

अन्नदृष्टि — From Wall Maps to World Models

A decision-support thesis for India's Public Distribution System, demonstrated as a 4D digital twin of the FCI grain network.

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1 The board on the wall

In a corridor of FCI's Regional Office in Lucknow hangs a printed map: 75 districts, 48 own depots, 14.79 LMT of capacity, every godown a coloured pin. It is the region's operating picture — and it is paper.

That board is the correct instinct executed in the wrong medium. Its makers understood that grain operations are fundamentally spatial: which depot serves which district, where wheat lands in April, where rice lands in November, which corridors carry the surplus of the north-west to the consuming east and south. What paper cannot hold is **time** — the fourth dimension in which every real decision lives. Stock is a derivative; the job is managing its flow.

ANNADRISHTI began as a literal digitisation of that board (v1) and became, over five verified iterations, a playable world model of the national grain network. This document states the thesis behind it, specifies the model, and lays out the path from demonstration to deployment.

2 Thesis

T1. Public logistics systems fail at the seams between data silos, not inside them. India's grain data exists (DOS, data.gov.in, NFSA, Annavitran, Agmarknet); what is missing is a shared operational picture that fuses **space × stock × time** at the desk where dispatch decisions are made.

T2. The correct product is **decision support, not automation**. A rule engine that detects overflow and stockout risk and drafts the order, with a human authorising it, fits both administrative reality and governance requirements — and builds the trust that later automation requires.

T3. Comprehension is the binding constraint, not computation. A tool for a Regional Office must speak Hindi first, render verdicts ("ठीक है / तुरंत") rather than raw ratios, and land inside existing daily routines (morning review, rake dispatch, procurement watch, offtake allocation) rather than demanding new ones.

T4. A **world model** — a simulator faithful to the network's seasonal physics — is valuable even before live data arrives: it trains users, stress-tests rules, generates realistic demonstrations, and later becomes the forecasting layer on top of actuals.

3 The world model, formally

The network is a set of storage nodes i with capacity C_i (MT), procurement weights $w_i, r_i \in [0,1]$ (wheat/rice), and drain multiplier m_i (consuming states > 1 , producing < 1). Daily state evolves over the FY 2025–26 calendar ($t = 0 \Rightarrow 01 \text{ Apr } 2025$):

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S_i(t+1) = clamp( S_i(t) + I_i(t) - O_i(t) + ε , 0.05·C_i , 0.985·C_i )

I_i(t) = 0.031·w_i·C_i·G(t;32,17)      # RMS wheat pulse (May peak)
        + 0.027·r_i·C_i·G(t;235,24)    # KMS rice pulse (late Nov)
        + 0.017·w_i·C_i·G(t;345,14)    # late-rabi pre-positioning
        + 0.0036·m_i·C_i·[m_i>1.2]     # interstate receipts (consuming)

O_i(t) = 0.0047·m_i·C_i·U(0.85,1.15)   # PDS offtake
        + 0.045·C_i·[S_i>0.90·C_i]    # pressure dispatch
        ; ×0.35 if S_i<0.18·C_i        # issue rationing

G = gaussian · U = uniform · PRNG mulberry32, seeded ⇒ fully reproducible
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Coverage per state pools its nodes: $\text{cov}(s,t) = \Sigma S / (\Sigma 0.0047 \cdot m \cdot C \cdot 2.1)$, read as *days of PDS cover*. Three rules generate the ops feed: utilisation > 90% → **OVERFLOW**; < 12% → **LOW BUFFER**; coverage < 15 days → **PRIORITY ALLOCATION**.

Emergent behaviour was not hand-scripted: Ludhiana breaches 90% in late April; national utilisation runs 52% → 81% (wheat peak) → 30% (autumn trough) → rice-season rebuild → year-end drawdown; interstate arcs activate along the real surplus→consuming corridors. The engine ships as **annadrishti-sim.js** and its full output as CSV/DuckDB, so every figure in the demo is auditable.

4 From synthetic to sovereign data

Each layer of the twin carries a provenance tag and a named source of truth. The production sequence replaces synthetic layers in order of leverage:

PHASE	LAYER	SOURCE OF TRUTH	EFFECT ON TWIN
1 · Registry	Depot identities, capacities, sites	fci.gov.in annexures · CWC/SWC directories · Sansad Q&A · RTI residuals	Columns become audited facilities (bitemporal registry)
2 · Time axis	Daily stock	data.gov.in FCI stock datasets · DOS	d.s[t] arrays become actuals; sim becomes forecast overlay
3 · Coverage	PDS allocation & offtake	DFPD bulletin · nfsa.gov.in · annavitran.nic.in · impds.nic.in	District/state coverage days become real; thresholds calibrated
4 · Movement	Rakes & road	FOIS (partnership/RTI) · telematics	Pegs track real vehicles

Boundary truth: Survey of India (authoritative) with LGD codes; the working GeoJSON (Census 2011+, community-maintained) is backed up in this package with checksums.

5 Interface doctrine

Five findings from the iteration cycle, each now a design rule:

- **One sentence beats five numbers.** The स्थिति banner — an auto-generated Hindi sentence with a green/amber/red edge — is the single highest-comprehension element in the product.
- **Verdict the number.** Every KPI carries ठीक है / ध्यान दें / तुरंत; officers act on judgments, not ratios.
- **Time needs chapters.** Labelled, tappable seasons (गेहूँ खरीद | भंडारण | धान खरीद | निकासी) turned an abstract slider into a story.
- **The board is a game.** Typed routes (gold/green/violet/blue) and shaped pegs (trucks, commodity-wagon rakes) with subsystem tabs let anyone isolate one system in one tap.

- **Meet the routine.** Duty modes mirror the RO day; the tool configures itself to the task instead of the reverse.

6 Deployment & governance

Single-file WebGL client (no runtime external calls), on-prem/NIC-cloud compatible; DuckDB→Postgres store with bitemporal history and per-field provenance; read-only integrations first; every engine recommendation logged with evidence and the authorising officer. Proposed entry: a 12-week pilot with FCI RO Lucknow (live registry + daily stock + duty-mode rollout), success measured as reduction in decision latency and overflow-days. Expansion: RO → Zone → national DFPD picture. PsyTech's Deepstar runtime operates ingestion and monitoring; the JOES defence line shares the doctrine — fused picture, human-authorised action.

7 Limitations

Operational series are synthetic (seasonally-shaped, not calibrated to actuals); national node capacities are representative order-of-magnitude allocations; part of the UP registry derives from photographic transcription with flagged confidence; movement corridors are stylised. None of these limits the thesis — all are scheduled replacements on the provenance ladder above.

8 Conclusion

The wall map was already a world model — frozen. ANNADRISHTI unfreezes it. The remaining work is not invention but plumbing: four data feeds, in order, each one converting a synthetic layer into a sovereign one. अन्न का हिसाब, आँख के सामने.