Wheat Supply Chain Optimization for Post-Harvest Loss Minimization

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Objective and Approach

- Post-harvest loss of grains high in India (5-20%)
- Several potential solutions for PHL reduction

- **Objective:** Determine the best combination of ***existing and novel*** solutions for ***wheat***
- **Approach:** Develop a large scale post-harvest supply chain optimization model
- **Deliverables:** Optimal design and management decisions and policy recommendations

Conclusions

- Good estimates of storage costs and losses critical
- 50% uptake by FCI at *Mandis* led to 1.6% PHL
- Pre-market storage provided several benefits
- Betul and Hoshangabad preferred RGY locations
- 21% increase in private trader price increased RGY storage amount by 31%
- Current FCI capacity insufficient (infeasible problem)

Optimization Model Formulation

Objective function: Maximization of

F = Farmer income + FCI income – RGY cost – Commission – Transport & Storage cost

Constraints:

- Mass balance and capacity constraints
- PDS demand for district population

PHL Calculation

Total loss = Transport loss + Storage loss

Production = Wheat from farms to regional market

PHL (%) = (Total loss/Production) x 100

- Farm sizes and number, yield, and distribution of wheat to different markets known
- Market locations and distances known
- Transport modes, their costs and loss rates known

Acknowledgement

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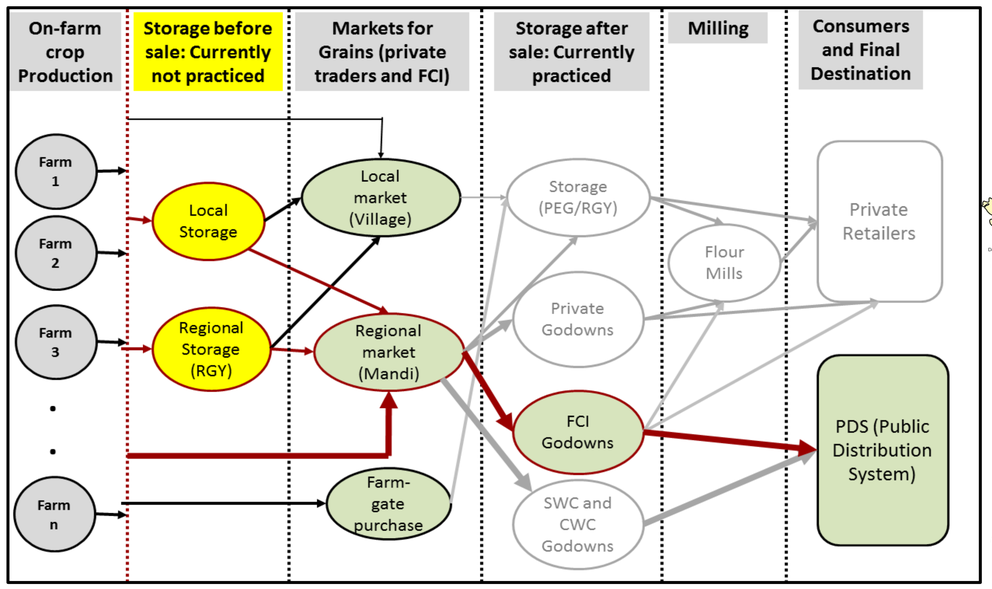
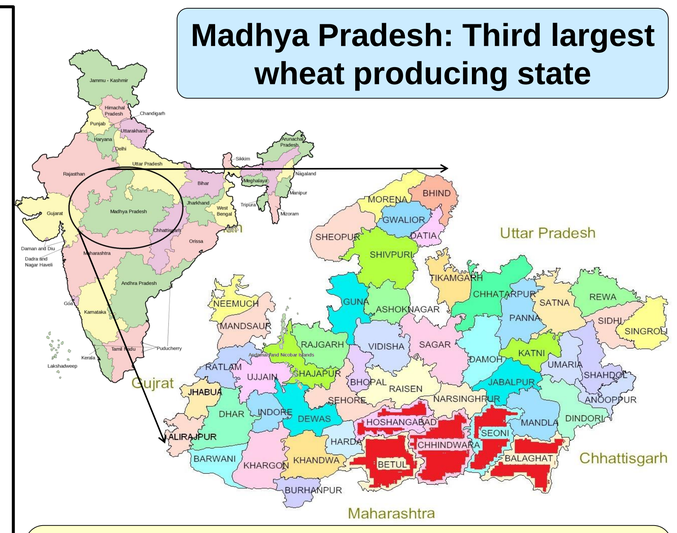
Model Structure and Case Study Application



Model schematic: Shaded components not considered for the case study; Components with red outline considered for PHL calculations

Madhya Pradesh: Third largest wheat producing state



- Model applied to five districts of the state
- Total 577179 farms aggregated to 2927
- 23 Mandis and three FCI godowns

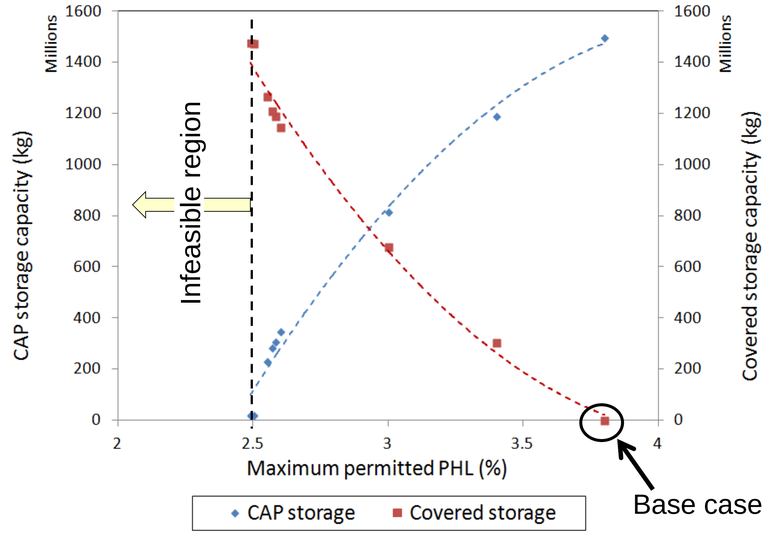
Results and Discussion

Without pre-market storage

Base case: 100% uptake by FCI at *Mandis*

- PHL = 3.73 % (for the considered components)
- FCI storage only using CAP (Covered and Plinth)
- Storage capacity requirement significantly higher than current FCI capacity
- No incentive to reduce PHL beyond PDS demand

Reduction in maximum allowable PHL altered the storage choices of FCI



Sensitivity analysis

Total PHL and storage mode distribution sensitive to:

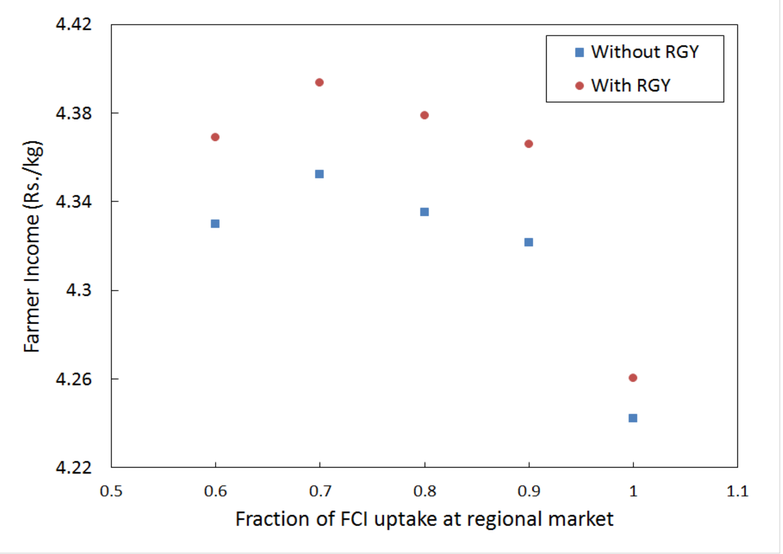
- Cost and loss rate of CAP and covered FCI storage
- Fraction of wheat uptake by FCI at regional market

With pre-market storage (RGY)

Per-market regional storage (RGY) had several advantages even with 100% FCI uptake

	Without RGY	With RGY
PHL (%)	3.73	3.70
Farmer income (Rs./kg)	4.24	4.26
FCI income (Rs./kg)	-13.71	-13.52
RGY capacity (Mg)	0	51728

Lower uptake by FCI increased the importance of RGY and led to inflection in farmer income



Redistribution of wheat across regional markets and FCI godowns caused the inflection