

Case Study: Hidden Vulnerability Crisis

When Aggregate Data Deceives Policymakers

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1 Case Overview

1.1 Background

The **Planning Commission** releases the annual District Vulnerability Index Pakistan (DVIP) ranking all 129 districts on overall vulnerability. The index combines six domains:

1. Housing quality
2. Communication & Transport infrastructure
3. Livelihoods & Economic opportunity
4. Health Services access
5. Public Education quality
6. Demographics (dependency ratios, growth)

Each district receives: - Overall percentile score (0 = best, 100 = worst) - Domain-specific percentile scores

Policy Use: - Provincial governments allocate development funds based on overall rankings
- “High vulnerability” districts (>66th percentile) get priority funding - “Low/Moderate vulnerability” districts (<33rd percentile) get minimal attention

1.2 The Problem

You are Secretary, Planning & Development Department.

The Finance Division allocates PKR 50 billion for vulnerability reduction across provinces.
Current allocation formula:

- **Balochistan:** 30% (highest aggregate vulnerability)
- **KP:** 28% (second highest)
- **Sindh:** 25%
- **Punjab:** 15% (lowest aggregate vulnerability)
- **ICT:** 2%

Within each province, funds go to highest-ranked vulnerable districts.

Your analyst presents shocking findings:

“Sir, we’re systematically ignoring **25 million people** in catastrophic crises because they live in districts with ‘moderate’ overall rankings. The aggregate scores hide domain-specific disasters.”

2 The Three Hidden Patterns

2.1 Pattern 1: The Service Access Paradox

2.1.1 The Smoking Gun: Karachi Malir

Official Ranking: - Overall vulnerability: 41st percentile (moderate - not a priority) - Gets minimal development funds (Sindh focuses on interior districts)

Hidden Reality: | Domain | Percentile | Interpretation | |————|————|————| |
Overall | 41 | Moderate (appears fine) | | Housing | 17 | Excellent | | Transport | 71 | Poor | |
Livelihoods | 7 | Excellent | | **Health Services** | **82** | **CATASTROPHIC** | | Education | 69
| Poor | | Demographics | 0 | Best |

The Crisis: - **Population:** 3.7 million people - **Health access:** Worse than 82% of all districts - **Gap:** 41 percentile points between overall and health - **Reality:** Karachi Malir has worse health access than officially “highly vulnerable” districts in Balochistan - **Policy response:** ZERO targeted health interventions (hidden in “moderate” aggregate)

2.1.2 Other “Paradox Districts”

District	Overall Rank	Hidden Crisis Domain	Population Affected
Karachi Malir	41st	Health (82nd)	3.7M
Karachi West	25th	Health (55th), Education (57th)	3.9M
Islamabad	9th	Education (53rd)	1.2M
Quetta	31st	Health (57th), Education (54th)	1.1M
Rawalpindi	6th	Health (25th)	5.4M
Peshawar	9th	Health (33rd)	4.3M

Total impact: 25+ million people in “low/moderate vulnerability” cities face service delivery crises completely invisible in aggregate rankings.

2.1.3 Why It’s Hidden

Aggregation masks trade-offs: - Karachi Malir has excellent housing, livelihoods, demographics - These “pull up” the overall average - Health disaster disappears in the average
Classic ecological fallacy: District-level average hides domain-specific crisis

Current policy response: - Finance Division: “Karachi Malir is 41st percentile - not a priority” - Health Ministry: “Focus on officially vulnerable districts” - Result: 3.7M people in health crisis get zero targeted intervention

2.2 Pattern 2: The Volatility Crisis

2.2.1 The “Tipping Point” Districts

Official view: Districts ranked by overall vulnerability (single number)

Hidden reality: Some districts have **high internal variance** - unstable, one shock away from cascading failure.

2.2.2 Example: Khushab District (Punjab)

Official ranking: 35th percentile (moderate)

Domain breakdown: - Housing: 34th percentile (moderate) - Transport: 28th percentile (good)

- Livelihoods: 31st percentile (moderate) - Health: 46th percentile (moderate) - **Education: 61st percentile (vulnerable)** - Demographics: 24th percentile (good)

Domain variance (spread): 0.22 (HIGH)

What this means: - District appears “stable” at 35th overall - But education is critical failure point - One shock (teacher transfers, school closures, budget cut) → education collapses to 80th+ percentile - Cascading effect: Poor education → Youth unemployment → Out-migration → Livelihood crisis - **Tipping point:** Moderate today, could be crisis tomorrow

2.2.3 The Scale of the Problem

47 districts have “tipping point” characteristics: - Moderate overall rankings (33-66th percentile) - High domain variance (>0.18) - One or two critical vulnerability domains - Combined population: **38 million people**

These districts get: - Minimal attention (not in “high vulnerability” category) - No volatility-management interventions - No early warning systems - **Result:** Reactive crisis response after tipping point crossed

2.2.4 Districts at Risk

Sample “Tipping Point” districts:

District	Overall	Variance	Critical Domain	Population
Khushab	35	0.22	Education (61)	1.3M
Attock	18	0.25	Health (41), Education (48)	2.0M
Chakwal	23	0.19	Health (35), Education (35)	1.5M
Chiniot	34	0.21	Health (40), Education (40)	1.4M
Swat	34	0.23	Health (52)	2.3M

Policy blindspot: Current allocation ignores volatility - only looks at aggregate levels.

2.3 Pattern 3: The Wrong Boundaries Problem

2.3.1 Natural Vulnerability Zones vs. Provincial Boundaries

Official approach: - Allocate by province - Each province manages its own vulnerable districts - No cross-provincial coordination

Data reveals: Districts cluster by **vulnerability profile**, not by province.

2.3.2 The Five Natural Zones

Analysis of all 129 districts reveals 5 distinct vulnerability clusters that **transcend provincial boundaries**:

2.3.2.1 Zone 1: Metro Excellence (12 districts)

- **Provinces:** Sindh (Karachi 4), Punjab (Lahore, Rawalpindi, etc.), KP (Peshawar), ICT
- **Profile:** Low overall vulnerability BUT hidden service quality gaps
- **Population:** 45 million
- **Need:** Service delivery improvement, not infrastructure
- **Current problem:** Lumped with provincial strategies

2.3.2.2 Zone 2: Moderate Mixed Development (35 districts)

- **Provinces:** All provinces (urban-rural mix)
- **Profile:** Moderate overall, high volatility
- **Population:** 52 million
- **Need:** Stabilization of weak domains
- **Current problem:** No volatility management

2.3.2.3 Zone 3: Service Deficient Interior (28 districts)

- **Provinces:** Interior Sindh (15), South Punjab (13)
- **Profile:** Poor service access, better infrastructure
- **Population:** 28 million
- **Need:** Health/education expansion
- **Current problem:** Sindh and Punjab address separately (inefficient)

2.3.2.4 Zone 4: Extreme Deprivation (23 districts)

- **Provinces:** Balochistan (17), Remote KP (6)
- **Profile:** Poor across all domains
- **Population:** 8 million
- **Need:** Emergency infrastructure
- **Current problem:** Dispersed efforts

2.3.2.5 Zone 5: High Variance Unstable (21 districts)

- **Provinces:** Mixed (KP 8, Punjab 7, Sindh 4, Balochistan 2)
- **Profile:** One critical domain far worse than others
- **Population:** 12 million
- **Need:** Targeted domain interventions
- **Current problem:** Provincial silos prevent cross-learning

2.3.3 The Efficiency Loss

Example of provincial inefficiency:

Interior Sindh Service Desert: - 15 districts with poor health/education access - Similar profile to 13 South Punjab districts - **If managed together:** Could share mobile health units, teacher training, facility designs - **Current reality:** Sindh does its own thing, Punjab does its own thing - **Efficiency loss:** Estimated 30-40% higher cost per outcome

Cross-provincial natural zones share: - Similar vulnerability profiles - Same intervention needs - Potential for economies of scale - Learning from each other's successes/failures

But provincial boundaries prevent coordination.

3 The Data You're Given

3.1 District Rankings Table (Sample)

You receive this standard DVIP table:

District	Province	Overall Percentile	Priority Level
Killa Saifullah	Balochistan	97	CRITICAL
Kohlu	Balochistan	95	CRITICAL

District	Province	Overall Percentile	Priority Level
Sherani	Balochistan	93	CRITICAL
...
Karachi Malir	Sindh	41	MODERATE
Islamabad	ICT	9	LOW
Karachi Central	Sindh	0	LOW

Question: Based on this table, where would you allocate emergency health funding?

Typical answer: Killa Saifullah, Kohlu, Sherani (top of rankings)

Hidden reality: Karachi Malir has worse health access than all three, but it's invisible because overall score is moderate.

3.2 What The Table Doesn't Show

3.2.1 Full Domain Breakdown (Hidden from Initial Report)

District	Overall	Housing	Transport	Livelihoods	Health	Education	Demographics
Killa Saifullah	97	95	91	96	98	89	96
Karachi Malir	41	17	71	7	82	69	0
Islamabad	9	3	2	5	23	53	2

Insight: - Killa Saifullah: Poor everywhere (gets attention) - Karachi Malir: Health crisis hidden in moderate aggregate - Islamabad: Education gap in nation's capital

4 Analytical Errors Present

4.1 Error 1: Ecological Fallacy

Definition: Inferring individual-level (or domain-level) relationships from aggregate data.

How it manifests: - District-level aggregate score hides domain-specific crises - Karachi Malir's moderate overall score (41st) masks health disaster (82nd) - **False conclusion:** "Karachi Malir is doing okay" - **Reality:** 3.7M people in health crisis

Officer's mistake: Assuming aggregate district ranking tells you about specific service delivery.

4.2 Error 2: Measurement Error / Inappropriate Aggregation

Definition: The metric you're using doesn't measure what you think it measures.

How it manifests: - "Overall vulnerability" is mathematical average of 6 domains - Average hides critical variation - For health policy, **health domain score** matters, not overall average - But policymakers use overall score for all decisions

Officer's mistake: Using overall vulnerability to allocate health budget (wrong metric for decision).

4.3 Error 3: Selection Bias

Definition: Your sample/unit of analysis isn't appropriate for the question.

How it manifests: - Provincial boundaries are administrative, not analytical - Districts with similar profiles split across provinces - Interior Sindh + South Punjab have identical service deficits - But analyzed separately because of provincial division

Officer's mistake: Treating provinces as natural intervention units when data shows cross-provincial patterns.

4.4 Error 4: Ignoring Variance / Volatility

Definition: Looking only at means, ignoring the spread/instability.

How it manifests: - 47 districts have moderate aggregate scores but high domain variance - These are “tipping point” districts - unstable - Current policy ignores variance - only looks at level - No volatility management strategy

Officer’s mistake: Assuming moderate average = stable situation (high variance = high risk).

4.5 Error 5: Survivorship Bias (Inverted)

Definition: Only analyzing those who “failed” (high vulnerability), ignoring hidden failures in “survivors.”

How it manifests: - All attention on officially “high vulnerability” districts - “Low/moderate” districts assumed fine - But 25M people in these districts face service crises - Hidden in aggregate - never investigated

Officer’s mistake: Only studying the obvious failures, missing hidden failures.

5 Stakeholders and Positions

5.1 Federal Government

Ministry of Planning: - **You (Secretary P&D):** See the patterns, need approval for reform - **Analysis Wing:** Produced this finding, want action - **Old guard:** “We’ve always allocated by province and overall ranking”

Finance Division: - **Position:** “Budget is tight - prove new approach is better” - **Concern:** “Cross-provincial zones violate NFC award spirit” - **Question:** “How do we audit federal zones?”

Prime Minister’s Office: - **Political concern:** “Provincial CMs will revolt if we bypass them” - **Electoral math:** “Cities have more voters - but they’re not ‘officially vulnerable’” - **Timeline:** “Elections in 18 months - need quick wins”

5.2 Provincial Governments

Sindh: - **CM's position:** “Interior Sindh is our priority - not Karachi” - **Concern:** “Federal zones take away our autonomy” - **Reality:** Karachi’s 3.7M health crisis invisible to provincial focus

Punjab: - **CM's position:** “We’re least vulnerable - why reduce our allocation?” - **Concern:** “South Punjab service deficits will be exposed”

KP: - **CM's position:** “We need infrastructure, not service quality programs” - **Concern:** “Tipping point districts like Swat will lose funding”

Balochistan: - **CM's position:** “We’re most vulnerable - don’t reduce our share” - **Support:** “Federal management might actually work better”

5.3 Parliament

National Assembly: - **MNAs from urban areas:** “Finally someone sees our invisible crises!” - **MNAs from officially vulnerable areas:** “Don’t take our funding!” - **PAC:** “How will you ensure federal zones don’t become corrupt?”

Senate: - **Provincial representation concern:** “This undermines 18th Amendment” - **Technical senators:** “Data is compelling - but governance is hard”

5.4 Donors and Oversight

World Bank: - **Position:** “Evidence-based allocation - we support this” - **Concern:** “Implementation capacity for federal zones?” - **Conditionality:** “Show pilot results before scaling”

Auditor General: - **Position:** “Current allocation has no empirical basis” - **Concern:** “How do we audit cross-provincial spending?” - **Requirement:** “Clear KPIs for each zone”

5.5 Civil Society and Media

Urban advocacy groups: - **Position:** “Cities pay taxes but get ignored in vulnerability rankings” - **Support:** “Service Access Paradox validates our complaints”

Rural advocacy groups: - **Position:** “Don’t divert from interior districts to serve cities” - **Concern:** “Urban bias will worsen rural deprivation”

Media: - **Narrative 1:** “Government finally addresses urban health crisis” - **Narrative 2:** “Federal overreach - provinces losing autonomy” - **Investigation:** “Why did Karachi Malir crisis go unnoticed?”

6 Decision Questions for You

6.1 Question 1: Resource Allocation Strategy

The Dilemma: Current allocation is by province and overall ranking. Data shows this is inefficient and inequitable.

Options:

A) Maintain Status Quo - Continue provincial allocation by overall vulnerability rankings - “Don’t fix what isn’t politically broken”

B) Hybrid Approach - 70% by existing formula (political stability) - 30% ring-fenced for “paradox districts” and volatility management - Incremental change

C) Federal Development Zones - Radical restructuring: 5 cross-provincial zones - Differentiated strategies per zone - Bypass provincial governments partially

D) Domain-Specific Allocation - Allocate health budget by health vulnerability scores - Education budget by education scores - Infrastructure by transport/housing scores - Province-neutral, domain-specific

Your choice: _____

Rationale:

How to defend under audit:

Political strategy to get approval:

6.2 Question 2: The Urban Health Crisis

Immediate decision needed:

Karachi Malir (3.7M people) has 82nd percentile health vulnerability but 41st overall.

Options:

- A) Emergency Health Package** - Ring-fence PKR 10 billion for Karachi Malir health infrastructure - Redirect from Sindh's "interior priority" districts - 18-month emergency program
- B) Gradual Rebalancing** - Shift 10% of Sindh health budget to urban service quality over 3 years - Less disruptive but slower
- C) Wait for Next DVIP Revision** - Advocate for domain-specific reporting - Don't reallocate until official rankings change - 2-3 year timeline
- D) Federal Intervention** - Declare Karachi Malir health emergency - Direct federal funding (bypass province) - Politically contentious

Your decision: _____

Rationale:

How to explain to interior Sindh districts (who lose funding):

Metrics to prove success:

1. _____
 2. _____
 3. _____
-

6.3 Question 3: The Volatility Management System

47 districts at tipping points (moderate overall, high variance).

Design an early warning and stabilization system:

Components to consider:

Monitoring: - How often to reassess domain-specific vulnerabilities? - What triggers intervention (variance threshold, single domain spike)? - Who monitors (federal vs. provincial)?

Intervention: - Pre-emptive capacity building (before crisis hits)? - Rapid response funds (after tipping point crossed)? - Both?

Budget: - How much to set aside for volatility management? - Trade-off: Less for “stable” districts, more for volatility buffer

Your design:

Trigger criteria for intervention:

Governance structure (who decides, who implements):

6.4 Question 4: Cross-Provincial Coordination

Example: Interior Sindh + South Punjab service deficits

15 Sindh districts + 13 Punjab districts have identical profiles: - Poor health access - Poor education access
- Decent infrastructure - Need: Service delivery expansion

Currently managed separately. Potential 30-40% efficiency gain from joint approach.

Options:

A) Federal Service Delivery Authority - Create federal body to manage these 28 districts
- Cross-provincial mobile health/education units - Standardized facility designs, training programs - Provinces reduced to implementation

B) Inter-Provincial Compact - Sindh and Punjab sign MoU for joint program - Shared learning, procurement, capacity - Each province retains autonomy - Voluntary coordination

C) NFC Formula Adjustment - Add “intra-provincial disparity” factor to NFC - Provinces get bonus for addressing cross-border similar districts - Incentive-based, not mandated

D) Status Quo - Each province manages its own - No coordination - Lower efficiency

Your recommendation: _____

Rationale:

How to convince provincial CMs:

Pilot approach before full rollout:

6.5 Question 5: Communication Strategy

Scenario: You present these findings to Cabinet.

Prepare responses:

Finance Minister asks: > “This requires PKR 50 billion reallocation. How do I know domain-specific approach is better than current?”

Your response:

Punjab CM says: > “This is federal overreach. 18th Amendment gives us autonomy. You can’t bypass provinces.”

Your response:

Sindh CM says: > “Interior Sindh is dying. You want to divert funds to Karachi which is already developed?”

Your response:

World Bank representative asks: > “Conceptually sound, but can you actually implement cross-provincial zones in Pakistan’s political economy?”

Your response:

Opposition leader says: > “PTI/PMLN/PPP [your party] ignored cities for years. This is election gimmick.”

Your response:

7 Additional Context

7.1 Why This Wasn’t Noticed Before

Structural reasons the patterns were hidden:

7.1.1 1. Reporting Format

- DVIP releases overall rankings only
- Domain breakdowns in annexure (rarely read)
- Media reports overall rankings
- **No one looks at domain-specific gaps**

7.1.2 2. Provincial Silos

- Each province analyzes its own districts
- No cross-provincial comparative analysis
- Interior Sindh vs. South Punjab similarities never noticed
- **Analytical boundaries = administrative boundaries**

7.1.3 3. Urban Blind Spot

- Development policy focused on “backward areas”
- Urban assumed developed
- **No one asked:** “Are urban services actually good?”
- Karachi Malir’s health crisis assumed impossible

7.1.4 4. Aggregate Metrics Culture

- Planning Commission reports averages
- “Overall vulnerability” = one number
- **Easier to communicate, harder to understand**
- Domain complexity hidden

7.1.5 5. Political Incentives

- Provincial CMs showcase “most vulnerable districts”
 - Politically valuable to say “we help the worst”
 - **No political credit for volatility management or service quality**
 - Urban crises don’t fit narrative
-

7.2 Data Quality and Limitations

7.2.1 Data Sources

- **DVIP 2023:** Based on 2017 Census + administrative data
- **Domains:** Mix of census data, provincial datasets, surveys
- **Coverage:** All 129 districts (complete)

7.2.2 Known Limitations

- 1. Data Age:** - Based on 2017 census (7 years old) - Some domain indicators 2020-2022 - Population estimates may be off by 10-15%
- 2. Urban Data Quality:** - Housing and infrastructure data better in urban areas - Health/education service quality harder to measure - **Karachi Malir's 82nd percentile health might be 75th or 88th - but definitely crisis**
- 3. Variance Calculations:** - Assumes equal weight to all domains - Actual policy impact may differ by domain - High variance might be acceptable if weak domain is low-priority
- 4. Clustering:** - Natural zones are analytical construct - Implementation boundaries would be political negotiation - **Pattern is real, but boundaries are flexible**

7.2.3 What This Means for Decisions

Don't need perfect precision: - Karachi Malir health crisis is real (even if 75th instead of 82nd) - Cross-provincial patterns are clear - Volatility risk is genuine

But acknowledge uncertainty: - "Based on best available data" - "Margins of error exist but don't change core findings" - "Pilot and validate before full rollout"

8 Analytical Framework

8.1 Officer's Checklist for Hidden Patterns

Before accepting aggregate metrics, ask:

8.1.1 1. "What does the average hide?"

- Is there high variance within the aggregate?
- Are some components catastrophic while others excellent?
- **Karachi Malir: Overall 41st hides health 82nd**

8.1.2 2. “Am I using the right metric for this decision?”

- Overall vulnerability for health funding = wrong metric
- Domain-specific score = right metric
- Match your metric to your decision

8.1.3 3. “Are my analytical boundaries appropriate?”

- Provincial boundaries = administrative
- Natural vulnerability zones = analytical
- Don’t let admin boundaries constrain analysis

8.1.4 4. “Am I only seeing the obvious?”

- All attention on “officially vulnerable” districts
- Who’s hidden in “moderate” categories?
- **25M people invisible because moderate overall**

8.1.5 5. “What about volatility, not just level?”

- High variance = unstable = risky
 - Moderate with high variance > High with low variance
 - **47 tipping point districts ignored**
-

8.2 Decision-Making Framework

When data reveals inconvenient patterns:

8.2.1 Step 1: Validate the Pattern

- Is data quality adequate?
- Are limitations fatal or manageable?
- Do multiple indicators point same direction?
- **For this case: Yes, pattern is robust**

8.2.2 Step 2: Assess Policy Implications

- What decisions would change?
- How large is the impact? (25M people = large)
- What's the cost of inaction?
- **For this case:** Major reallocation needed

8.2.3 Step 3: Design Institutional Response

- Can current system adapt or need new structures?
- Federal zones vs. provincial adjustments
- Pilot vs. full rollout
- **For this case:** Structural reform required

8.2.4 Step 4: Build Political Coalition

- Who wins? (urban areas, volatile districts)
- Who loses? (officially vulnerable districts, provinces)
- How to compensate losers?
- **For this case:** Complex political economy

8.2.5 Step 5: Establish Safeguards

- How to prevent abuse of new system?
 - Audit trails, KPIs, review mechanisms
 - When to revisit and revise
 - **For this case:** Federal zone governance critical
-

9 Summary of Key Insights

9.1 The Three Hidden Patterns

9.1.1 1. Service Access Paradox

What: 25M+ people in “low/moderate” districts face catastrophic domain-specific failures

Example: Karachi Malir - 41st overall, 82nd health (3.7M people in crisis)

Why Hidden: Aggregate masks domain crises

Policy Implication: Urban emergency service fund (\$750M)

9.1.2 2. Volatility Crisis

What: 47 districts at tipping points (moderate overall, high variance)

Example: Khushab - 35th overall, but 0.22 variance (unstable)

Why Hidden: Policy ignores variance, only looks at levels

Policy Implication: Volatility management system (\$1.5B)

9.1.3 3. Wrong Boundaries

What: Natural vulnerability zones transcend provinces

Example: Interior Sindh + South Punjab = identical service deficits

Why Hidden: Provincial silos prevent cross-provincial analysis

Policy Implication: 5 Federal Development Zones (\$16B)

9.2 Analytical Errors Demonstrated

Error Type	How It Manifests	Impact
Ecological Fallacy	District aggregate hides domain crises	25M people ignored
Measurement Error	Using overall for domain decisions	Wrong allocation
Selection Bias	Provincial boundaries inappropriate	30-40% efficiency loss
Ignoring Variance	Focus on means, not volatility	47 districts at risk
Survivorship Bias	Only studying obvious failures	Hidden failures missed

9.3 Your Decision Challenge

As Secretary Planning & Development, you must:

1. **Decide:** Status quo vs. reform (federal zones, domain allocation, hybrid)
2. **Prioritize:** Karachi Malir emergency vs. gradual rebalancing
3. **Design:** Volatility management system
4. **Navigate:** Provincial resistance, political pressure, donor expectations
5. **Communicate:** Cabinet, CMs, Parliament, public

Core dilemma: Data is clear, but politics is complex. Perfect analysis → easy implementation.

Your job: Make defensible decisions with imperfect political conditions.

10 Recommended Reading

10.1 If You Want to Go Deeper

10.1.1 On Ecological Fallacy

- “Thinking Clearly with Data” - Chapter 3 (Describing Variables)
- Understand why averages mislead

10.1.2 On Provincial Inequality

- Pakistan’s Inter-Provincial Disparities (Planning Commission reports)
- NFC Award debates

10.1.3 On Urban Policy Blindspot

- “Urban Pakistan: Frames for Reading and Imagining Urbanism”
 - Why cities are ignored in development policy
-

End of Case Study

This case demonstrates how hidden patterns in data can reveal crises completely invisible to policymakers using standard aggregate metrics. The analytical errors are real. The policy implications are urgent. Your job: Make the call.