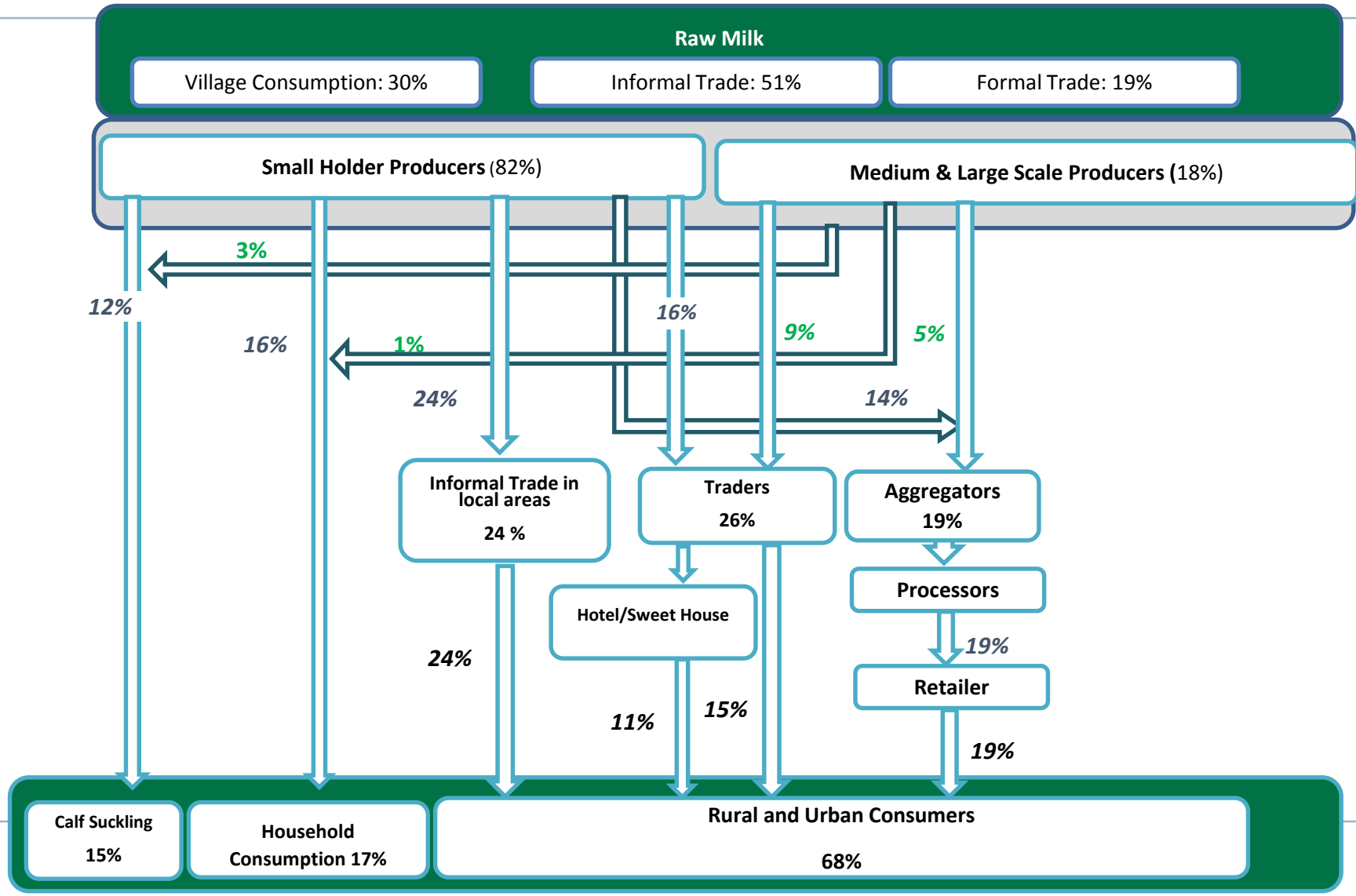
Rationale:

- ❑ Economic Importance
- ❑ Production and demand for the product.
- ❑ Generation of foreign exchange
- ❑ Contribution to State food consumption
- ❑ Contribution to State nutrition
- ❑ Impacts on environment and climate change
- ❑ Feasibility of assessment
- ❑ Vulnerability to the loss

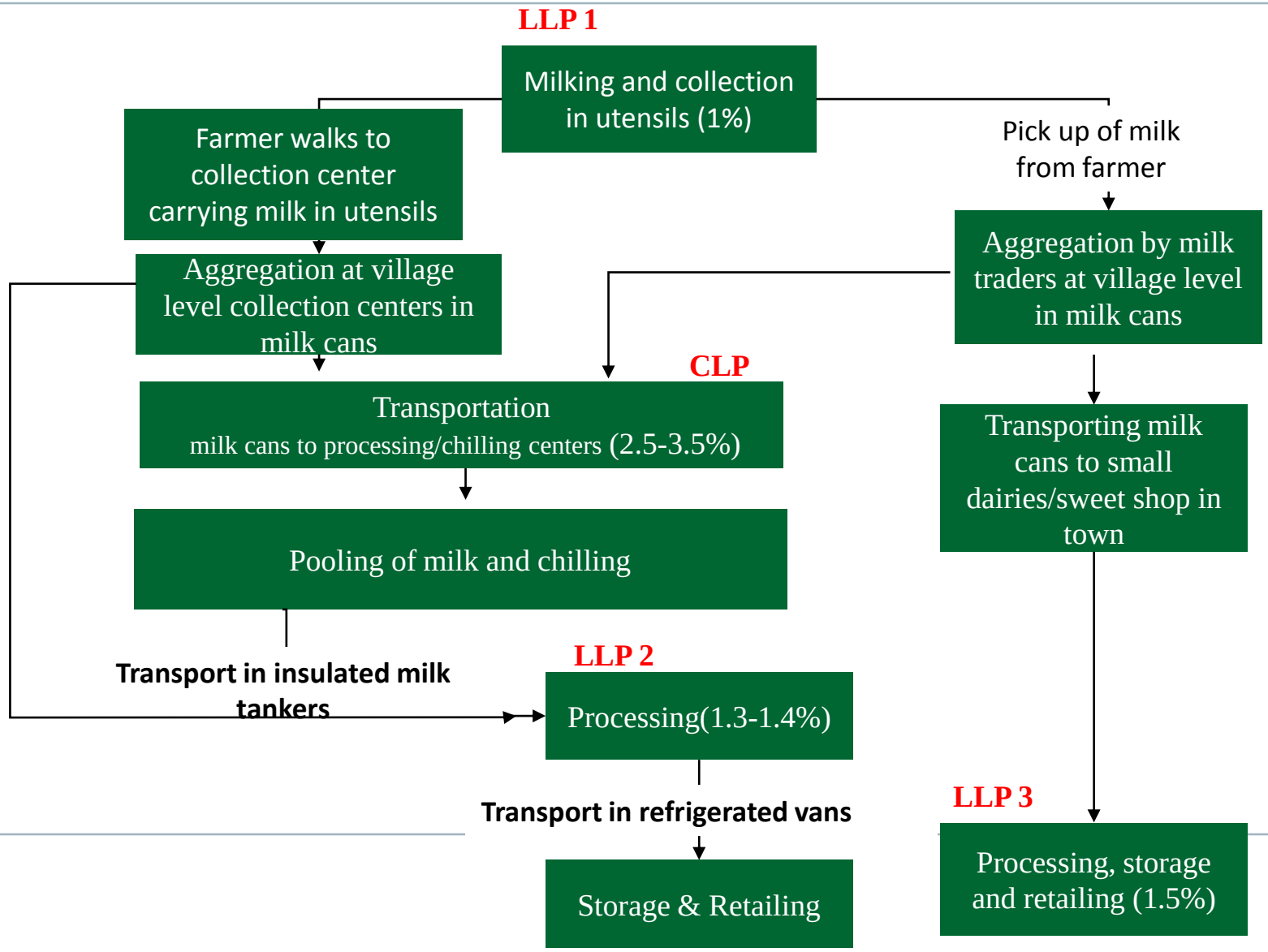
<u>Food Value Chain selected and studied</u>:

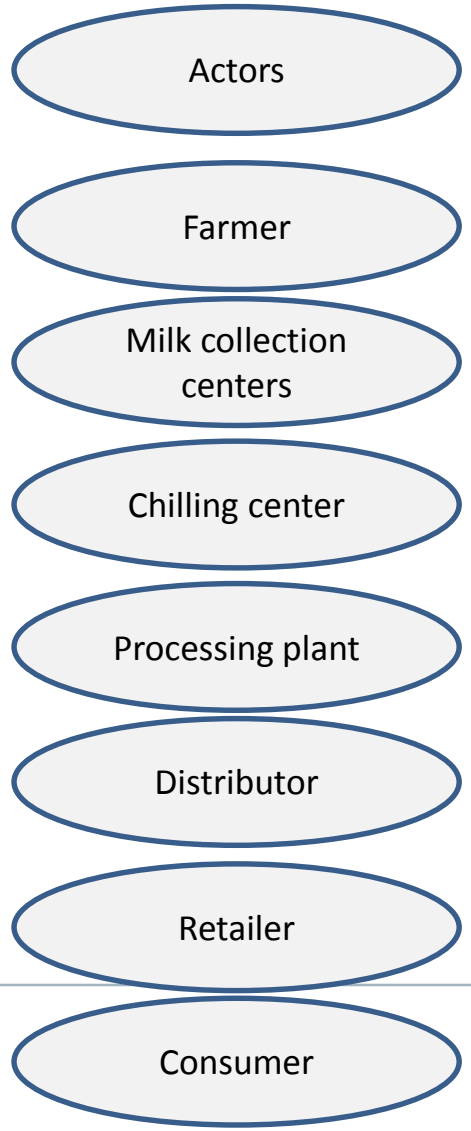
Liquid Milk

Actors & Product Flow : Liquid Milk Sector



Steps in Value Chain





Loss Points and Causes

Loss Point	Root cause
Milking and collection	Spillage loss Loss due to mastitis/other animal disease
Aggregation of milk at village level	Spillage loss Rejection of milk due to spoilage
Transportation (raw milk) (CLP)	Spillage during transfer Spoilage
Chilling & Storage	Processing losses Spoilage
Processing	Quality rejection – incoming raw milk Processing losses Finished good rejection due to non compliance of quality standards
Transportation (processed milk)	Physical damage (Leakages) Spoilage
Storage and retailing	Physical damage (Leakages)
	Unsold Inventory Return by consumers due to bad quality Spoilage

Critical Losses

Transportation Loss

- Spillage and Spoilage are major cause for loss during transportation of milk to chilling center
- Drawbacks in utilization of milk cans are :
  - No temperature control
  - Improper sealing
  - Susceptible to microbial contamination

Loss due to adulteration

- Adulteration of milk, when detected at the MCCs and chilling centers leads to rejection of the lot resulting in quantitative and economic losses.
- Some of the common adulterants detected in milk are :
  - Water
  - Urea/ Ammonia fertilizers
  - Starch and cereal flours
  - Salt
  - Hydrogen peroxide

FSSAI Study in 2011: 68.4% of total samples collected across the country were found non-conforming; 68.9% - urban samples and 31% - rural samples

Deviations/ non - conformity: Fat (%) and SNF (%) possibly due to dilution with water, presence of skim milk powder, glucose, detergents

Food For Thought

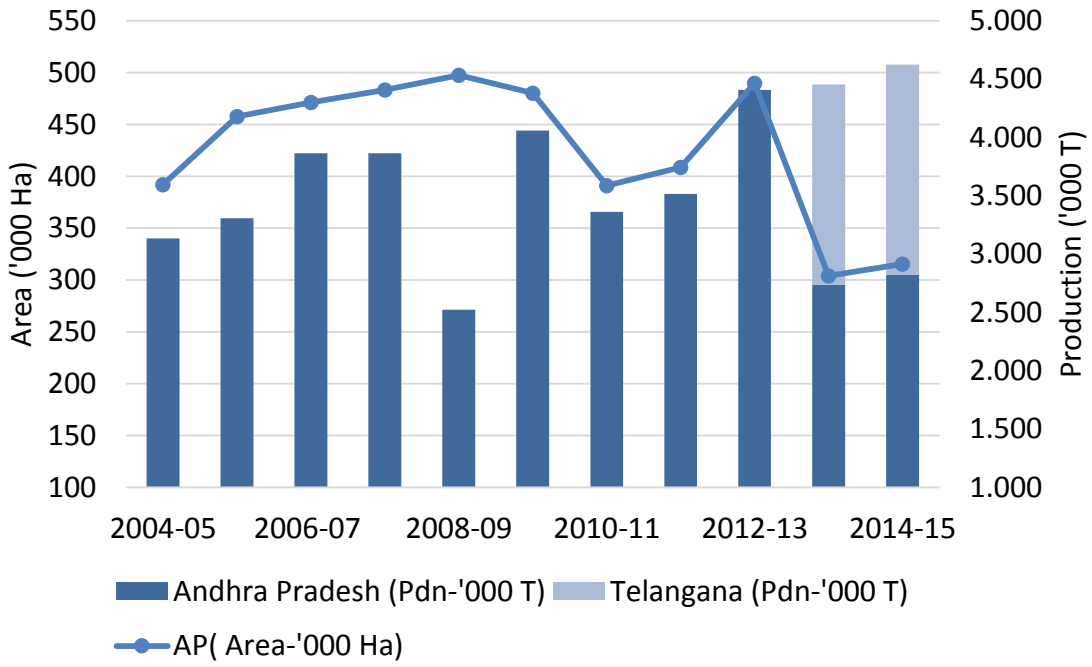
Supply Chain Activity	Challenges	Potential Solutions
Primary Production and Milking	• Productivity of cattle • Lack of policy focus on strengthening indigenous breeds • Inadequate feeding of animals/ Quality Feed Availability • Maintaining animal health - Veterinary services • Maintaining Hygiene conditions	• Optimal feeding, • Animal health • Training on Clean milk production/ hygienic milking
Transportation	• Spillage Losses • Equipment sanitation	• Good hygiene practices • Automation of cleaning of tankers • Better transport containers
Aggregation of milk	• Food Safety • Spillage losses • Rejection of milk on quality parameters	• New technologies in storage of raw milk, chilling and transportation
Chilling	• Environmental impact of refrigerators	• Solar Panels • Utilizing refrigerants that don't cause ozone depletion
Processing	• Adulteration and contamination	• Real time quality assessment • Cold chain and new processing technologies • Value added dairy products, • Innovative packaging,
Marketing	• Packaging Techniques • Cold Chain Availability	• New technologies

Subsector : Mango

- Mango- “King of the fruits”
- India- Leading producer of mango
- Andhra Pradesh- Second leading Mango producing state (15 % of National production)
- Contributes to 5.6 % of global Mango production
- 1st In area; Low productivity

Andhra Pradesh:

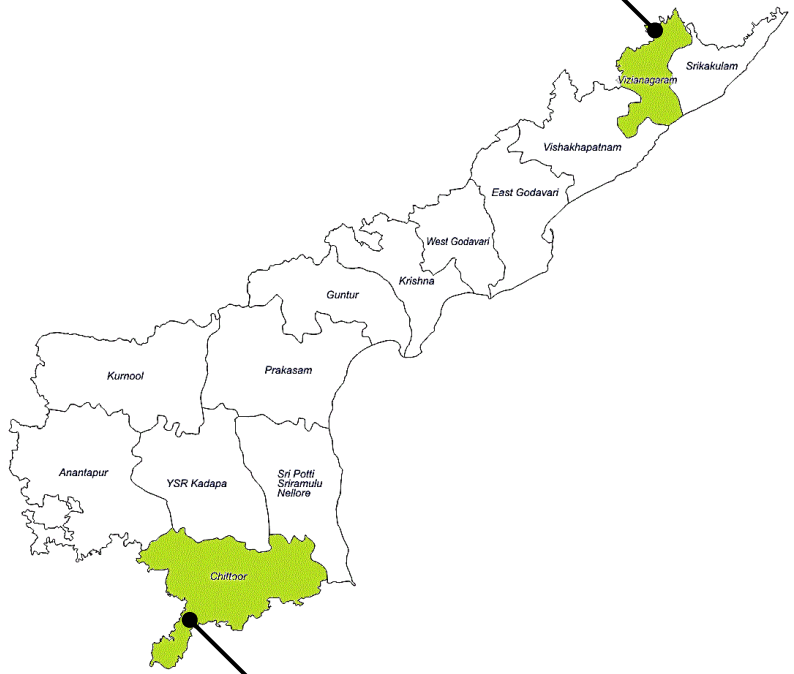
- Area Under Mango Cultivation: 317 thousand Ha
- Productivity: 9.3 T/ Ha



Area growth : 3.5 % Average per year
Post Bifurcation area: 304000 Ha; (Cumulative Area till 2013: 490000 Ha AP+Telangana)
Productivity stagnated at an average of 9 for last 3 years
Chittoor, Krishna, Vizianagaram, Ananthapur and Kadapa – Major Mango producing districts
76% of mango farmers are small and marginal ; 24% are medium and large farmers

FSC chosen and rationale

Geographies Selected		
Districts	**Chittoor**	**Vizianagaram**
Rationale	• Highest share of Area and Production (22 % of state production) • Well developed processing infrastructure • Higher share of Small farmers	• Second Highest producer of Mango in the state (17.5 % of state production) • Fresh fruit FSC • 84 % are small and marginal farmers • 90 % Area under rain fed condition
Agro climatic zone	Southern zone	North coastal and high altitude zone



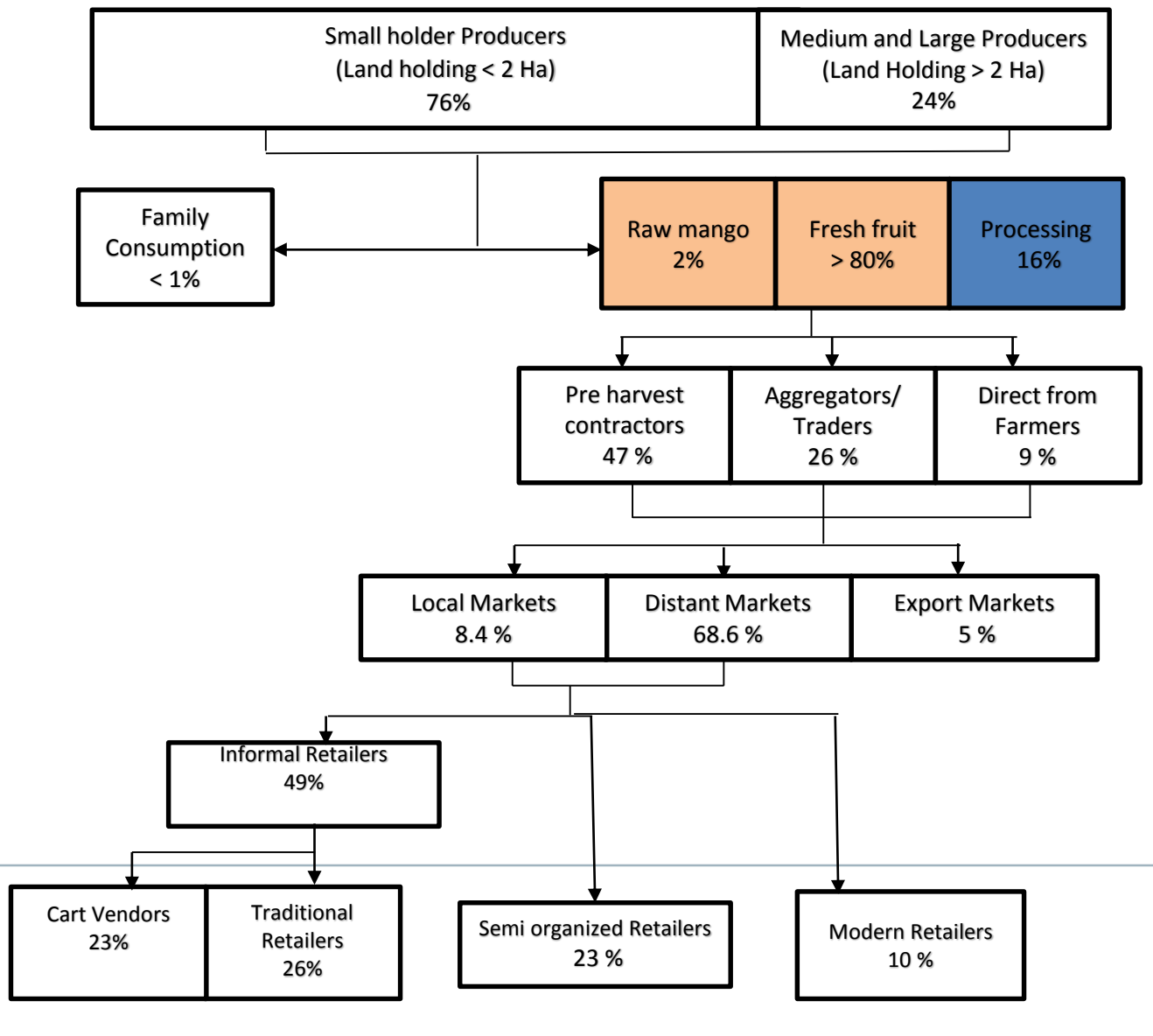
Pulp processing supply chain:

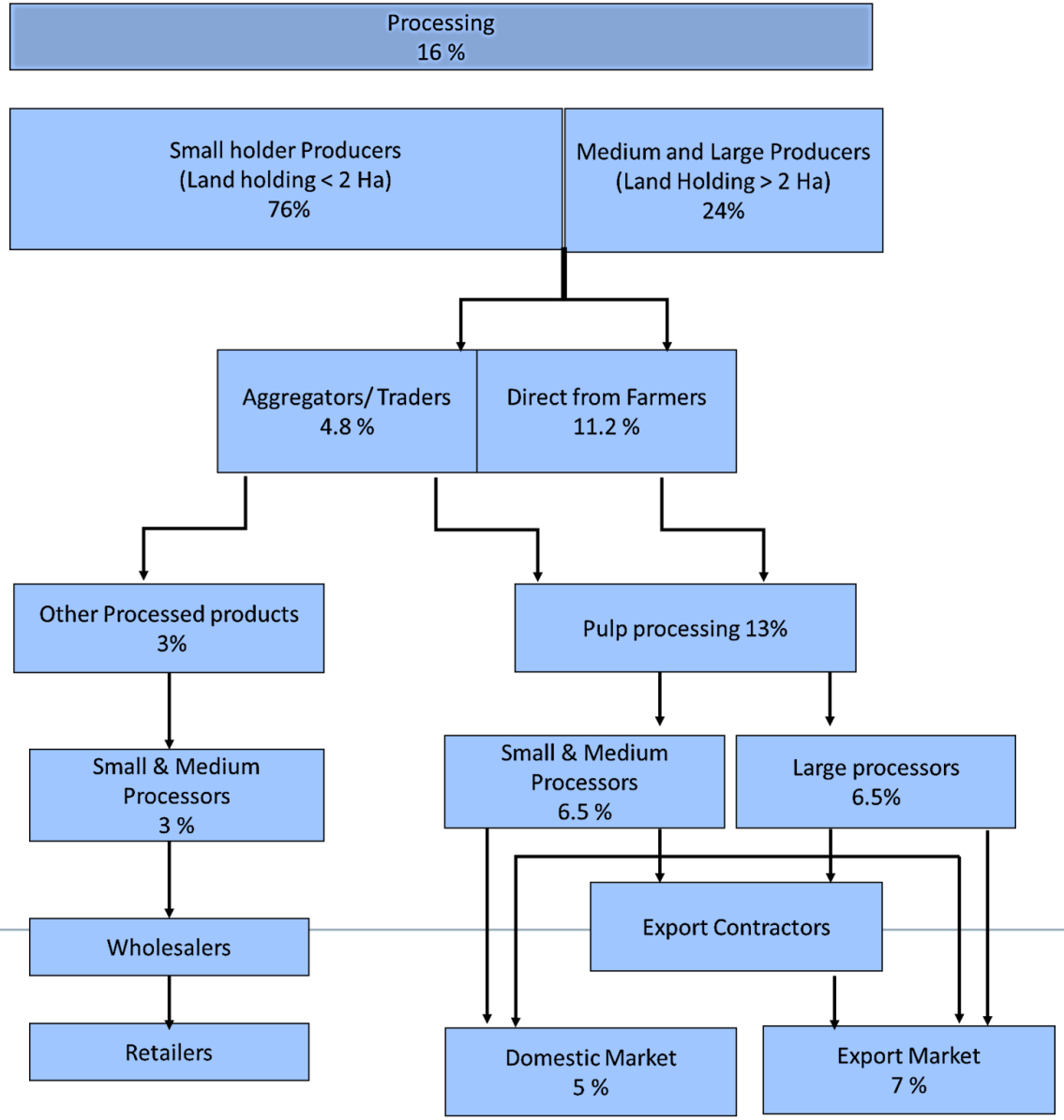
- Well developed processing infrastructure in Chittoor district
- 70 % of the district ‘s produce is processed (16 % of state production)
- Established markets and systems
- Exported through Chennai and Mumbai ports
- Significant contribution of agri exports from state

Fresh fruit Supply chain:

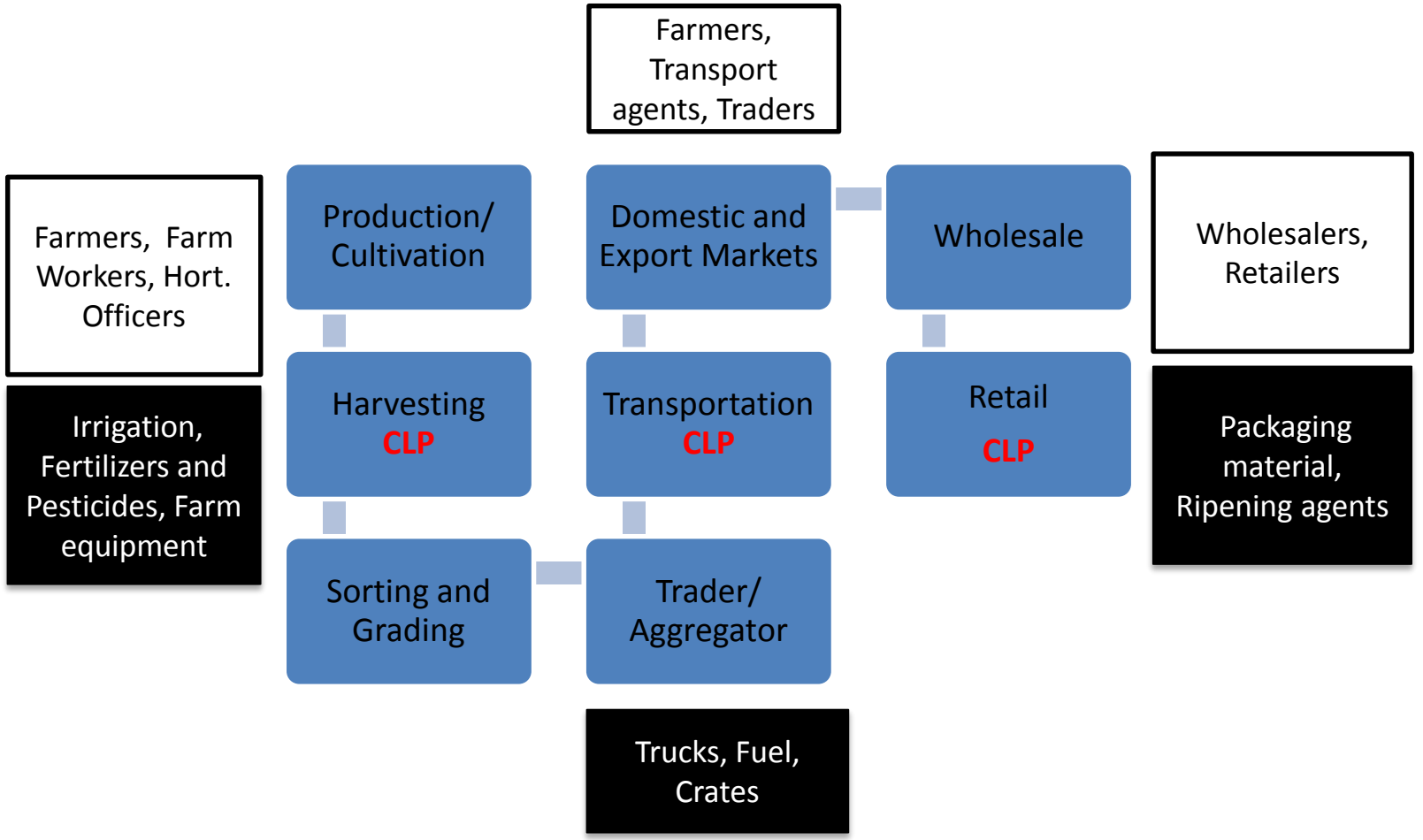
- Major supply chain in the state in most districts; Vizianagarm
- For Domestic and Export market
- Mainly to other metros like Delhi, Kolkata
- Important actors- Farmers, Pre-harvest/ farm contractors, Traders
- Not well connected trade linkages

Food Supply Chain flow- Actors





Food Supply Chain flow diagram- Fresh fruit



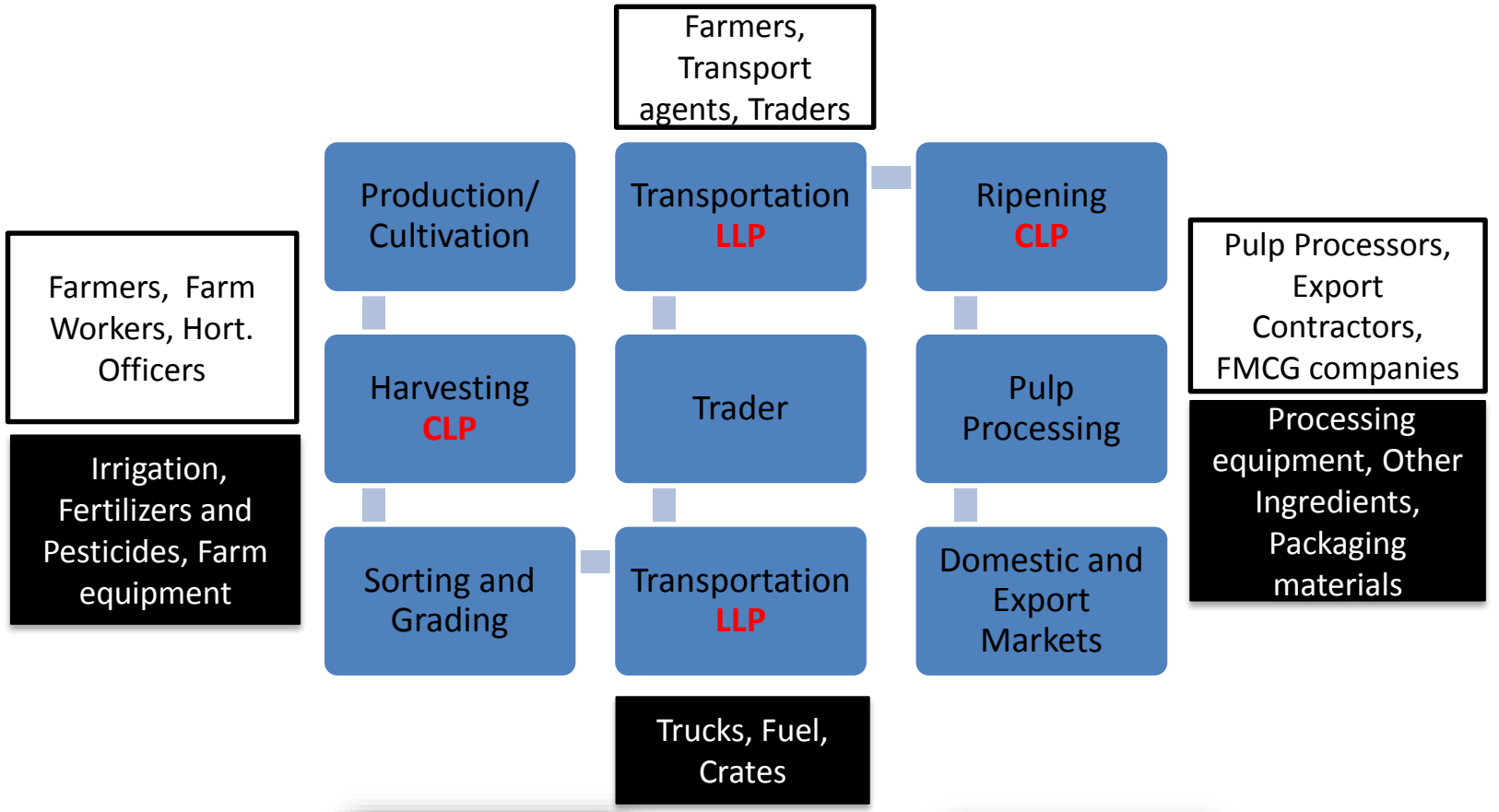
Distinct features:

- Main varieties: Banginpalli, Suvernarekha, Pedda rasalu, Chinna rasalu, Panukulu etc
- Small and marginal farmers- Leases out their farms to farm contractors
- Older orchards, large canopy.
- Harvesting: completely manual, 3-4 instances- major stage of fruit loss.
- Traders/ Aggregators play an important role- price determination, reaching markets
- Long distance of transportation- 800-1200 km (Kolkata, Delhi)





Food Supply Chain flow diagram- Pulp processing







Distinct features:

- Main varieties: Tothapuri, Alphonso and Neelam.
- Better managed orchards and well aware farmers.
- Traders/ Aggregators –also acts as financiers.
- Smaller canopy- varietal and soil conditions.
- Harvesting- Completely manual; done in 1-2 instances at optimum maturity.
- Majority pulp processing units- Small/ Medium scale.
- Nearly half of the processed pulp gets exported.
- Well developed ancillary units.
- Short distance of transportation, better infrastructure.

Food loss findings

FSC stage/ process	Quantitative Loss	Qualitative Loss	Rationale
Harvesting	12 % **CLP**	5 % **CLP** **EV**	• Improper harvest, maturity, Damaged fruits. • Some times low quality fruits are sold for lower value or used as cattle feed
Transportation – Pulp processing FSC	0.5 % LLP		• Short distance and duration; Better infrastructure
Transportation- Fresh fruit FSC	15 % **CLP**	20 % **CLP** **EV**	• Long distance of transportation • Improper packaging and handling
Ripening- Traditional Process	10 -15 % **CLP**	20 % **CLP** **QV**	• Improper handling in prior steps • losses vary from lot to lot
Ripening – Ripening chambers	3-6 % **CLP**	2 % LLP **QV**	• Improver harvesting, Internal bruises of fruits • Process variance
Retail	5 % **CLP**	25 % **CLP** **EV**	• Qualitative loss due to storage diseases, improper handling- produce is mostly salvaged for lower value

Food loss reduction strategy

Challenge	Intervention	Outcome
Unavailability of skilled labour - hindering the better handling of produce in both the FSC'S	Farm and post-harvest services by Private Entities	• Training of local manpower and absorbing them into the enterprise thereby creating employment. • Lowered financial burden on framer for mechanization
Limited Training to farmers at Centralized location, Limited AV support	Training on the Farm	• Increased participation in training . • Higher chances of implementing the training as it is delivered right before the start of the operations • Usage of ICT tools.
High transportation losses in Fresh Fruit FSC- Ineffective trade linkages	Plastic Crate circulation network by Govt/ Market yards/ Private Agencies	• Improved participation in market yards -well integrated supply chains which can be extended to other horticultural crops. • Realistic data capturing for production, trade volumes and food loss.

Food loss reduction strategy

Technological Interventions

Cultivation practices: High density plantations

- Better controls; Higher Production volumes

Harvesting: Improved Harvesting Techniques

- Improved harvesting tools
- Training on usage of tools
- Post Harvest Care- Simplifying desapping operations

Transportation:

- Better Packaging structures
- Creation of linkages

Ripening:

- Standardization of natural ripening process
- Promotion of research

Irrigation: Micro Irrigation

- Improved pre-harvest losses and quality of the fruits

UHDP

Packaging Designs

Drip Irrigation

Policy Interventions:

- Setting up of Mango Development Board- expected by all actors.
- To promote and nurture the interests of farmers, traders and processors
- To effectively lobby with policy makers
- Currently under consideration- APFP Policy 2016

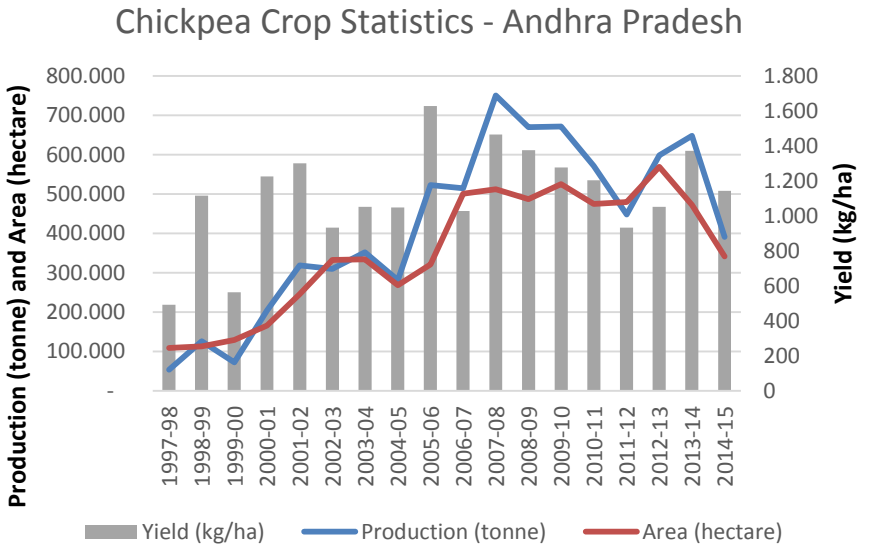
Other Interventions:

- Extension training through ICT/ Videos
- Value added products for reducing food losses- Business incubators
- Development of effective linkages for value added products

Subsector - Chickpea

PRODUCTION STATISTICS

- **India** : World's Largest Producer and Consumer
- **Andhra Pradesh** : 5th in India (Production) and in top 2 for productivity;
- Contributes 9% of national and 6% of global production



INTERESTING HISTORY

- How AP came to be a significant Chickpea player?

CHICKPEA

NUTRITIONAL IMPORTANCE

- Low cost vegetarian source of protein
- Chickpea seed has 22-24% protein
- Rise in income → protein demand

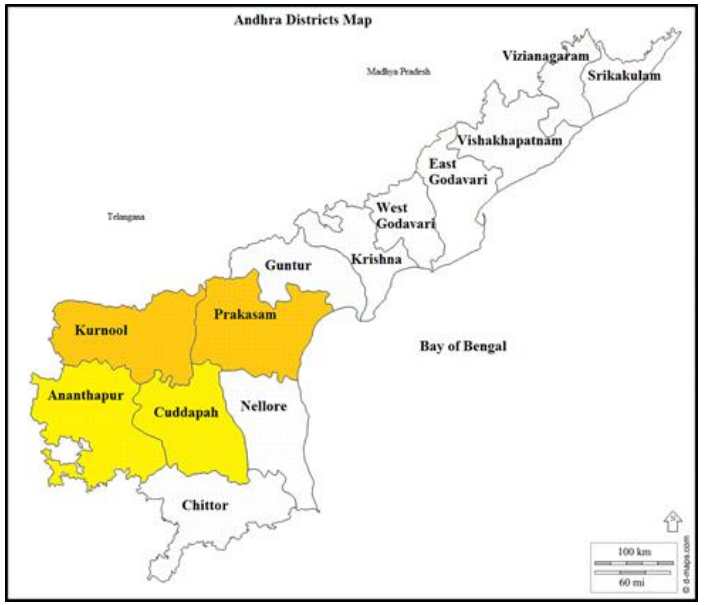
ECONOMIC IMPORTANCE

- >USD 330mn (Rs. 2000cr) to the AP economy
- Major part of pulse export - import
- In 2014-15, import was 418,870 MT of desi chickpeas (about 5% of the total production of India)

Food Supply Chain (FSC) Selection Rationale

Geographies Selected		
Districts	**Prakasam**	**Kurnool**
Rationale	• Adequately represent the selected food supply chain (FSC) for the state • FSC selected has all four final products (whole, split, roasted, flour) with all players within the state	

Other criteria	
Types grown	• Kabuli is only grown in Prakasam and share is reducing, exported out of state • Desi chana type selected since it accounts for more than 90%
Storage practices	• Both cold and dry storages studied • Prakasam has predominantly cold storage • Kurnool has predominantly dry storage
Trading practices	• Trade through commission agents studied since it accounts for more than 90%
Processing practices	• Both processing stages studied – the first stage of split dal (normal and roasted) and second stage of chickpea flour

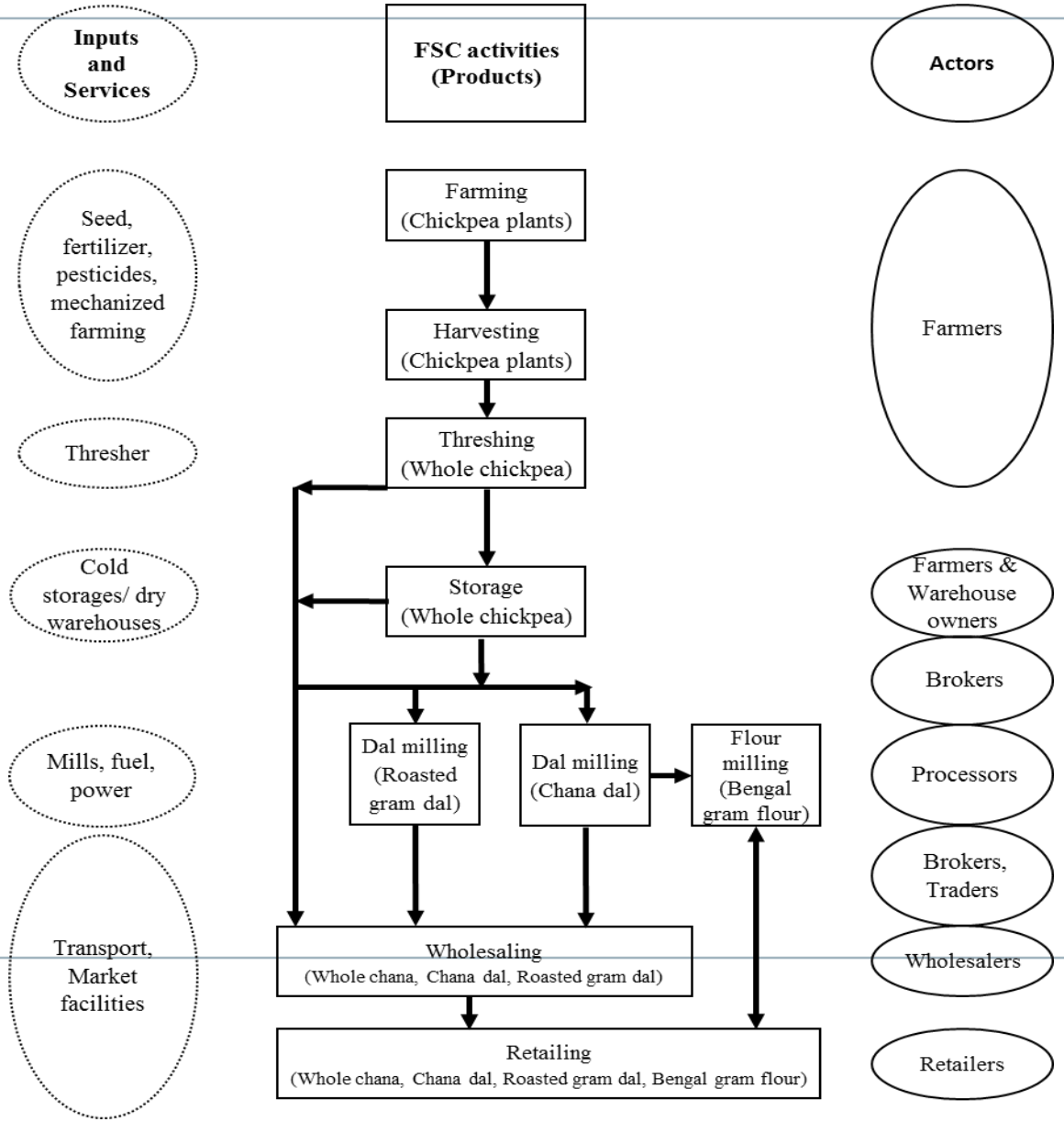


Food Value Chain selected and studied:

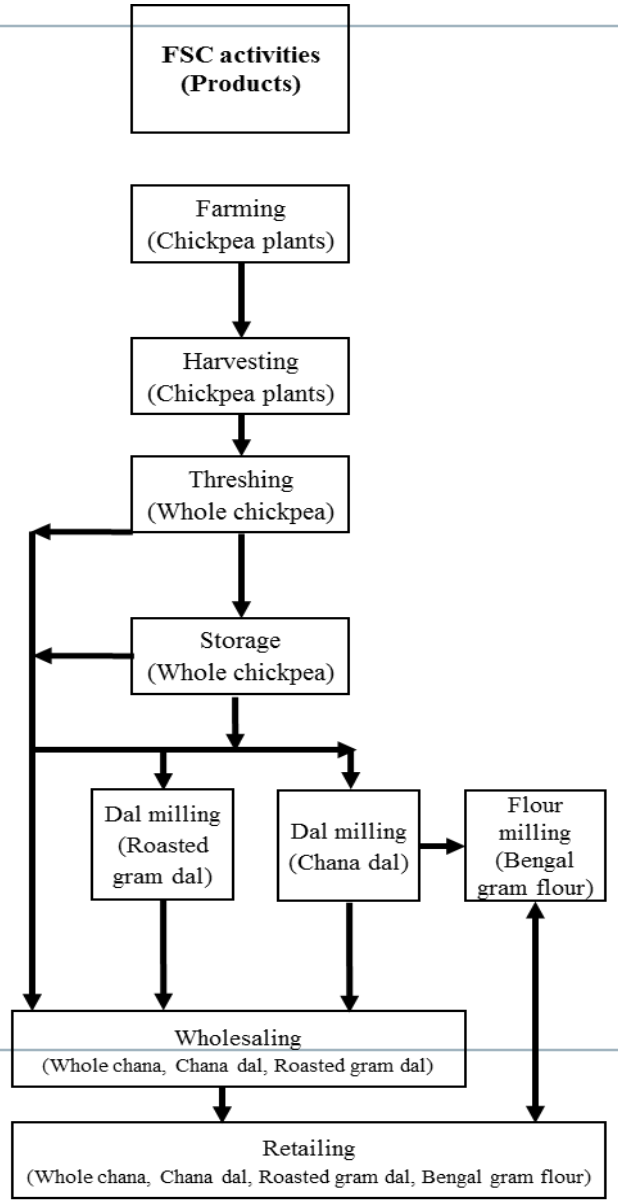
Desi Channa from Prakasam and Kurnool districts leading upto four different final products:

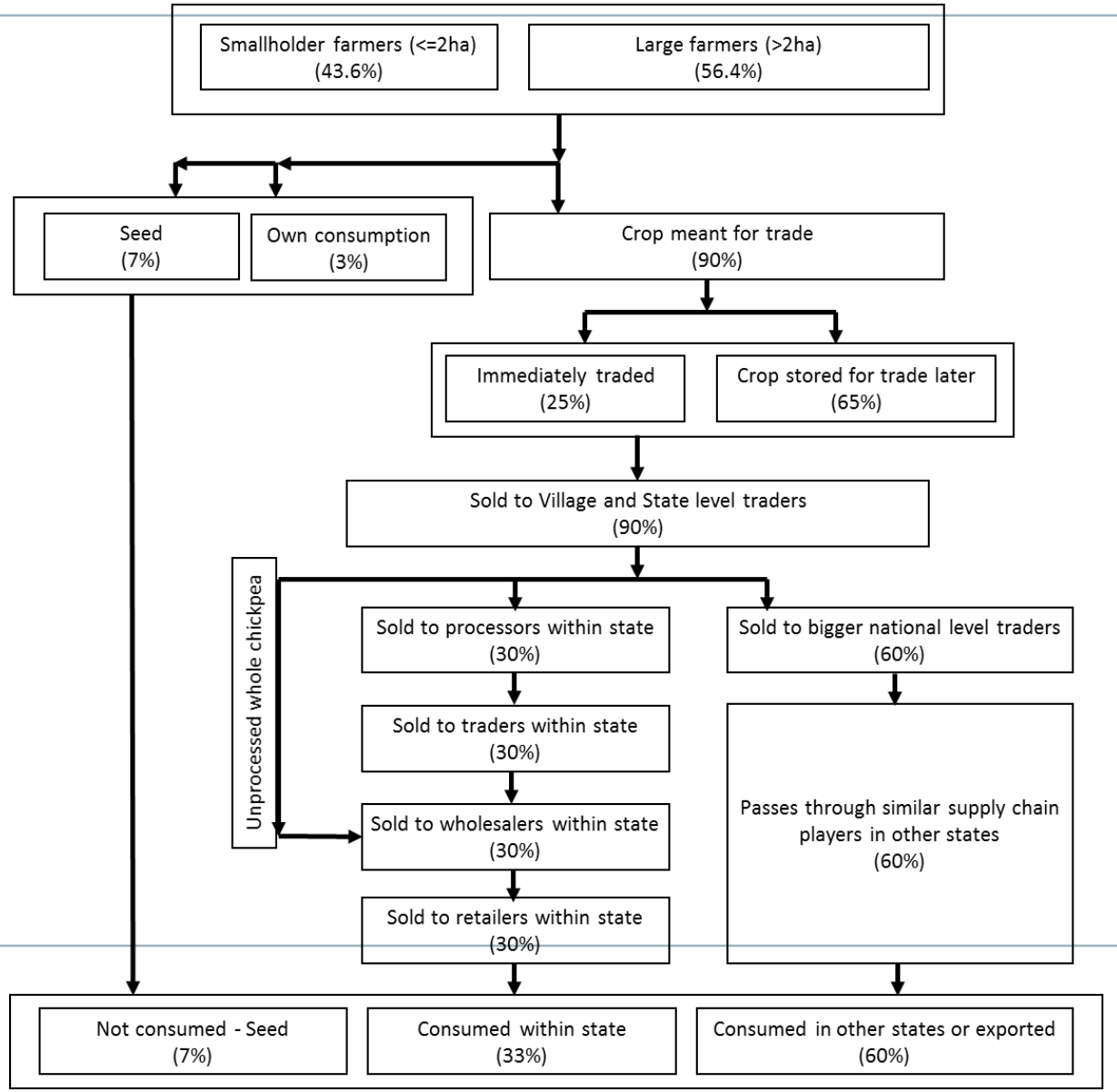
whole chickpea, chickpea split dal, roasted chickpea dal, and chickpea flour

Supply Chain Flow…1/2



Supply Chain Flow…2/2





Low Loss Points and Observations

FSC stage/ process	Quantitative Loss*	Qualitative Loss *	Remarks
Harvesting & Threshing	0.1%		- Activity not observed due to timing of season; Farmers say 50-60gm lost per quintal - **Mechanical threshing with machines tuned for chickpea crop** - Birds/ spillage is not an issue; **Picking of leftover pods by labor**
Storage	0.1%	1.0%	- **Cold storages available esp. Prakasam;** Good private dry warehouses in Kurnool - Storage practice widely adopted by farmers - Farmers use chemicals/ jute packaging immediately after threshing - Traders talk about weight gain due to moisture gain in rainy season
Processing	0.25%	0.25%	- **Uniform grain size due to widely adopted JG11 variety** - Continuous monitoring by operators; Basic technology machines - Brokens observed
Transportation	0.1%		- Low distances and well maintained; Usage of tarpaulin sheets for weather protection - **Good packaging: HDPE layered for roasted gram**
Wholesalers	0%		- Fast rotation - Personal monitoring and well maintained shops
Retailers	0%		- Fast rotation & quantity procured as per demand - **Low quantity and usage of metal drums**

Low loss findings corroborated by CIPHET, ICAR 2015 study

Analysis of low loss Points…1/2

Good research leadership & adoption of latest technologies	• High adoption rate; Nearness of research institutions like ICRISAT, ANGRAU, RARS
Adoption of good agricultural practices	• Progressive farmers; Deeper extension penetration;
Collective management	• Farming activities like ploughing, spraying etc. offered as business services resulting in higher efficiency
Availability of storage facilities	• Large no. of cold and dry storages available; Gov. support available for infrastructure establishment
Transparent sales system	• Access to price information from exchange market – better price discovery; High competition induced efficiency
Better support infrastructure	• Successive governments have concentrated and developed good road infrastructure – low transportation losses
Simple processing technologies	• Processing technology and machines are simple and easy to maintain at high efficiency

Analysis of low loss Points…2/2

Good research leadership & adoption of latest technologies	• High adoption rate; Nearness of research institutions like ICRISAT, ANGRAU, RARS
Adoption of good agricultural practices	• Progressive farmers; Deeper extension penetration;
Collective management	• Farming activities like ploughing, spraying etc. offered as business services resulting in higher efficiency
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Actions to promote LLP further

Capacity building

Cold storage

Any other?