

❖ ECO-TECH HACKATHON 2026 • ENVIRONMENT WATCH: BUET

NodiWatch

AI-Powered Satellite Surveillance — Automated Environmental Triage for
River Pollution, Illegal Encroachment & Riverbank Erosion from Space

নদী দূষণ River Pollution

নদী দখল River Encroachment

নদী ভাঙ্গন Riverbank Erosion

⌚ One Platform. Three Crises. Real-Time Intelligence.

Team AlphaVerse • February 2026

① PROBLEM STATEMENT

Bangladesh's Rivers Face a Triple Threat

60%

Industrial pollution in Dhaka's rivers (IWM)

40%

Dhaka riverbanks seized by land grabbers

10K ha

Farmland lost to erosion every year

\$500M

Annual economic loss from riverbank erosion



① River Pollution (নদী দূষণ)

60% of Dhaka's river pollution is industrial, yet among 2,500+ factories, **pinpointing the source is impossible** without spectral evidence — polluters escape accountability.

Untraceable sources

Zero accountability



② River Encroachment (নদী দখল)

40% of Dhaka riverbanks seized by **land grabbers**. Filling happens so slowly it's undetectable — until floods devastate entire communities.

Incremental & invisible

No temporal proof



③ Riverbank Erosion (নদী ভাঙ্গন)

~**10,000 hectares** vanish yearly. Over **1 million people** displaced annually across 94 upazilas — costing \$500M/year. Projected to rise **13% by 2050**.

Climate-accelerated

Field surveys impossible

Sources: IWM Study, Finance Today, bdnews24/RDRC, Banglapedia, ResearchGate (2024-2025)

STAKEHOLDERS

Who Needs This Solved?



Government Agencies

DoE — automated pollution tracking & industrial cluster profiling

NRCC — monitor 1,400+ rivers for encroachment

BWDB — erosion early warning & embankment planning

DDM — evacuation & disaster response



Financial & Legal

Banks — automated "Green Banking" due diligence per Bangladesh Bank mandate

Environmental Courts — time-series satellite intelligence to support targeted prosecution

9M+ citizens in flood-prone Dhaka directly at risk



NGOs & International

BAPA, RDRC, Waterkeepers Bangladesh — satellite evidence for policy advocacy & public awareness

World Bank, ADB, UNDP — ESG compliance data for funded environmental infrastructure projects

Global RMG Buyers — supply chain environmental due diligence

② PROPOSED SOLUTION

Introducing NodiWatch

An AI-powered satellite surveillance platform that transforms **10 years of free satellite imagery** into actionable enforcement intelligence for Bangladesh's rivers.

Pollution Fingerprinting (নদী দৃষ্টি)

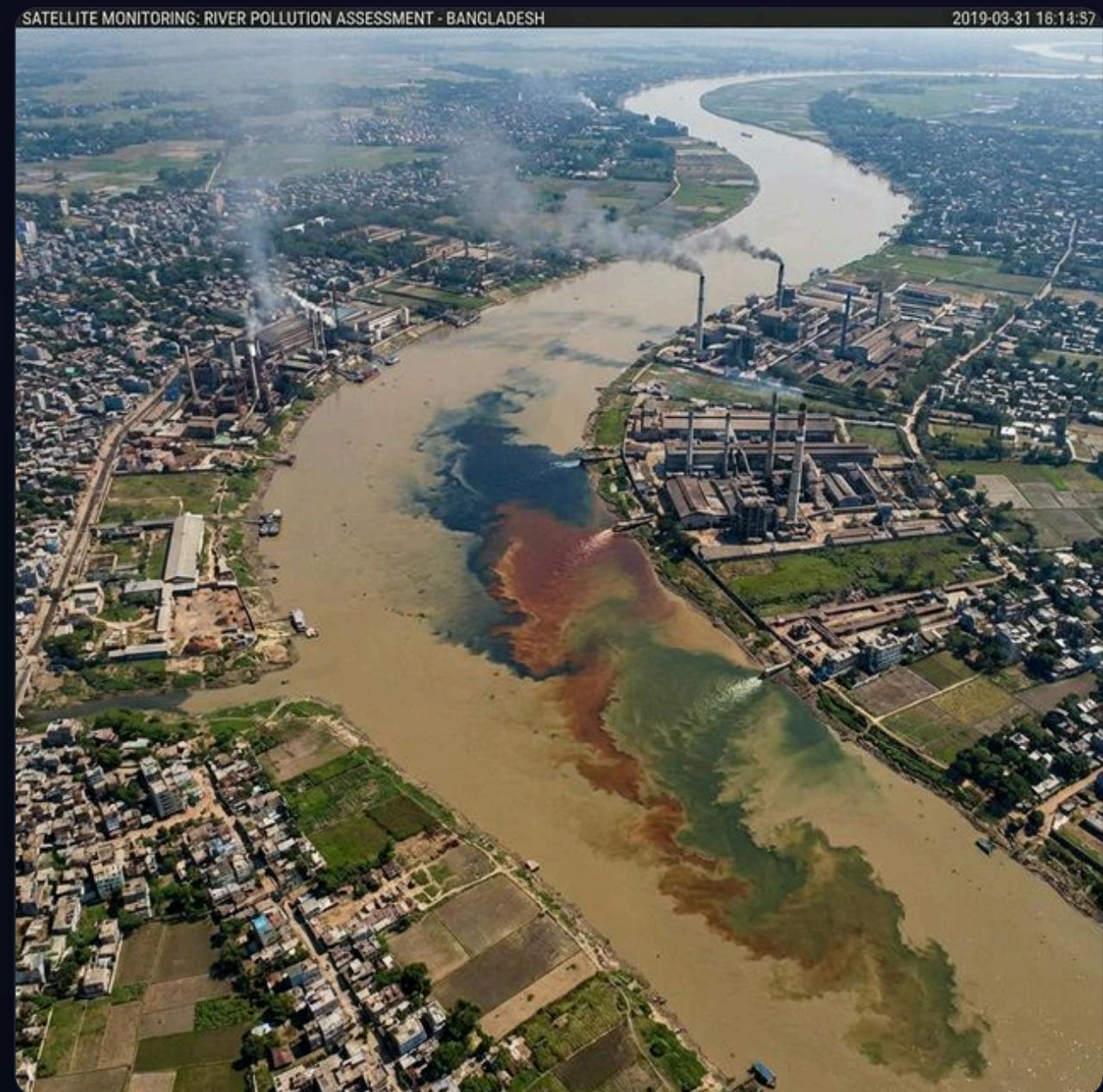
Multispectral indices (NDTI, CDOM, SWIR color ratios) profile effluent type — textile dye (Red/Blue ratio), tannery (high turbidity + organic load), chemical discharge (SWIR anomalies). Each industrial cluster gets a **probability profile**.

Encroachment Detection (নদী দখল)

MNDWI-based water segmentation compares 2016 vs 2026 river boundaries from Sentinel-2 imagery (10m resolution). Automatically generates **enforcement-grade intelligence** showing river width shrinkage over time.

Erosion Risk Forecasting (নদী ভাঙ্গন)

Sentinel-1 SAR radar (works through monsoon clouds, 12-day revisit) + temporal analysis tracks shoreline regression. AI forecasts **probabilistic erosion risk corridors** — enabling BWDB and DDM to deploy resources proactively.

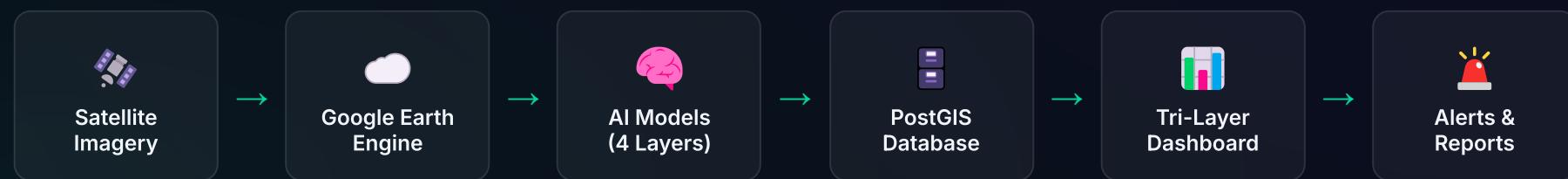


River pollution visible from satellite — NodiWatch profiles the effluent type & likely source cluster

 **Key Insight:** The same AI that detects land *filling* (encroachment) also detects land *disappearing* (erosion). **One model, two critical problems solved.**

② HOW NODIWATCH WORKS

From Raw Satellite Data to Actionable Intelligence



📡 Data Sources (All Free)

- **Sentinel-2** — 10m optical, 5-day revisit (pollution + encroachment)
- **Sentinel-1 SAR** — Radar, works through clouds/night, 12-day revisit (erosion)
- **Landsat 8/9** — 30m, 16-day revisit, 10+ year archive (historical baselines)
- **OpenStreetMap** — Industry geolocation for factory attribution

📍 Output Products

- **Pollution Heatmap** — color-coded severity zones with factory attribution scores
- **Encroachment Timeline** — 2016→2026 river boundary change animation
- **Erosion Risk Map** — probabilistic risk corridors with severity grading
- **Intelligence Reports** — enforcement-grade PDFs with timestamped satellite data

[Sentinel-2](#)

[Sentinel-1 SAR](#)

[Landsat 8/9](#)

[Google Earth Engine](#)

[TensorFlow](#)

[Scikit-learn](#)

[PostGIS](#)

[React/Next.js](#)

[Python](#)

[OpenStreetMap API](#)

③ AI / MODERN TECHNOLOGY

How Our AI Actually Works

STEP 1 Water Segmentation (MNDWI + ML)

Modified Normalized Difference Water Index (MNDWI) classifies every pixel as **water** or **land**. By comparing 2016 vs 2026 water masks, we detect where river area *shrank* (encroachment) or where land *disappeared* (erosion). ML enhances boundary accuracy.

STEP 2 Pollution Classification (Random Forest)

A Random Forest model learns unique spectral signatures: textile effluent = high Red/Blue ratio, tannery = high turbidity (NDTI) + organic load (CDOM), chemical discharge = SWIR anomalies. Each polluted zone gets classified by **effluent type**.

STEP 3 Erosion Forecasting (SAR + ML)

Sentinel-1 SAR penetrates monsoon clouds (12-day cycle). Combined with ML, it tracks shoreline retreat rate and forecasts **high-risk erosion corridors for the next season** — even during heavy rains when optical satellites are blind.

STEP 4 Industrial Cluster Profiling (Bayesian)

For each pollution hotspot, the system queries OpenStreetMap for factories within 500m. A Bayesian model weighs **distance + pollution pattern + industry type** to rank suspects.

Example output:

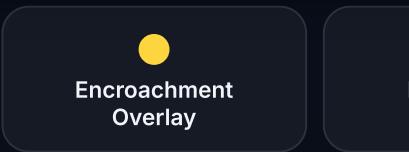
"Textile cluster: 78% • Tannery cluster: 22%"

⌚ Why This Architecture?

- **MNDWI** = proven, robust water-land classification index
- **Random Forest** = fast, interpretable spectral matching
- **SAR** = weather-independent, critical for monsoon-heavy Bangladesh
- **Bayesian** = rigorous probabilistic ranking with spatial decay

④ FEATURES & APPLICABILITY

Tri-Layer Heatmap Dashboard



● Pollution Severity Heatmap

Color-coded risk zones (green → yellow → red) overlaid on a live river map. Click any hotspot to see: pollution type, severity score, nearby factory list with probability rankings, and historical trend data.

● Encroachment Timeline Layer

Toggle between 2016 → 2026 river boundaries. Shaded areas show exactly where land filling occurred. Slider to animate year-by-year changes. Each zone tagged with area lost (m^2).

● Erosion Risk Corridors

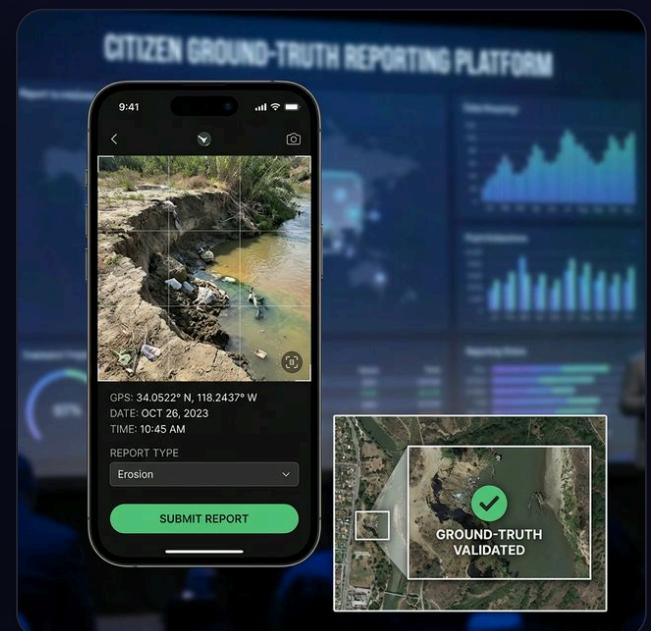
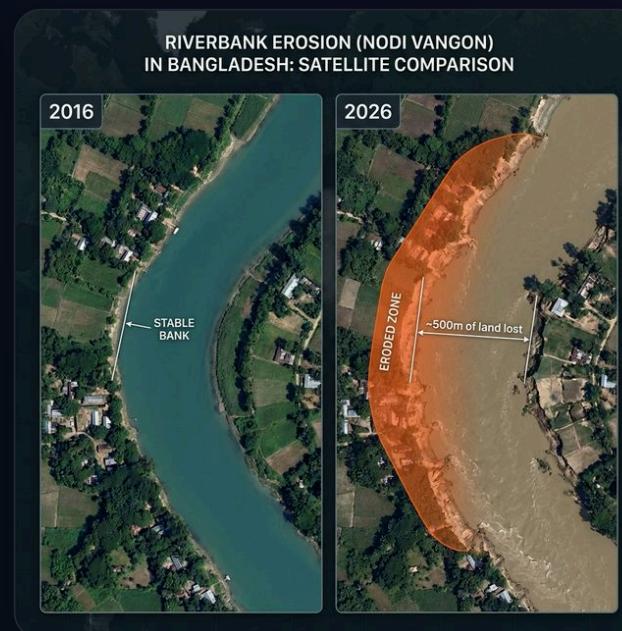
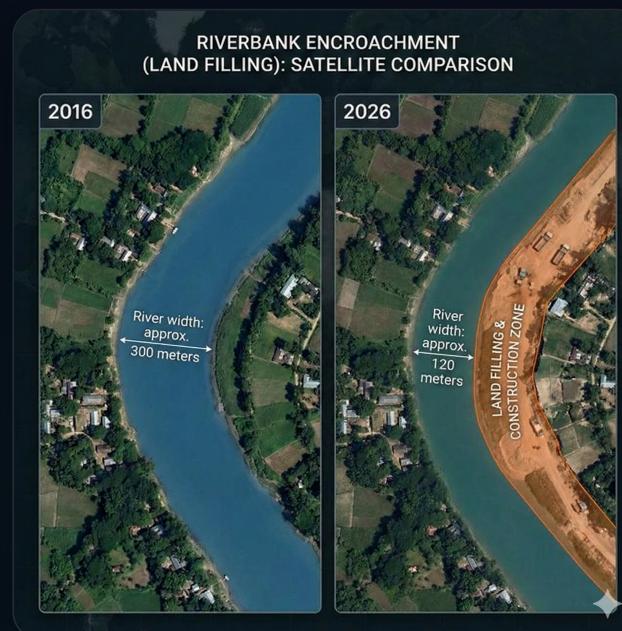
SAR-derived erosion probability zones: **high (red) / medium (orange) / low (green)**. Shows predicted bank retreat distance for next monsoon season. Critical for BWDB embankment planning.

● Smart Alert System

Automated SMS/email when: pollution spikes above threshold, encroachment exceeds 10% baseline width, or erosion rate crosses critical level. Configurable per river segment.

④ EVIDENCE & GROUND TRUTH

Satellite + Citizen Validation



Pollution Evidence (নদী দূষণ)

Multispectral indices reveal **effluent type & source**. Textile dye (Red/Blue), tannery (NDTI), chemical (SWIR). Each factory within 500m gets a probability score.

Encroachment Evidence (নদী দখল)

10-year satellite comparison: river width **300m** → **120m**. Land filling zones highlighted. Auto-generated as enforcement triage reports.

Erosion Detection (নদী ভাঙ্গন)

SAR + optical imagery reveals bank retreat. Orange zones show **eroded land**. Alerts BWDB & DDM before communities lose homes.

Citizen Ground-Truth

Community members upload **geotagged photos** of pollution, encroachment, or erosion. GPS-validated against satellite data.

Enforcement-Grade Intelligence: Every report includes satellite timestamps, spectral data, geolocation, and optional citizen photo corroboration — **designed to direct DoE/NRCC inspection teams to exact coordinates**

⑤ MARKET OPPORTUNITY

A Massive, Untapped Market

1,400+

Rivers to monitor nationwide

\$500M

Annual loss from erosion alone

94

Upazilas severely affected

Zero

Automated monitoring systems exist today

B2G — Government

DoE, NRCC, BWDB, DDM — replace manual inspections with AI-driven enforcement, erosion early warning, embankment planning.

DoE NRCC BWDB DDM

B2B — Financial

Banks need automated environmental risk scoring per Bangladesh Bank's Green Banking mandate. **Environmental Courts** need time-series evidence.

Banks Courts

B2G — NGO & Advocacy

BAPA, RDRC, Waterkeepers Bangladesh — satellite evidence for environmental policy advocacy, public awareness campaigns, and legal cases.

BAPA RDRC Waterkeepers

B2I — International

World Bank, ADB, UNDP and global RMG buyers need precise ESG data to monitor environmental compliance of funded projects & supply chains.

World Bank UNDP ADB

⑥ BUSINESS MODEL

Free + Paid Revenue Model

FREE TIER Open Access

Available to all — no cost, no login:

- Basic river health heatmap (public dashboard)
- Monthly pollution severity snapshots per river
- Citizen ground-truth photo submission
- Open API for NGO researchers with rate limits
- Community alert subscription (SMS/email)

Goal: Maximize adoption, build ground-truth training data, create public awareness

PAID TIER Premium Intelligence

For government, banks, international orgs:

- **Real-time** tri-layer heatmaps with cluster attribution
- Unlimited intelligence report generation (enforcement-grade PDFs)
- Erosion risk corridors & embankment advisories
- Green Banking API integration (per-query billing)
- Custom river segment monitoring & priority alerts
- Historical data access (full 10-year archive)

 **Key Cost Advantage:** Sentinel-2, Sentinel-1 SAR & Landsat data are **completely free** — publicly funded satellite programs. GEE is free for research. Our primary costs are **compute + engineering**.

⑥ REVENUE STREAMS

Sustainable Growth Path

TIER 1 — B2G

Government SaaS License

৳ 15–25 Lakh/yr

Annual subscription for DoE, NRCC, BWDB. Full dashboard access, unlimited evidence reports, erosion forecasts, automated alerts, API access per region.

TIER 2 — B2B

Green Banking API

Pay-per-query

Banks query NodiWatch API during loan processing. Returns factory pollution risk score + violation history. Automates Bangladesh Bank's Green Banking compliance.

TIER 3 — B2I

ESG Data Licensing

Custom / Annual

World Bank, ADB, UNDP, global RMG brands license ESG compliance data. Custom river monitoring reports for environmental development project tracking.

💰 Year 1 Target

2–3 government pilots (DoE, BWDB) + 5 banks on API + 1 international org license. Focus on Dhaka river system first. Revenue target: ৳ 40–60 Lakh

📅 Year 3 Vision

Expand to all 1,400+ rivers. 20+ banks on API. UNDP/World Bank data licensing. Regional expansion to India, Myanmar. Revenue target: ৳ 2–5 Cr

⑦ ENVIRONMENTAL & SOCIAL IMPACT

Transforming River Protection



Triple Enforcement

One platform addresses pollution, encroachment **and** erosion — three crises, one intelligent system. No duplicate infrastructure needed.



Enforcement Intelligence

10-year satellite comparison generates high-probability intelligence — timestamped, geolocated, satellite-verified. Directs inspection teams to exact coordinates.



Erosion Early Warning

SAR-based erosion risk corridors alert **before** banks collapse — protecting ~1M displaced people/year, potentially saving \$500M annual loss.



Infrastructure Guidance

Erosion corridors guide BWDB embankment projects & DDM evacuation — **data-driven** protection instead of reactive crisis response.



Climate Resilience

Erosion projected to rise **13% by 2050**. NodiWatch provides real-time intelligence infrastructure to adapt and build climate-resilient river communities.



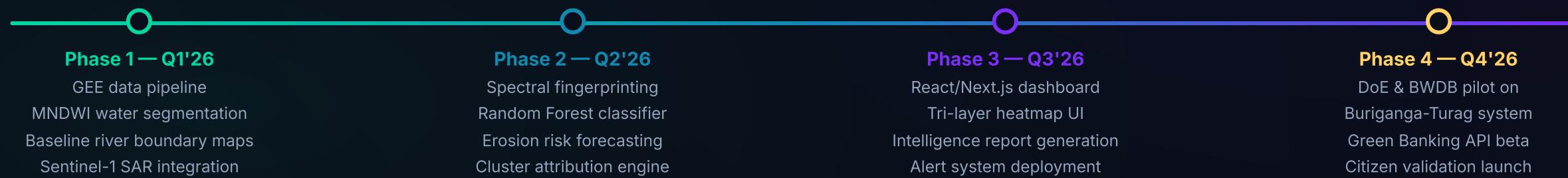
Community Empowerment

Citizen ground-truth gives riverside communities a **voice**. Their photos become satellite-corroborated evidence — democratizing environmental monitoring.

⑧ PROTOTYPE & ROADMAP

From Concept to Impact

Current Stage: Early Prototype — GEE Pipeline Validated



Challenges & Mitigations

- **Cloud cover** — Sentinel-1 SAR works through monsoon clouds
- **10m resolution limit** — cluster-level profiling, not individual pipe detection
 - **Erosion vs. natural deposition** — seasonal baseline filtering
 - **Ground-truth gap** — citizen photos + DoE field calibration

Scalability Path

- **Pilot:** Buriganga, Turag, Shitalakshya, Jamuna (4 rivers, Dhaka region)
 - **Year 2:** All 94 erosion-prone upazilas + 50 major rivers
 - **Year 3+:** Pan-Bangladesh 1,400+ rivers → South & SE Asia expansion

⑨ TEAM ALPHAVERSE

The Team Behind NodiWatch


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AI / ML Lead

CNN & Random Forest models, spectral analysis, TensorFlow pipeline, erosion forecasting

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EA
Ekramul Haque Amin

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Habiba Rafique

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SK
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Full-Stack Developer

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[🔗 LinkedIn](#)

Let's Protect Our Rivers — From Space

নদী দৃষ্টি • নদী দখল • নদী ভাঁজন — NodiWatch gives authorities the intelligence to protect rivers at scale.

 Thank You — Innovate for Green