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Will Free Trade Help India's Livestock Sector?

Macroeconomic & welfare effects of livestock-sector interventions - a CGE approach

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DATA

IFPRI India SAM 2022–23

MODEL

Comparative-static CGE

DESIGN

7 cumulative simulations

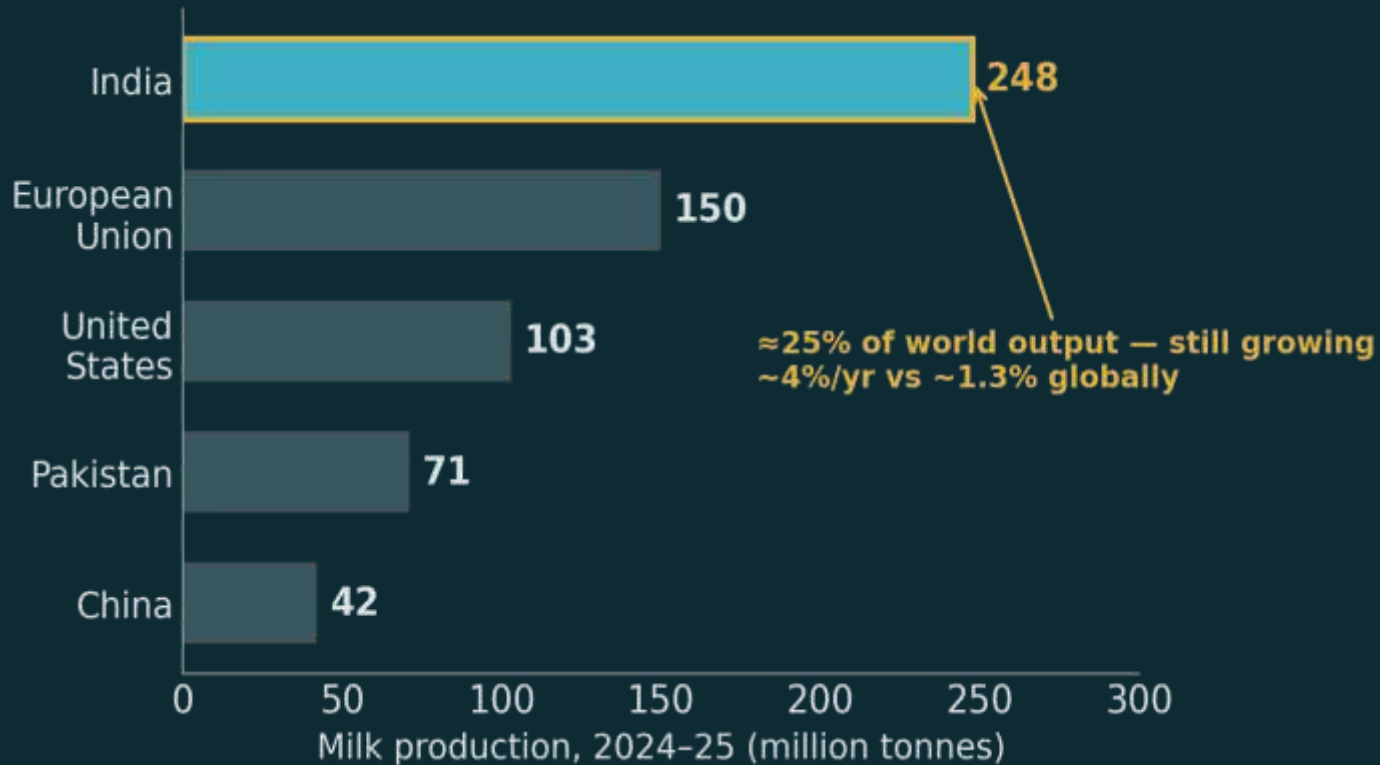
India - world's largest milk producer (~25% of global output) · dairy is overwhelmingly smallholder & cooperative

Free trade helps the livestock sector — but only when sequenced behind productivity.



A static, single-shock study would miss this. A structured, cumulative set of simulations makes the sequencing visible.

A Production Giant, a Trade Minnow - the Opportunity



485 g/day per-capita milk availability - world average ≈328 g/day

+18% in 4 yrs production growth (210→248 Mt) - a structural surplus

0.25% of world dairy trade - a 100-to-1 gap with its production share. **That gap is the opportunity.**

Why livestock matters for India: ≈5% of national GDP · 40% of agricultural GDP · livelihoods of 80+ million farm households · smallholder- and women-led · counter-cyclical cash income when crops fail

Raw milk is India’s single largest farm activity

40%

of agricultural GDP
from livestock

4.4%

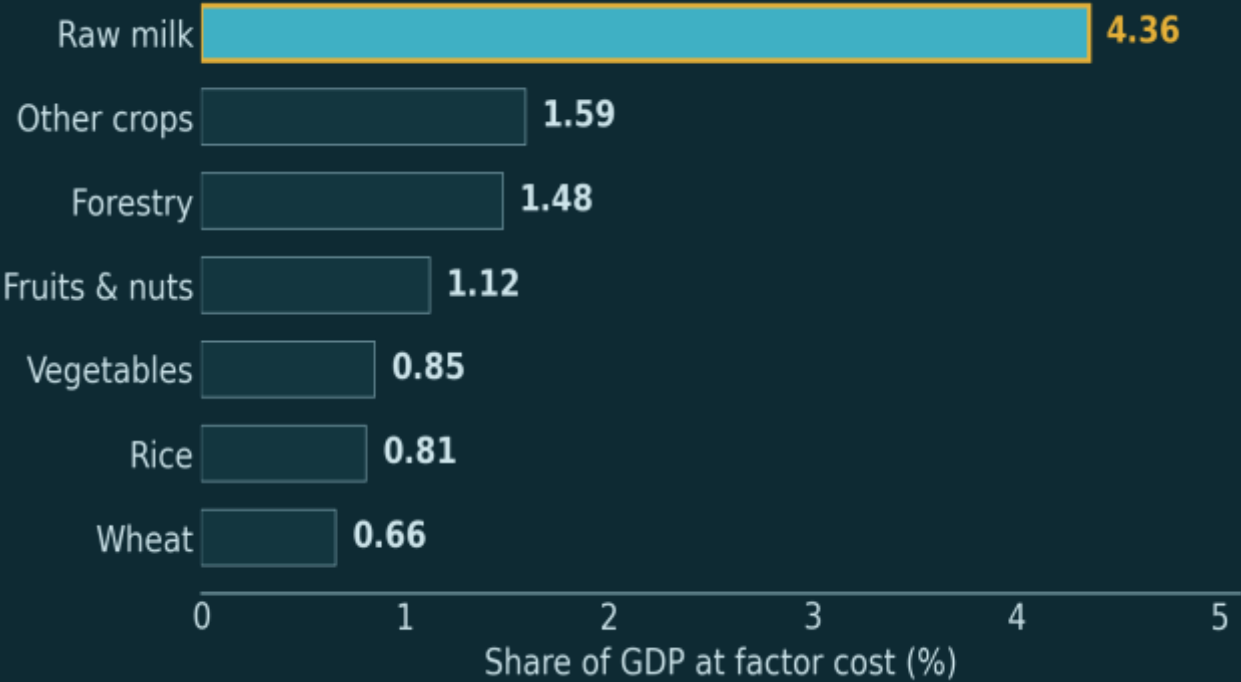
of national GDP
is raw milk alone

70%

of livestock VA
is milk

56%

of household income
is rural



Larger than rice, wheat, or any horticultural crop - so “livestock policy” in India is, to first order, “dairy policy.”

Three contributions to the India CGE literature

1

Joint, SAM-consistent incidence

Macro, sectoral, factor-market and household outcomes reported together - not one margin at a time - from a single calibrated 2022-23 base.

2

Sequencing identified by design

Seven cumulative experiments make the marginal value of each lever - productivity, processing, exports, trade - directly readable as differences between adjacent scenarios.

3

Mechanisms partial analysis misses

A 'productivity paradox' in sector-specific livestock capital, and an exchange-rate-driven reshuffle across protected food processing under tariff removal.

Prior India work examined trade reform or growth–inequality; the livestock/dairy value chain and reform sequencing have not been treated jointly.

A 112-activity SAM in a neoclassical CGE core

Social Accounting Matrix - IFPRI India 2022–23

- 112 accounts; detailed agri-food disaggregation
- 6 livestock activities; processing split into dairy, meat, fats & oils, milling

Model closure - the parts that drive results

- Sector-specific capital, imperfectly mobile (short run)
- Savings-driven investment; fixed foreign savings; flexible real exchange rate; govt. saving flexible
- Single year model solved with base year 2022-23
- Any deviation from base line due to policy shocks under different scenario is considered for analytical purpose • Producers maximize profit, households maximize utility
- Unemployment in the labor market mainly for un-skilled and semi-skilled workers.
- For skilled labour, flexible wage rate clears labour market equilibrium
- Capital is immobile and fully employed across activities • Land is fixed in supply no change
- • Single country open economy model - flexible exchange rate clears external market



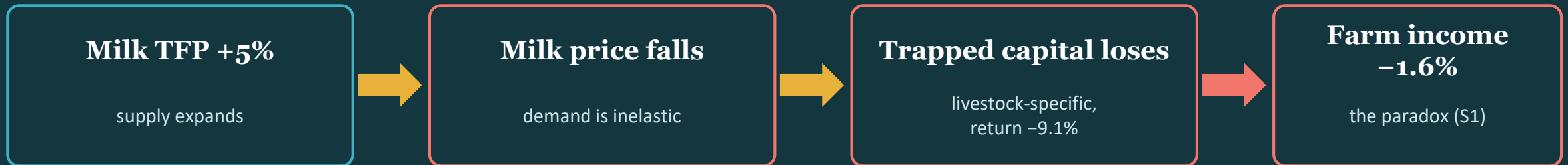
■ Capital 61.9% ■ Labour 33.8% ■ Land 4.3%

Livestock capital is only ≈2.5% of factor income - a thin, captive factor (key to the “paradox”, slide 12).

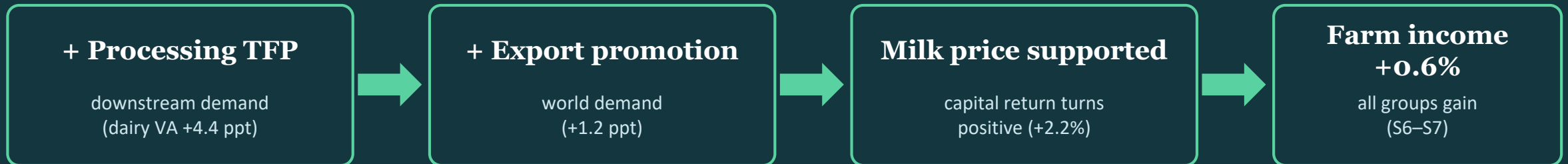
Seven simulations, three policy families

S1	Milk productivity +5%	Farm-gate TFP only	PRODUCTIVITY
S2	+ Processing (dairy & fats/oils TFP +30%)	Primary + processing	PRODUCTIVITY
S3	+ Export promotion	World dairy export price	PRODUCTIVITY
S4	Free trade - tariff –100%	Pure liberalisation	TRADE
S5	Partial free trade - tariff –50%	Pure liberalisation	TRADE
S6	Productivity + free trade	Combined	COMBINED
S7	Productivity + partial FT	Combined	COMBINED

One mechanism organises all five findings

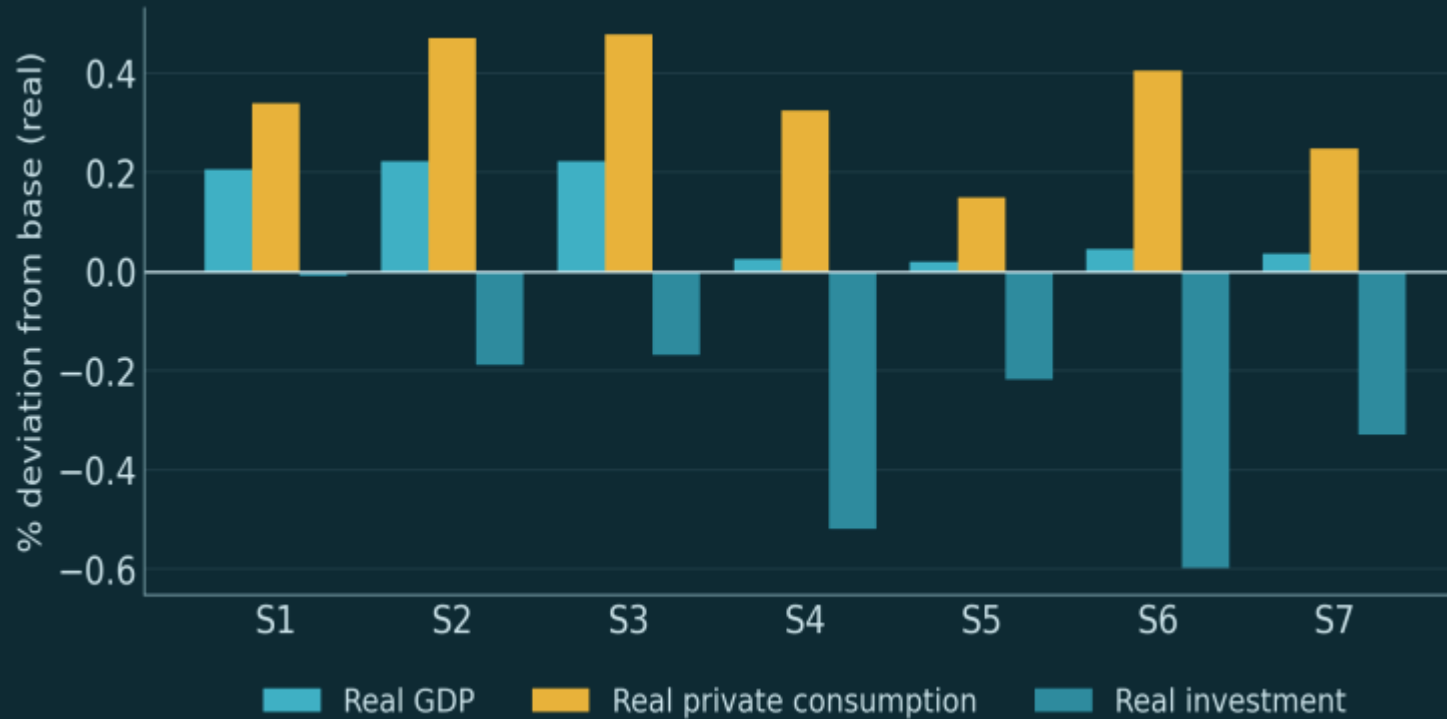


THE REPAIR: create demand that absorbs the extra milk



Trade liberalisation enters through a second channel — the real exchange rate — which reshuffles processing (meat ↑, oils ↓) but cannot create the demand that repairs the paradox. That is why sequencing matters.

Real output and consumption rise across scenarios



Real GDP positive throughout (peak +0.22%)

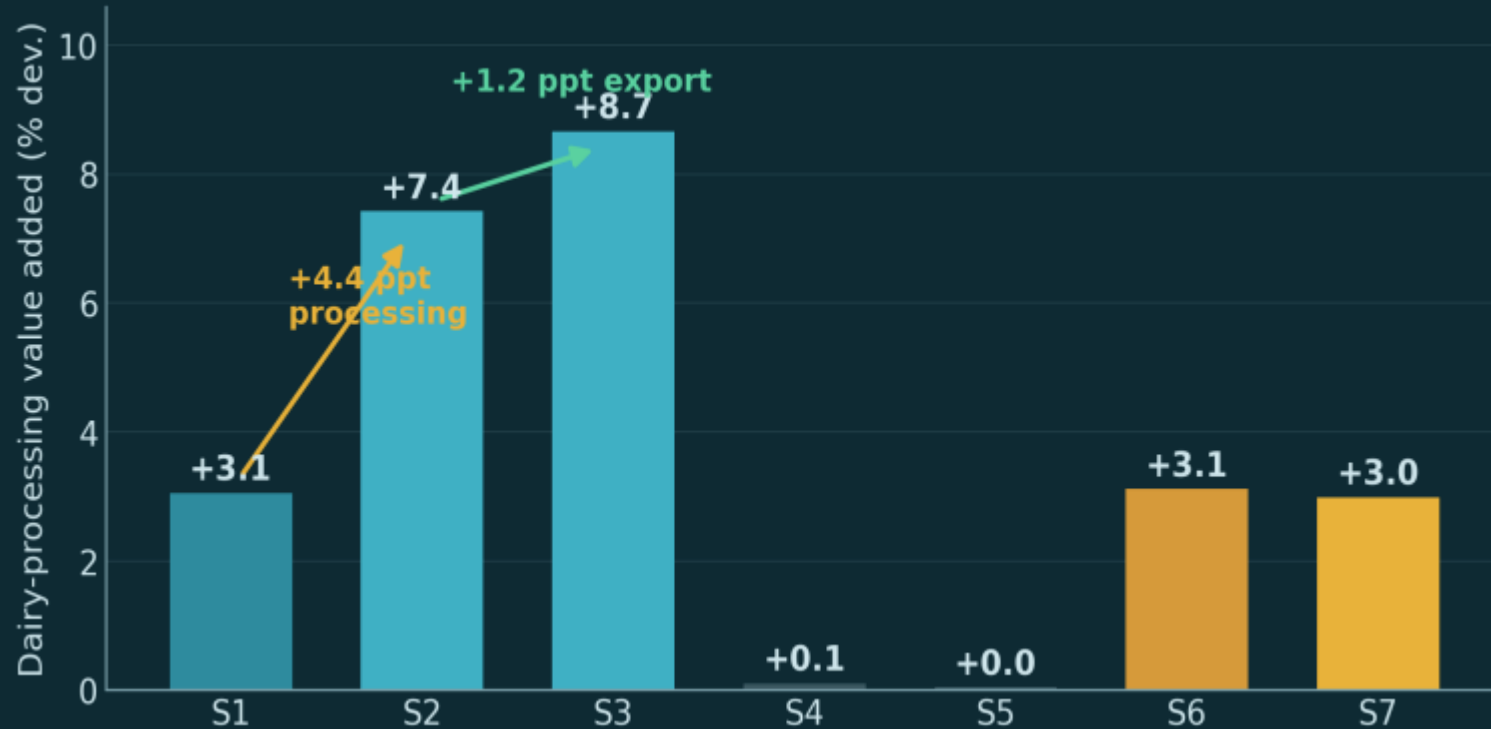
Real consumption up to +0.48%

Real investment is the consistent trade-off

Gains via factor income, not price effects

Results are real (CPI-deflated) deviations. The expansion works through higher factor income; investment is the standing trade-off a static model cannot net out.

Processing is where the value compounds



+4.4

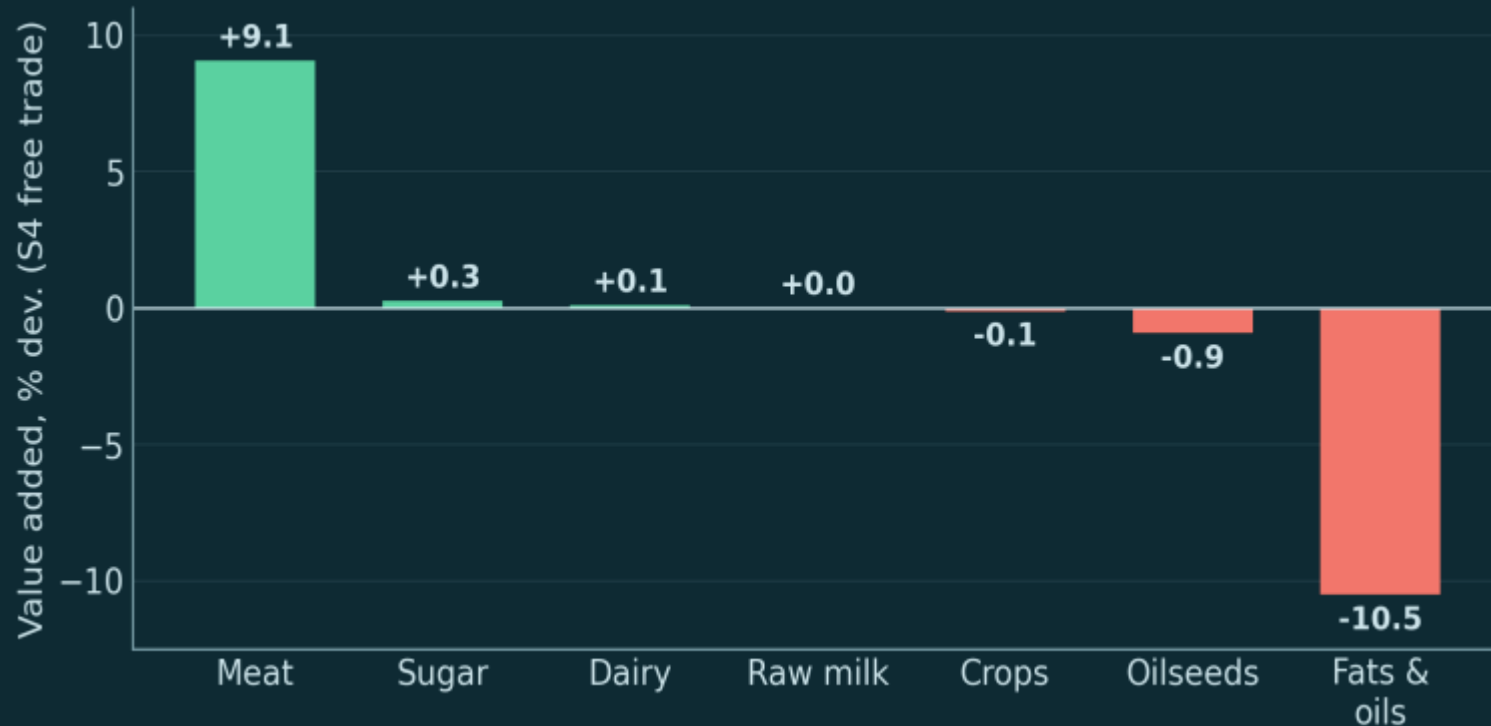
ppt added by processing (S1→S2)

+8.7%

peak dairy GDP gain (S3)

Farm-gate gains alone depress the producer price (inelastic demand). Processing & exports create the demand that supports it.

Tariff removal reshuffles food processing

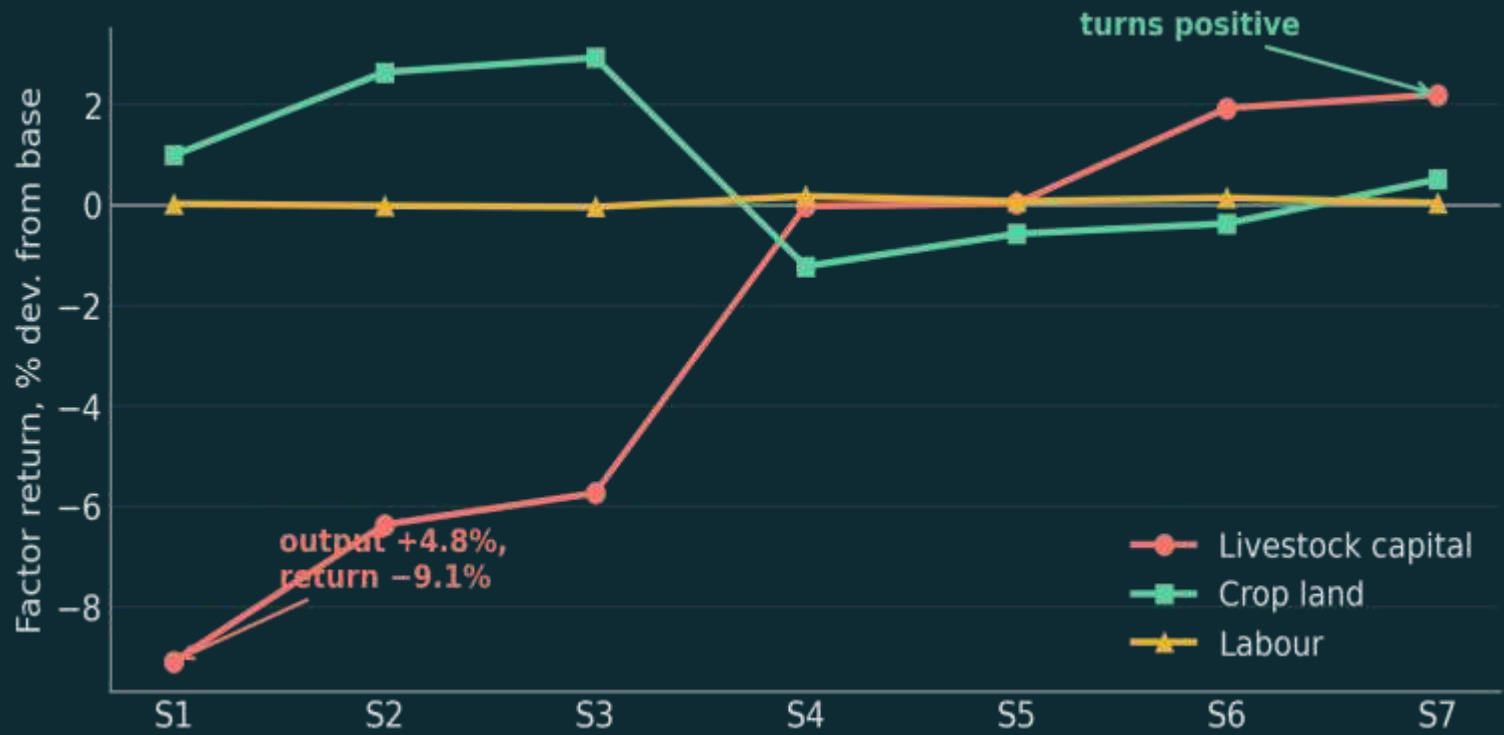


- Meat processing surges +9.1%
- Fats & oils collapses -10.5%
- Dairy itself barely moves (+0.1%)

Mechanism

Tariff cut → wider deficit → real depreciation → exposes protected oils, makes meat exports competitive. The exchange rate does the reallocating.

The productivity paradox -and its cure

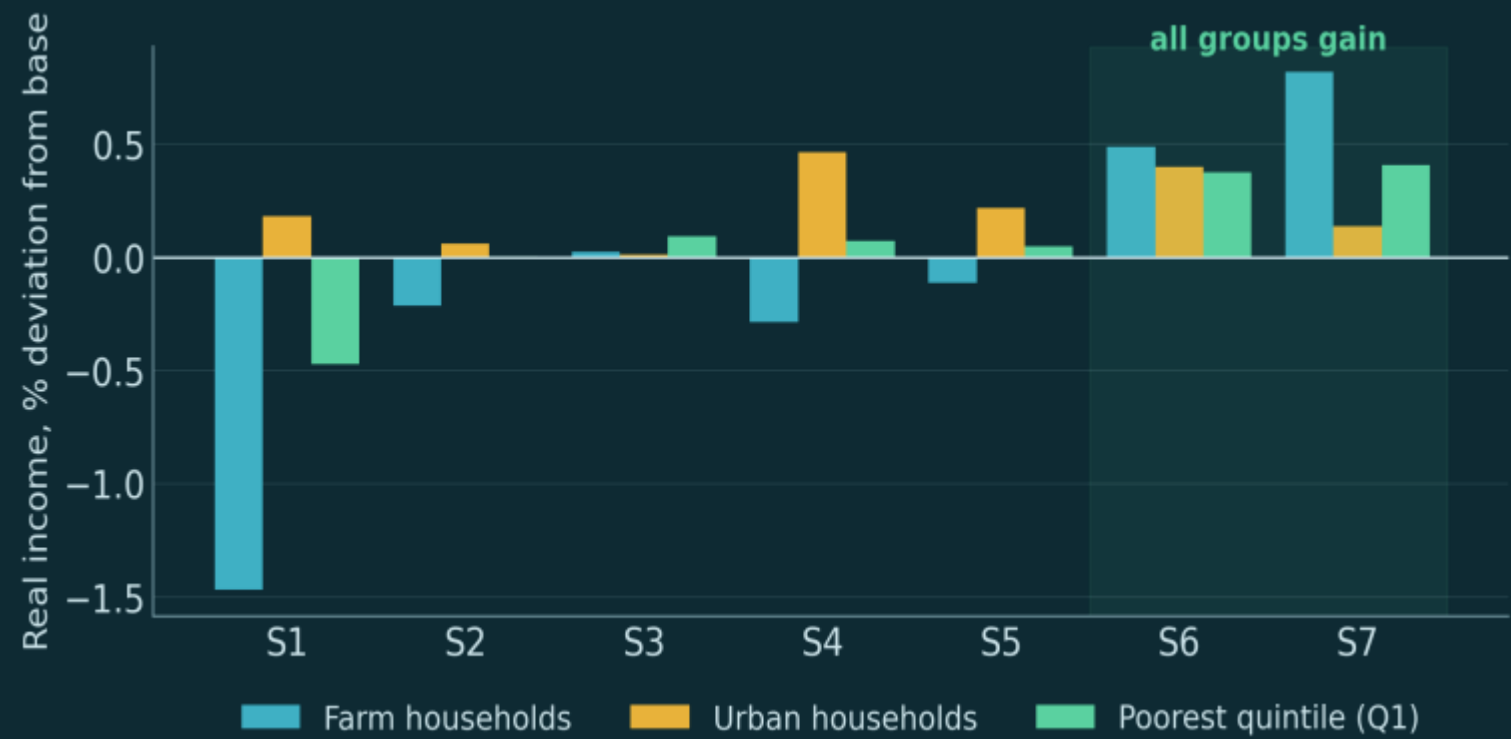


Milk output +4.8%, yet livestock-capital return -9.1%.

Sector-specific capital + inelastic demand: the price fall outweighs the volume gain, so revenue per trapped unit falls.

Processing & exports progressively repair it — turning the return positive (+2.2%) in S6–S7.

Only the combined package lifts everyone



Free trade alone: farmers still lose in real terms (-0.29%)

Processing dividend lifts real farm income markedly (S1→S3)

S6–S7 raise REAL income for ALL groups — incl. poorest quintile

Real (CPI-deflated) income. Because prices fall, every group fares better in real terms than in nominal terms - and the combined package lifts all of them.

Scenario scorecard

Scenario	GDP	Dairy	Farmers	Consumers	Fiscal
S1 Milk +5%	+	+	-	+	≈
S2 Processing	++	++	+	+	≈
S3 Proc.+Export	++	+++	+	+	≈
S4 Free trade	≈	≈	--	++	--
S5 Partial FT	≈	≈	-	+	-
S6 Prod+FT	+	++	+	++	-
S7 Prod+PT	+	++	++	+	-

+ positive ++/+++ strongly positive ≈ neutral - negative -- strongly negative · Only S6–S7 are green across growth, dairy, farmers & consumers.

A phased agenda, not a single reform

1

Build the value chain

Primary + processing (S2): largest real-GDP gain, strongest dairy growth, pro-farmer.

2

Harness export potential

Add export promotion (S3): dairy peaks at +8.7% at negligible macro cost.

3

Sequence liberalisation last

Open trade after competitiveness is built (S6–S7): the same tariff cut now lifts all groups.

4

Protect investment & the fisc

Recycle efficiency gains into public investment; broaden the indirect-tax base.

THE BOTTOM LINE

Competitiveness, not tariff walls, is the durable basis for Indian dairy.

Free trade pays off for the sector and for farmers and the poor - only when it follows productivity and processing.

Sequence the reforms: value chain → exports → trade opening.

Data: IFPRI India SAM 2022–23 · Comparative-static CGE · Seven cumulative simulations · GTAP 29, Japan

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Thank you

ありがとうございました · Questions welcome

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Appendix

Small macro numbers are expected — and not the point

Dairy processing is only 0.10% of GDP at factor cost; even raw milk is 4.4%. A shock to a thin activity cannot move headline GDP much — by construction.

The economically interesting signal is the reallocation, not the aggregate:

- Dairy VA moves up to +8.7%; fats & oils −10.5%; meat +9.1%
- Livestock-capital return swings from −9.1% to +2.2%
- Farm income swings ~2.2 ppt across scenarios

Rule of thumb

A 0.2% real-GDP gain on a ≈35-trillion-rupee economy is still large in absolute terms. The distributional and sectoral shifts are where the policy bite is — and those are an order of magnitude bigger than the macro deviations.

Because dairy is barely traded — oils carry the protection

Commodity	Imports	Exports	Tariff revenue	Trade status
Dairy	3.1	35.6	0.4	net exporter, ~unprotected
Meat	3.0	204.4	0.4	net exporter
Grain milling	33.4	73.9	4.6	lightly protected
Fats & oils	1,793.9	143.3	588.7	heavy imports, heavily protected

The intuition: India’s dairy is already a near-unprotected net exporter, so cutting its tariff does little. Fats & oils is the economy’s big protected import — so when liberalisation depreciates the real exchange rate, the oils complex bears the adjustment and export-capable meat expands. The reshuffle on slide 11 falls directly out of these base-year shares.

Values are base-year SAM flows (₹ billion). Source: IFPRI India SAM 2022–23, authors’ computation.

Direction is robust; magnitude scales with key parameters

Parameter	Plausible range	What it changes	Direction holds?
Armington / CET (trade)	0.5– 4	Size of the meat↑ / oils↓ reshuffle	Yes — sign stable
Capital mobility	specific ↔ mobile	Depth of livestock-capital fall	Yes — paradox softens
LES income elasticities	±25%	Household welfare spread	Yes
Processing TFP shock	20–40%	Height of the value-chain gain	Yes — monotone
Export-price shock	5–15%	S3 export increment	Yes

Bottom line: every qualitative result — productivity raises welfare, processing compounds it, liberalisation alone is regressive, the combined package lifts all groups — survives the parameter ranges. What moves is the size of the effect, not its sign.

Closure rules and shock calibration

Closure

- Savings-driven investment — so falling savings (from lower income / tariff revenue) compresses GCF. This is the source of the investment dip, not a behavioural result.
- Fixed foreign savings; real exchange rate clears the external balance — drives the depreciation in S4.
- Government: tax rates fixed, savings flexible — so tariff cuts show up as a lower tax/GDP ratio.
- CPI is the numéraire reference; results read as real deviations.

Shock calibration

- Milk TFP +5%: consistent with realised yield-growth trends from breeding, health & fodder programmes.
- Processing TFP +30% (dairy, fats/oils): scale-up of organised processing capacity; a deliberately ambitious value-chain scenario.
- Export promotion: +5–15% world export price facing the CET function; central case ~10%.
- Tariff: –100% (S4) and –50% (S5) on the dairy import duty.

The natural next step: a multi-region GTAP version

Limitation of the present design

The export-promotion shock raises the world dairy price exogenously. In a single-country model the rest of the world is a price-taker backdrop — fine for a domestic-incidence study, but it cannot tell us how India’s own expansion moves global markets.

What a GTAP embedding would add

- Endogenous world dairy price — terms-of-trade effects of India’s supply surge
- Partner-country responses, bilateral tariffs, and trade diversion
- Non-tariff measures & SPS frictions, which bind harder than tariffs in dairy
- **Welfare decomposition (alloc. efficiency, ToT, endowment) in the GTAP idiom**

Single-country first establishes the domestic incidence cleanly; GTAP then situates it in world markets. Complementary, not competing.

One-stop results table (% deviation from base)

Indicator	S1	S2	S3	S4	S5	S6	S7
Real GDP	+0.21	+0.22	+0.22	+0.03	+0.02	+0.05	+0.04
Real consumption	+0.34	+0.47	+0.48	+0.33	+0.15	+0.41	+0.25
Dairy VA	+3.1	+7.4	+8.7	+0.1	+0.0	+3.1	+3.0
Fats & oils VA	0.0	+4.7	+5.7	-10.5	-4.7	-7.3	-0.9
Livestock capital	-9.1	-6.4	-5.7	0.0	+0.0	+1.9	+2.2
Farm income (real)	-1.47	-0.21	+0.03	-0.29	-0.11	+0.49	+0.82
Poorest quintile (real)	-0.47	+0.01	+0.09	+0.07	+0.05	+0.38	+0.41

All values are real (CPI-deflated) % deviations. Green = improvement, coral = decline. Full tables in the companion paper.

Honest limits - and a road ahead

Caveats

- Comparative-static — directional, not forecasts
- Static frame omits dynamic cost of lower investment
- Small aggregate magnitudes — dairy is a thin VA share; the story is sectoral & distributional
- Results sensitive to capital-mobility & Armington elasticities

Extensions

- Recursive-dynamic version — capture investment & accumulation
- Systematic sensitivity on trade & factor elasticities
- **Embed in a multi-region GTAP framework — endogenise the world dairy price rather than shock it**
- Add non-tariff measures & SPS frictions on dairy trade