Market Fit Research for Air Purifier Development Using AQI Analytics

Presented By :
Prabhakar Singh

About AirPure Innovations

"AirPure Innovations" is a startup born out of the air quality crisis in India, with 14 cities ranking among the world's top 20 most polluted urban centers. The company is in the early stages of product development and is unsure whether there is a strong, sustained demand for its air purifier product. Before committing to production and R&D, they need to answer critical questions:

Problem Statement

1.What pollutants or particles should their air purifier target?
2. What are the most essential features that should be incorporated into the air purifier?
3. Which cities have the highest demand for air purifiers, and what is the market size in these regions?
4. How can R&D be aligned with localized pollution patterns?

Q1. List the top 5 and bottom 5 areas with highest average AQI. (Consider areas which contains data from last 6 months: December 2024 to May 2025)

The Top 5 areas with highest average aqi are Byrnihat, Greater Noida, Sri Ganganagar, Begusarai.

Reasons :

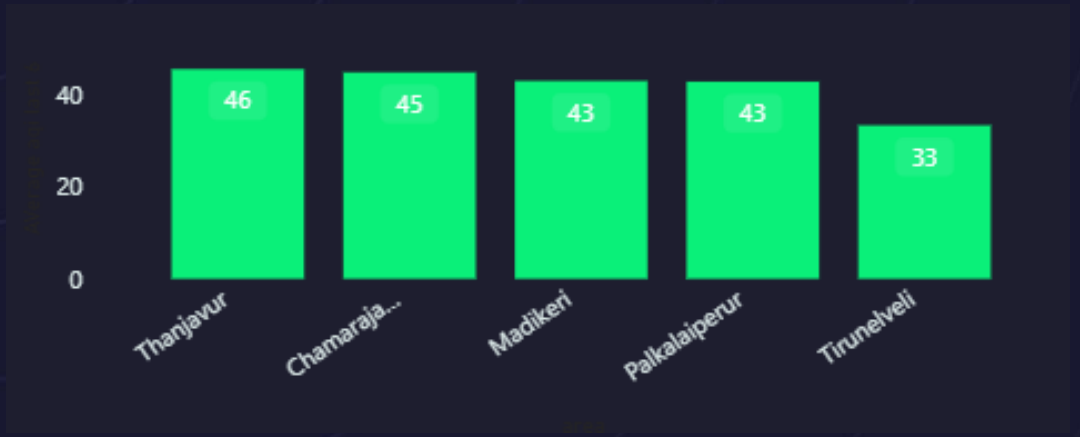
Heavy Traffics ,Road Dust, Infrastructure disrepair, agriculture stubble burning

Bottom 5 areas with lowest average aqi are

Tirunelveli, Palkalaiperur, Madikeri, Chamarajanagar, Thanjavur

Reasons:

Some of these areas fall into river delta geography, very less traffic and due to rural settings with minimal emissions



Q2.List out top 2 and bottom 2 prominent pollutants for each state of southern India. (Consider data post covid: 2022 onwards)

Top Two Prominent Pollutants Of Each States are as follows :
Andra Pradesh - > PM10, PM2.5
Karnataka - > PM10, PM2.5
Kerla - >PM10, PM2.5
Tamil Nadu - > PM10, PM2.5
Telengana - > PM10, PM2.5

PM10 - *These particles are generally from dust, construction, and mechanical processes*
PM2.5 - These come from combustion processes and are more harmful because they penetrate deep into the lungs.

Bottom Two Prominent Pollutants Of Each States are as follows :
Karnataka- > SO3,NH3
Kerala - > SO2,NH3
Tamil Nadu - >NH3,NO2
Telangana- > NO2,03
Andhra Pradesh - > SO2,NO2

Fertilizer-heavy agriculture states → *High NH_3 (Karnataka, Kerala, Tamil **Nadu).***
Coastal & port states → *Higher SO_2 (Kerala, Andhra Pradesh) from shipping and diesel fuel use.*
Industrial & urbanised states → *High NO_2 (Tamil Nadu, Andhra Pradesh, Telangana) due to traffic and manufacturing.*
Sunny, polluted urban regions → More O_3 (Telangana) due to photochemical reactions.

state	prominent_pollutants	PollutantCount
Andhra Pradesh	PM10	3606
Andhra Pradesh	PM2.5	2244
Karnataka	PM10	14572
Karnataka	PM2.5	3182
Kerala	PM10	3538
Kerala	PM2.5	1344
Tamil Nadu	PM10	7187
Tamil Nadu	PM2.5	3016
Telangana	PM10	1002
Telangana	PM2.5	590
Total		**40281**

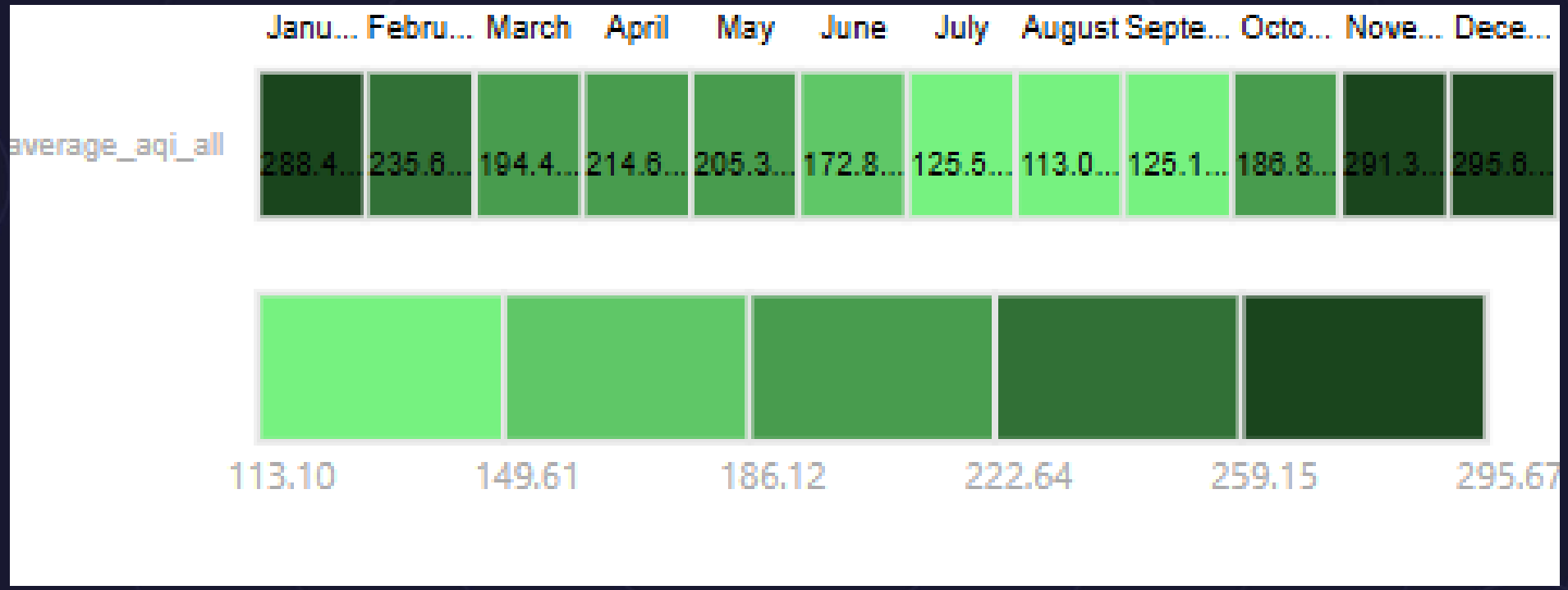
state	prominent_pollutants	PollutantCount
Karnataka	SO3	1
Kerala	SO2	7
Kerala	NH3	10
Tamil Nadu	NH3	11
Andhra Pradesh	SO2	11
Karnataka	NH3	34
Telangana	NO2	119
Telangana	O3	152
Andhra Pradesh	NO2	259
Tamil Nadu	NO2	500
Total		**1104**

Q3. Does AQI improve on weekends vs weekdays in Indian metro cities (Delhi, Mumbai, Chennai, Kolkata, Bengaluru, Hyderabad, Ahmedabad, Pune)? (Consider data from last 1 year)

There's no single "weekend improvement" that holds for all Indian metros — it depends on the city, pollutant, and season.

In many metros you'll see modest weekend improvements in traffic-related pollutants (NO_2, CO, primary PM) because road traffic and some industries fall on weekends — but there are clear exceptions (winter crop-burning, festivals, coastal shipping, or increased weekend leisure travel can push pollution up on some weekend days

Q4. Which months consistently show the worst air quality across Indian states — (Consider top 10 states with high distinct areas)



Reason for Poor Air Quality in These Months

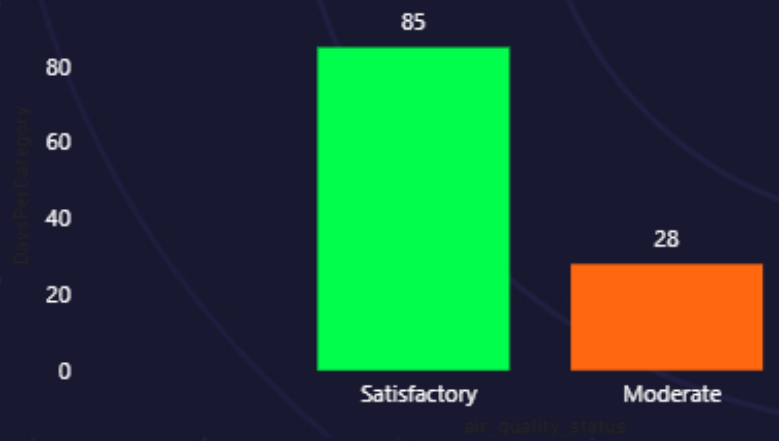
Crop residue burning: Especially in Punjab, Haryana, and parts of UP during Oct–Nov, affecting north India heavily.

Increased heating and biomass burning: More coal/wood used in rural/urban households.

Festivals & fireworks: Diwali (Oct/Nov) spikes PM2.5 and PM10 levels.

Q.5.For the city of Bengaluru, how many days fell under each air quality category (e.g., Good, Moderate, Poor, etc.) between March and May 2025?

Bengaluru’s pollution is driven more by vehicular traffic than heavy industry (unlike Delhi or Chennai’s industrial belts).
It lacks large-scale coal-fired power plants within city limits — reducing SO_2 and PM emissions.
Pre-monsoon winds (March–May) in Bengaluru are relatively steady and help disperse pollutants.
Traffic congestion peaks on certain weekdays can push NO_2 and PM2.5 into moderate range.



Q.6.List the top two most reported disease illnesses in each state over the past three years, along with the corresponding average Air Quality Index (AQI) for that period.

Acute Diarrheal Disease:
Poor drainage, monsoon flooding, and unhygienic street food practices in urban areas.
Rural areas have limited access to treated drinking water.
Cholera: Often flares up during monsoon season in coastal Andhra.Linked to Vibrio cholerae bacteria in contaminated water.
Chickenpox: Outbreaks occur in areas with low vaccination coverage and high population movement.Cold winters force people indoors, increasing transmission.
Dengue: Stagnant water during monsoon and post-monsoon seasons allows Aedes mosquito breeding.Urban crowding in Patna and other cities increases risk.

state	disease_illness_name	Sum of TotalCases
Andaman and Nicobar Islands	Acute Diarrheal Disease	117
Andaman and Nicobar Islands	Fever with Rash	8
Andhra Pradesh	Acute Diarrheal Disease	3311
Andhra Pradesh	Cholera	1081
Arunachal	Rabies	1
Arunachal Pradesh	Acute Diarrheal Disease	347
Arunachal Pradesh	Chickenpox	166
Assam	Acute Diarrheal Disease	2803
Assam	Food Poisoning	2057
Bihar	Acute Diarrheal Disease	1388
Bihar	Dengue	856
Chandigarh	Cholera	16
Chhattisgarh	Acute Diarrheal Disease	9035
Chhattisgarh	Food Poisoning	780
Dadra and Nagar Haveli	Acute Diarrheal Disease	89
Dadra and Nagar Haveli	Fever of Unknown andigin (PUO)	101
Dadra and Nagar Haveli and Daman and Diu	Acute Diarrheal Disease	23

Q.7.List the top 5 states with high EV adoption and analyse if their average AQI is significantly better compared to states with lower EV adoption.

Even though air pollution is severe, EVs still have a higher upfront cost compared to petrol/diesel two-wheelers and cars.
People prioritize affordability over long-term environmental benefits.

Dominance of non-EV vehicles – Even with some EV growth, the vast majority of vehicles still run on petrol and diesel.

High AQI doesn't necessarily lead to high EV adoption — the relationship is weak because EV adoption is driven more by policy, infrastructure, and affordability than just pollution awareness.

state	average_aqi	% EV ADOPTION
Karnataka	63.15	0.09
Uttar Pradesh	120.81	0.09
Maharashtra	103.32	0.08
Rajasthan	127.79	0.07
Tamil Nadu	67.60	0.06

state	average_aqi	% EV ADOPTION
Sikkim	53.69	0.00
Nagaland	80.46	0.00
Arunachal Pradesh	54.49	0.00
Andaman and Nicobar Islands	57.71	0.01
Mizoram	47.25	0.01

Secondary Analysis

Q1. Which age group is most affected by air pollution-related health outcomes — and how does this vary by city?

Young children (especially under-5) — they suffer the biggest relative burden of acute respiratory infections, developmental harms and early-life deaths attributable to air pollution.

Older adults (middle-aged & elderly — roughly ages 50+ / 65+) — they account for the majority of pollution-related deaths in India because long-term $PM_{2.5}$ exposure raises the risk of cardiovascular disease, stroke, COPD and lung cancer, which are concentrated in older age groups.

*National/state analyses (GBD and Lancet series) estimate **hundreds of thousands to over a million pollution-attributable deaths** in India per year, with most deaths occurring in older adults while a substantial share of child deaths (especially under-5 pneumonia) is also attributed to pollution*

City	Most Affected Age Group	Main Outcome(s)	Why (1 line)
Delhi	50+	Premature cardiovascular & respiratory deaths	Very high $PM_{2.5}$; long-term exposure → fatal chronic disease in older adults
Mumbai	50+	Cardiovascular deaths	Urban $PM_{2.5}$ drives excess adult mortality; skewed to older ages
Kolkata	50+ & U5	IHD & respiratory deaths; child ARI	High $PM_{2.5}$; older adults bear most deaths; under-5s show high respiratory admissions
Chennai	50+	Cardio-respiratory deaths	Persistent $PM_{2.5}$ → greater absolute mortality in older adults
Bengaluru	50+	Chronic disease deaths (CVD/COPD)	Traffic & urban emissions → long-term effects in older ages
Hyderabad	50+	Cardiovascular & respiratory mortality	Cumulative $PM_{2.5}$ exposure → higher adult mortality
Pune	50+	Adult chronic disease deaths	Industrial & traffic sources → adult mortality concentrated in older ages
Ahmedabad	50+	Cardio-respiratory mortality	High $PM_{2.5}$ + heat/ozone → increased risk in older adults

Q2.Who are the major competitors in the Indian air purifier market, and what are their key differentiators (e.g., price, filtration stages, smart features)?

The Indian air purifier market is highly competitive, with both global giants and domestic players offering a range of models tailored to different budgets, room sizes, and feature preferences. Here's a concise overview of the major competitors and their key differentiators as of 2025:

1. Dyson – Premium & Design-Focused
Price: High (₹32k–₹66k)
What stands out: Sleek bladeless fan design, 360° air intake, formaldehyde removal, very quiet, app & voice control.

2. Coway – Filtration Quality & Reliability
Price: Mid-premium (₹25k–₹54k)
What stands out: Very thick H13 HEPA filter, long filter life, low maintenance, silent running.

Brand	Price Range (₹)	Filtration Features	Smart / Unique Features
Dyson	₹32,000 – ₹66,000	HEPA filters, + formaldehyde-destroying tech	360° intake, Air Multiplier fan, voice/remote control, Wi-Fi app (housegyan.com, DealsDekho, The Economic Times)
Coway	₹25,000 – ₹54,000	HEPA H13 (thick), pre-filters, ionizers	Silent, smart air quality indicators, long warranty (housegyan.com, GyroTech, Digital Biriyani, Reddit)
Philips	₹9,000 – ₹35,000	VitaShield/NanoProtect HEPA, activated carbon	Low noise, auto-purification, app-controlled, child lock (housegyan.com, homeherald.in, Reddit)
Sharp	₹10,000 – ₹30,000	HEPA + PlasmaCluster ions	Virus/mold protection, energy-efficient, sleek design (GyroTech, mint)
Mi (Xiaomi)	₹10,000 – ₹20,000	3-layer (prefilter, HEPA, carbon)	OLED display, Mi Home app & voice control, budget-friendly (housegyan.com, GyroTech)
Honeywell	₹7,300 – ₹25,500	3–5 stages, including HEPA H13, UV LED, ionizer	Real-time PM2.5 level, Wi-Fi, high CADR, child lock (housegyan.com, HT Affiliate, mint)
Blue Star	~₹14,000	HEPA + activated carbon	SensAir auto-sensing, multi-stage purification (MouthShut, DealsDekho)
Havells	~₹40,000	H14 HEPA, TiO_2 + UV-C in SpaceTech purification	360° intake, wireless charging, smart compatibility (idigibuzz.com, The Economic Times)

3. Philips – Balanced & User-Friendly
Price: Mid-range (₹9k–₹35k)
What stands out: Good build quality, effective filters, auto-mode, easy controls, brand trust.

4. Sharp – Ion Technology Specialist
Price: Affordable to mid-range (₹10k–₹30k)
What stands out: PlasmaCluster ion technology for killing germs/mold, energy-efficient.

5. Xiaomi (Mi) – Budget Smart Choice
Price: Budget (₹10k–₹20k)
What stands out: App control, OLED display, decent filtration at low price, compact size.

6. Honeywell – Large Room & Smart Features
Price: Mid-range (₹7.3k–₹25.5k)
What stands out: High CADR, real-time air quality display, multiple filter stages, child safety features.

7. Blue Star – Local Brand Value
Price: Mid-range (~₹14k)
What stands out: Solid build, multi-stage filtration, decent sensors, Indian service network.

8. Havells – Premium Tech & Style
Price: Premium (~₹40k)
What stands out: H14 HEPA, UV-C, 360° design, even wireless charging pad on top.

Q3.What is the relationship between a city’s population size and its average AQI — do larger cities always suffer from worse air quality? (Consider 2024 population and AQI data for this).

Key Findings from 2024 Data

Most Polluted Cities: The cities with the worst AQI in 2024 (e.g., Delhi—310-417 AQI range, Ghaziabad, Noida, Rohtak) are largely *major urban centers or industrial hubs*, which do have large populations.

However, some smaller cities (such as Singrauli, Bhiwani, Jind) also rank among the most polluted, despite smaller populations compared to metropolises, primarily due to local industrial activity and geographic factors.

Larger population size increases the risk of poor air quality—mainly through traffic, residential combustion, and construction, but it is *not the sole determinant*. Local emission sources (industrial, agricultural), meteorological conditions, regional geography, and pollution-control policies are equally—if not more—important in determining a city’s average AQI.

Many small or mid-sized Indian cities (especially those with coal power plants, heavy industry, or frequent crop burning nearby) often report AQI as poor as, or worse than, many large metros.

Q4. How aware are Indian citizens of what AQI (Air Quality Index) means — and do they understand its health implications?

Awareness is highest in metropolitan areas, where air quality routinely becomes headline news.
Rural populations, in contrast, often lack information on AQI or its health implications, mainly due to less access to digital media and air quality monitoring infrastructure.

Health implications awareness: While it's commonly known that higher AQI is "bad," many Indians—especially in cities—take action only when AQI hits extreme levels. Most people do not fully understand the specific health impacts (e.g., for children, elderly, those with respiratory conditions), nor the importance of preventive measures on poor-air days.

Q5. Which pollution control policies introduced by the Indian government in the past 5 years have had the most measurable impact on improving air quality — and how have these impacts varied across regions or cities?

National Clean Air Programme (NCAP): Targeted 20–40% reduction in PM2.5/PM10 in major cities, but results vary; improvement in some cities, stagnation or worsening in others due to limited fund utilization.

Graded Response Action Plan (GRAP): Emergency measures in Delhi/NCR led to modest air quality improvement, but severe pollution remains due to cross-border sources.

Bharat Stage VI (BS-VI) Standards: Stricter vehicle emission norms nationwide; gradual impact expected, but immediate gains limited by slow fleet turnover.

Ujjwala Yojana: Mass LPG adoption in rural north India reduced household air pollution significantly.
Renewable Energy Expansion: States like Gujarat and Tamil Nadu saw air quality gains from increased renewables, but coal dependence persists elsewhere.

Regional Variation: Delhi/NCR and northern cities face persistent problems; coastal/southern cities fare better due to climate and better implementation. Results depend on local execution and budget use.

Overall: Policies *show mixed but measurable improvements, strongest where execution is robust; further progress needs cross-regional coordination.*

Thank You

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