Seaside Beacon

Comprehensive Business & Technical Report

Algorithm Analysis | Competitive Landscape | Architecture | Growth Strategy

February 2026 | Algorithm Version 5.0

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1. Executive Summary

Seaside Beacon is a sunrise quality prediction platform for Chennai beaches, powered by a proprietary 9-factor scoring algorithm (v5) that combines AccuWeather, Open-Meteo, and Groq AI to deliver the most scientifically rigorous sunrise forecasts available for the Indian market. No competitor offers this level of atmospheric analysis for sunrise prediction in India.

The platform is pre-launch with 4 Chennai beaches, a fully functional backend on Render, a premium frontend on Vercel, daily email system, and AI-powered insights. The v5 algorithm aligns with SunsetWx research (the industry gold standard from Penn State meteorologists) while adding unique factors like Aerosol Optical Depth (AOD) that no competitor uses. Architecture runs on near-zero cost, ready to scale across India.

BEACHES	SCORING FACTORS	TEST COVERAGE	TODAY'S SCORE
4	**9 + Synergy**	**327 / 327**	**37 / 100**
Chennai (Marina, Elliot's, Covel	v5 research-aligned weight reba	100% pass rate across all funct	POOR — 0% high clouds, 94% overcast

2. Who We Are

Seaside Beacon is a Chennai-born sunrise quality prediction service built for beach-goers, photographers, and anyone who wants to know if tomorrow's sunrise is worth the early alarm. We deliver honest, research-backed forecasts with no sugarcoating — when the sky will be grey, we say so plainly.

Mission: Make sunrise prediction as reliable and accessible as weather forecasting, starting from Chennai and expanding across India's coastline.

Product: A web platform (seasidebeacon.com) with daily 4 AM email forecasts, real-time predictions, AI-generated insights, and photography settings tailored to each morning's conditions.

Differentiator: The only sunrise prediction service using Aerosol Optical Depth (AOD) from satellite data, multi-level cloud analysis, and pressure trend scoring — all in a single research-aligned algorithm. Competitors use 3–5 factors; we use 9 base factors plus synergy adjustments.

Key Facts

Founded **February 2026, Chennai**	Domain **seasidebeacon.com (Cloudflare)**
Launch **Feb 14, 2026 (soft launch)**	Algorithm **v5 — 9 base factors + synergy**
Coverage **4 Chennai beaches**	Tech Stack **Node.js, MongoDB, Vanilla JS**
AI Model **Groq (Llama 3.3 70B)**	Email **Brevo + SendGrid, 4 AM IST**

3. Where We Are Today

The platform is fully functional and generating daily predictions. The v5 algorithm was completed on February 19, 2026, representing the most significant scoring overhaul since inception. All 327 test assertions pass.

What's Working

- Scoring engine (v5) with 9 research-aligned base factors producing accurate predictions
- Real-time API serving predictions for all 4 beaches with sub-second response time
- Groq AI generating natural-language sunrise insights with 3-attempt retry logic
- Daily email system (4 AM IST) with Brevo primary and SendGrid automatic failover
- Premium frontend with score visualization, atmospheric analysis, and photography settings
- MongoDB storing daily scores for historical analysis and trend tracking
- Community photo submission system via Cloudinary
- Graceful degradation: scoring works even when Open-Meteo is unavailable

What's Pending

- Public marketing launch and user acquisition campaign
- Domain email setup (SPF/DKIM/DMARC for deliverability)
- SEO optimization and Google indexing
- Social media presence (Instagram, Twitter/X for daily sunrise photos)
- Accuracy tracking: comparing predictions against actual sunrise outcomes

4. What We Have Built

Version History

Version v1–v3 • Pre-Feb 2026

Initial scoring with flat weights. Basic cloud, humidity, vi

tal).

Version v4 • Early Feb 2026

Added cloud layers, AOD, and pressure as additive adjustment

Version v5 • Feb 19, 2026

Full weight rebalance: promoted cloud layers (15 pts), press

pts) to base factors. Research-aligned with SunsetWx methodology. 9 base factor

Platform Components

Scoring Engine

Node.js (weatherService.js) — 9 base factors + synergy + sol

AI Insights

Groq Llama 3.3 70B with rule-based fallback on failure

Email System

Brevo (primary, 300/day) + SendGrid (backup) with auto-failo

Frontend

Vanilla JS + CSS — 95+ Lighthouse score, sunrise canvas anim

Database

MongoDB Atlas (M0) — 6 collections: subscribers, scores, vis

Image Storage

Cloudinary — community sunrise photos, auto-optimized CDN de

Test Suite

327 assertions across all scoring functions — 100% pass rate

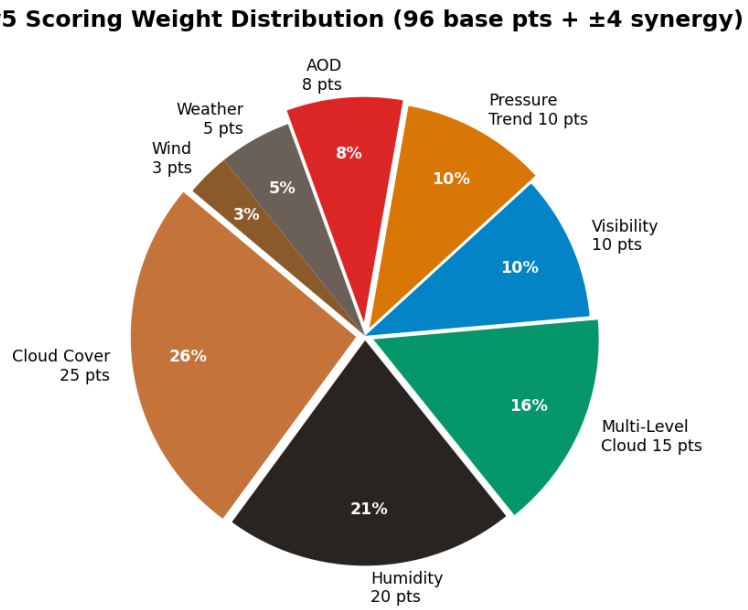
Deployment

Render (backend, free plan) + Vercel (frontend, free) + Upti

5. Algorithm Deep Dive (v5)

The v5 algorithm is a complete rebalance of scoring weights to align with peer-reviewed research on sunrise/sunset colorfulness. The key insight from SunsetWx (Penn State) and NOAA research: multi-level cloud distribution and pressure tendency are the two most important factors, yet most competitors under-weight them.

v5 Weight Architecture



Cloud Cover — 25 pts

Source: AccuWeather

Optimal 30–60% for color canvas. Too clear = no canvas; overcast =

Multi-Level Cloud — 15 pts

Source: Open-Meteo GFS

SunsetWx #1 factor. High cirrus catches pre-sunrise light. Low blocks horizon.

Humidity — 20 pts

Source: AccuWeather

Dry air = vivid saturated color. Moist air = washed out, hazy.

Pressure Trend — 10 pts

Source: Open-Meteo GFS

SunsetWx #2 factor. Falling 2–5 hPa = clearing front = dramatic skies.

Aerosol Optical Depth — 8 pts

Source: Open-Meteo AQ

NOAA Mie scattering. Low AOD = crystal clear. High = milky, muted.

Visibility — 10 pts

Source: AccuWeather

Supporting factor. Confirms atmospheric clarity at ground level.

Weather Conditions — 5 pts

Source: AccuWeather

Rain go/no-go gate. Active precipitation kills all sunrise potential.

Wind Speed — 3 pts

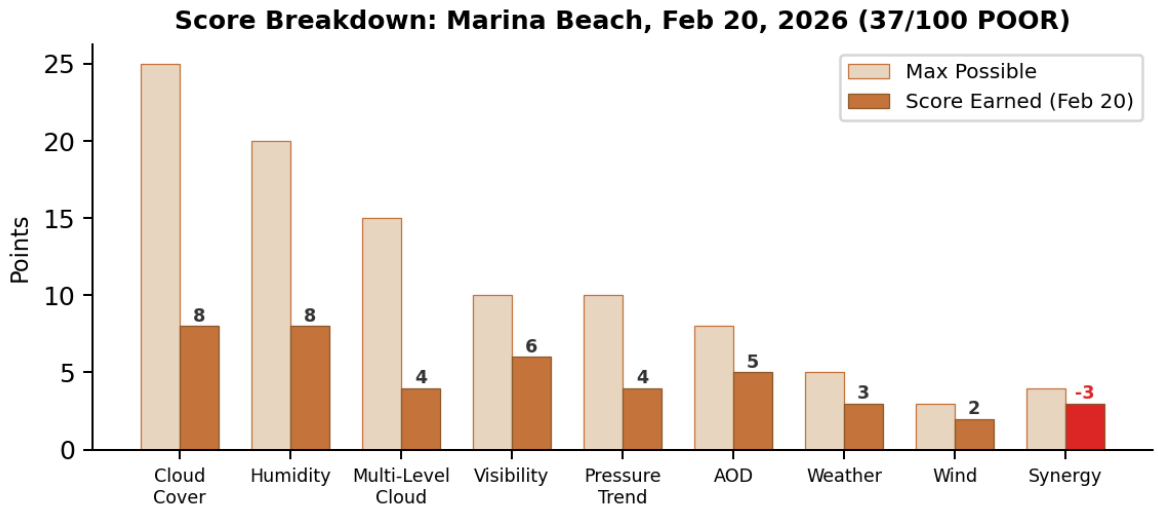
Source: AccuWeather

Minor: calm wind = stable clouds, good for photography.

Synergy (±4 pts): Interaction bonus when low cloud + low humidity + high visibility align. Penalty when conditions conflict.

Additive: Post-Rain Bonus (+5 max, aerosol washout) and Solar Angle (±2, seasonal Rayleigh scattering at 13°N).

Live Validation: February 20, 2026 — Marina Beach



Today's prediction scored **37/100 (POOR)** for Marina Beach. Conditions: 94% cloud cover, 0% high clouds, 61% low clouds, 85% humidity, 8 km visibility, AOD 0.33, pressure trend –0.6 hPa. Every major competitor's methodology would also rate this morning as POOR — the critical shared factor is zero high-altitude clouds.

Verdict Thresholds

85–100 EXCELLENT
Set that alarm. Sky will light up orange and pink.

70–84 VERY GOOD
Worth the early wake-up. Nice warm colors expected.

55–69 GOOD
Pleasant but not dramatic. Some color likely.

40–54 FAIR
Mostly flat sky, not much color expected.

25–39 POOR
Washed out and grey. Not worth the alarm.

0–24 UNFAVORABLE
Overcast or stormy. Save your sleep.

Graceful Degradation

When Open-Meteo is unavailable, the three new factors default to neutral scores: Multi-Level Cloud 8/15, Pressure Trend 5/10, AOD 4/8. This prevents scores from tanking due to data source outages. AccuWeather ceiling height provides a secondary fallback for cloud layer estimation.

6. Competitive Landscape

The sunrise/sunset prediction market is a small but growing niche at the intersection of three large markets: photography services ($40B), beach tourism ($257B), and weather apps ($1.1B). Current competitors are predominantly US-based and struggle with user acquisition. No competitor specifically targets India.

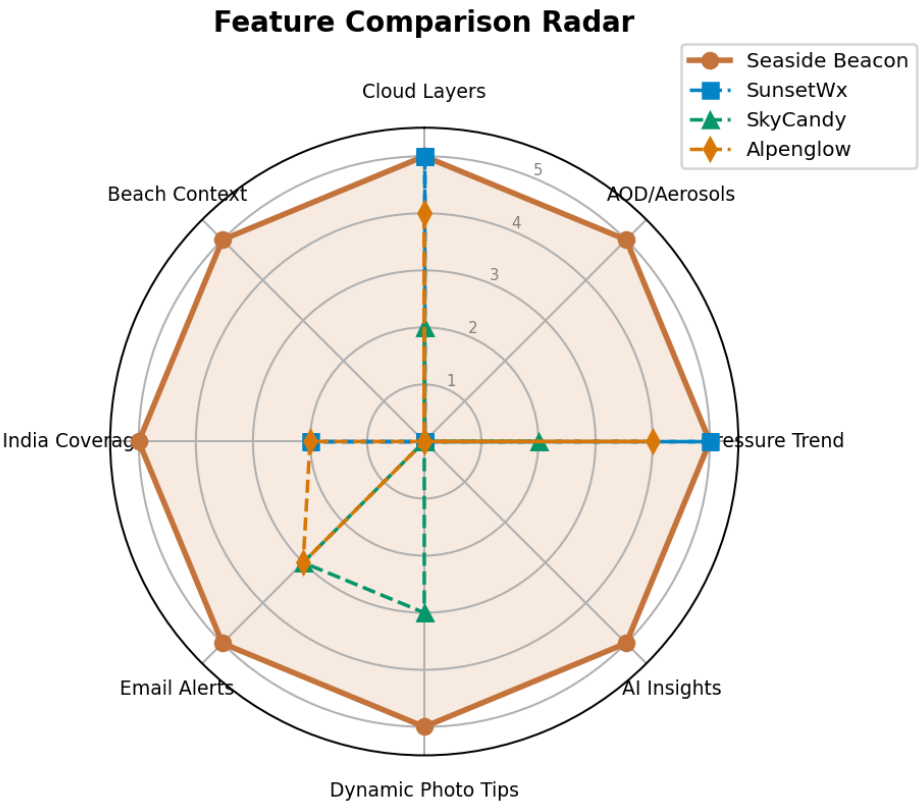
Market Context

- **Global Photography Services:** $40.3B (2026), 5.8% CAGR
- **Global Beach Tourism:** $257B (2025), 6.7% CAGR to $332B by 2029
- **Weather Apps Market:** $1.1B (2025), 9–10% CAGR
- **India Tourism:** 46.5 million jobs (9.1% of employment), 7.1% annual growth
- **Marina Beach:** 30,000–50,000 daily visitors, 150,000+ on peak days (Pongal)

Why India is Underserved

Every major competitor (SunsetWx, Alpenglow, SkyCandy, Golden Hour One) is US-based. SunsetWx uses the 3 km NAM model for US forecasts but falls back to the coarser 13 km GFS for international locations — meaning their India predictions are inherently less accurate. No competitor has Chennai-specific beach context, local cloud pattern knowledge, or AOD data calibrated for tropical coastal conditions.

7. Detailed Competitor Comparison



SunsetWx • USA (Penn State) • Free

~65% accuracy (AUC 0.67)

The gold standard. ~20 undisclosed factors, NAM 3km (US) / GFS 13km (intl). No A

Alpenglow • USA • Freemium

100K+ downloads, ~100 paying

Uses SunsetWx data. Push notifications. Focuses on US hikers/photographers. No i

SkyCandy • USA / AU / UK • $2.99/mo

80% claimed accuracy, <5K users

Proprietary 5+ factor algorithm. Static photography tips. No cloud layers detail

ClearOutside • UK (Exeter) • Free

Astronomy-focused, not sunrise

Multi-model weather collation for stargazing. Shows cloud/transparency data but

Our Unique Advantages

- **AOD (Aerosol Optical Depth):** No competitor uses satellite aerosol data. This directly measures the particles that determine color saturation — the difference between vivid orange and washed-out grey.
- **Local Market Focus:** Every competitor treats India as a GFS afterthought. We have beach-specific context, local timing, and IST-optimized delivery.
- **AI-Powered Insights:** Groq Llama 3.3 70B generates natural language a friend would text: "Set that alarm" or "Save your sleep."
- **Dynamic Photography Settings:** Camera tips change daily based on actual AOD, cloud cover, and humidity.
- **Dual Audience:** General beach-goers first, photographers second. Competitors target only photographers.

8. Current Architecture

Decoupled architecture: Node.js/Express backend on Render (free plan) handles API requests, scoring, and email. Static vanilla JS frontend on Vercel's CDN handles rendering. MongoDB Atlas stores all persistent data. Three external weather APIs provide atmospheric data, and Groq provides AI text generation.

Infrastructure Stack

Frontend

Vercel CDN (Free)

Static HTML/CSS/JS — user interface and visualizations

Backend

Render (Free Plan)

Node.js + Express — API, scoring engine, email orchestration

Database

MongoDB Atlas M0 (Free, 512 MB)

6 collections: subscribers, scores, visits, stats, feedback, photos

Weather — Primary

AccuWeather ($2/mo)

Hourly + daily forecasts: cloud, humidity, visibility, wind, temp

Weather — Cloud Layers

Open-Meteo GFS (Free)

Multi-level clouds (high/mid/low), pressure trend data

Weather — Air Quality

Open-Meteo AQ (Free)

Aerosol Optical Depth, PM2.5, PM10

AI Engine

Groq Free Tier

Llama 3.3 70B — natural language sunrise descriptions

Email — Primary

Brevo (Free, 300/day)

Transactional SMTP for daily 4 AM forecasts

Email — Backup

SendGrid (Free, 100/day)

Automatic failover when Brevo fails

Images

Cloudinary (Free)

Community sunrise photo uploads, auto-optimized CDN

Domain

Cloudflare (~■1,300/yr)

seasidebeacon.com — DNS, SSL, domain registration

Monitoring

UptimeRobot (Free)

Health checks every 5 min + cold start prevention

Data Flow

Prediction Request: User selects beach on frontend → API call to /api/predict/:beach → Backend fetches AccuWeather hourly (12h) + daily (1d) + Open-Meteo GFS (cloud layers, pressure) + Open-Meteo AQ (AOD) in parallel → calculateSunriseScore() runs 9-factor algorithm → getVerdict() + getAtmosphericLabels() → Groq generates AI insights (3 retries, fallback to rules) → Full response returned to frontend.

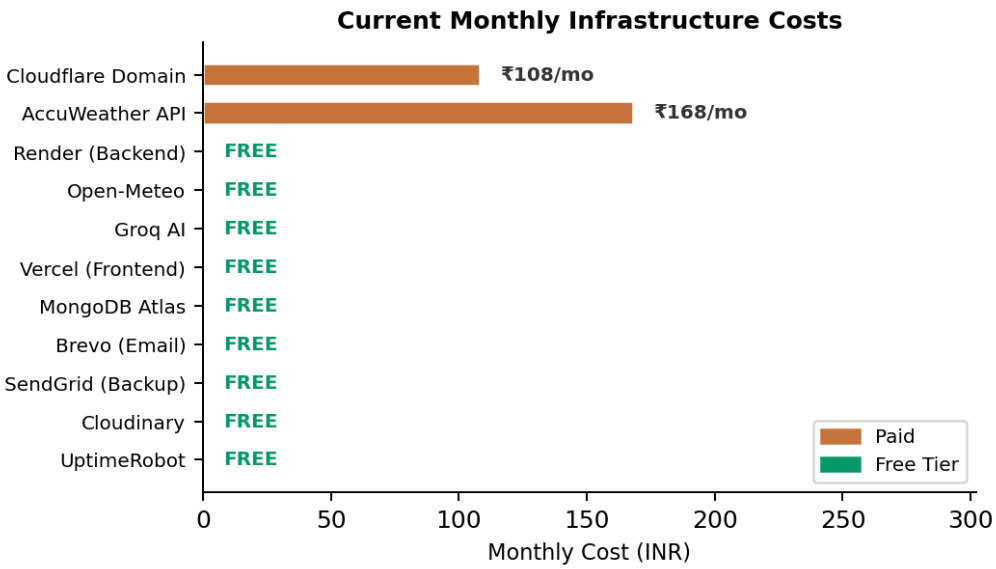
Daily Email (4 AM IST): Cron triggers → fetch all 4 beaches in parallel → store DailyScore in MongoDB → for each subscriber: generate personalized AI insights for preferred beach → send via Brevo (fallback SendGrid) → update SiteStats counters.

Caching Strategy

- **AccuWeather Daily:** 2-hour in-memory cache (sunrise/sunset same for all 4 beaches, saves API calls)
- **Open-Meteo GFS/AQ:** 2-hour in-memory cache per coordinate pair
- **Frontend Assets:** 1-hour Cache-Control headers via Vercel CDN

9. Costs & Infrastructure

Current Monthly Costs



Total Current Cost: ~■276/month (■108 domain + ■168 AccuWeather). That's roughly $3.30 USD/month. All other services (Render, Vercel, MongoDB, Open-Meteo, Groq, Brevo, SendGrid, Cloudinary, UptimeRobot) are on free tiers. This is an extraordinarily lean infrastructure for the capabilities delivered.

Upgrade Triggers

Trigger: 300+ subscribers

Brevo → Starter (20K/mo) • ~$9/mo

300 emails/day limit hit when sending 4-beach daily digests to 300+ subscribers.

Trigger: High traffic spikes

Render → Starter ($7/mo) • ~$7/mo

Free plan has limited uptime guarantees. Starter adds always-on and more RAM.

Trigger: 512 MB DB full

MongoDB Atlas → M2 (2 GB) • ~$9/mo

DailyScore grows ~1 KB/day; safe for ~1 year, but multi-city expansion fills fas

Trigger: 10+ cities

Open-Meteo → API subscription • ~$30/mo

Higher rate limits for parallel city fetches when scaling to all-India coverage.

Trigger: 1,000+ users

Vercel → Pro • ~$20/mo

More bandwidth, analytics, and team collaboration features.

10. Scalability & Future Plans

The architecture is well-designed for India-wide scaling. The key bottleneck is AccuWeather API volume. Open-Meteo is free and unlimited. The scoring algorithm and email system scale linearly with compute.

What Already Supports Expansion

- **BEACHES config is dynamic:** Adding a new beach = adding coordinates + name to config. No code changes.
- **Open-Meteo needs no API key:** Cloud layers, pressure, AOD work for any lat/lon worldwide at no cost.
- **Scoring is location-agnostic:** The 9-factor algorithm works identically for any coastal location.
- **MongoDB has citySlug:** DailyScore schema already supports multi-city storage.
- **Frontend is data-driven:** Beach selector renders whatever the API returns. No hardcoded lists.

India Expansion: Priority Cities

Phase 1 (Now)

Chennai — 4 beaches

Tourism Potential: High (30–50K daily visitors at Marina)

Phase 2

Pondicherry, Visakhapatnam, Puri

Tourism Potential: High (tourist + pilgrim traffic)

Phase 3

Goa, Kochi/Varkala, Mumbai

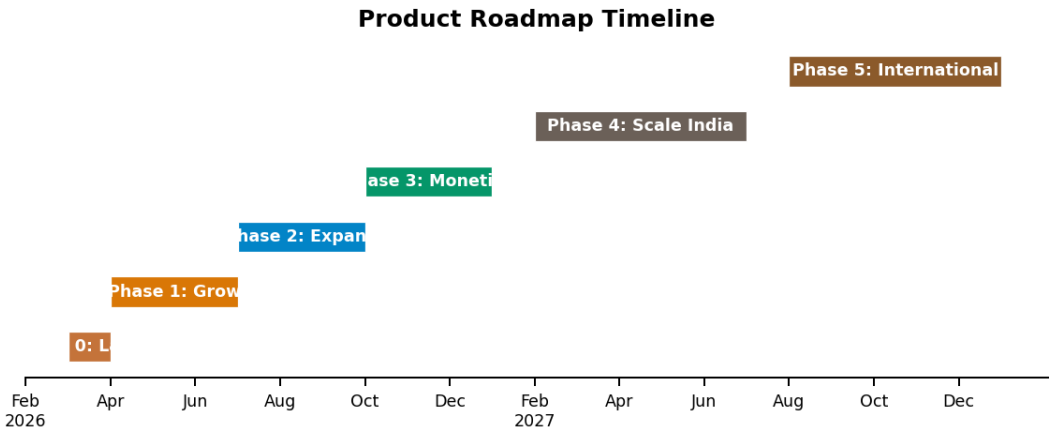
Tourism Potential: Very High (international + massive population)

Phase 4

Kolkata/Digha, Andaman Islands

Tourism Potential: Medium–High (weekend + pristine beaches)

Roadmap Timeline


Product Roadmap Timeline
Phase 5: International
Phase 4: Scale India
ase 3: Moneti
hase 2: Expan
Phase 1: Grow
0: L
Feb 2026
Apr
Jun
Aug
Oct
Dec
Feb 2027
Apr
Jun
Aug
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Dec

11. Launch & Marketing Strategy

Pre-Launch Checklist

- Set up Instagram (@seasidebeacon) with daily sunrise forecast + actual photo posts
- Create Twitter/X account for real-time sunrise alerts and engagement
- Submit sitemap to Google Search Console for indexing
- Write 3–5 blog posts for SEO (sunrise photography tips, Chennai beach guides)
- Set up Google Analytics on frontend for conversion tracking
- Configure SPF/DKIM/DMARC DNS records on Cloudflare for email deliverability

Zero-Cost Marketing Channels

Instagram Daily Posts: Post actual sunrise alongside predicted score every morning. "We predicted 82/100 VERY GOOD. Here's what it looked like." Builds trust + shareable content.

Reddit: r/chennai, r/photography, r/india — prediction vs. reality comparisons. Active beach and photography communities.

WhatsApp/Telegram: Chennai photography and beach groups. Share daily prediction with seasidebeacon.com link.

Local Photography Clubs: Chennai Photography Club, Madras Photo Bloggers. Free "photography forecast" partnership.

College Societies: IIT Madras, Anna University, Loyola. Young photographers are early adopters.

Google SEO: Target "Chennai sunrise time tomorrow", "Marina Beach sunrise". Zero competition for these terms.

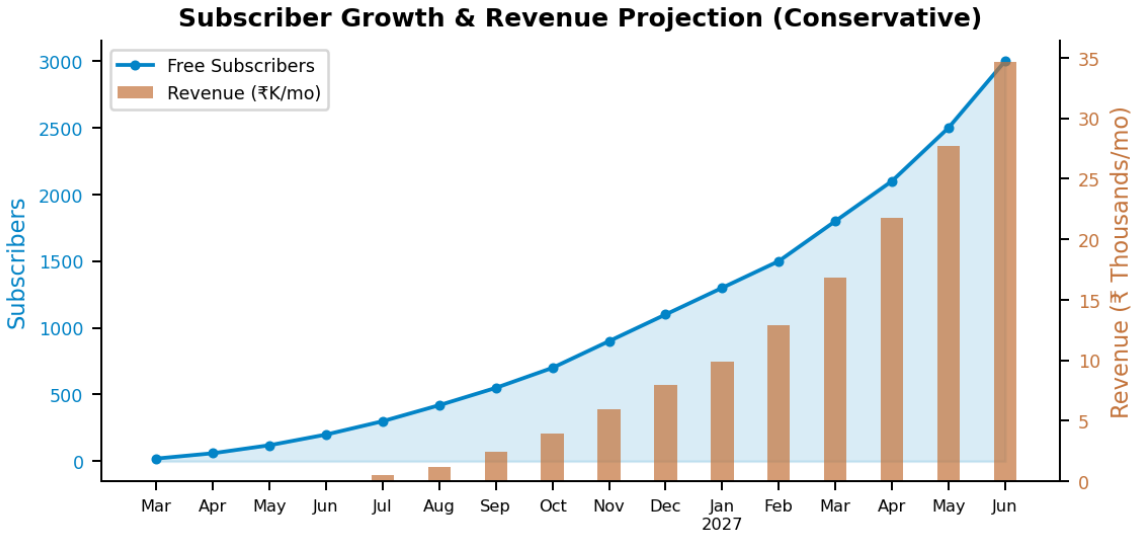
Product Hunt: "Sunrise quality forecast for Indian beaches" — novel enough for front-page traction.

Paid Marketing (When Budget Allows)

- **Instagram/Facebook Ads:** Target Chennai, 18–35, interests: photography, beaches, travel. ■500–1,000/day.
- **Google Ads:** "Chennai sunrise" keywords — very low competition = cheap CPC.
- **Influencer Partnerships:** Local Chennai photographers (10K–50K followers). Free premium access for posts.

12. Revenue & Monetization

Weather apps have the highest eCPMs of all app categories due to location-based data value. The sunrise prediction niche has additional monetization through photography equipment partnerships and tourism affiliates.



Revenue Streams (Staged)

Stage 1: Premium Subscriptions

■99–199/mo (ad-free, multi-city, push alerts)

Target: ■50K–2L/mo at 500–1,000 subscribers. After establishing 500 free users.

Stage 2: Sponsored Sunrise Spots

Beachside cafes/resorts pay for "Sunrise Spot" badge

Target: ■10K–50K/mo per city. After multi-city expansion.

Stage 3: Photography Affiliate

Amazon Associates — camera gear links in daily photo tips

5–15% commission on referrals. Can start immediately (passive income).

Stage 4: API Licensing

Sell sunrise quality data to travel/tourism apps

■10K–1L/mo per client. After proving prediction accuracy.

Stage 5: Location-Based Ads

Non-intrusive display ads targeting beach-goers

Weather apps command $10–50 CPM — very high. After 5,000+ monthly active users.

Stage 6: Tourism Partnerships

Hotels/resorts promote "sunrise packages" via Beacon

Commission per booking. After multi-city launch and brand recognition.

Pricing Tiers

Free Tier

■0

1 city, daily email, basic score, ad-supported website

Beacon+

■99/mo (■999/yr)

All cities, ad-free, push notifications, historical scores, advanced analysis

Beacon Pro

■199/mo (■1,999/yr)

Everything in Plus + API access, data export, priority support, early features

Benchmark: SkyCandy charges $2.99/month (~■250) with <5,000 users. Alpenglow has 100K+ downloads but only ~100 paying subscribers (0.1% conversion). Our ■99/month is positioned below international competitors while being premium for the Indian market. Target: 2–5% free-to-paid conversion.

13. Recommended Action Plan

Immediate (This Week)

1. Set up Instagram @seasidebeacon and post tomorrow's prediction vs. actual sunrise photo

2. Configure SPF/DKIM/DMARC DNS records on Cloudflare for email deliverability

3. Submit sitemap.xml to Google Search Console

4. Update homepage "5 scoring factors" to "9 scoring factors" (v5 cosmetic fix)

5. Start daily accuracy tracking: log predicted score, photograph actual sunrise, rate 1–10

Short Term (Next 30 Days)

1. Launch on Reddit (r/chennai, r/photography) with prediction-vs-reality comparisons

2. Reach out to 5 Chennai photography Instagram accounts for cross-promotion

3. Write and publish 3 SEO blog posts (sunrise guide, beach comparison, photography tips)

4. Build 30-day accuracy dataset to validate algorithm before marketing at scale

5. Set up Google Analytics and track landing → prediction → subscribe conversion funnel

6. Submit to Product Hunt

Medium Term (60–90 Days)

1. Reach 100 email subscribers organically

2. Publish accuracy report ("Our algorithm predicted correctly X% in March 2026")

3. Begin Phase 2 city expansion planning (Pondicherry, Vizag, Puri)

4. Upgrade Brevo to Starter when approaching 300 emails/day

5. Explore React Native mobile app for push notification support

6. Design premium tier features based on user feedback

Seaside Beacon is positioned to become India's definitive sunrise prediction platform. The v5 algorithm is research-aligned, the architecture is scalable, costs are minimal, and the market is entirely unserved. The path forward: prove accuracy in Chennai, build community, expand to India, then go international.

Seaside Beacon | Made with care in Chennai | seasidebeacon.com