

Keralam 2040

Building the economic form that fits the society



PRAMOD PRASANTH

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that fits the society*

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Acknowledgement. Some of the thinking in this series came from calls run by [y]our 2040 (your2040.com), the community founded by Chris Luebke and Jonelle Simunich. Four things came out of those calls: regenerative placemaking, futures thinking, strategic foresight for a positive tomorrow, and the choice of regenerative over sustainable.

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A note to the reader

These essays first appeared on pramod.ch between 5 and 28 August 2026, as a series asking what Keralam in 2040 would have to be. They are printed here in series order.

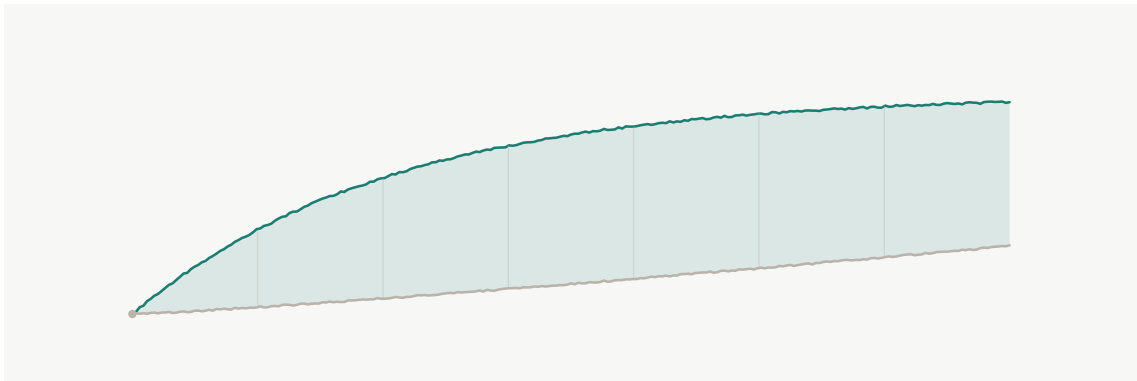
Some of the thinking in these essays came from calls run by [y]our 2040 (your2040.com), the community founded by Chris Luebke and Jonelle Simunich: regenerative placemaking, futures thinking, strategic foresight for a positive tomorrow, and the choice of regenerative over sustainable.

I wrote the essays as a public dossier, not a manifesto. Each one takes a single part of the problem (labour, industry, the civic networks, research, capital, one chosen industry, the ecological estate, the city) and asks what would have to be true by 2040. Each carries its numbers and names its sources, so a reader who disagrees can find where the disagreement starts.

The position running through all of them is that Keralam's social achievements are its deepest asset. What remains is to build the economy that fits them, and that work needs institutions that outlast any one government.

Two passages point past the end of this book. The ninth essay closes by announcing an essay about a single company, and "Your Turn, Keralam" promises a final essay with my own answers to its three questions. Both point to a tenth essay, which is still being written. The three questions are printed with "Your Turn, Keralam", and the form for answering them is open at pramod.ch/essays/your-turn-keralam. I read every response.

Pramod Prasanth



PART 1

The Half-Finished Miracle

Keralam solved more of the human development problem than almost any Indian state, but not the productivity problem. From a series asking what Keralam 2040 would have to be.

Keralam is one of the few places in India where everyday expectations of life feel closer to parts of Europe than to much of the subcontinent. People expect literacy to be normal. They expect public argument, not deference. They expect some baseline of dignity in work, public services, and social life. They do not always get these things. But the expectation exists. That matters. I grew up in Kerala. I have lived and worked in France, Singapore and Switzerland. That combination makes certain things hard to unsee.

It matters because development is not only about income. It is also about what a society comes to regard as ordinary.

In Keralam, the sequence mattered as much as the substance. Education and political organising came first: princely-state schooling, missionary networks, and a reading public that argued in print were in place by the early twentieth century. Land reform under the 1957 and 1969 governments broke the landlords who had lived off farm rents and spread a surplus that elsewhere in India stayed at the top. Unions and parties then won higher pay and better services from a state that was not yet industrialising. Large-scale Gulf migration began after the oil price rise of 1973-74. The money sent home sustained household incomes and spending, while the state paid for its social spending mainly by borrowing, so a productive base at home did not have to pay for either.^{1,5,11} Decentralisation in the 1990s moved welfare delivery into local bodies. The result is a population that behaves less like a labour reserve and more like citizens who expect a say.

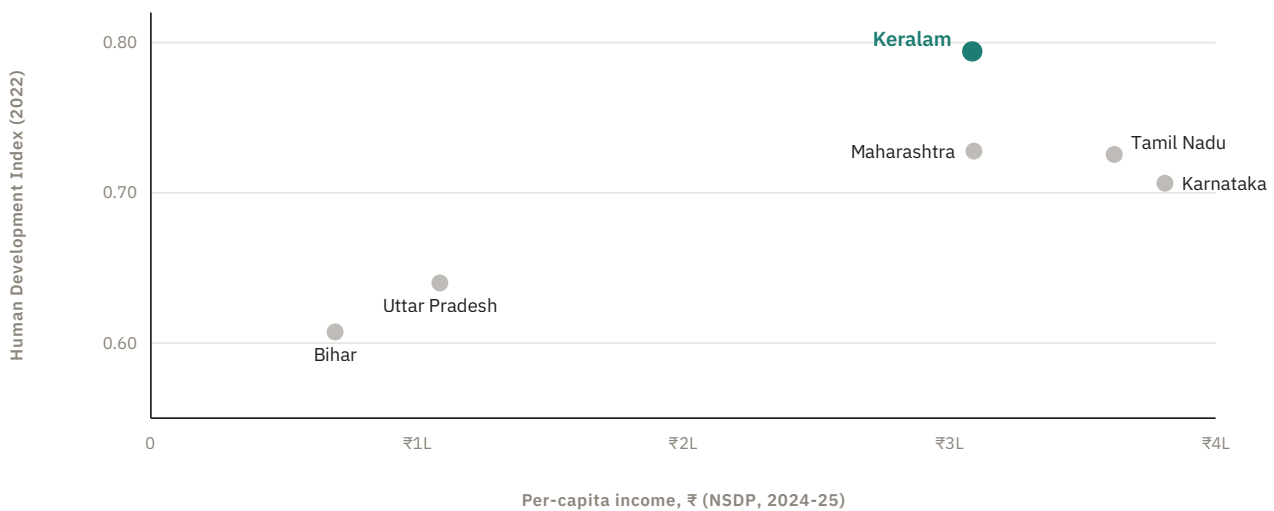
Set income aside and Keralam has long looked exceptional within India, with literacy, life expectancy and health outcomes at the top of the national table.^{3,4}

But that is only half the story. The other half is that Keralam never fully built the productive base, research depth, or employment structure that usually underwrites such social outcomes.^{1,7} The state succeeded in creating a more civilised society faster than it succeeded in creating a deeply productive economy. That is the paradox. It is also the policy problem.

The outlier

High development, middling income.

Human Development Index against per-capita income, major states.



Keralam posts the highest human development of any major Indian state while sitting mid-pack on income, level with Maharashtra and below Karnataka and Tamil Nadu. Richer states here do not have higher development; that gap is the point. HDI from the Global Data Lab subnational index (2022); income from RBI per-capita net state domestic product, current prices (2024-25). Six states shown on a consistent basis.

Most Indian development arguments are still structured around a model Keralam does not fit. They assume that prosperity comes first, welfare later; that human beings can be sorted into cheap labour pools and moved into factories or service centres; that public services can wait until after growth; that labour should stay quiet while capital compounds. Keralam disrupted that sequence. It proved that social development can run ahead of income.⁴

That was a historic achievement. It also created a trap.

A state that has taught its citizens to read, mobilise, demand, and compare cannot indefinitely run on remittances, welfare expansion, public employment, and generic services alone.^{2,5} A society that has produced European-style expectations on parts of health, education, and citizenship cannot easily revert to the low-wage, low-voice development bargains that remain common elsewhere in India. Keralam has, in effect, socialised its population into a more advanced model of life than its economy is capable of sustaining on its own.

What makes this a trap and not just a mismatch is that several of the mechanisms holding it in place actively resist their own dismantling. Committed expenditure on salaries, pensions, and interest already absorbs about

three-quarters of the state's revenue receipts, which leaves little room for new productive investment without either fresh borrowing or a politically costly retrenchment. That ceiling, and what is still worth imagining underneath it, is the subject of an earlier essay on the 2026 Fiscal Status Report.² Public-sector employment has long served as the consolation prize for educated unemployment, which both major political fronts have an electoral incentive to protect rather than reform. And out-migration has eased unemployment at home: by the late 1990s, the Centre for Development Studies' migration survey found it had cut the number of unemployed Keralites by 32 per cent.¹² In doing so it quietly relieved the domestic pressure that might otherwise have forced structural change.

It built a social contract its own economy does not yet earn.

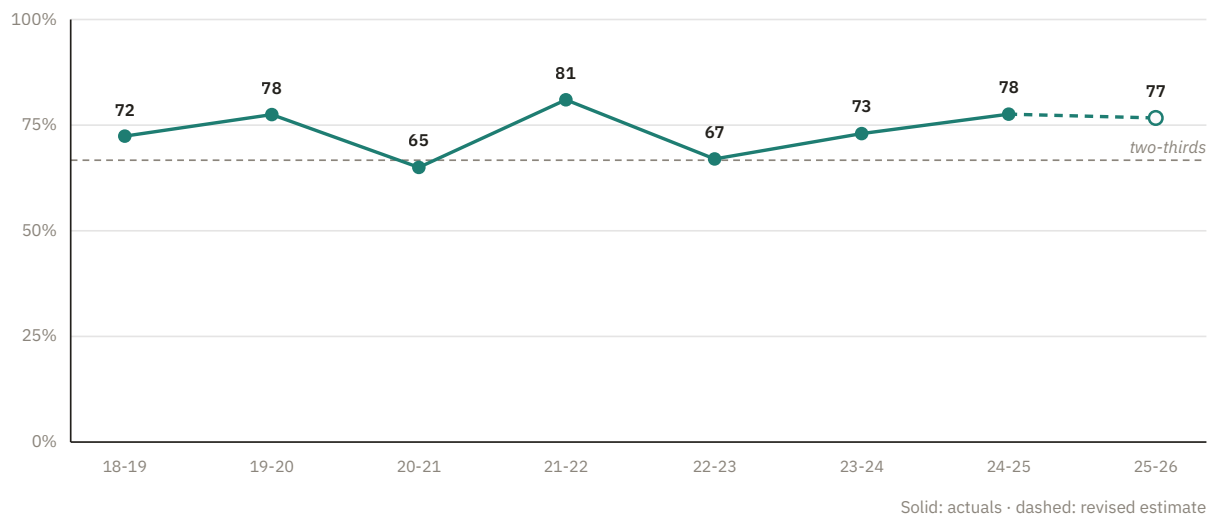
This is why Keralam so often feels like a place suspended between two levels of development. On one side sits the everyday evidence of social achievement: literacy, political consciousness, public debate, strong health indicators, and a social fabric in which pluralism is ordinary rather than aspirational.^{3,4} On the other sits the evidence of incompleteness: educated unemployment, out-migration, a service-heavy economy, weak industrial depth, shallow research intensity, and a state budget under persistent stress.^{2,6,7}

The clock on this structural transformation is tighter than it might appear. Keralam's total fertility rate has fallen to 1.5 (below replacement), and its share of population aged sixty and above is already the highest among Indian states, at 16.5% for 2021 in the UNFPA India Ageing Report 2023 projections that the state's Economic Review cites.^{1,10} By 2030, roughly 35 Keralites over sixty will exist for every 100 working-age ones. For India as a whole, the dependency ratio starts to rise in the 2040s, and the old-age ratio is projected to reach 30 per 100 working-age people only by 2050.¹⁰ Keralam is running that experiment now, without having yet built the productive economy that would make it manageable.

Fiscal stress

Three-quarters of every rupee is already spoken for.

Committed spending (salaries, pensions, interest) as a share of revenue receipts.



Committed spending has taken roughly two-thirds or more of Kerala's revenue receipts every year since 2018-19, with no downward trend. The 2019-20 peak came as revenue fell and committed spending rose, before the pandemic hit; the 2021-22 peak came as revenue recovered and committed spending jumped 40%, led by salaries. Figures are actuals through 2024-25 and the revised estimate for 2025-26. Sources: PRS Legislative Research, Kerala Budget Analyses (2020-21 through 2025-26), for 2018-19 to 2022-23; Government of Kerala, Medium Term Fiscal Policy and Strategy Statement with Medium Term Fiscal Plan, 2026-27 to 2028-29, State's Fiscal Plan, for 2023-24 to 2025-26.

The usual ways of describing Kerala miss this tension. Admirers turn it into a morality play about welfare and equality. Critics reduce it to a cautionary tale about unions, rigid labour, and fiscal weakness. Both are too simple. Kerala is neither a finished success nor a failed model. It is a half-finished one, and that is a description of sequence rather than an insult: the state built social capability faster than economic depth, and taught its citizens to expect dignity before building an economy that could make dignity materially easy.

That mismatch now defines almost every serious question Kerala faces.

Why is educated unemployment so high in a highly literate state? Because education is not the same as employability, and employability is not the same as a matching local economic structure.⁶ Many Kerala graduates leave university with a degree and without the apprenticeship, applied technical practice, or industry-specific exposure that converts a degree into a hireable signal. Even those who do are not finding firms in Kerala calibrated to use them, because the links between research and industry remain weak. Why does so much ambition still leave the state? Because talent fol-

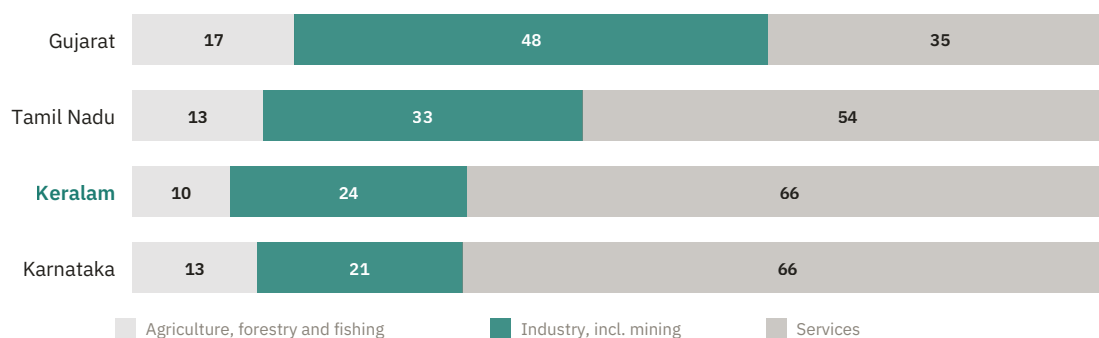
low dense opportunities, serious firms, research ecosystems, and global networks, not just school completion rates.^{7,9} Why does generic capital often treat Keralam as difficult? Because a population with strong expectations of labour voice, social protection, and environmental restraint is difficult for capital calibrated to low-cost, low-voice environments.

This is also why Keralam cannot simply copy the developmental scripts that worked, or appeared to work, elsewhere in India. It cannot become a giant-factory state without tearing through land, ecology, and local political resistance. It cannot compete forever as a labour-arbitrage services economy because educated people do not want to remain permanently trapped in low-value execution roles, and because generic services rarely create deep local capability or sticky value capture. And it cannot rely indefinitely on migration and remittances to solve structural weaknesses at home.¹ Each of the standard Indian developmental templates (Bengaluru's services boom, Gujarat's manufacturing scale, Tamil Nadu's industrial corridor) was built on a population profile, fiscal architecture, and political economy that Keralam simply does not have.

Economic structure

Gujarat's path runs on industry. Keralam's does not.

Share of the state economy by sector (gross value added, current prices, 2022-23).



Gujarat's economy runs on industry, with the highest industry share of the four; Keralam's runs on services, with the smallest farm sector and a thin industrial base. Karnataka, on Bengaluru's software, and Keralam are the most services-heavy, level at about two-thirds. This is why the giant-factory script that suited Gujarat does not map onto Keralam's structure. Sector shares of gross state value added at current prices, 2022-23: RBI, Handbook of Statistics on Indian States 2024-25, Tables 25, 41 and 49. The first segment is value added less industry and services, so agriculture, forestry and fishing; mining is counted in industry. Shares sum to 100%.

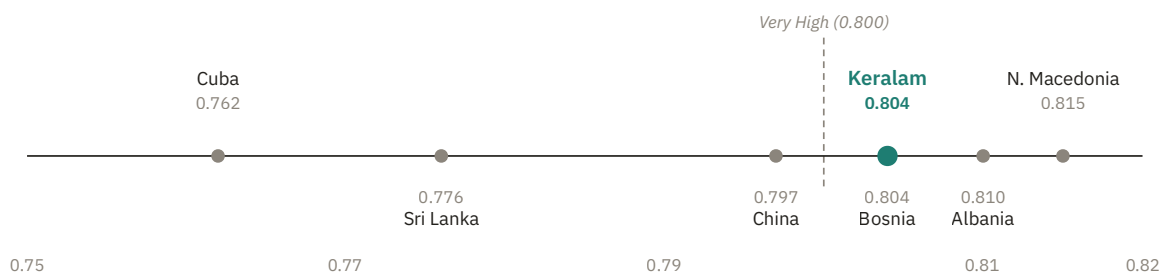
The future therefore has to begin from a more honest premise: Keralam is not a place waiting to industrialise in the standard Indian way. It is a place that has already become too socially advanced for that script, without yet discovering its replacement.

That is why the comparisons that matter are not only with Bengaluru, Gujarat, or Tamil Nadu. They are also with smaller, high-skill, high-cost places I have watched turn institutional quality, research depth, and human capital into durable economic advantage.⁹ Singapore and Switzerland are not templates for Keralam. But they are useful provocations. They show that small places with expensive labour, limited land, and strong social expectations do not have to become irrelevant. They can become precise: world-scale in two or three domains, and merely competent in the rest.

A country, not a state

On human development, Keralam sits among nations.

Where Keralam's HDI (0.804 in 2023) falls on the global scale.



By human development, Keralam lands where nations land, not where Indian states do: above its usual comparators Sri Lanka and Cuba and above China, level with Bosnia and just inside the "very high" tier. HDI on the UNDP scale for 2023: national values from the Human Development Report 2025, Keralam from subnational estimates (Global Data Lab).

Precision is exactly what Keralam has lacked in its economic imagination. Precision in this sense is the discipline of choosing a small number of high-stakes sectors, building deep institutional capacity inside each (research labs, training pipelines, public procurement, patient capital), and letting that depth compound. Picture a compact biopharma corridor stitched to a university hospital and its laboratories, or an animation, gaming, and visual-effects cluster anchored in Kochi and built for owned IP and export rather than back-office volume. It is the opposite of the investment-summit approach, where ambition is announced in many directions and absorbed in almost none. Much of its policy debate remains trapped between two inadequate instincts. One is defensive romanticism: the belief that Keralam's

social model is already enough, and that growth will somehow emerge from more of the same. The other is imported impatience: the belief that Keralam should become more “investor friendly” in the generic Indian sense, which usually means industrial parks without depth, quick MoUs without follow-through, and labour rollback without capability building. Neither is serious.

The first ignores the fact that the current model no longer produces enough productive depth. The second ignores the fact that Keralam’s social achievements are not decorative but constitutive. They are not a burden to be shed. They are the state’s deepest asset.^{4,5} The real question is how to turn that asset into a different kind of economy.

That economy will not be built on scale in the old sense. Keralam does not have the land, ecology, or political structure for giant low-cost industrial sprawl. Its path is more likely to run through compact, knowledge-intensive, research-linked, globally connected sectors that can thrive in a high-HDI, high-expectation society.⁸ That shift sounds abstract until it is made concrete. It means moving from degrees to employability, from publication counts to deep labs, from generic investors to long-horizon builders, and from labour export to capability creation.^{8,9} An Elsevier report released through KSHEC found that publications by the state’s universities grew 11% a year between 2018 and 2023, while academic-corporate collaboration stood at 0.6%, which is precisely the gap that distinguishes a research-active state from a research-driven economy.⁷

It also means accepting something politically uncomfortable. Keralam’s next development phase cannot be won mainly through rhetoric, cultural self-congratulation, or partisan rotation. The state is entering a stage where institutional depth matters more than narrative fluency. It needs better research systems, more serious firms, more precise talent pipelines, and a public sector able to act as a competent partner rather than a slow-moving commentator.⁷

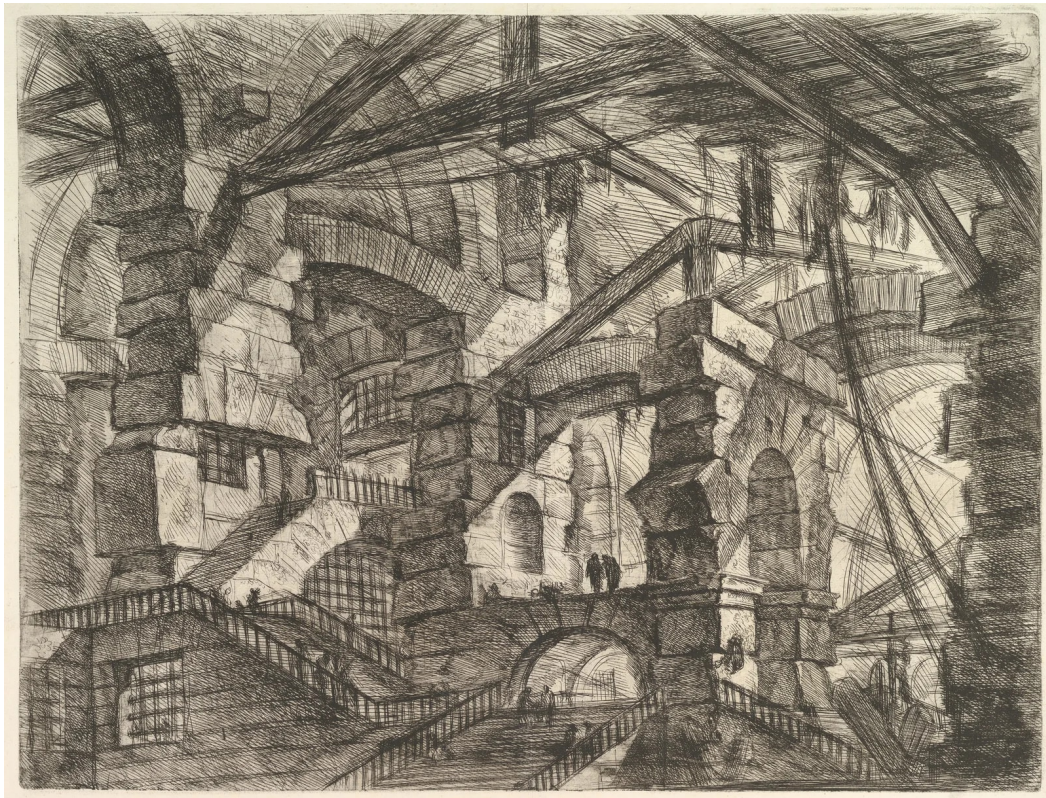
The state is entering a stage where institutional depth matters more than narrative fluency.

If that sounds less romantic than old stories about the Kerala model, that is because it is. But it is also more useful. The achievements of the last century were real. They gave Keralam a population with unusual capabilities, expectations, and social instincts. The challenge now is to build an economy worthy of them.

That is the half-finished miracle. Keralam already built the society. It still has to build the economic form that fits it.

The rest of this series approaches that question from a sequence of lenses (labour, industry, the networks that already carry knowledge, research, capital, the ecological estate, the city, the future firm) and will keep adding more as the work progresses. It is partly a public dossier on Keralam. It is also an attempt to think clearly about the future of a place I know, by walking around it from one angle after another. The next essay begins with the most immediate manifestation of the mismatch: a state that succeeded brilliantly at education, and then discovered that literacy is not the same thing as employability.⁶

. . .



Giovanni Battista Piranesi, *The Gothic Arch*, from *Carceri d'invenzione* (Imaginary Prisons), ca. 1749–50. The Metropolitan Museum of Art, CCo.

WHAT IT IS

“The Gothic Arch”, one plate from Giovanni Battista Piranesi’s series *Carceri d’invenzione*, the Imaginary Prisons. Piranesi (Italian, 1720–1778), about 1749 to 1750, etching and engraving. A vast vaulted hall of stone stairs, timber galleries and arches that climb in every direction and arrive nowhere. This impression is the first of six states. The Metropolitan Museum of Art.

WHY IT IS HERE

Piranesi drew prisons no one could build and no one could finish. Staircases turn into other staircases. Beams bridge the void only to reach more beams. The scale is monumental and the structure never resolves into a building that works. That is the half-finished miracle held in a single image: enormous capability assembled into something that does not yet cohere. There is a second reason it fits. Piranesi did not abandon these plates. He went back to the copper years after first publishing it and reworked the lines, darkening and deepening prisons he had already made. The grand thing was returned to and finished better. That, not demolition and not nostalgia, is the essay’s wager for Keralam.

WHAT TO LOOK AT

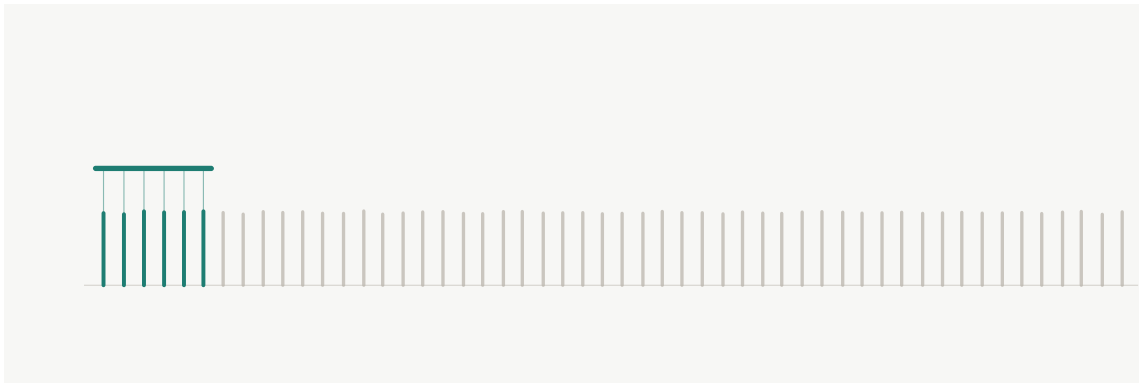
Follow a single staircase and see how far you get. It rises to a landing, turns, climbs again, and delivers you to a gallery with no floor you could stand on. Then look at how exactly each part is cut: the treads, the tie-beams, the springing of the arch are all drawn as if

they carry real weight, mortised and pinned like true construction. The precision of every piece is total. The plan of the whole is missing. That gap, between parts that work and a whole that does not, is the essay.

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PART 2

Literate, Yet Jobless

Keralam produced degrees more successfully than it produced people whom high-productivity firms can hire. From a series asking what Keralam 2040 would have to be.

Drive through almost any small town in Keralam on a Friday evening and the same scene repeats. Outside the tea stall, young men in their twenties and early thirties sit on motorbikes nicer than their employment. Most are graduates. Some have a B.Tech. Some are studying for the Public Service Commission exams. Most are technically employable on paper and not employed in any way that uses what they were taught. The bikes show what a degree was supposed to be worth. The labour market is paying a different price.

Keralam's miracle is half-finished: the human-development achievement is real, the productive economy that should match it is not. Keralam produced literacy and degrees more successfully than it built the firms that know what to do with them.

This essay stays with three pieces of that picture: why degrees became a queue, why educated women are the most under-used cohort, and what a 2040 vocational system would have to look like.

Degrees as a Queue

By the standard measures, Keralam's labour market does not look like a state with India's best human development indicators. The 2023-24 round of the Periodic Labour Force Survey put Keralam's overall unemployment rate at 7.2% for persons aged fifteen and above, against an all-India figure of 3.2%.² Among persons with secondary-or-above education, Keralam's rate climbs to 12.3%, against an all-India 7.1% on the same measure. The figure that drives the difference is gender. Educated men in Keralam face 7.5% unemployment, modestly above the all-India male figure of 5.9%. Educated women in Keralam face 18.9%, against 10.6% for India, nearly 1.8 times the national rate.² Among young men aged fifteen to twenty-nine with secondary or higher education, the India Employment Report 2024 puts unemployment in 2022 at 31.29% in Keralam against 20.28% all-India.¹⁴

The numbers describe what the Friday evening scene shows: degrees translate into a queue.

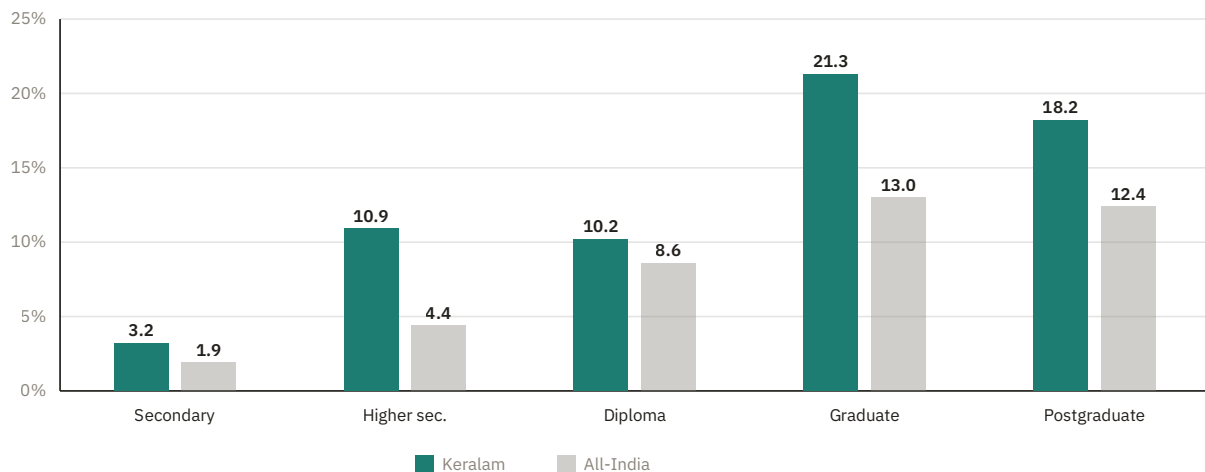
What sustains the queue is a stack of overlapping incentives. The years of preparation already invested are a sunk cost most aspirants will not write off. A government posting carries wage and benefit terms that small private firms in Keralam cannot match. Marriage prospects are tied to it, sometimes openly, more often through the household calculus that makes a clerk's job a more legible signal of arrival than a private engineer's salary. And every year

the queue does not move is one more year in which exiting to migration or to a low-margin private job feels like accepting the original investment was wasted.

Educated unemployment

Unemployment climbs with education. In Keralam it climbs further.

Unemployment rate by highest qualification, persons aged 15+, 2023-24.



Unemployment in Keralam climbs steeply above the secondary level and peaks among graduates at 21.3%, against 13.0% nationally. Below secondary level it stays under 2%, which inverts the intuition that more schooling means more work. Usual-status unemployment rate, persons aged 15 and above. Source: MoSPI, Periodic Labour Force Survey 2023-24 (Annual Report).

The queue itself is institutionally telling. The state Public Service Commission recruits for government clerical and lower-administrative posts, and for many educated young people in Keralam a government job is the goal. A study of the state's educated unemployment puts it bluntly: "The general mindset of an average educational youth is to get a government job." The preference is understandable, because high-productivity private firms in Keralam remain scarce.³ It is also a symptom. A state that channels its best-educated citizens toward clerical posts has not built an economy that can absorb them.

The Under-Used Cohort

The most under-reported part of this story is what happens to Keralam's educated women after they graduate. Keralam's female labour force participation rate, 40.8 per cent, sits below Tamil Nadu's and the national average and only just above Karnataka's, although a larger share of Keralam's women

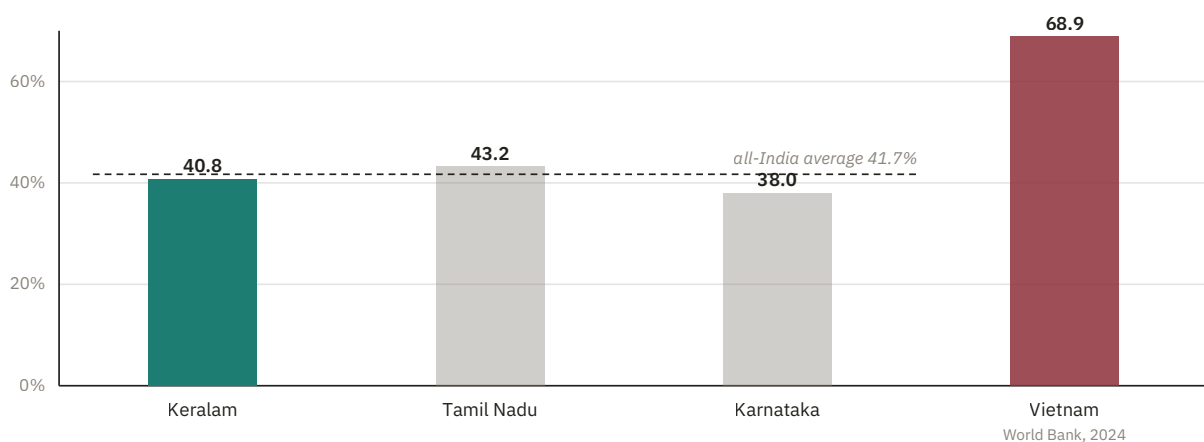
hold a degree than in either neighbour: nearly one in five.^{1,2} Tertiary completion among Keralam women is high. In the 2024 Plus Two results, girls took about three-quarters of the full A+ grades (29,718 of 39,242). Women dominate enrolment in many Keralam undergraduate programmes.⁴ And the trajectory diverges from the men's: educated Keralam women who do not enter government employment, teaching, or healthcare have limited routes into the broader economy. The result does not appear on any budget line. It is a large, well-educated female workforce that the state is not deploying.

Keralam's under-used female workforce is not a welfare statistic. It is the deepest talent pool any firm trying to build here can draw on.

Female participation

Keralam schools its women, then does not employ them.

Female labour force participation rate, ages 15+.



Keralam's female labour force participation, 40.8%, sits just below the all-India average and below Tamil Nadu, even though a larger share of Keralam's women hold degrees than in either. Vietnam, an industrialising economy, mobilises its women at nearly 69%. High female education has not translated into high female employment. Indian figures: usual-status participation, ages 15+, PLFS 2023-24. Vietnam: World Bank modelled ILO estimate, 2024; the methodologies differ, so the international comparison is directional rather than exact.

A frequently cited statistic from the 2023 Kerala Migration Survey is the share of degreed emigrants. 71.5% of female Keralam emigrants now hold a degree, against 34.7% of male emigrants.⁵ The figure is sometimes read as straightforward evidence Keralam is exporting its most talented women.

Two effects sit inside it. First, Keralam does not run a low-wage female emigration channel like Sri Lanka or the Philippines. The survey does not split emigrants by occupation, but Keralam women, on the whole, do not migrate as domestic workers, and the missing low-wage channel inflates the degree share at the upper end. Second, Keralam's resident female population genuinely outperforms the resident male population in higher-education attainment, so the degreed female pool inside the state is large to begin with. Both effects are operating.

Taken together, the resident and emigrant numbers point in the same direction. The under-use is structural, not a statistical artefact, and the state can measure it.

This is also where 'employability policy' diverges from the usual debates about more colleges and more courses. Care infrastructure (childcare, elder-care, accessible public transport, workplaces designed for women who carry the disproportionate weight of household coordination) is the labour-market enabler in this framing, not the amenity it is usually treated as. Treating it as welfare misclassifies a structural input. Treating it as economic infrastructure aligns the policy lever with what it is doing.⁶

The sector alignment makes this argument less abstract. The World Economic Forum's 2025 projections expect care-economy jobs to grow significantly over the next five years, while technology roles grow fastest in percentage terms.¹⁵ Keralam's female educational pipeline, its deep health sector institutional base, and its already-advanced ageing demographic (the highest 60+ population share among Indian states)¹ describe a precise match that the current employability policy has not engaged with.

Designing for 2040

The half-finished miracle is clearest in this gap. Educated unemployment in Keralam is not primarily a problem of job scarcity. It is a series of gaps between what graduates know how to do and what employable adults need to be able to do, and a separate gap between what they are calibrated for and what the local economy is calibrated to use.

The first gap is the absence of apprenticeship as a norm. In most Keralam undergraduate programmes, the formative years are spent inside lecture halls. The student finishes a degree without ever having worked on a problem someone else needed solved.

This is true of arts and commerce graduates, and increasingly true of engineering graduates from the lower tier of Keralam's many engineering colleges. The second gap shows up even among those who do gain applied practice (the better engineering interns, the polytechnic graduates with hands-on training, the medical and nursing graduates): the firms in Keralam set up to use that training are few. The educated worker often leaves. The firm set up to use them is in Bengaluru, in Mumbai, or in the Gulf.⁷

A useful contrast lives in two countries that have not solved everything about young people and work, but have solved more of the deployment problem than India has. In Germany, around half of young people begin a dual apprenticeship at some point (50.7% in 2021). Apprentices spend part of the week in a vocational school and part in a firm that has agreed to train them under chamber-of-commerce-supervised standards.⁸ The firm is building its own future workforce on state co-funding and an industry-co-designed curriculum. Switzerland runs the same kind of system, where around two-thirds of young people go through vocational education and training.⁹

What I have watched on the floor of Swiss industrial firms is the same intelligence as Keralam's, arranged around a different system. A worker barely out of her teens, two or three years into an apprenticeship at a precision-engineering firm, will set up a complex machining job to spec, check her own tolerances, and tell you why the previous run drifted, all before the shift lead has walked over. She is not the exception there. She is what the system reliably produces. Each time, what stayed with me was the contrast with the Keralam graduate of the same age, often with the greater raw ability, who has read about the process and can write a clean report on it, and has never once been handed the actual part. The trained machinist or chemical technician arrives on the job knowing how to set up a piece of work and finish it. The graduate arrives knowing how to write about it.

Two features of the dual system are doing the work that classroom education on its own cannot do. The first is that the curriculum for the in-company training is written by employers' associations and trade unions with the Federal Institute for Vocational Education and Training, BIBB, so the firms that will employ the graduates help decide what is taught. The school teaches what the industry needs, not what a syllabus committee in a state capital decided was relevant a decade ago. The second is that the certification mechanism, administered by chambers and recognised across the country, gives an apprenticeship qualification a consistent meaning in the labour market. An employer hiring a graduate of a Swiss federally certified apprenticeship knows precisely what that person can do.

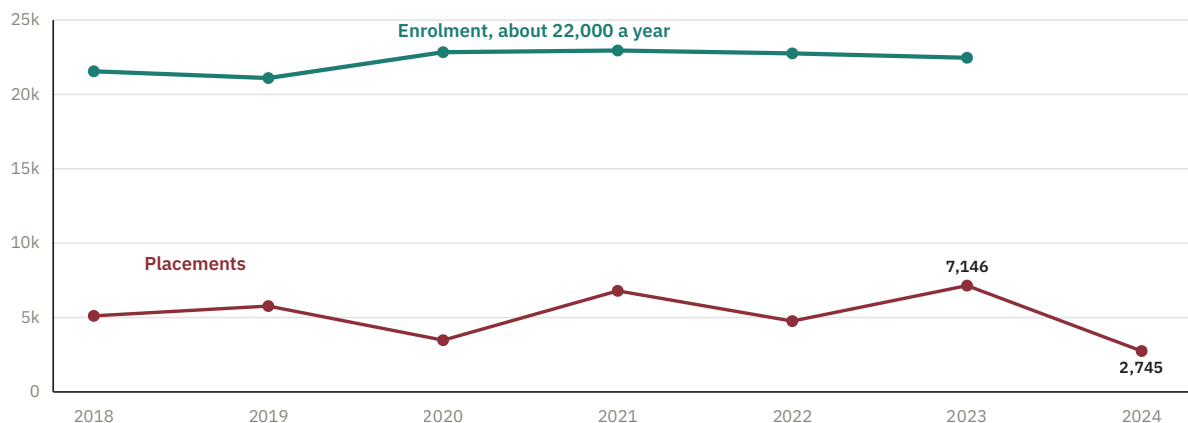
Keralam already has this track. Its Industrial Training Institutes (ITIs), run under the national Craftsman Training Scheme the Government of India started in 1950, and its polytechnics were the parallel vocational route. They lost grounding for traceable reasons. The curriculum is written in New Delhi, by the Directorate General of Training, and the state delivers it. Firms rarely co-owned the pipeline. Outside a dual-training channel that enrolled about 45,000 trainees across India in 2023, against more than 26 lakh ITI seats, they were customers of the output, not partners in its design. Social stigma kept the degree route as the status route, which made the ITI track a fallback rather than a choice.¹⁰

The ITI system was the right idea. What it lacked was a firm co-owning the outcome.

Vocational training

A steady intake. A fraction of it placed.

Keralam government ITI enrolment and recorded placements.

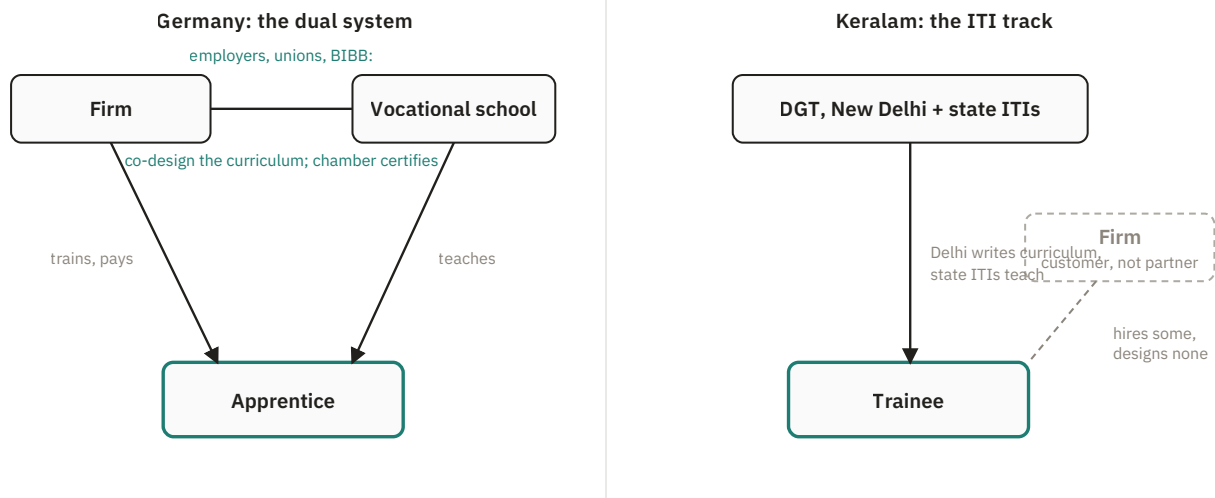


Keralam's government ITIs enrol a steady 22,000 or so each year, but recorded placements run far below that and swing from about 7,100 in 2023 to 2,700 in 2024. The Economic Review does not express placements as a share of those trained, so this is a comparison of levels, not a placement rate. Enrolment is government ITIs, academic years 2018-19 to 2023-24; placements are government ITIs by calendar year, as reported by the Industrial Training Department; the 2024 figure was unchanged in the 2025 Review. Source: Kerala Economic Review 2024 (Industrial Training Department).

Two systems

The difference is one arrow: who helps write the curriculum.

The firm sits inside the German loop and outside the Keralam one.



In Germany employers' associations and trade unions help write the curriculum with the federal VET institute, the firm pays the apprentice while it trains them, and the chamber issues a certificate that means the same thing nationwide. In India the Directorate General of Training in New Delhi writes the ITI curriculum and Keralam's ITIs deliver it, and the firm stays a customer of the output rather than a partner in its design. The missing arrow, the firm into the curriculum, is what the 2040 reform has to add.

Run the old ITI script with new slogans and you get the same result. The 2040 script has to be different.

The skills environment any 2040 system has to design for is already in motion. The World Economic Forum's 2025 projections put 39% of current skill sets as needing significant change before 2030.¹⁵ Stanford's empirical data from the United States shows that entry-level employment in high-AI-exposure roles fell 6% between late 2022 and September 2025; software developers aged twenty-two to twenty-five are down nearly 20% from their late-2022 peak.¹⁶ The pattern is directionally clear even where the magnitude is contested: early-career roles where AI automates the work are being compressed fastest, while care roles and experienced technical roles hold or grow.

Physical AI is moving into manufacturing lines, hospital diagnostics, marine systems, and agricultural processing fast enough that the basic competence a Keralam apprenticeship has to teach is no longer craft skill in isolation. It is AI-enabled problem-solving in the loop with physical AI: operating, troubleshooting, adapting, redesigning. Keralam has the foundation for this.

The literacy and numeracy that the half-finished miracle built sit well for it. What is missing is the apprenticeship system that turns that foundation into the new core competence.

For Keralam's apprenticeship design, this changes one thing in the German template: the content half-life. In Germany a training regulation is revised when employers report that the work has changed, and the process of agreeing the new one is meant to take no more than a year. A 2040 Keralam system cannot wait to be asked. It has to review its content on a fixed cycle of two to three years, or the trained worker graduates into a labour market that has already moved. The structural architecture (firm co-ownership of the curriculum, earn-while-you-learn, sector councils) is the right template. Deciding when content gets reviewed, instead of waiting for someone to ask, is the design challenge the template does not automatically solve.

The shape of that system is easiest to see in one sector. Take medical devices. A Keralam Medical Devices Apprenticeship Council would seat the device manufacturers, the major hospital networks, and the state directorate, with a small certification body run jointly. The council would set the curriculum for clinical engineering technicians, ISO 13485 compliance roles, and biomedical equipment maintenance. Apprentices would rotate on a defined cycle: six months in the vocational school, twelve months on a manufacturing line, six months in a hospital biomedical engineering department. The certification, when carried, would mean a specific named thing to every employer on the council.

That architecture, applied beyond medical devices, needs four things to hold that the existing system does not have.

1. **Sector councils.** Apprenticeship councils co-governed with firms in named industries (medical devices, marine industries, specialty foods, applied software), replacing the centralised state directorate as the curriculum authority for those sectors.
2. **Status by wage signal.** Vocational graduates reframed first through firms paying and promoting them visibly well, not first through public campaigns.
3. **Retention-linked incentives.** Training credits that vest only if apprentices stay three years, so a firm that trains a worker and loses them to Bengaluru does not unintentionally subsidise another state's workforce.
4. **Gender design from the outset.** Default arrangements (transit, dormitories, expected trades) configured so women are not silently filtered out.

With different firms and different roles, the same structure can carry marine industries, specialty foods, and applied software.

Keralam has a precedent for the kind of reframing the vocational status problem requires. The “God’s Own Country” tagline dates from the late 1980s, and Kerala Tourism still uses it. Between 2008 and 2019, domestic tourist visits rose from 7.6 million to 18.4 million and foreign visits from about 600,000 to 1.19 million.¹¹

God’s Own Country worked because Kerala Tourism committed to one phrase and held it. Vocational rebranding requires the same institutional stubbornness.

The asset is harder. The natural beauty of Keralam did not require improvement. The “God’s Own Country” campaign rebranded what already existed. A vocational rebrand requires the underlying capability to be there too. ITI graduates need to be reliably trained before any campaign claims they are.

The narrative campaign is the third step, not the first.

One further reason to draw the precedent carefully: the God’s Own Country brand succeeded. The planning did not keep pace with the tourism it attracted. In Wayanad, homestays and resorts spread across fragile hill terrain, often without serious environmental scrutiny, Down To Earth reported in 2025, and a citizens’ scientific study called the 2024 landslide a direct consequence of reckless human interference with fragile ecosystems.¹² It is a cautionary example of what happens when narrative is treated as the job rather than the preface to institutional redesign. Reframing is the right tool; institutional infrastructure has to follow it.

The employability problem in Keralam is often dismissed as one that all-India reform has to solve first. The division of authority is more granular than that. The ITI curriculum is set in New Delhi, but Keralam controls enough to start redesigning the school-to-work transition on its own. It can stand up sector-specific apprenticeship councils within its current authority. It already owns a body the national regulator lists as an awarding body, ASAP Kerala (the Additional Skill Acquisition Programme), through which those councils can design qualifications with firms and submit them for national approval.¹⁰ Its ITIs can sign the dual-training agreements that put trainees on a shop floor during the course. And it can turn state procurement into a

wage signal by prioritising contracts for firms that hire and retain apprenticeship graduates. What genuinely needs Delhi is narrower but real. Rewriting the national ITI trades is the Directorate General of Training's job, and every new qualification still needs the national qualifications committee's approval. The central scheme for upgrading ITIs requires a state share, ₹20,000 crore of its ₹60,000 crore outlay, which makes experimentation expensive for a state with no fiscal room. Delhi also decides whether Keralam certifications are recognised in central employment and contracting, and that recognition is the wage premium the whole reframing argument leans on.¹³ Keralam can begin without waiting for any of it.

The first essay argued that Keralam's economic future runs through precision: a few sectors chosen, each built deep, rather than scale chased across the board. That precision only pays if the workforce feeding those sectors is built with the same deliberateness, skill by skill and sector by sector, instead of produced by the thousand and left to find its own use.

Solving the employability problem will not, by itself, solve Keralam's structural employment shortage. A trained workforce is a necessary input. The economy that uses that workforce (the firms, the clusters, the productive specialisations Keralam chooses to build) is the question the next essay opens. Keralam does not get to keep its young people parked outside tea stalls indefinitely, regardless of how well any curriculum is reformed. It has to give them somewhere to go. The standard answer is to attract big manufacturers, build industrial parks, chase foreign investment. It sounds obvious. The next essay argues it is the wrong script for Keralam's geography, labour force, and starting conditions.

. . .



Kehar Singh, Weaving and Spinning, c. 1860. The Cleveland Museum of Art, CCo.

WHAT IT IS

Kehar Singh, “Weaving and Spinning,” painted around 1860 in the Punjab, probably Amritsar or Lahore. Gum tempera and ink on paper, 23.7 by 19 centimetres. A man works a wide wooden loom lashed together from rough branches on the left. A woman sits at a spinning wheel on the right, her head covered, a low stool beneath her. A line of Persian script across the top names the painter and the trades. It is a Company School painting, made by an Indian artist for British patrons who were cataloguing the crafts of the subcontinent. The Cleveland Museum of Art.

WHY IT IS HERE

Hand-spun and woven cotton was, for a long stretch, the most valuable thing India sent into the world, and the skill in this picture is complete. The two of them know exactly what they are doing. What they lack is everything around the skill. The loom is tied from branches, the floor is the workshop, and the trade their cloth fed was owned and priced somewhere they would never see. That is the half-finished miracle from the other side. Kerala’s bind has never been a shortage of ability. It is that the firms and institutions that would let ability compound were built elsewhere, so the trained hand keeps working at the edge of an economy someone else arranged. A century and a half on, the export is no longer cotton. It is the graduate.

WHAT TO LOOK AT

Follow the loom first. It is less a machine than a set of straight branches held in tension, and still the cloth coming off it is even. Then the woman’s hand at the wheel and the single thread running from her fingers. Neither of them is watching the work. They do

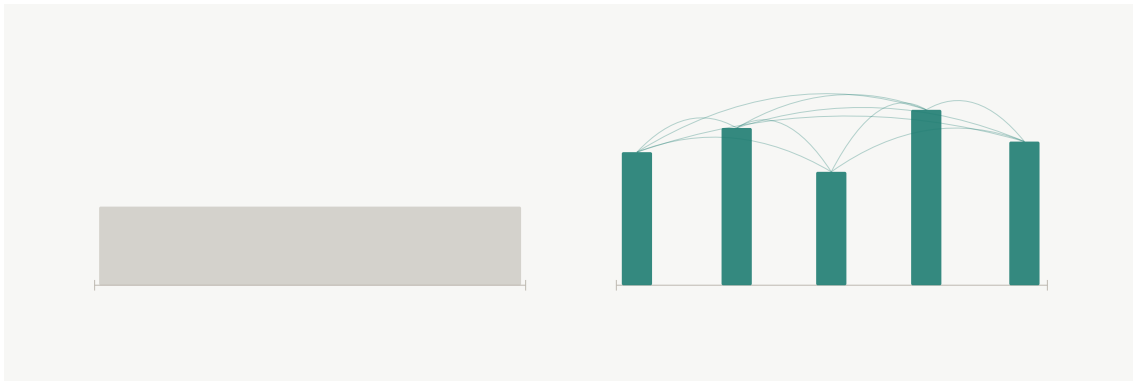
not need to. The knowing has moved into the hands, which is the one thing a degree on its own never manages. Last, the Persian line along the top. Someone thought the trade worth recording, but recorded it as a specimen rather than a future.

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PART 3

Factories Will Not Save Kerala

Keralam does not need a factory. Keralam needs an institution that can hold a thirty-year industrial bet. From a series asking what Keralam 2040 would have to be.

Some years ago I went through the process of building a plant in Jurong Island, Singapore. The facilitating agency was Singapore's Economic Development Board. It remains the most professional institutional engagement I have encountered in two decades of working across fifteen countries. They knew exactly what they wanted, why they wanted it, and what they were prepared to offer. There was no ambiguity about the state's position. There was no confusion about who was deciding.

Keralam does not yet have an institution that works like that. The question worth asking is what it would take to build one, and what kind of industry would be worth building it for.

Keralam's situation is what I have called a half-finished miracle: the human-development achievement is real, the productive economy that should match it is not. The previous essay argued that closing the talent-supply side of that gap requires an apprenticeship system Keralam does not yet have. This essay asks the symmetric question on the demand side. What is Keralam's trained workforce meant to build, and what institutional capacity does building it require?

The factory fantasy

The default Indian industrial answer is the low-cost factory at scale: large contiguous land, mass assembly, low wages, suppressed voice on the shop floor, volume export.

It does not translate to Keralam. Not because Keralam is anti-industry, but because the model is built around conditions Keralam structurally does not have, and around a population that would not accept the conditions if they were produced.

Land. Keralam has 860 people per square kilometre, among the highest densities in India.¹ Settlement is a near-continuous spread, ribboning along roads rather than nucleating into discrete towns surrounded by usable hinterland.¹ Large contiguous industrial land assembly is structurally costly. Every sizable parcel requires displacement that the social model treats as a public negotiation, not an administrative formality.

Labour. Keralam's workforce is politically conscious and organised in ways most Indian states are not. Voice on the shop floor is louder. The low-cost factory model assumes a workforce willing to absorb conditions that Keralam's trade union infrastructure has long worked to prevent. This is not a dysfunction. It is the social model working as intended.

Ecology. The Western Ghats, the coastal systems, and the backwaters are not externalities to be managed around an industrial siting decision. They are the state's long-term asset base, ecologically and economically.² Treating them as land-acquisition friction misclassifies the asset.

Political economy. Large land acquisitions in Keralam often meet organised resistance. This is sometimes characterised as progressive heroism, sometimes as economic obstacle. Both readings flatten what is happening. Land is dense, lives are tightly woven into specific places, displacement is contested politically. The state cannot will this away. Industrial strategies that assume otherwise fail.

Jurong Island sharpens the argument

None of this means Keralam cannot industrialise. It means the conventional model is the wrong one. Jurong Island is the proof of both halves at once.

Singapore had less usable land per capita than Keralam does. Beginning in 1993, JTC Corporation merged seven small islands south of the main island into a single 3,000-hectare industrial island. By 2009 the landmass was complete, and it now anchors more than SGD 50 billion in cumulative investment across three decades.³ It is one of the world's top integrated energy and chemicals complexes.

Two features matter about how this happened.

First, the cluster is capital-intensive and vertically integrated. Companies are adjacent because they share feedstocks, utilities, pipelines, and safety infrastructure. The state built the shared layer. The firms used it. The proximity is not a coincidence; it is a design.

Second, the firms were matched. Singapore's aim, as its trade minister put it when the reclamation was completed, was "finding out the right match of companies to maximize the synergies of integration and co-location", with upstream plants supplying feedstock to downstream manufacturers. The Economic Development Board then went out and sold that design to foreign petrochemical companies.⁴

The lesson Keralam should take from Jurong Island is not about petrochemicals. Keralam already makes them: BPCL's Kochi refinery added a propylene-derivatives project in 2021, and the company is investing in a polypropylene unit that will run on the same refinery's propylene. What Keralam cannot do is find 3,000 hectares for a Jurong-scale complex, or accept the ecological exposure that would come with it. The lesson is about institu-

tional architecture: a state agency that knows what it wants, can hold a thirty-year industrial bet, has the discipline to match the firms it brings in, and delivers on its commitments to builders.

What Keralam does not yet have is an institution like it.

Keralam's cluster candidates

Four candidates illustrate what cluster-fit could look like for Keralam. They are not a recommendation list; they are a worked example of the thinking the institutional architecture would have to do.

Each candidate has to satisfy four conditions. Keralam has the raw material or the knowledge base. Land intensity per unit of value is materially lower than conventional industry. Value per square metre is high. Firms in the cluster benefit from being near each other.

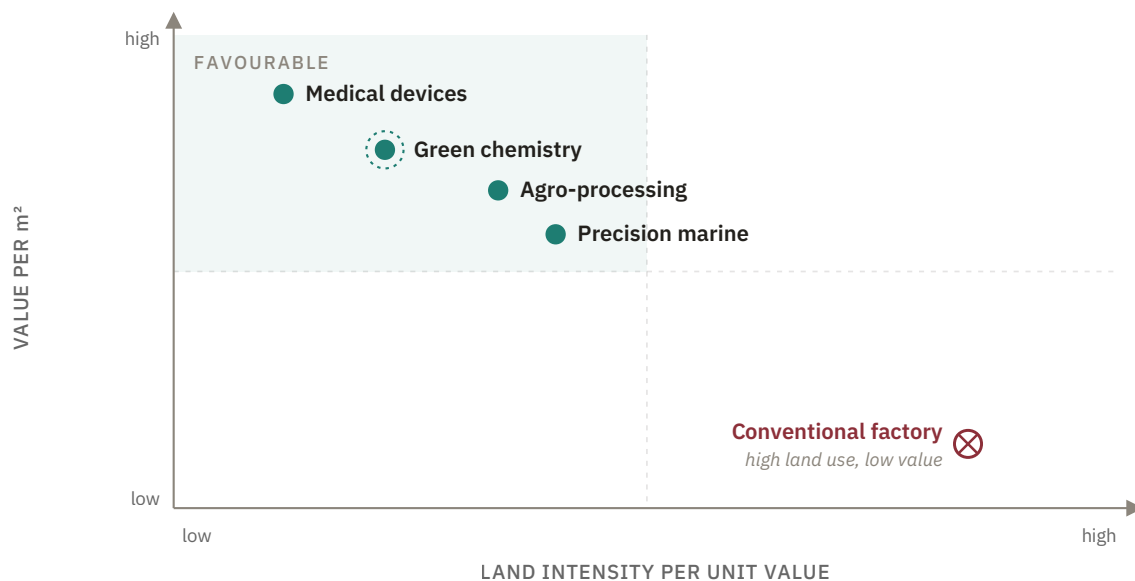
1. Specialty agro-processing. India still exports about three-quarters of its spices, by value, in primary form. Rubber stays inside India: Keralam grew about 71% of the national crop in 2023-24, and India remains a net importer of natural rubber. A processed specialty foods and ingredients cluster, integrated with global pharmaceutical and food-tech firms, builds on supply chains that already exist. The Spices Board, Rubber Board, and Coconut Development Board are institutions whose mandate already covers this work; they are not directed at it as cluster anchors.⁵

Keralam grows the inputs. Too much of the value still gets added elsewhere. Bringing it home is the industrial policy agenda.

2. Medical devices and diagnostics. Keralam has a strong public health system, a tradition of surgical practice, and an existing research base at the Sree Chitra Tirunal Institute for Medical Sciences and Technology in Thiruvananthapuram.⁶ Devices require precision manufacturing, not mass assembly. Land intensity is lower. Intellectual property captured locally is higher. The cluster logic is genuine: device manufacturers benefit from proximity to clinical-trial sites, hospitals, and biomedical research institutions.

3. Green chemistry and bio-based materials. Keralam's agricultural base, ecological constraints, and existing chemistry research capacity together describe a candidate. Green chemistry sits inside one of the largest industrial transitions of the next two decades, not outside it. If, as the International Energy Agency's Stated Policies Scenario projects, oil demand levels off around 2030, I would expect bio-based materials to be one part of the industrial supply response.¹⁰ I do not think the research-to-firm translation infrastructure required to make this real exists in Keralam yet. A later essay in this series returns to that gap.

4. Precision marine industries. Keralam has roughly 590 kilometres of coastline. The cluster candidate is not a shipyard in the old sense. It is a precision marine cluster: vessel maintenance, marine engineering, and specialised coastal infrastructure, with the port at Kochi as the anchor.⁷



The two spatial-economic conditions, land intensity and value per square metre, are what separate the four candidates from the conventional factory. All four also clear the raw-material or knowledge-base test; green chemistry, ringed, is the one still short on institutional readiness.

These four are illustrations, not a shortlist: the point is that Keralam's menu is not limited to large-format factories, and that the alternative depends on institutional architecture the state has not yet built.

The state capacity gap

Jurong Island required an EDB. Not a promotional agency. Not a clearance authority. An institution that could make a thirty-year industrial bet, hold it through political cycles, curate the firm mix, and deliver on its word to builders.

The closest Keralam equivalent is KINFRA, the Kerala Industrial Infrastructure Development Corporation. KINFRA is a real institution. It runs industrial parks, manages land, and sets the allotment and lease terms in its parks.

Keralam has also attempted sectoral clusters of its own. The KINFRA Defence Park at Ottapalam and the state’s K-Space initiative at Technopark Thiruvananthapuram (a separate state society, not KINFRA) are direct attempts at the kind of single-sector, curated park this essay argues for. KINFRA’s food and electronics parks elsewhere in the state are others. Neither the Defence Park nor K-Space has yet become a cluster. The Defence Park has been built, but KINFRA’s own 2025 brochure lists it as only 37.5% allotted. In February 2026 K-Space was still at the land stage: the cabinet had only just approved buying land for a new K-Space project.⁸ Keralam has the ambition. It lacks an institution that can turn a sector-park label into what Jurong Island became.

Five dimensions describe the distance:

DIMENSION	SINGAPORE EDB	KERALAM KINFRA
Mandate	Curate and grow named industrial sectors over decades	Develop industrial parks and administer state incentives
Horizon	Thirty-year sectoral bets, held	Priorities set by government direction, open to change with each government
Decision authority	Sector-level firm selection and incentive negotiation	Project-level land allocation against standard schemes
Firm curation	Matches firms so that one plant’s output feeds the next	Parks labelled by sector, without a state choice of which clusters to build and hold
Incentive design	Performance-linked incentives that vest over time	Land leases paid 20% upfront, the balance in five yearly instalments

The gap is not personnel. KINFRA has competent people. It is constitutional. KINFRA is a statutory body, but its own Act binds it to follow the government’s policy directions, so nothing in law holds its priorities steady when

the government changes. Its parks carry sector labels, but no one has told it which two or three clusters the state is building and held it to that choice. And no Keralam industrial agency has yet built the multi-decade track record that makes a thirty-year promise to a builder credible.

An EDB-equivalent is not a promotion board. It is an institution that knows what it wants, can hold a thirty-year bet, and delivers on its word to builders.

Closing the gap is not a personnel problem. It is a political and constitutional one. Who has the authority to make decisions, on what horizon, accountable to whom.

The gap is real, but it is not binary. Some of it Keralam can close within its existing authority. Some of it requires a longer political fight with Delhi.

What Keralam can do now

Within KINFRA's current authority, the state can design sector-specific cluster policy for compact precision sectors rather than running a general industrial-promotion mandate. State procurement is the most under-used industrial-policy lever Keralam owns. Prioritising contracts for processed Keralam specialty foods, locally manufactured medical devices, and precision marine services would create a first-customer signal that private buyers extend over time. KINFRA's incentive structure can be reformed to time-vest benefits: the firm receives the subsidy when it stays, employs, and delivers, not before. Diaspora capital, which Keralam has in unusual abundance, can be channelled toward cluster-compatible sectors by institutions designed for that job rather than left to settle into real estate.

What requires federal change

Special Economic Zone rules are written for large-format export-processing zones and would need rewriting for compact precision clusters. Central environmental-clearance timelines are a real bottleneck for any industrial project of meaningful scale. And greater state autonomy in sector-specific trade and investment promotion would let Keralam pursue cluster-compatible firms abroad without going through central procedures designed for general FDI.⁹

Building precision clusters requires research that translates into firms: ideas that move from a laboratory or a hospital ward into a manufacturing line, a product, a company. Keralam has a research base. If the state cannot connect its laboratories to its factories, the way MIT connects to Kendall Square, the clusters will not be built.

. . .



Michele Marieschi, Views of Venice: The Gates of the Arsenal, 1741. The Cleveland Museum of Art, CCo.

WHAT IT IS

“Views of Venice: The Gates of the Arsenal”. Michele Marieschi (Italian, 1710–1743), 1741, etching. The ceremonial land gate stands on the left under the winged lion of Saint Mark, fenced off behind iron railings and marble lions. The crenellated water tower is beyond it, with the masts and rigging of a ship showing above the wall. The Latin line etched under the plate reads “Magni Armamentarii Veneziarum portae duae; artificibus altera, altera navibus duplex aditus”: the two gates of the great Arsenal of Venice, one for the craftsmen, the other for ships. The Cleveland Museum of Art.

WHY IT IS HERE

The Venetian Arsenal is the institution this essay asks Keralam to build, four centuries early. The state owned the yard, employed the workforce directly, standardised the parts, built the shared layer that made the whole thing cohere, and held that arrangement across centuries rather than electoral cycles. Firms were not attracted to it. They were assembled inside it, by design. What makes the plate right rather than merely apt is its caption. Marieschi does not describe the Arsenal. He describes its two doors and states who each one admits: craftsmen through one, ships through the other. An institution of this kind is defined at its boundary, by what it lets in, what it turns away, and on whose authority. That is the essay’s argument about the Economic Development Board reduced to a single etched line. Keralam is not short of land or labour or even capital. It is short of the body that can stand at the gate and choose.

WHAT TO LOOK AT

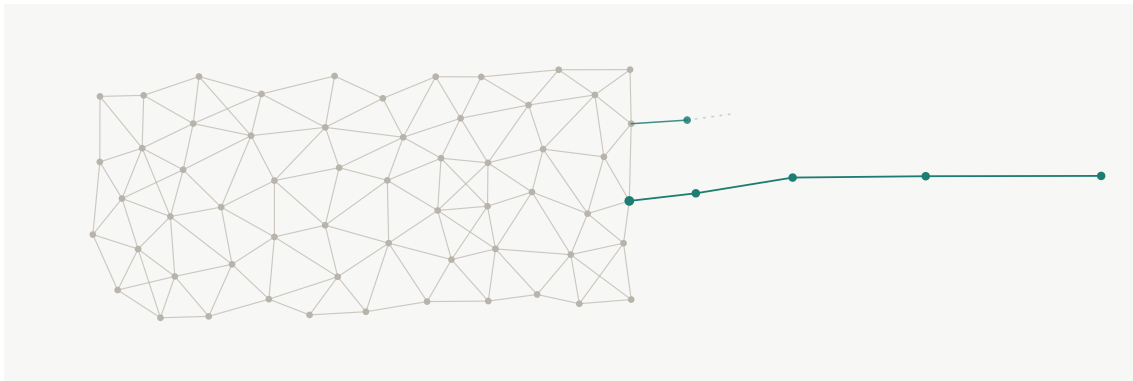
How little of the Arsenal you can actually see. The wall runs across the middle of the plate and stops the eye dead. The only evidence that Europe's largest manufacturing operation lies behind it is a set of masts over the parapet and one hull at the water gate. Then look down into the foreground: a moored gondola, a man carrying a load on his shoulder, two figures talking, a dog. Ordinary Venice, going about its afternoon against a blank wall. What the public ever meets of an institution like this is the door.

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PART 4

Built for Rescue

Keralam owns a machine that can find anyone in the state when it matters. Whether machinery built for coverage can carry knowledge to a production line is the harder question. From a series asking what Keralam 2040 would have to be.

In August 2018, fishing boats moved through the Keralam midlands on the backs of lorries. They had come up from the coast: mechanised country boats, loaded onto lorries there and driven inland. The rivers of central Keralam had left their beds. In Pathanamthitta, in Chengannur, in the low country around Kuttanad, people were marooned in flooded homes; across the state, close to 14 lakh had to be evacuated to relief camps. The fishermen worked the flooded streets. When the water receded, the accounting credited 669 boats with roughly 65,000 rescues. In Pathanamthitta district, fishermen rescued about seven of every ten people marooned.¹

The fleet did not simply appear. On 15 August, as unusually heavy rain flooded the state, the fisheries department sent for it. Announcements over loudspeakers in the fishing villages along the coast called boats to rescue duty. The department found the lorries that carried them. While the rescue was still running, the Chief Minister promised the crews fuel and fair compensation for their damaged boats, and afterwards the state honoured them in public.¹ Volunteers turn up at every disaster, everywhere in the world. What is rare is a government that knows, on its worst day, exactly which of its citizens hold the right equipment and the right knowledge, and can reach them within hours through channels it maintains in ordinary time. The boats were private. The improvisation was the fishermen's own. The telephone line was the state's.

The remarkable thing is not that the fishermen came. The remarkable thing is that the state had a number to ring.

The first essay in this series called Keralam a half-finished miracle: the society is built, the economic form that fits it is not. The second and third essays examined the two conventional answers, trained labour and industrial parks, and found each waiting on institutions Keralam has not yet constructed. The third ended on a condition it could not show met: that Keralam's research can reach a production line. Before the series takes that up, an asset the first three essays kept in the background needs to be brought forward and named, because every proposal that follows depends on it. Keralam owns a machine for finding people and moving knowledge between its institutions and its households. This essay is an inventory of that machine, and of what it has never been asked to do.

The asset register

What follows should be read the way an auditor reads fixed assets: flatly, with dates. Keralam's civic infrastructure is not one network but four: household reach, care reach, civic knowledge, and local public authority.

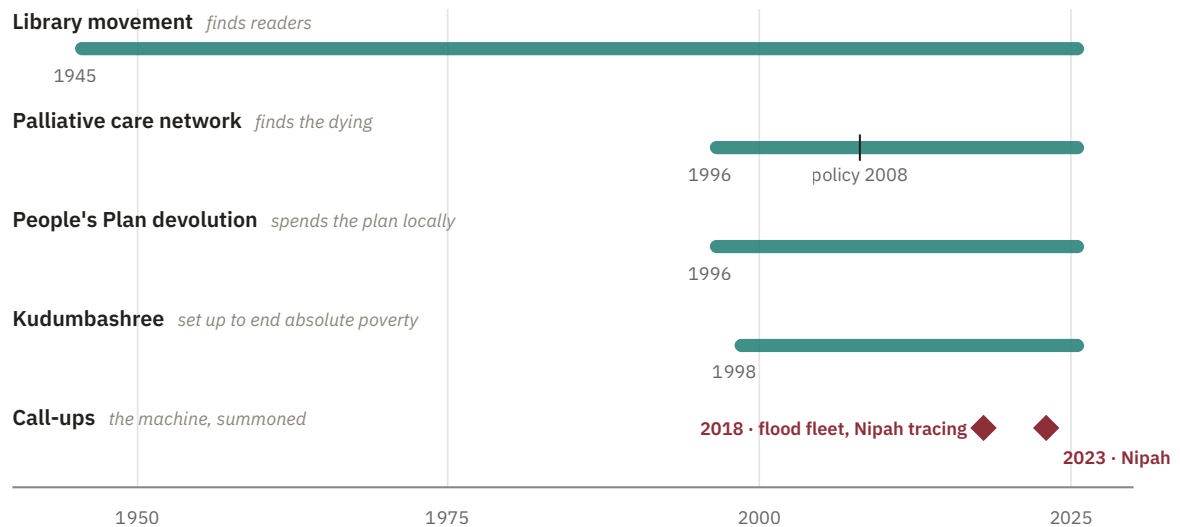
The state set up Kudumbashree on 17 May 1998 as a poverty eradication mission. The Comptroller and Auditor General's 2018 performance audit, which is not a promotional document, describes what it became: a mass women's participation programme of 4.3 million members, organised as neighbourhood groups that federate upwards through ward-level societies to a society in each local government.² The base unit is small enough to meet in a front room and knows its territory house by house.

The palliative care network is older and grew from the opposite end, from society rather than the state. In 1996 a group in Malappuram began training neighbourhood volunteers to find and visit the incurably ill and the dying in their own homes, with nurses and doctors in support rather than in charge. In Malappuram there were 29 such clinics by 2008.³ In 2008 the government issued a Pain and Palliative Care Policy, the first Indian state to have one, which named home-based care the cornerstone of the service and set the volunteer networks to work alongside the primary health centres under local-government coordination.⁴ Dying at home, which most health systems treat as invisible, is in much of Keralam a condition somebody is assigned to notice.

The oldest layer is the library movement. On 16 September 1945, delegates from 47 Travancore libraries met at Ambalapuzha under P. N. Panicker's leadership and formed the Travancore Grandhasala Sangham. The network it coordinated passed four thousand libraries by 1975, the state stepped in in 1977, and a democratically elected Kerala State Library Council followed in 1994.⁵ A village library is distributed infrastructure in the most literal sense: knowledge stored locally, lent by someone who knows every borrower by name.

Around these sit the layers nobody founded on purpose and the one big layer the state added deliberately. Since 1996, when the People's Plan Campaign moved part of the state's plan spending into the hands of village, block and district governments,¹² the panchayat has been a place where money and information change hands in public. Residents' associations, arts and sports clubs, reading rooms, co-operatives, temple and church and mosque committees, party branches, union locals, and the diaspora's home-town as-

sociations complete the stack. No single item on this register is unique to Kerala. The density of the whole, and the fact that every layer is still standing, is.



Each layer arrived without dismantling the one before it, which is why the oldest bar on this chart is also still the longest. When the flood came in August 2018, the state did not have to build a rescue network. It rang one that had been standing for decades.

Why information does not have to jump

Three structural facts explain why this stack works in Kerala and resists transplantation.

The first is that Kerala has no sharp edge between town and country. Settlement runs nearly continuously along the coastal plain and up the river valleys, houses strung along roads rather than gathered into towns with empty land between. The census took decades to catch up with this: between 2001 and 2011 Kerala's recorded urban share jumped from about 26 per cent to 47.7 per cent, and most of that growth was reclassification: census towns rose from 101 to 461, as villages whose people had moved out of farming into other work crossed the census's urban tests.⁶ The settlement was already continuous. What the census recorded was a change in what people did for a living. A message moving from a research institute in Thiruvananthapuram to a fishing harbour in Kollam never leaves settled country.

The second is language. Whatever else a household speaks, Malayalam remains the state's shared public language, the one in which more than thirty-three million people read, argue, broadcast and are governed, and the same newspapers and the same phone screens saturate the whole state. A notice read out at a panchayat meeting, a health warning, a loudspeaker announcement at a harbour: each arrives in a language nearly every household it reaches can act on, first time.

The third is the register above. No index measures associational density, and the depth of Keralam's has to be argued from the inventory rather than read off a table. The practical effect is close to this: most people are within one hop of an organised structure, and most such structures are within one hop of the state. Information travels because it never has to jump a gap to arrive.

Thirty-five million people is not a small place. Keralam is a large place wired like a small one.

A name for the machine

There is a name for a system built this way. Edwin Hutchins, watching a ship's navigation team at work, observed that no individual on the bridge computes the ship's position. The fix emerges from the interaction of people, instruments and routines; the thinking is a property of the whole arrangement. He called it distributed cognition.⁷ The term describes a system that knows things no single member knows.

Keralam at its functioning best is one of India's clearest examples of distributed cognition at the scale of a state. That sentence is an argument, not a measurement, and it should be weighed as one. But the August 2018 record is hard to read any other way. The knowledge of where the currents ran in a flooded street existed in fishermen's hands. The knowledge of who was stranded existed in neighbours' phone calls and ward members' lists. The authority to move boats over land existed in the fisheries department. No one of those parts could have produced 65,000 rescues. The arrangement did.

One shape of problem

Now look at what every proven success of this machine has in common.

In the flood, success meant reaching everyone stranded. When Nipah broke out in Kozhikode in May 2018, three months before the flood, the health system traced about 2,600 contacts, followed each for 21 days, and contained an outbreak that ran from May into June.⁸ A single response is a story; a repeated one is a capability. Nipah has returned to Kerala several times since, and each time the tracing apparatus has stood up again.⁹ The palliative network succeeds when no one dies unattended. Kudumbashree was set up to eradicate absolute poverty from the state.²

Different domains, one success condition: nobody is missed. And in every case, failure is loud and specific. The household not reached in a flood has an address. The contact not traced becomes a case with a name. The machine has been tuned for seventy years by exactly that feedback, and it has proved itself at problems of this shape. Call them coverage problems.

A machine tuned by one kind of feedback is not thereby good at problems that provide a different kind, and not thereby bad at them either. It is unproven.

A different cargo

Set against that record the job the series actually needs done. The third essay argued that Kerala's industrial future lies in precision clusters, and that clusters need research that translates into firms. Translation is also a network problem, but a different shape of one.

Kerala has done translation at least once. A team at the Sree Chitra Tirunal Institute in Thiruvananthapuram designed a mechanical heart valve; in 1991 the institute transferred it to TTK, a company based in Chennai; the Chitra valve has since gone into more than a hundred thousand chests, and it is made today in Thiruvananthapuram, in a factory in a KINFRA park at Thumba.¹¹ Count what that journey needed. A design team, an institute willing to license, one firm willing to build: dozens of people, not millions, carrying one idea across the boundary between an institute and a firm, between a patent and a purchase order, through organisations that were never designed to hand anything to each other. Coverage asks a dense network to reach every nearby node. Translation asks a few nodes to pass one thing outward across organisational walls, and most attempts are supposed to die on the way. Success is not everyone reached; success is one thing carried far.

The failure modes differ the same way: the paper unread, the prototype unfunded, the licence never taken up. Nobody stands on a roof. No list exists of the ideas that drowned, and watching for one going under is not anybody's assigned work.

Coverage fails loudly, with a name and an address.

Translation fails quietly, and it is nobody's job to notice.

None of this says Keralam cannot start companies. The evidence points the other way; the central government's 2022 startup ranking placed Keralam in its top band, alongside Gujarat, Karnataka and Tamil Nadu.¹⁰ The claim is narrower, and stranger. Keralam holds strong proof of one network capability and no proof either way on the other, because nothing in its history has ever demanded translation from its networks at scale. The machinery's tuning is an inference from its record, not a measured law. The question is open. But it is the right question, and the series has not found it asked anywhere in the state's official imagination.

The edge of the network

Keralam's civic density is not politically neutral. Much of the associational life on the register operates through affiliation and inherited loyalty: reading rooms, youth wings, co-operatives, unions and arts clubs that belong, formally or by long habit, to one political formation or another. The alignment accelerates coordination inside a bloc and complicates it across blocs. Information moves at extraordinary speed inside a formation and often stops dead at its edge. No survey measures this. It is an observation, and Keralam's readers can test it against their own wards.

For coverage, the alignment has mattered less than one might expect, because a flood does not check party cards and a virus does not either; the great call-ups temporarily fuse the factions into one network. But a system that shares intensely within its parts and reconciles poorly between them is not one mind. For contested cargo (an idea that must cross the state whole rather than arrive in pieces) the seams are the structure. Any attempt to point this machinery at new work will have to reckon with the fact that it is several machines wired in parallel, which sometimes agree to be one.

What Keralam can do now

Nearly everything on the register above is the state's own creation or its decades-long partner, and pointing it at new cargo requires no one's permission. The levers are concrete: state procurement, the plan funds its local governments already spend, and the mandates it writes for Kudumbashree and the mission agencies. A district could choose one problem already close to production (diagnostic devices, assistive technologies, food-processing machinery) and put a named team on it, convened by the district administration with a university or technical partner, to walk a small portfolio from laboratory result to procurement, licensing, pilot customer and factory partner. Unlike a flood roster, its register would contain ideas at risk of being lost. What the state lacks is not authority over the network but a demonstrated use for it beyond coverage, and demonstrations are within its gift.

What requires federal change

Much of the knowledge the network would need to carry sits in institutions that answer to Delhi, the Sree Chitra Tirunal Institute among them: the central research institutes and councils, and the regulators who approve what a laboratory may hand to a factory. Their incentives, hiring and technology-transfer rules are set centrally, and a state that wants its networks connected to its laboratories negotiates with owners it does not control.

. . .

What would it take for machinery whose success condition is that nobody is missed to carry cargo whose success condition is that a few people carry it far?

Keralam built a machine that can find anyone in the state. Nobody has yet asked it to move an idea.

. . .



Kitagawa Utamaro, Net Fishing at Night on the Sumida River, c. 1800. The Cleveland Museum of Art, CCo.

WHAT IT IS

“Net Fishing at Night on the Sumida River”. Kitagawa Utamaro (Japanese, 1754–1806), about 1800, triptych of colour woodblock prints. A night scene under a crescent moon on the Sumida River in Edo, now Tokyo. A drinking party on a roofed pleasure boat has drawn alongside a fishing boat, and a great scoop net, printed as a fine red mesh, fills two of the three sheets. The museum’s own note has the party interrupted by the encounter: one fisherman strains at the net while a woman in the party boat offers her sake dish. The Cleveland Museum of Art.

WHY IT IS HERE

The essay is about a network called out onto dark water, and here is one, drawn at working size. A net is the essay’s structure made physical: no strand matters on its own, every strand holds because of the knots around it, and the whole thing only works spread wide. Utamaro puts it in front of everything. You read the entire party through its mesh. The deeper reason is how the object was made. A colour woodblock triptych is manufacture by network: Utamaro drew the design, block cutters carved a separate block for every colour, printers pulled the sheets, and a publisher coordinated and sold them. No single hand made this picture. And each sheet carries its own signature and was sold as its own print; the image only resolves when the three are laid side by side. A picture that exists in the relations between its parts, made by a system that thought through many hands: that is the essay’s subject, hanging on its wall.

WHAT TO LOOK AT

Start with the mesh: a red crosshatch fine enough that every figure behind the net stays legible through it, each crossing cut into the block by hand. Then find the vertical seams where the sheets join, and watch the net’s mesh and rigging carry straight across the right-hand seam; the net is what stitches the sheets into one picture. Count the signa-

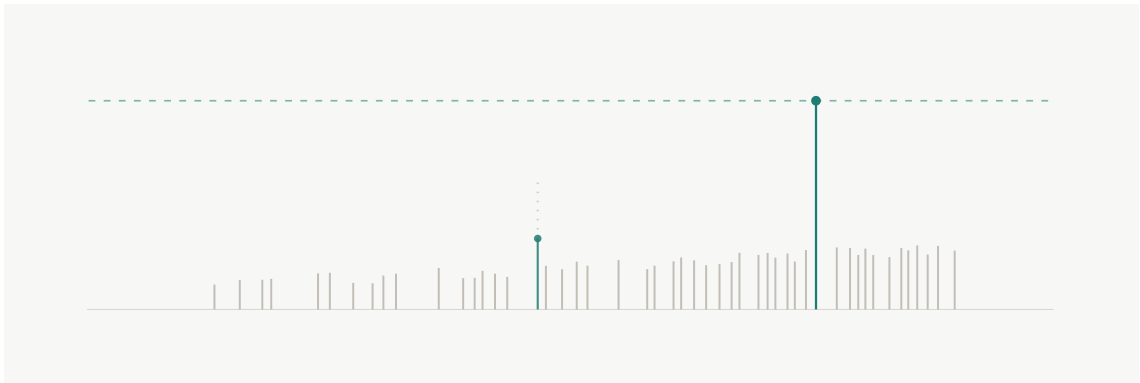
tures: each sheet bears its own, three for one image. Then look for what all this machinery has actually caught, at the bottom of the centre sheet: a single small fish, above the round tub.

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PART 5

Beyond Literacy, a Research Republic

Keralam produces more papers each year. That is a starting point, not a destination. From a series asking what Keralam 2040 would have to be.

On its own fellowship, the University of Kerala was still paying a doctoral researcher ₹13,000 a month in 2022, a rate set in 2016. One who wins a national fellowship is paid ₹37,000 a month in the first two years and ₹42,000 from the third, at a rate set centrally, in Delhi, that Keralam cannot change.⁹

The average salaried employee in Keralam earned about ₹22,000 to ₹23,000 a month in 2023-24.⁹ A capable Keralam graduate holding a master's degree is therefore not choosing between research and unemployment. On the University of Kerala's own fellowship, they are choosing between research on little more than half an ordinary salary and a job in the same city, available immediately, with no thesis at the end of it. This is the same graduate the second essay in this series tracked at the tea stall: over-qualified for the local job market, under-rewarded for the research career that could feed the precision clusters this series has been describing.

Most take the job. Each of those decisions is sensible on its own, and the sum of them is a state that cannot staff a research base.

None of this appears in the number Keralam publishes about its research.

A few years ago I came across a news item reporting Keralam's research output statistics. Publication growth between 2018 and 2023 was strong, the headline said. The original study, an Elsevier report released through the Kerala State Higher Education Council, was not available online. It still is not. The question that did not get asked, in that news item or in any of the news items like it I have seen since, is what those publications do once they exist. Where they are cited. By whom. In what fields. And whether the institutions producing them are growing into research bases that compound, or producing more papers each year without building the compounding institutional base those papers should feed.

Keralam's publication numbers grew. This essay is about the distance between that and a research base whose work other serious institutions regard as essential reading.

This series has argued that Keralam's half-finished miracle has a talent-supply gap, a demand-side institutional gap, and a cluster-architecture gap. The research base is the fourth gap. Keralam has substantial talent and a broad institutional base; what it has not built is the layer that turns research into compounding capacity. Without that layer, the precision clusters this series has been describing have no research base to feed them.

The applause trap, applied to Keralam

Publication growth makes the deeper question harder to ask. Nobody wants to be the one asking what a number counts while everybody else is congratulating the state on it going up.

Keralam's publication growth, in its current form, measures volume. It does not yet measure depth. Citation impact in priority domains. International researchers who choose Keralam as a sabbatical destination because the work is serious. Industrial firms that fund Keralam research because the output feeds their R&D pipelines. Doctoral graduates who stay because the work here can hold a career. None of these track with publication count, and three specific substitutions show up in Keralam's current research policy debates.

Publication growth read as research depth. Publications by Keralam's state universities grew 11% a year between 2018 and 2023 on Elsevier's count.¹ A count of this kind can include mandatory course papers, derivative work, and conference proceedings. The volume is real. In that total, a required coursework paper counts for exactly as much as a paper other institutions treat as essential reading.

MoU announcements read as industrial linkage. A memorandum between a university and a firm is easy to sign and easy to announce. An MoU is not a research partnership. A research partnership involves shared problems, shared data, shared staff, and shared intellectual property. A count of MoUs measures signatures. It does not show how many reach the four-shared structure.

Joint degree programmes read as internationalisation. The UGC's regulations on twinning, joint and dual degrees, notified in May 2022, are precise about how coursework is divided. A dual-degree candidate must earn at least 30% of total credits from the Indian institution, a twinning student may take no more than 30% abroad, and in a dual degree both universities award a degree. The framework requires each agreement to cover intellectual property rights, but says nothing about how the research produced inside such an arrangement is attributed or whose affiliation appears on the resulting paper.² Nothing in the rules stops the foreign partner from taking the affiliation and the citation for work done in India. For the individual candidate that is often a good deal. It does not internationalise Keralam's research base; it internationalises the foreign partner's, using Keralam's labour.

A second constraint sits inside the same rules. Only Indian institutions with a National Assessment and Accreditation Council (NAAC) accreditation score of at least 3.01, a place in the NIRF university top 100, or a place in the top 1,000 of the Times Higher Education or QS rankings may enter these partnerships at all. Restricting entry to the accredited and the ranked protects standards, and it shuts out the colleges below that line, which are the places that would gain most.

An MoU is not a research partnership. It is the press release for one.

The landscape Keralam would be entering is itself moving. In 2024 China extended its lead over the United States on the Nature Index, which tracks contributions to 145 high-quality science journals. China's adjusted share rose 17.4% in a single year while America's fell 10.1%, ending the year at 32,122 against the United States' 22,083. Georgetown's Center for Security and Emerging Technology projected China would graduate more than 77,000 STEM doctorates in 2025 against America's 40,000.¹² The bar for what counts as a globally legible research base is rising, not holding still. A Keralam research republic built for 2040 cannot be designed against the standards of a decade ago.

What a serious research base looks like

Two countries built serious research bases at small national scale. Neither was a historical accident. Both were institutional choices held over decades.

Singapore's research engine is *ASTAR (Agency for Science, Technology and Research)*, together with the *National University of Singapore*. ASTAR funds and runs research institutes in deliberately chosen domains rather than spreading capacity across every field a Singapore academic might pursue.³ NUS runs joint laboratories with industry firms: actual joint laboratories, with shared problems and embedded researchers, not memoranda. Doctoral and postdoctoral fellows are paid at rates that make staying globally competitive. The signal is that the state values research talent enough to pay for it. The institutions are globally legible: a researcher in Seoul, Boston, or Stockholm regards them as serious peer destinations.

Switzerland's research engine works differently. ETH Zurich and EPFL Lausanne are federal technical universities with a mandate to produce research that compounds into firms. ETH has spun out more than 580 companies since 1973, a record 43 of them in 2023 alone, which puts it among the strongest performers in Europe on that measure.⁴ Switzerland spends around 3.2% of GDP on research and development, among the highest rates in Europe, and about two-thirds of that research is carried out by private enterprises.⁵

Basel's life sciences cluster, Roche and Novartis and the biotechs around them, sits beside that research base; Roche was founded in the city in 1896.⁵

Both countries express the same structural argument in two institutional forms. Research becomes infrastructure for the productive economy when three conditions hold together. The work itself, where individual researchers do frontier research. The institutions that fund, teach, and house them. And the distribution layer, which turns the first two into compounding capacity: the international peer network, the industrial linkage, the multi-generational doctoral pipeline. Keralam has the work. Keralam has institutions that publish. The distribution layer is what Keralam has not yet built.

The precision-cluster candidates this series has described depend on exactly this missing layer. A medical-devices cluster needs serious tropical health and ageing research feeding it. A green-chemistry cluster needs serious bio-based materials work. A precision-marine cluster needs serious marine science. None of these compound from publication count alone.

A common reading of AI's impact says long-form research training is becoming irrelevant: adaptability and short, modular skills are what matter now. That reading is right for applied vocational work, where skill turnover is real and accelerating, and where the apprenticeship system this series has earlier argued for is the institutional response that fits. It is wrong for research depth. AI amplifies what trained researchers can do; it does not substitute for the institutional infrastructure that produces frontier insight. In doing so, it widens the advantage of institutions with genuine depth over those with only volume output, making the case for concentration in Keralam's research system stronger now than it was a decade ago. The AI-accelerated world widens the comparative advantage of places with patient research capacity. The question is whether Keralam chooses to be one of those places.

Where Keralam could plausibly matter

Keralam does not need research capacity in every field. It needs concentrated excellence in a small number of institutions and a small number of domains. The political challenge is that every institution wants to be included. The fiscal reality is that not every institution can be. At Keralam's scale and budget envelope, concentration is the only strategy that produces globally legible results.

The obstacle is not a lack of awareness. The incentives point the other way: an institution that adds departments, subjects, memoranda and publications looks as if it is growing, whatever the depth of any of them. Reward concentration and the system optimises for something else.

Better two world-class labs in tropical health than twenty mediocre departments in everything.

Four domains have a genuine basis for world-class Keralam research. They are the four where an existing institutional anchor, a natural endowment, and growing global research demand intersect cleanly enough to justify concentrated investment.

Tropical health and ageing. Keralam has one of India's most sophisticated public health systems and the oldest population of any Indian state: 14.4% were aged sixty or over in 2021, on the Sample Registration System's count. Neglected tropical diseases affect more than a billion people worldwide and have historically sat almost outside the global health policy agenda, until the Sustainable Development Goals took them up in 2015. The Sree Chitra Tirunal Institute for Medical Sciences and Technology in Thiruvananthapuram and the Amrita Institute of Medical Sciences in Kochi are existing anchors.⁶ The research feeds directly into a medical devices and diagnostics cluster of the kind this series has been describing.

Climate and coastal systems. Keralam's geography (Western Ghats, coastal plain, backwaters, monsoon intensity) is a natural laboratory for tropical climate adaptation research. The 2018 floods exposed gaps in what the state knew about its own flood risk: three years later, the Comptroller and Auditor General found that its flood plains had still not been demarcated and that no large-scale flood hazard map existed.¹⁵ Climate adaptation

research for tropical coastal systems is a globally significant gap. The output translates into climate-risk tools, water-management systems, and sustainable land-use design.

Marine science and blue economy. A coastline of about 590 kilometres, a deep traditional fishing economy, and an existing marine biology base at the Central Marine Fisheries Research Institute (CMFRI) in Kochi describe a credible research domain.⁷ The output feeds sustainable aquaculture, marine biotech, and precision fishing, which is the precision marine cluster.

Applied AI for public systems. Kerala has one of India's most extensive public service-delivery networks: health, education, local governance. The Kudumbashree programme organises 43 lakh women into 2.77 lakh neighbourhood groups, yet in a 2018 audit the Comptroller and Auditor General found fewer than one per cent of its members registered on the web portal of one of its programmes, Sreesakthi.⁸ The network is real. The data it could produce mostly does not exist yet, and building it well is itself a research problem. Applied AI research that started there, at this scale and with this institutional reach, would be globally legible. Concrete examples are not hard to find: AI-assisted epidemic surveillance over Kerala's health network data, decision-support for local-government service delivery, applied-language tools for Malayalam public services. The specific industrial direction is a question for later in this series; the research depth that any of these would require is the same.

The PhD economics

Set even the national rate against what the comparators pay. A*STAR's graduate scholarship in Singapore pays a doctoral scholar SGD 3,600 to SGD 4,500 a month on its standard science track, depending on citizenship, and more on specialised tracks in semiconductors, quantum and computing. Switzerland's national science funder sets a band of CHF 50,000 to CHF 55,000 a year.¹⁰ Converted at market rates those are six to fifteen times the Kerala figure, which is the number usually quoted and the least useful one. Rent in Zurich is not rent in Thiruvananthapuram. Adjusted for what the money actually buys, a Kerala doctoral researcher on the national rate receives 1,900 to 2,100 international dollars a month, against 3,500 to 4,400 on Singapore's standard track and 3,900 to 4,300 in Switzerland.

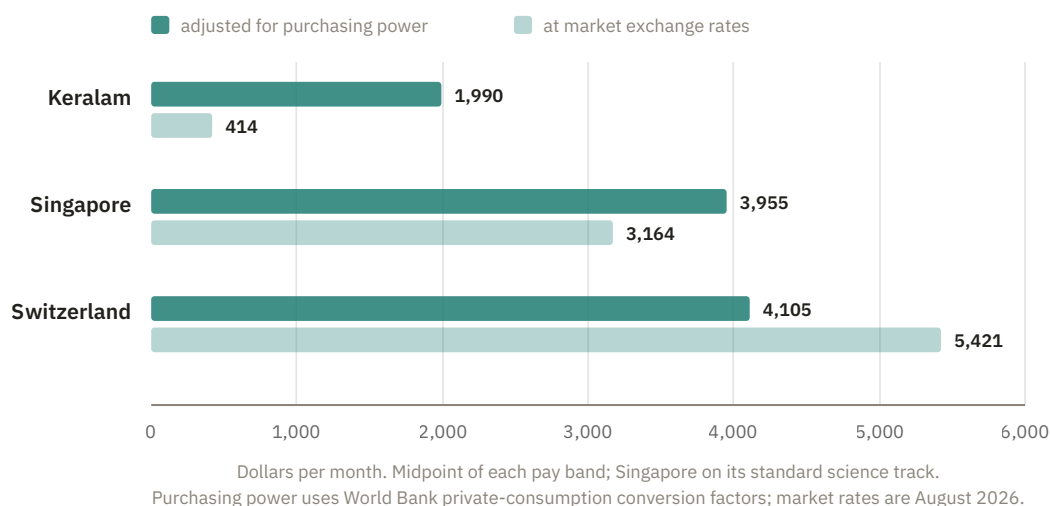
So the honest gap is about twice, not tenfold, and once Swiss prices are taken into account Singapore's standard track and Switzerland end up close together. Twice is still the difference between a career and a sacrifice, and the

nominal gap is not irrelevant either: a researcher who intends to save, support a family at home, or come back with capital is paid in the currency that converts, and there the gap is closer to tenfold. Both numbers push the same way. Neither makes staying the obvious choice.

The pattern is national before it is local. Among the countries the 2026 Stanford AI Index charts, India had the largest net outflow of AI authors and inventors in 2025, a net flow of -16.9, more than double Canada's -7.1 and Germany's -2.4.¹³ Keralam's doctoral economics are a state-level instance of that.

The researchers who can do frontier work are precisely the ones who leave. This is not a criticism of individuals. It is a statement about a system that has not yet made staying the rational choice.

Keralam's budget is tight. What it adds on top of the central rate is its own decision, and three moves fit inside what it can afford. A small number of state-level doctoral fellowships in the four priority domains, paid at competitive rates: not hundreds, perhaps fifty per year, well-paid enough to send the signal that the state values the work. A returnee researcher programme: Keralam-origin researchers abroad who would come back for a credible appointment with proper compensation. International research-fellow appointments: bringing twenty to thirty senior researchers from abroad each year in priority domains. The numbers are small enough to be fiscally manageable and large enough to change the institutional culture of the receiving departments.



Converted at market rates, Keralam looks a tenth of Switzerland. Adjusted for what the money buys where it is spent, it is closer to a half. The second comparison is the fairer one, and the Keralam bar is the national fellowship: the University of Kerala's own fellowship paid about a third of it in 2022. Note which way Switzerland moves: it is the only bar here that shrinks when purchasing power is taken into account, which is what an expensive country does to a salary.

What Keralam can do now

Keralam can fund the fellowships and the international appointments described above on its own authority. It can reform university intellectual-property policy to allow Keralam institutions to retain and commercialise research outputs from publicly funded work. State procurement can act as the first customer for locally developed research outputs in applied AI for public systems and in health diagnostics. None of these requires central permission.

What requires federal change

Topping up has a cost of its own: it creates two tiers of researcher inside the same department, doing the same work for different money. Rules on hiring foreign faculty and running joint degrees are written centrally too.

High-skill visa policy is a central matter too, and it is the basis of any international researcher programme. The returnee researcher and international research-fellow appointments named earlier all run through that constraint, and without movement on it, topping up only goes so far.

Central research money is not allocated to states in the first place. It goes to central mission agencies. In 2020-21 the central government accounted for 43.7% of all Indian R&D spending, and 84% of that flowed through twelve scientific agencies, with defence, space, agriculture and atomic energy

taking close to three-quarters of the agency total between them. The higher education sector, where a state's universities sit, accounted for 8.8% of national R&D spending.¹¹ What a state gets therefore depends on which central establishments sit inside it and what those establishments were built to do. Keralam hosts a large one: the Vikram Sarabhai Space Centre in Thiruvananthapuram is ISRO's lead centre for launch vehicle development, and the Department of Space took 18.4% of central agency R&D spending that year. That is real research capacity inside Keralam. Its core mission, launch vehicles, sits outside the four domains named above.

The instrument built to correct exactly this has its own record. India's Anusandhan National Research Foundation was legislated in 2023 with a five-year corpus of ₹50,000 crore, of which 72% was expected to come from private sources rather than from the exchequer. Its allocation for the first year was ₹2,000 crore. Within the same financial year that figure was revised down to ₹258.6 crore. A separate Research, Development and Innovation scheme worth ₹1 lakh crore followed in 2025, and, in the Department of Science and Technology's words, it "aims to promote a private sector-driven research and development ecosystem".¹⁴ The gap between announced and disbursed national research funding is the applause trap operating at the federal level. Keralam's state-level doctoral fellowships and international appointments are not supplementary to a functioning national system. They are what a sub-national research strategy has to look like when the national system disburses a fraction of what it announces.

A research base that compounds also requires patient capital: multi-decade funding commitments that a fiscally stretched state cannot provide alone. Where that capital comes from, and what kind of investor will hold a fifteen-year horizon for Keralam research and Keralam firms, is the question the next essay opens.

Keralam's publication count will keep rising. It is the one number in this essay that requires no decision from anyone. The concentration, the salaries, the laboratories that industry pays to sit next to: each of those waits on a decision the state has not made.

. . .



Muhammad Zaman al-Munajjim al-Asturlabi, Planispheric Astrolabe, dated 1065 AH/1654–55 CE. The Metropolitan Museum of Art, CCo.

WHAT IT IS

“Planispheric Astrolabe”. Muhammad Zaman al-Munajjim al-Asturlabi, Iran, dated 1065 AH, which is 1654 or 1655 in the Common Era. Brass and steel, cast and hammered, then pierced and engraved. The Metropolitan Museum of Art. An astrolabe is an analogue computer for the sky: set it for your latitude, sight a star along the rule, and you can read the hour, your position, the times of prayer, or the height of a tower.

WHY IT IS HERE

This is what a distribution layer looks like once somebody has built one. Every reading this instrument gives depends on centuries of observation the person holding it never made, compressed onto plates precise enough to trust and small enough to carry. The astronomers whose work is in here were long dead by 1654. Their tables are not cited on it. They are machined into it, and they work for a stranger in another city who never read a word they wrote. The maker signed himself twice over as a specialist, al-Munajjim the astronomer and al-Asturlabi the astrolabe-maker, because by then building these was a trade with its own training and its own succession. That is the layer this essay says Keralam has not built: a form that lets work be used by people who did not produce it, and the trained hands that keep making the form.

WHAT TO LOOK AT

Look underneath the openwork. The curved brass tracery on the face is the rete, the star map, and it is cut away so that the engraved coordinate grid on the plate beneath shows through the gaps. Two layers of accumulated data, read at the same time, one legible through the other. Then find the single dark steel pointer pinned through the centre. It is the only part the user moves, and the only part that is not brass.

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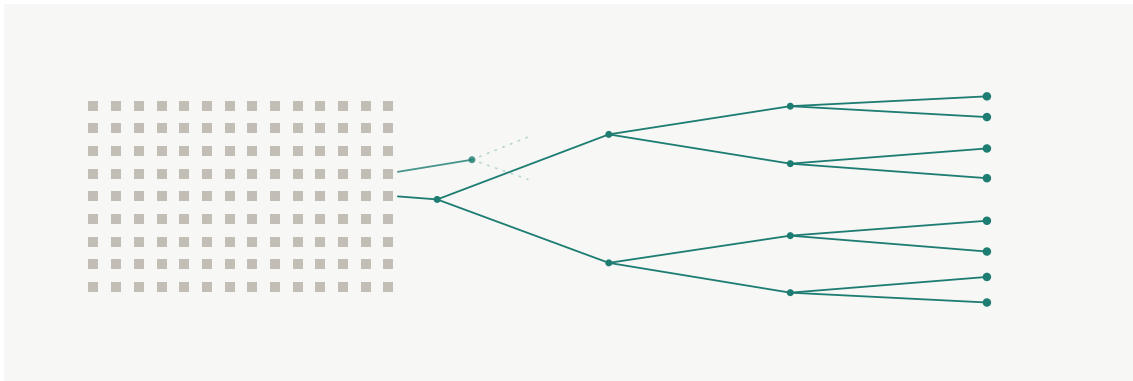
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U.S.-STEM-PhD-Growth.pdf), which projected more than 77,000 Chinese STEM doctorates in 2025 against 40,000 in the United States. That figure is a projection from enrolment data rather than an observed count, and is quoted as such.

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PART 6

Builders, Not Investors

Keralam's diaspora has been sending capital home for forty years. Very little of it has been structured to build firms. The question is what would have to change. From a series asking what Keralam 2040 would have to be.

A house in central Keralam goes up one floor at a time. The ground floor first, then years, then the first floor, and rebar left standing out of the roof slab where a second floor will go. The paint is fresh because it was done for a visit. Each floor is a stretch of years worked in Dubai or Doha or Riyadh by people who are home for two weeks twice a year and spend part of that fortnight deciding what gets built next. Keralam's diaspora has been sending capital home for forty years. It has financed those houses, and gold, deposits, consumption, education and security. Very little of it has been deliberately structured to become patient capital for firms.

This essay asks what it would take for a fraction of that capital, and the larger pool of dormant capital sitting inside Keralam itself, to become firms instead of houses.

This series has argued that Keralam's half-finished miracle has talent, institutional, cluster, and research gaps. The capital question is the fifth, and it threads through all four. None of the earlier arguments produces firms by itself.

Keralam's diaspora has been sending capital home for forty years. Very little of it has been deliberately structured to become patient capital for firms.

The investor and the builder

There is no shortage of "investment" in Keralam. Investment summits announce thousands of crores. MoUs accumulate. Foundation stones are laid. What happens after that is harder to read than either the state or its critics allow. The Invest Kerala Global Summit of February 2025 collected 499 letters of intent worth roughly ₹1.8 lakh crore. By November, a hundred of those projects, worth ₹35,111 crore, had got under way. By the first anniversary in February 2026, the state counted 115 projects under construction, worth ₹54,908 crore, out of 449 expressions of interest.¹

In November the state reported a conversion rate of 36.23%, and the industries minister called a hundred projects taking off "a record in the history of investment summits in the country". The hundred are real. The percentage is a hundred divided by 276, which is the count of projects that had already

obtained land. Against the 499 letters of intent the summit collected, the same hundred projects come to 20%. The February count runs the same way: 115 is 40% of the 285 projects with land, and a quarter of the 449.

A conversion rate counts announcements that turned into construction. It says nothing about whether what gets built compounds: whether the firm keeps its intellectual property here, hires here at the top of its wage scale, and is still here in fifteen years. Keralam is not unique in measuring the tractable thing. What is different here is the kind of capital that turns up.

Most of the capital that announces itself in Keralam is calibrated for a different kind of place. It seeks upfront subsidies and easy land. It assumes a workforce that is cheap, abundant, and weakly organised. It treats environmental clearances as a friction to be managed. It carries an embedded expectation that exit will be easy: if Keralam becomes inconvenient, the same money can move to a state with better terms. That capital, when it looks at Keralam, sees difficulty. Land is dense. Labour is organised. Voice on the shop floor is loud. Environmental concerns are politically serious. The state is treated as a counterparty, not as a service provider.

From the capital's perspective, this reads as risk. From Keralam's perspective, these are its core social achievements. They are not bugs in the investment environment. They are the human development indicators the first essay in this series called a half-finished miracle, and the productive economy that fits them has not yet been built.

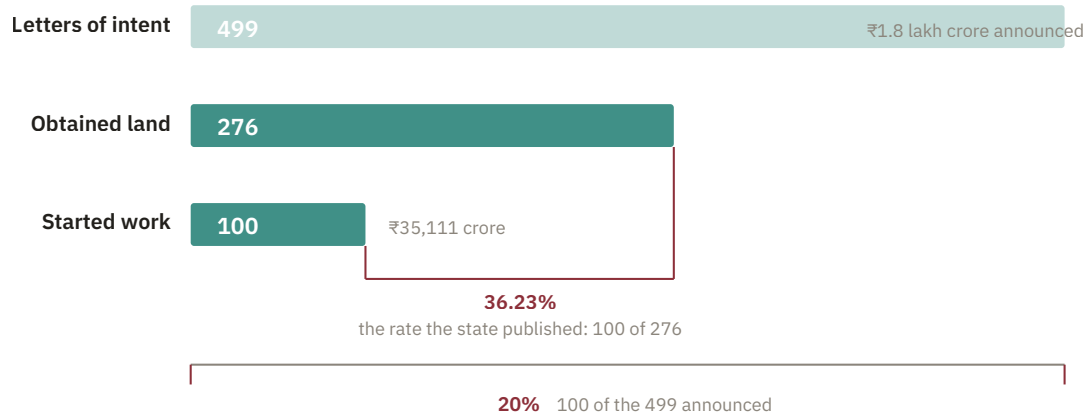
The mismatch is not moral. It is structural. Capital optimised for one operating environment does not become useful when transplanted into another. A different kind of capital is required. Call the first kind the investor and the second kind the builder.

The investor is interested in arbitrage. The builder is interested in compounding. The investor has exit optionality as a design feature. The builder is committed enough that leaving would destroy what was made. The investor centralises IP and high-value functions elsewhere; Keralam gets the execution slice. The builder retains IP and core capability locally because that is where the work is. The investor measures success in quarters. The builder measures in decades.

A firm building medical devices for a global market needs a workforce that operates expensive equipment carefully, a regulatory environment that takes safety seriously, a city its engineers want to live in, and a research base it can recruit from. Keralam's social contract, organised labour, environment-

al sensitivity, higher wages, public investment in health and education, is the operating context that firm needs. The same social contract is exactly what footloose capital reads as obstacle.

Organised labour, environmental expectations, and higher wages look like risk to capital optimised for low-cost arbitrage. They look like features to a firm building for the long term.



Both percentages are true. They answer different questions. One asks how many projects that had already cleared the hardest hurdle went on to start work, which is a fair measure of administrative follow-through. The other asks how much of what was announced became something real, which is the question an investment summit invites when it publishes a headline number.

The third essay in this series argued that Keralam needs an institution like Singapore's Economic Development Board: a body that knows what it wants and can hold a thirty-year industrial bet. The other half of that story is what kind of capital responds to such an institution. The EDB matched the firms it brought in, so that one plant's output fed the next, and went out to sell the idea to foreign companies. The institutional architecture and the capital strategy were two sides of one decision.²

The dormant capital problem

Keralam is not capital-poor. It looks capital-poor only because most of the capital is dormant.

The World Gold Council's head for India has said that gold use per person is seen to be higher in Kerala.³ Non-resident deposits in Kerala's banks stood at ₹3.24 lakh crore in March 2026.⁴ Remittances reached 23.2% of net state domestic product in 2023, up from 13.5% five years earlier, which is 1.7 times everything the state government collects in revenue in a year.⁵

The problem is not the absence of capital. The problem is the form it takes. Almost none of it is structured to back firm-building. Household fixed deposits sit in bank accounts. Gold is the most patient capital of all, and the most immobilised. Real estate is a savings instrument and a status signal but not a productive investment. Diaspora remittances go above all to renovating houses, paying off bank loans and education, and what is saved sits as cash at home, a bank deposit, a plot of land or a gold chain. The Kerala Migration Survey has no line for money put into a business.

Capital is not patient because of its origin. It is patient because of the institutions that hold it.

What I have seen in Basel is the answer to this in another form. Swiss household capital is famously cautious. The private investor base is conservative. Yet Switzerland built one of the world's most R&D-intensive economies: Basel's life sciences cluster, ETH Zurich's spin-off pipeline, the watch industry's hundred-year horizons.⁶

Private banks holding cautious money well is the easy explanation, and on its own it is not enough. Swiss patience rests on a stack of things working at once: family ownership that does not answer to a quarterly market, pension and insurance funds with liabilities measured in decades, universities that generate opportunities a firm can buy into, a skilled labour market deep enough to staff a fifteen-year programme, corporate reinvestment out of retained earnings rather than fresh capital, legal and regulatory predictability, and research-to-industry links dense enough that the distance from laboratory to production line is short. No single one of those is the mechanism. The combination is, and it took decades to assemble.

Israel ran a different version of the same move with Yozma in 1993. The government put up \$100 million: \$20 million into a fund of its own, and \$80 million to take a 40% stake alongside private domestic and foreign managers in new Israeli venture funds. The mechanism that mattered was the exit.

Each private partner held an option to buy the government's 40% back over five years, and most of them did. The state supplied the credibility needed to raise a first fund and then removed itself. By 1996 the programme had seeded eleven funds holding \$263 million, which went on to make 217 investments and exit 122 of them.⁷ Israel had no inherently patient capital. It built the institutional layer that turned cautious capital into firm-building capital.

The Keralam question is the same. The capital exists. The institutional infrastructure that would redirect it from real estate into firms does not.

A Keralam Builders Fund is one shape of the missing institution: a state-anchored, diaspora co-invested vehicle with a fifteen-to-twenty year horizon and a mandate to back qualifying firms rather than real estate. Yozma is the template.

The design has to withstand a minister who wants a favour and a manager who wants an easy year. The state anchors the fund and does not choose the firms. Independent professional managers make the investment decisions and are paid on what the portfolio returns. Diaspora and institutional investors enter on a defined co-investment structure, with an option to buy out the state's stake on fixed terms after a fixed period, which is the Yozma mechanism and the reason it worked. The mandate is confined to Keralam-domiciled firms that keep core intellectual property, research and high-value employment in the state. Reporting is public and annual, on portfolio returns and on capability retained locally, not on announcements made or money moved. That last one is the discipline the rest depends on, because a fund measured on how much money it moves will move money whether or not the firms deserve it.

Differentiated tax treatment is a second lever, and it needs stating as a proposal rather than as a complaint about parity. Non-resident capital placed in an operating company and non-resident capital placed in land are not taxed identically today; treatment turns on the vehicle, the investor's residence status, the asset, the character of the income and the structure of the transaction.⁸ What does not exist is a deliberate wedge between the two, wide enough and stable enough that a diaspora investor choosing between a flat in Kochi and a stake in a Kochi firm can see it from the outside and price it over a decade. Building that wedge is the ask. The wider category of redirected domestic savings, household deposits flowing into Keralam-domiciled patient-capital instruments rather than into central government borrowing, is the harder political move but the largest pool.

The other half of the pair

Singapore's Economic Development Board is the institution Keralam's industrial strategy has learned from. It is only half of what Singapore built.

The EDB, founded in 1961, went out and recruited firms. In its first years it also lent to industry, until a new development bank, the Development Bank of Singapore (DBS), took that work over in 1968. In 1974 Singapore incorporated Temasek and transferred to it an initial portfolio of thirty-five companies the Ministry of Finance had been holding directly, so that the ministry could go back to writing policy while a separate body owned those assets and was judged on making them pay. In 1981 it created GIC to invest the accumulated reserves abroad.⁹ One body to attract firms, one to own industrial assets and make them pay, one to manage the surplus. Keralam's conversation has been almost entirely about the first.

This matters now because of who is holding the long money. Sovereign wealth funds were party to \$46 billion of AI venture transactions between January and September 2025, close to half of all such investment in the period, and they entered that market as serious players for the first time.¹⁰ This is capital with a mandate to think in decades, actively looking for industrial exposure, and a great deal of it sits in the Gulf, where most of Keralam's emigrants already work.

The question that poses for Keralam is concrete. What would KINFRA, or whatever succeeds it, have to become before a GIC or a Gulf sovereign fund could treat it as a partner for a decade rather than a counterparty for one transaction?

Three things would have to be true of it. A balance sheet that survives the diligence such an investor's own auditors would run, which means published accounts, assets carried at defensible valuations, and a record of returns rather than a record of disbursements. A governance structure that outlives an election, because a fund committing for ten years is underwriting the institution and not the minister who signed. And a mandate to hold equity, take losses on individual bets, and be judged on the portfolio, which is close to the opposite of how a state agency is normally assessed.

Keralam has already built one institution that meets all three tests. Cochin International Airport Limited dates from 1994. By March 2001 it had about ₹79 crore of paid-up equity, in shares of ₹10. About two-fifths came from the state and its own enterprises, and about a quarter from the companies that would serve the airport, Air India, BPCL and two banks among them. Most of the rest came from non-resident directors and their families, and from some ten thousand small shareholders, 3,880 of them non-resident

Indians spread across thirty countries, who between them put in about ₹10 crore.¹¹ It paid a dividend every year from 2003-04 to 2019-20, and resumed after the pandemic. It publishes its accounts, its governance has outlasted every change of government since its founding, and the state answers for what it returns rather than for what it announced.

Acquiring the site took about 1,300 acres and the resettlement of 872 families, who received market-value compensation, six cents of land each, and, for one member of each family that lost both house and land, an airport job or a livelihood linked to it.¹¹ The dividend record begins after Keralam paid that bill.

An airport is still not a firm. It has a captive catchment, a regulated tariff, and land whose value it partly creates, which puts it closer to the real estate this essay has been arguing against than to a company that has to win a customer every quarter. Cochin shows that the state can anchor a Keralam-domiciled vehicle on a twenty-year horizon and bring Keralites at home and abroad in alongside it, and that it can run one to a standard an outside investor would recognise. It does not show that the same money will back a company that might fail.

None of that requires Delhi's permission. All of it requires the state to decide that an industrial-capital institution is something it wants to own and be measured against, rather than a scheme it wants to announce.

The returnee paradox

The temptation, when arguing for builders, is to lean on the returnee story: the Keralam-origin engineer who left for Silicon Valley, made money, and is now building something back home. It is a flattering narrative. It is also misleading as the default model.

The empirical pattern crosses over. An Observer Research Foundation study of 596 Indian high-tech startups founded between 2016 and 2023 gave the pattern its name, the Indian returnee paradox. Returnee-founded firms do better through the middle of the distribution: median capital raised of \$441,000 against \$113,000 for domestic-founded firms, and median revenue of \$92,500 against \$43,700. Domestic founders own the top of it outright. Their mean revenue was \$5.39 million against the returnees' \$0.68 million, and of the firms in the sample that reached a billion-dollar valuation, three were founded by domestic teams and none by returnees.¹² Returnees

cluster in the knowledge-intensive sectors where a foreign track record reads as credibility, and in none of those sectors do they outnumber domestic founders.

Returnees are not underperforming. They produce a dependable middle and seldom an outlier. The founders in this sample who built something large were domestic, and the authors suggest that local founders, embedded in local markets, institutions and ways of getting things done, may now be better placed to reach scale. They call their own analysis correlational. My own reading is that they grew up inside the discipline of scarcity rather than carrying the abundance assumptions of foreign capital. One of the study's authors is AnnaLee Saxenian, whose earlier work on brain circulation made the case that returning migrants drive technology development in their home countries. The paper calls its India finding a contradiction of that earlier work, and then narrows it to the top of the distribution, where the large outcomes now go to domestic founders.

For Keralam specifically, this matters. The patient builder here is primarily the Keralam-grown founder who never left, or who left for a defined window and came back without that becoming the founding identity. Returnees and incoming foreigners are useful: they bring networks, technical depth, and capital channels. They are auxiliary infrastructure, not the engine.

A successful Keralam 2040 is not one where the diaspora came back to save it. It is one where fewer people felt they had to leave in the first place.

This reframes the diaspora capital argument. Diaspora capital is one channel, not the centre. The centre is dormant domestic capital, redeployed through institutions Keralam has not built.

The AI volatility objection

The fairest objection to a fifteen-year capital horizon in 2026 is that the underlying technology now moves faster than the horizon. AI capability stacks turn over fast. A firm-building bet made today could be obsolete before the capital has finished vesting. Why fund patience in a market that no longer rewards it?

The objection does not survive contact with the firms it describes. Anything that needs a workforce, a regulatory pathway, embedded enterprise customers and a production line takes years to compound, and the AI tooling inside that work updates on its own clock without changing the clock the work runs on. A medical-device firm using AI for diagnostic imaging still sits inside a multi-year regulatory pathway and a longer adoption curve with payers. A precision-manufacturing firm using AI for process optimisation still needs the manufacturing line. The capital backing the deepest AI-era work runs on horizons longer than the AI cycle, not shorter, which is why sovereign funds are already underwriting large AI data-centre buildouts.

For Keralam the implication is narrow and useful. Patient capital and AI-enabled work are not in tension. The firms that can hold a fifteen-year horizon are the same firms that can put AI to work inside it.

Five policy principles for a builder-friendly Keralam

The policy moves do not need to be elaborate. They need to be coherent. Their structure matters.

First, incentives that vest over time rather than upfront. A subsidy paid before a firm has built anything attracts capital that came for the subsidy. A benefit that grows as the firm hits milestones (local headcount, local R&D spend, IP retention, years of continuous operation) attracts capital that intends to compound. Singapore's Pioneer Certificate Incentive and Development and Expansion Incentive are written the conditional way. Each runs for five years; extension depends on the firm committing to further expansion; the firm reports its progress and is judged on it; and if it breaches the terms, Singapore can revoke the incentive and recover the tax relief already granted.¹³ The award requires the company to build what it said it would build. Keralam's incentives mostly do not work this way.

Second, benefits linked to local wage bill and R&D spend, not only capital expenditure. Capex is easy to measure and easy to game; a firm can build a shell facility, claim incentives, and keep all high-value functions elsewhere. Local wage bill captures whether the firm is actually building a team in Keralam. Local R&D spend captures whether the firm is doing intellectual work here or only execution. Singapore's assessment criteria start from the employment created, weighed by skills and seniority rather than headcount alone, then total business expenditure and the commitment to grow technology and knowhow locally. Fixed asset investment in plant and buildings is required in addition, and only of manufacturing projects.¹³

Third, state procurement as the first customer. Keralam's government is itself a large buyer of health services, public infrastructure, education materials and government IT. Directing a meaningful share of public procurement to qualifying locally-built products (medical devices from a Keralam device cluster, marine engineering from the Kochi precision cluster, applied-AI tools for Keralam's public service network) de-risks the first-customer problem that hobbles most early-stage Keralam firms. It is the most under-used industrial-policy lever the state owns.

A preference regime is also the easiest of these five to corrupt, and saying so strengthens the standard rather than weakening it. Preference without published qualification criteria, measurable performance standards and genuine competition among qualifying suppliers stops being industrial policy and becomes protection for whoever is best connected. The discipline that makes it work is the same one that makes the fund work: the criteria are published, the performance is measured against them, and a supplier that fails them loses the preference.

Fourth, IP retention requirements for research-linked support. Firms that draw on the labs the previous essay described (Sree Chitra, CMFRI, the proposed concentrated research base) should accept a condition of access. Intellectual property belongs to a legal entity rather than to a place, so the condition has to be written that way: ownership, or exclusive commercial rights, held by a Keralam-domiciled entity for a defined period, with stated exceptions where genuine multi-party research makes shared or split ownership unavoidable. This prevents the joint-degree pattern transposed onto industrial research, where Keralam provides the input and the intellectual property is captured elsewhere.

The harder question sits underneath, and this essay does not settle it. A domicile requirement tells a firm where to register something. It does not make Keralam the place a firm would choose to hold its most valuable asset anyway, and a firm that resents the condition will find a way around it. What would make a Keralam-domiciled entity the natural home for the IP, rather than the compulsory one, is a question about courts, tax, talent depth and the credibility of the state as a long-term counterparty. Better to answer that before the condition is drafted.

Fifth, administrative predictability over speed. Builders do not need the fastest clearances in India. They need predictable ones: timelines they can plan against, decisions that hold across electoral cycles, and bureaucratic in-

terlocutors with the authority to deliver on what they say. Unpredictability is more damaging to a fifteen-year bet than slowness, because the bet cannot be reset every time the political wind shifts.

*Time-vested incentives attract capital willing to commit.
Upfront subsidies attract capital looking for a subsidy.
The difference is in who shows up.*

Each principle is mechanical, not aspirational. None requires the social contract to change. All require institutional discipline of the kind the third essay argued for, applied here to the incentive and procurement architecture rather than to the cluster mandate.

The female talent dimension

The capital and institutional story has a talent dimension that connects directly back to the second essay in this series. A builder operating in Keralam cannot afford to ignore half the talent pool. The female labour force participation gap is a competitive constraint on every firm that builds here.

The firm that designs for female participation (care infrastructure, transit safety, dormitory and shift design, predictable working environments, leadership pipelines that do not bottleneck) recruits from a fundamentally larger pool than the firm that does not. In a state where resident women outperform resident men in tertiary attainment, the firm building on a male-only operating model is competing for the smaller half of the educated workforce.¹⁴ The case is a talent case, not a diversity case. It belongs in the builder argument as part of the operating-context calculation.

Cosmopolitan flow as background infrastructure

The cleanest signal that a state is producing the right kind of capital and the right kind of firms is what its talent flow looks like at steady state. Singapore, Zurich, and Basel all carry continuous in/out movement: foreign professionals on multi-year assignments, native talent rotating through tours of duty abroad, both treated as background infrastructure rather than as policy events.

Keralam's current diaspora discourse is structured around departure as loss and return as redemption. A 2040 Keralam that has built the talent base, the institutional architecture, and the capital infrastructure should be able to drop that framing. Native outflow becomes a normal life choice when the underlying economy is strong; the pathology is not the going but the not-coming-back, and the not-coming-back is what an economy with insufficient firm-building produces. Native return becomes a normal commute, not a rehabilitation programme. Foreign inflow (researchers, engineers, founders from Korea, Brazil, Switzerland, Vietnam, the Gulf) becomes the diversity signal that the firms and the research base both need. A later essay in this series argues that the city itself has to be built to absorb that inflow.

Keralam 2040 succeeds when leaving is a choice, not a structural necessity, and when arriving from outside is a choice, not an exception.

What Keralam can do now

Within the state's current authority, the moves are real. Design the time-vested incentive structure described above within the existing industrial-policy framework. Launch a Keralam Builders Fund with state anchor investment and diaspora co-investment, structured for a fifteen-to-twenty year horizon, mandated to back firms rather than real estate. Implement state procurement preferences for locally-built qualifying products and services. Create a returnee founder programme: not a generic subsidy track, but a dedicated bureaucratic interlocutor with the authority to make procurement, research-access, and IP commitments. Reform IP retention requirements for state-research-linked firms.

What requires federal change

Some of the harder moves need Delhi. The income-tax code has no deliberate wedge between diaspora capital placed in a firm and diaspora capital placed in land, and only the centre can create one.⁸ High-skill visas, which any serious builder will need, are a central matter. As I read them, central R&D incentives favour large firms in established clusters over smaller firms

in newer places, which works against Keralam. And the room a state has to depart from central industrial policy is limited. Keralam needs movement on all four, and it controls none of them.

. . .

Getting the capital right is not the last decision. A state with patient money still has to say what it is for, and then build the institutions, the training and the place that one answer needs. That choice, and what it obliges, is the question the next essay opens.

The houses will still be there. They are not a mistake, and nobody who built one owes anybody an apology. A family with no institution willing to turn its savings into a firm put those savings into the safest available thing, and concrete is safe. Forty years passed and nobody built the alternative.

. . .



Unknown Chinese lacquer workshop, Covered Box, Ming dynasty, Jiajing reign, 1522–1567. Art Institute of Chicago, CCo.

WHAT IT IS

“Covered Box”. China, Ming dynasty, Jiajing reign, 1522 to 1567. Carved cinnabar lacquer on wood, 25.6 centimetres across. Art Institute of Chicago. Carved lacquer is built up rather than cut from a block: thin coats are laid over a wooden core, each left to harden before the next, until there is enough depth to carve into.

WHY IT IS HERE

This essay is about capital that cannot be hurried, and this is an object whose value is almost entirely time already spent. Money does not shorten the making. The material hardens at its own rate, and a coat laid on too early spoils everything under it. A workshop could not have delivered this box faster for a better price. It could only have started earlier. That is the condition a builder accepts and an investor looking for an exit does not.

WHAT TO LOOK AT

Look at the ground between the dragons, then at the carving standing over it. The recesses read brown where the raised surfaces read bright red, so the colour tells you how far down the tool cut. Then follow the horizontal seam running round the middle, where the lid meets the base, and see that the dragons carry across it without interruption.

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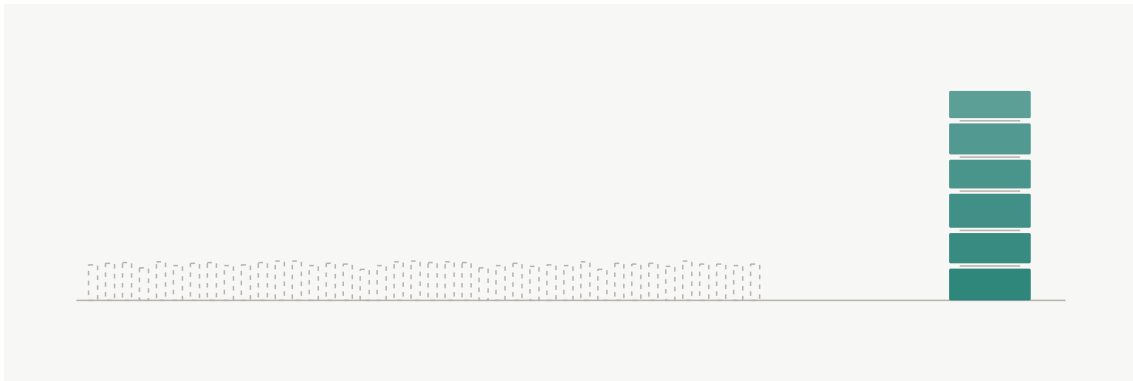
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PART 7

One Industry, Built Whole

A state that has the right kind of capital still has to say what it is for. Choosing one industry means building everything that choice requires, and the evidence says choose for what can be learned rather than for what is already in the ground. From a series asking what Keralam 2040 would have to be.

Somewhere in India there are silos holding thorium hydroxide. It was separated out of monazite dug from beach sand, much of it off the coasts of Kerala and Tamil Nadu, and the government's own mineral yearbook records that the agency which produced it "has built a large stockpile of impure thorium hydroxide".¹ The plant that separates it is at Aluva, in Kerala. The material has been mined, refined, and put away against a day that has not arrived. Thorium has fuelled power reactors in Germany and the United States, but no country runs its power programme on it.

That is not a scandal. It is a position. The thorium is already out of the ground, and the only open question is what anyone intends to do with it.

This series has argued for talent, for institutions, for clusters, for research, and for a different kind of capital. None of it decides what to build. Kerala has not stayed with one answer long enough to build around it.

The wrong inference

The obvious conclusion is that a stockpile like that is worth building an industry around. It is the wrong one, and Kerala has reached for it before.

In June 1947, with independence weeks away, the Dewan of Travancore declared that the state would stand alone, and Travancore at that moment held beach sands said to be exceptionally rich in thorium and a standing arrangement to ship nine thousand tonnes of monazite to Britain over three years.¹⁰ The arithmetic seemed to work: the new nuclear powers wanted monazite, and Travancore had it. Within weeks an attempt on the Dewan's life ended the experiment and Travancore acceded.

The inference was that sitting on something scarce is itself a position. It was wrong then, and the eighty years since have not improved it. A deposit is worth rent to whoever processes it and a position to whoever can use it, and those are different parties.

The industry worth building is not thorium extraction, reactor construction, or a local claim on a national security resource. It is advanced materials, qualification and fuel-cycle engineering, capabilities whose customers begin in India and need not end there. Nothing here depends on thorium arriving on schedule, or at all.

A deposit is worth rent to whoever processes it and a position to whoever can use it. Those are different parties.

What a choice costs

The gap shows in how the state presents itself. An investment summit that collects 499 letters of intent across every sector at once is not making a bet.² It is keeping 499 doors open, which is what a government does when it has not decided which room it wants to be in.

Breadth looks like ambition and costs nothing to announce. A choice is expensive, because everything that follows one has to be built, and most of it takes longer than the government that starts it. That is the real barrier, and it is not money. A state can fund a scheme in a budget speech. It cannot fund a fifteen-year institution in a budget speech, because the thing being bought is continuity, and continuity is paid for in elections rather than rupees.

Breadth looks like ambition and costs nothing to announce. Choosing is expensive, because everything that follows a choice has to be built.

What choosing looked like somewhere else

Taiwan chose. The story is usually told backwards, as though the island had a latent advantage waiting to be released.

It had none. In the mid-1980s, the podcast Acquired reckons, the average Taiwanese company ran gross margins of four to five per cent, which is the margin of a place that assembles what other people design. Morris Chang, instructed by a minister to build a semiconductor company, set out the starting position without flattering it: no strength in research and development, none in circuit design, little in sales and marketing, almost none in intellectual property. One possible strength, and by his own account a potential rather than an obvious one, in manufacturing wafers.³

His question follows from that inventory. What kind of company would you create to fit that strength and avoid all the other weaknesses?

Note what the question does not ask. It does not ask what the island was sitting on. Taiwan had no ore, no oil, no rare earths, and no deposit of anything a foreign buyer wanted.

The tidy version of what happened next makes it look like one clever decision, and it was not. Chang had spent thirty years in semiconductor manufacturing before anyone in Taipei rang him. His first success at Texas Instru-

ments, in 1958, was a yield problem on a transistor line being built for IBM, and he went on to run TI's worldwide semiconductor business before being passed over for the top job.³ Asked what Taiwan should build, he named the thing he had spent his working life doing.

Nor were semiconductors a fresh choice in 1985. Taiwan had committed to them a decade earlier and spent the intervening years building the capability to match. Chang inherited that decade rather than starting one.

Which makes the better question not what he chose but why a minister went looking for him at all. The state had built the capability and understood that it could not turn that into a globally competitive firm by promoting from inside its own bureaucracy. So it recruited one of the most experienced semiconductor manufacturing executives anywhere: fifty-four, recently passed over at TI, and unhappy in the job he took next.

The business model came from that career rather than from anything in Hsinchu. In his final months at General Instrument a founder called Gordie Campbell asked Chang for fifty million dollars to start a chip company, and when Chang called him three weeks later, said he needed only five, because he had decided against building a fab.³ Chang saw what that implied before the industry did. A foundry that makes other companies' designs and competes with none of its customers is what you build if you think a generation of designers is about to be freed from owning factories.

Note the order. The institute came first, and the company fourteen years later.

The institute that measured the industry instead of itself

The company is the part everyone remembers. The part worth copying came first.

The Industrial Technology Research Institute was founded in 1973 out of three merged government laboratories, with a budget of NT\$210 million and four hundred staff, of whom ten held doctorates.⁴ Three years later it signed a technology transfer with RCA for about ten million dollars. The technology was deliberately old: a 7.5-micron process, several generations behind what the American and Japanese leaders were running. Engineers went to RCA sites in New Jersey, Ohio, California and Florida for a year of training in design, process and quality control.

In 1977 the demonstration fab opened and reached a seventy per cent yield. RCA's own American plants were running at fifty.⁴ The trainees beat the licensor inside a year, on a process several generations behind the leaders.

Then the institute did the thing that makes it worth studying. In 1980 it gave the demonstration plant away, to a new company called UMC, and over the next twenty years it spun out nine more.⁴ It set itself a target of fifteen per cent staff turnover a year, deliberately, and funded employees through doctorates and MBAs at Stanford and MIT at an average cost of four hundred thousand dollars each. By the late 1990s it held nine hundred doctorates among six thousand employees. Around eighty-five per cent of the people who left went to Taiwanese firms, and roughly forty per cent of the managers in the Hsinchu Science Park had worked at ITRI at some point.⁴

A research institute normally measures retention and treats departures as a failure of compensation. ITRI measured the industry, and counted the people it lost as its output. In 1993, after the firms it had created objected that it was no longer needed, the ministry cancelled the annual budget its founding terms had guaranteed.⁴

The place was built to match. Hsinchu covers six and a half square kilometres, with two universities beside it; more than fifty of its tenant companies began as spinoffs from those universities or from ITRI.⁵ Park sales went from NT\$10.5 billion in 1985 to NT\$1.6 trillion in 2005. The Hsinchu campus now holds about 420 companies and some 148,000 workers on that same small footprint.⁵

None of that is a subsidy schedule. It is an institute whose product was trained people, a park where the firms and the toolmakers and the universities were close enough to walk between, and twenty years of not changing the plan.

A research institute normally treats departures as a failure of compensation. ITRI counted the people it lost as its output.

The usual dismissal is that Taiwan did this under authoritarian rule, so none of it transfers to a place with elections.

Martial law in Taiwan ran from May 1949 to July 1987, thirty-eight years.⁶ TSMC was incorporated that February, in the final months of it. The company listed in Taipei in 1994. The first direct presidential election was in 1996 and the first transfer of power between parties in 2000.⁶ The founding decisions, from ITRI in 1973 to TSMC's incorporation, were all made under martial law. Most of the compounding, including the bulk of the park's growth in sales, came after it ended, while Taiwan democratised. The institutions outlasted that transfer.

What survived the transition was not a strongman's preference but a set of institutions: an institute with a budget line, a park beside two universities, a company with published accounts and a board. Keralam does not need more executive authority than it has. It needs the thing Taiwan turned out to have, which is continuity, a fifteen-year commitment that survives a five-year cycle and a front that alternates.

This is not a free lesson. Singapore, the other comparator this series keeps returning to, also bought coordination by narrowing the range of things that could be argued about. Both places got their industrial policy partly by constraining contestation, and contestation is precisely what Keralam's social contract exists to protect. The honest version of the lesson is narrower than the usual one: the institutions can outlive the conditions that created them, but somebody has to build institutions rather than schemes.

Taiwan had no deposit of anything, and built the industry anyway. It bought old-generation technology, trained about thirty engineers on it for a year, and beat the seller's own factories within twelve months. The endowment was never the point. The people were the point, and the institutions that kept turning out more of them were the point.

What Keralam holds

The Chavara deposit runs about twenty-two kilometres along the Kollam coast from Neendakara to Kayamkulam. Kerala's own Department of Mining and Geology puts it at 127 million tonnes of heavy minerals, including 80 million tonnes of ilmenite, out of a raw sand reserve of around 1,400 million tonnes.⁷ Monazite, which carries the thorium, is a small fraction of the black sand by weight. India holds roughly an eighth of the world's identified thorium.¹

The deposit is worked by two companies. The Kerala Minerals and Metals Limited is a state undertaking making titanium dioxide pigment at Chavara, with revenue on the order of nine hundred crore rupees. IREL is a Govern-

ment of India enterprise. It has sat under the Department of Atomic Energy since 1963 and reported turnover of more than ₹2,024 crore in 2023-24 across its mineral-sands and rare-earth units.⁸ Kerala's own mining department describes the barrier beach blocks as apportioned between the two.⁷

So Keralam's position is that it hosts a world-class deposit, captures the titanium end of it through a state company, and watches the atomic end go to a central undertaking that refines a small part of the thorium for the Bhabha Atomic Research Centre and the Nuclear Fuel Complex and holds a large stockpile of it unrefined.

And then, this April, the future stopped being hypothetical. On 6 April 2026 the 500 megawatt Prototype Fast Breeder Reactor at Kalpakkam attained first criticality, having satisfied the Atomic Energy Regulatory Board. It was designed by the Indira Gandhi Centre for Atomic Research and built and commissioned by Bharatiya Nabhikiya Vidyut Nigam Limited.⁹ India has formally entered the second stage of the three-stage programme Homi Bhabha sketched in the 1950s, the stage whose reactors breed the fuel that makes the third, thorium, possible. On full operation India becomes the second country after Russia to run a commercial fast breeder.⁹

The geography of that sentence invites a wrong reading. The reactor is at Kalpakkam in Tamil Nadu, the centre that designed it is at Kalpakkam, and another of IREL's beach sand plants is at Manavalakurichi, also in Tamil Nadu. Tamil Nadu built none of it. IGCAR, BHAVINI and IREL are central bodies, and where the Union puts its atomic establishment is settled in Delhi rather than in Chennai.⁹

That closes off the complaint, and what is left is worse. Keralam has hosted a central scientific institution of the first rank since 1962. The Vikram Sarabhai Space Centre at Thumba designs India's launch vehicles, and around it in Thiruvananthapuram sit the Liquid Propulsion Systems Centre, the ISRO Inertial Systems Unit, the Indian Institute of Space Science and Technology and BrahMos Aerospace.¹³ Nothing was withheld from Keralam.

Sixty years on, the state's technology press counts more than fifty spacetechnology firms, and reports that between them they handle less than a tenth of the work India's space agencies contract out and that none has grown into a leading national player.¹³

Set that beside ITRI, which over a comparable span gave away a fab to UMC and spun out nine more companies, TSMC and Vanguard among them, with UMC in turn producing MediaTek.⁴ The institutions here are not weak-

er, and neither are the people in them. One of those bodies was built to put companies into the world and was measured on whether it had. The other was not asked to.

Keralam has spent this series being told it has the input that matters and no structure pointed at it. That is the same finding again, in a new sector.

So what is the capability worth building

If the state does not mine the sand, it has to build a capability instead. So where are the hard unsolved problems? Two of them face every nuclear programme, not only India's.

The first is what neutrons do to materials. A reactor that burns thorium subjects its inner wall to intense neutron bombardment. So does any fusion machine that might one day breed the fuel faster. A first wall would take upwards of ten displacements per atom every operating year. Neutrons knock each atom out of its lattice position ten times a year, and the structure has to hold anyway.¹¹ Engineers have to test materials that survive that before anyone builds with them, and here is the gap: no facility anywhere in the world can currently irradiate candidate structural materials under a genuinely fusion-like neutron spectrum. The proposed answer, IFMIF-DONES in Spain, received its building permit only in June 2026.¹¹ An unsolved problem with no test rig is an opening.

Second, you cannot measure efficiency in isolation. When the laboratories reported a fusion breakthrough, they measured the energy at the target. Measure it at the wall plug instead, against the power the building drew from the grid, and the same shot returns a figure a hundred and fifty times smaller. Both numbers are correct.¹² They differ only in where the boundary is drawn. The gap between a celebrated laboratory result and a commercial system is an inventory of engineering work still available to whoever acquires the capability to do it.

Which brings the question back to Thiruvananthapuram, where there is already more of this than the state seems to notice. The Vikram Sarabhai Space Centre works on materials that have to survive launch and re-entry. CSIR's National Institute for Interdisciplinary Science and Technology works on advanced materials and process engineering. Sree Chitra Tirunal Institute qualifies materials that go inside human bodies, which is a regulatory discipline as demanding as any reactor code. The Indian Institute of Space Science and Technology, IISER Thiruvananthapuram, CUSAT and NIT Calicut all feed the same pool.¹³

None of that amounts to a nuclear industry. What it amounts to is the potential strength Chang described rather than the obvious one, which is close to the raw material ITRI was handed in 1973 with its four hundred staff and ten doctorates.

What has to be true by 2040

This series picked 2040 as its horizon, and a horizon is not a forecast. The question each essay asks is what would have to be true by then, and for this one the answer does not depend on any particular technology arriving on schedule.

A materials and fuel-cycle capability is worth building on four counts. It is learnable, in the way wafer yield was learnable, by acquiring processes other people have already worked out and training about thirty engineers in them. It requires nothing further from the coast, because the thorium in question has already been mined and is sitting in storage. It sits upstream of a bottleneck that every serious programme will hit, which means the customer is not only Indian. And it survives its own schedule slipping, because the same materials science, separation chemistry and qualification discipline serve fission reactors, medical isotopes and space power whatever else happens.

That last property is the one that makes it a responsible bet rather than a gamble on a technology that may take longer than anyone says.

The institution this requires

Name it whatever it ends up being called. A Keralam Institute for Materials and Qualification will do as a working label, and the name is the least important thing about it. The mandate is the thing, and five parts of it are not negotiable if the point is to copy what worked rather than the words.

A statutory mandate of fifteen years, with a board the government does not control. ITRI kept its guaranteed budget for twenty years and lost it in 1993, when the firms it had seeded argued it was no longer necessary and the ministry agreed.⁴ Fifteen years is the minimum span over which a materials programme produces anything, and it is three governments. A board that a chief minister can reconstitute is a board that will be reconstituted.

Funding by formula, argued once. The most useful thing Morris Chang did on returning to TSMC was to fix research spending at a set percentage of revenue whatever the year, so that his research director never had to make

the case again.³ A state institute has no revenue to take a percentage of, so the equivalent is a statutory share of something predictable rather than a line item competing afresh in every budget. The principle survives the translation. An institute that has to re-win its existence each year will spend its best people on winning it.

A training pipeline with defined numbers, and no bond. Doctoral places and multi-year overseas placements in materials science, irradiation testing and separation chemistry, sized in hundreds rather than dozens. Tie them to opportunities worth returning for rather than to a contractual obligation to return. Keralam has fifty years of evidence that people leave anyway, and little reason to think compelling them would work; it has rather less evidence about what happens when there is something specific to come back to.

A spinout mandate, and a measure that admits it. The institute should be assessed on firms created and on where its alumni end up, not on how many staff it retained. This is the part that will be hardest to get past a state audit process, because every existing instrument treats an employee leaving as a loss. ITRI targeted fifteen per cent attrition on purpose and ended up staffing forty per cent of Hsinchu's management.⁴

One campus, not fourteen grants. This is where the geography matters, and it argues against the obvious answer. Keralam's materials research sits in Thiruvananthapuram. Its materials industry sits seventy-odd kilometres north in Kollam, where KMML already does pigment chemistry and process engineering next to the deposit itself.⁸ Hsinchu was built seventy to eighty kilometres from Taipei, next to the institutes and universities rather than next to the government.⁵ The equivalent here is a corridor of almost exactly that length, and the campus belongs at the Kollam end of it, close to the industry and far enough from the capital not to be absorbed into it.

Dispersing the same money as grants across the institutions that already exist would be easier, would offend nobody, and would produce papers. The entire lesson of the last fifty years of industrial policy is that proximity is not a nice-to-have. People have to be able to walk between buildings.

What requires Delhi

The hard parts are not Keralam's to decide. Atomic energy is a Union subject. Thorium and uranium are prescribed substances under the Atomic Energy Act of 1962, and under the Sustainable Harnessing and Advancement of Nuclear Energy for Transforming India (SHANTI) Act that Parliament

passed in December 2025 to replace it they stay under central control: thorium that is mined or extracted vests in the Union, and only government bodies and government companies may mine it. IREL answers to the Department of Atomic Energy rather than to Thiruvananthapuram.¹⁴ A state cannot licence itself into this sector.

What has changed is who may apply. Under the same Act, as its provisions come into force, any government company, including one a state owns, and any other company may seek a licence to build and run a reactor or to make nuclear fuel, while reprocessing, heavy water and enrichment beyond a notified threshold stay with the Union. The government has set targets of about 22.5 gigawatts of nuclear capacity by 2031-32 and 100 gigawatts by 2047.¹⁵ Keralam already owns a government company working the Chavara sands. A state with trained people and a functioning institute is in a position to use that licence. A state with a deposit and a grievance is not.

. . .

Keralam has been holding this material for as long as it has been a state, and holding is the only verb that applies. The reactor that might one day use it went up in the next state along, built by an institution that did not exist when the sand was first dug and does now.

There is a second thing Keralam is holding, and it is not financial either. It is older than the sand, most of it is still standing, and almost none of what it is worth has ever appeared on anyone's books. The next essay tries to put a number on it.



Unknown Iranian die-cutter, Die for a Coin, Early 14th century. The Metropolitan Museum of Art, CCo.

WHAT IT IS

“Die for a Coin”. Iran, early fourteenth century. Cast bronze, three centimetres across. The Metropolitan Museum of Art. A die is the tool a mint strikes coins with. The design exists once, on the face of the die, and passes from there to every coin made with it.

WHY IT IS HERE

This essay argues that the asset worth holding is the capacity to make something rather than the material itself, and a die is that argument in one object. The bronze is worth almost nothing. Three centimetres of cast metal, unglamorous, easy to lose. Its whole value sits outside itself, in coins that have long since been spent and in a mint that could keep striking them for as long as the face held. Keralam has the material already. This is the other thing.

WHAT TO LOOK AT

Look at the outer edge of the disc, then at the face inside it. The edge is lumpy and out of round, left as the metal came. The face carries a ring of beading, two ruled circles inside that, and a squared panel of inscription at the centre, all of it worked precisely. Only the part that would touch a coin was ever finished.

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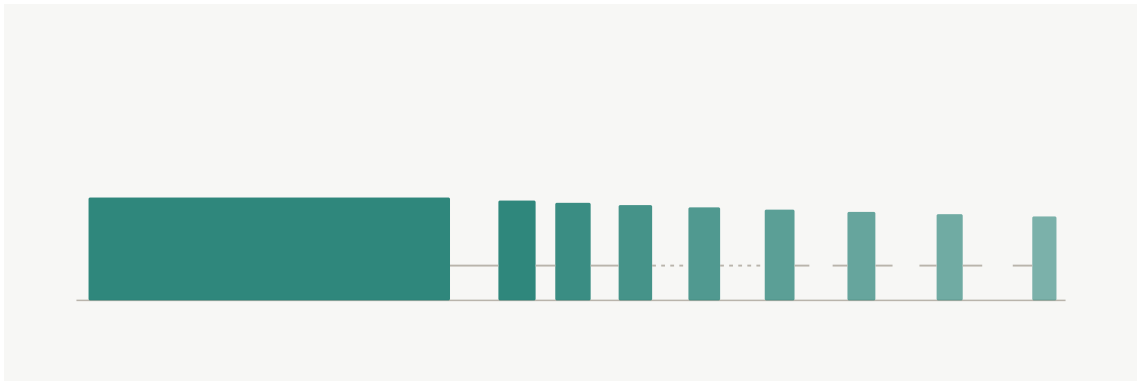
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PART 8

What Keralam Is Still Sitting On

Keralam protects what ecological wealth remains and quietly degrades the rest. Restoring it is not idealism but infrastructure with a measurable return. From a series asking what Keralam 2040 would have to be.

Someone asked me recently why Keralam needs elephants and tigers when Europe is prosperous without them. The question states the development-first argument plainly: get prosperous first, and sort out the ecology later, or not at all.

Europe destroyed most of its large wild fauna over centuries, banked the prosperity, and is now spending some of that accumulated wealth trying to put back what its great-grandparents removed. Wolves, strictly protected under the 1979 Bern Convention, have spread back across the continent and now occur in all 34 countries and regions the EU monitors, with the monitored European population about 23,000 in the 2023 assessment.³ That protection has since been loosened. In March 2025 the wolf was downgraded under the Bern Convention, and in June 2025 the EU moved it to a lower tier of its Habitats Directive, a reminder that even a rich continent's buy-back can be revised.³ The lynx is recovering too, helped by translocations and new reintroduction projects.³ The EU's Nature Restoration Law, in force since August 2024, sets an EU-wide target of restoration measures on at least 20% of the Union's land and sea areas by 2030, and on every ecosystem that needs it by 2050. It was contested all the way: the European Parliament passed it by 329 votes to 275.¹ The bill is real money: the EU's LIFE programme runs to €5.4 billion for 2021 to 2027, of which about €2.1 billion is set aside for nature and biodiversity.²

Europe is not a model of prosperous ecology. It is a cautionary tale with a good balance sheet. Keralam still holds, intact, much of what Europe is now paying to rebuild. The question is whether it keeps it.

Holding Is Not Rebuilding

Keralam already does the first half of this work. It conserves. The state has a forest department, wildlife sanctuaries, and protected areas covering 6.4% of its geographical area, a little over a fifth of its recorded forest land. Satellite mapping, which counts every patch of tree canopy of a hectare or more, puts the state's forest cover at about 54%.⁵ Periyar, Silent Valley, the Wayanad sanctuaries: these mostly hold. Conservation, the holding action, works.

Restoration is the other half, and Keralam does not yet have it at any serious scale. Conservation asks how much of what remains we can protect. Restoration asks how much of what we have already degraded we can rebuild. The gap between the two is a failure of ambition, not of intent.

Keralam built the institutions to hold a forest. It has not yet built the ones to rebuild one.

A word on what restoration here does not mean. It is not a plea to return to a pristine, pre-human Keralam. There is no going back, and the reason is demographic, not sentimental. The land-use decisions that did the damage, the eucalyptus from the 1950s, the teak plantations from the 1840s, the wet-land drainage spread across the whole century, were made when Keralam held a fraction of the people it holds today. We are more people now, on the same land, while expecting more from it. An argument that ignores that is romanticism, and will rightly be dismissed as such. The frame is regenerative rather than preservationist. The question is not how to get back to what was there before people. It is how to build forward to an ecological estate that flourishes alongside the population and economy Keralam has. Every target below is a forward design choice under present constraints, not a rollback.

Four things are worth rebuilding, and each of them has a matching thing the state could do about it. Start with the objection underneath the original question, which is that elephants and tigers are a luxury, an amenity a developing state can defer. The ecology says otherwise. They are keystone species, which means their presence or absence reorganises the entire system around them.

The Shola

Start with the eucalyptus, wattle, and pine that were planted across the high ranges and the Nilgiri Biosphere from the 1950s onward as industrial plantations. As recently as 2024 the government allowed its own forest development corporation to plant more eucalyptus for its finances, before freezing the order after protests. The monocultures remain. What they replaced was shola grassland, a mosaic of montane grass and stunted evergreen forest that is home to threatened species found nowhere but these mountain-tops,⁷ and, more usefully for this argument, a water tower. Shola grassland holds the monsoon in a sponge and releases it slowly into the rivers through the dry months. Replace it with bluegum and you do not just lose an ecosystem. You lose dry-season flow downstream: a paired-catchment study in the Nilgiris found that converting grassland to bluegum cut annual water yield by 16 per cent in the first rotation and 25 per cent in the second, with low flows falling

further still.⁶ There is no reliable state-wide figure for how much shola Keralam has lost. Across the Shola Sky Islands of the southern Western Ghats, which span Keralam, Tamil Nadu and Karnataka, remote sensing puts the montane grassland lost to exotic trees, both planted and spreading on their own, at roughly 340 square kilometres between 1973 and 2017.⁷ The encouraging part is that removal works: in Pampadum Shola, the Forest Department cleared around 475 hectares of wattle between 2020 and 2024, and Keralam adopted a State Eco-Restoration Policy in 2021 that prioritises pulling these exotics off high-altitude land.⁸ The scale of the problem still dwarfs the scale of the response.

The eucalyptus went in as an industrial crop. As late as 2024 the state allowed more of it to be planted. The shola has not come back.

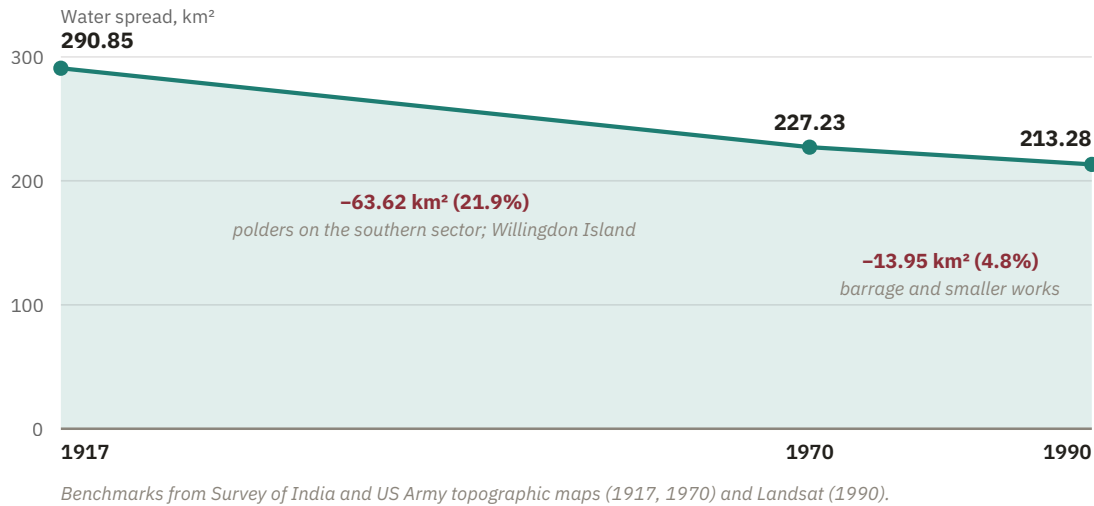
Teak complicates the picture usefully. Teak is native to India, including the moist deciduous forests of Keralam's lower slopes where Nilambur sits, though not to the wet evergreen forest higher up the Ghats. The systematic monocultures here are a colonial inheritance: the first organised plantations went in at Nilambur in the 1840s, to replace the teak that naval timber contracts had stripped from Malabar.⁹ Much of what people take for Keralam's ancient forest is, in part, a nineteenth-century timber estate. That does not weaken the case for restoration. It makes it selective. Teak stays, because the wildlife that now depends on it has no alternative and the economic value is real, but the monoculture can be diversified over time, native canopy and understory threaded back in. The shola case is different: the eucalyptus there is not economically necessary to the state, it actively harms the water system, and it is replaceable. Not every plantation carries the same restoration logic, and a doctrine that treats them alike will be wrong about one of them.

What to do about it is within Keralam's own hands. The state can direct its Forest Research Institute to put a rupee value on what shola restoration is worth in dry-season river flow, which is the number that would make the economic case for eucalyptus removal at scale. It can spend its compensatory-afforestation money on shola restoration. And it can make the fund do what it exists for. The Comptroller and Auditor General's 2013 audit of com-

pensatory afforestation found that in Keralam, according to the state's own records, "no afforestation was done on non forest land and degraded forest land", the land set aside to receive it, and that 0.96 crore rupees of the CAMPA money had gone on the "purchase of vehicles".²⁰ The money has to reach the land.

The Wetlands

Keralam's wetlands have been drained and filled for aquaculture, paddy, and construction for decades. The trend is clearest at Vembanad, the great backwater lake behind Kochi and Alappuzha. Benchmarked against Survey of India mapping, its water spread fell from 290.85 square kilometres in 1917 to 213.28 by 1990, a loss of just over a quarter, most of it reclaimed for polders on the southern sector and to enlarge Willingdon Island.¹⁰ Three of these systems, Vembanad-Kol, Ashtamudi, and Sasthamkotta, carry Ramsar designation as internationally important, which makes their decline a public statement about what the state values.¹⁰ The official post-disaster assessment judged that, at that rainfall, flooding along the backwaters was unavoidable. It also found that the limited capacity of Vembanad Lake and the Thottappally Spillway worsened the flooding in Kuttanad, and that silting had left Kuttanad's drainage canals far below their original capacity. It put the damage and loss at about ₹26,700 crore.¹¹ Some unknown share of that was a bill for reclamation and drainage decisions made decades earlier. To hold what is left, the state must do more than print protection labels. It must reverse the worst reclamations, reopen blocked channels, restore polder hydrology, buy development rights on the worst-placed parcels, and enforce a no-net-loss rule so that every new conversion is offset in function, not on paper. It must give its wetland authority real restoration targets with five-year milestones, where today it has labels.

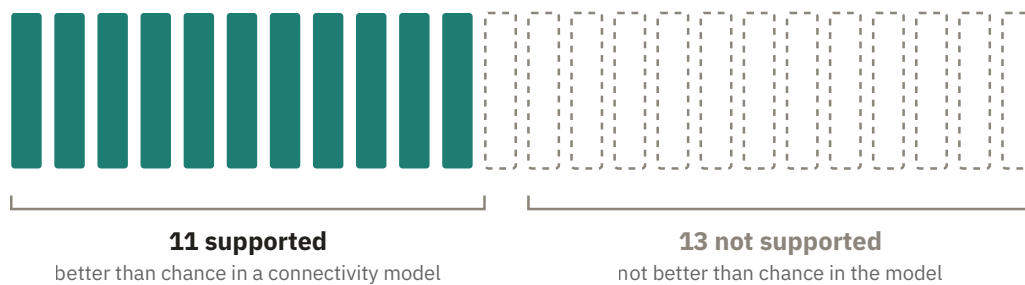


The lake lost just over a quarter of its water spread across the twentieth century, and three-quarters of that loss was finished before 1970. The often-quoted 365 square kilometres is an older estimate of the backwaters' extent up to 1834, not comparable with the 1917 water spread measured here.

The Corridors

Keralam's protected areas are becoming islands. The land between them, where the roads and plantations and settlements are, has broken the routes wildlife once used to move, breed, and follow the seasons. The data is less clear than it should be. Of twenty-four elephant corridors that experts had drawn in the Nilgiri Biosphere, a connectivity model found that only eleven followed routes better than chance, and the expert teams agreed with each other on just two.¹² One Keralam corridor, Peria to Pannippad, is only about four hundred metres wide, with private land and a road at its bottleneck, though the 2023 national survey records elephants using it more, not less.¹³ I suspect many of the elephant-in-the-village stories that fill Keralam's news are a corridor problem: animals moving along historical routes that development has narrowed.

Each bar is one corridor identified by experts in the Nilgiri Biosphere Reserve



One Keralam corridor, Peria to Pannipad, is only about four hundred metres wide.

Roughly half the corridors the experts mapped do not hold up when connectivity is modelled, and the experts agreed with each other on only two.

Elephants are ecosystem engineers in the technical sense.¹⁴ They open the canopy and let light reach the floor, they break limbs that become deadwood habitat, they dig at mineral seeps that other animals then use. Most consequentially, they may be the main disperser left for some of Keralam's largest-fruited forest trees. If they go, those trees may regenerate less, and the composition of the forest may drift, slowly and without anyone deciding it, over the decades that follow. For Asian elephants the evidence, as of the 2011 review, was fragmentary.¹⁵

Keralam's elephants are not decorative. They are the architects of the forest. Remove them and the forest may change composition, slowly, over the decades that follow.

The state can write the most fragmented corridors into its land-use plans, starting with the worst few in the Nilgiri Biosphere. But a corridor on a plan is only a corridor if something stops the edge from closing on it, and that is a decision someone has to defend at a budget meeting. It has two halves, and they only work as a pair. The first half is a line.

The first half is a line. There has to be a firm, mapped boundary for where cultivation and settlement are permitted on land that abuts forest. Today that boundary is soft and quietly receding. Cultivation, plantation, and settlement creep into the forest edge and into the corridor land between re-

serves, which is precisely what narrows those corridors. A soft boundary means the conflict zone grows every year, and every new hectare of forest-edge planting manufactures human-wildlife conflict that did not exist the year before. The line is not anti-farmer. It is the precondition that makes the rest fair.

The Human-Animal Edge

Tigers sit at the top of the same system. Tiger numbers track the numbers of their prey closely, so tigers are bound tightly to the herbivores beneath them.¹⁶ Whether tigers in turn hold browsing and rooting low enough to protect forest regeneration is plausible but not yet well shown. The best-known case of a predator reshaping a landscape is the Yellowstone wolf, and even that is disputed: a twenty-year experiment there found that the streamside willows had not recovered after the predators returned.¹⁷ The tigers themselves do not respect the question's framing, or the state's borders. Keralam's own estimate is 213 tigers, part of one connected Western Ghats population estimated at 1,087 in 2022.¹⁸ That a tiger cannot be assigned to a single state is exactly the point of an essay about corridors.

The second half is the bill. Inside the permitted zone, where conflict still happens, the state pays for animal-caused damage in full and on time. It does not answer crop loss by licensing farmers to eliminate the animal they identify as the cause. Recent policy has moved the other way. In May 2022 the state empowered local bodies to shoot wild boars threatening crops, life and property, and it has asked the Centre more than once to declare the animal vermin under the Wildlife (Protection) Act, which the Centre has so far declined to do.⁴ For wild boar, the direction of travel hands the animal to the local body's gun. Extended to every conflict species, the same logic would make an elephant or a tiger the individual farmer's problem to solve with a gun or a live wire. That drift is understandable and it is wrong, because it trades a permanent, shared, irreplaceable asset for a temporary, private loss that money can cover.

Keeping elephants and tigers alive is a common need, so the cost of keeping them alive is properly a common cost. The farmer at the forest edge did not choose to be the one who absorbs the price of the state's biodiversity. Asking that farmer to either swallow the loss in silence or kill the animal is asking one person to pay for something everyone owns. Full and prompt compensation is just the public paying for the public asset it has decided to

keep. That reframes the whole question of crop-damage compensation. It is not welfare and it is not appeasement. It is the carrying cost of the ecological estate, and it should be budgeted and defended as exactly that.

The line and the bill need each other. Compensation without a line is unbounded: if farming keeps advancing into the edge, claims rise without limit until the scheme collapses and takes public patience for wildlife down with it. A line without compensation is unjust: it freezes the edge farmer inside a conflict zone with no recourse. Only together are they stable. Draw the line, and inside it pay every claim in full. That is a system a farmer can live with and a treasury can sustain.

Today's compensation is a floor, not a ceiling. The Forest Department has proposed setting aside about ₹15 crore a year for crop-damage compensation, a figure based on past claims and the rate revision it expected, and even that understates the real loss, because its divisions could not release all claims for want of funds and, until 2025, the rates had gone years without revision.¹⁹ The 2024 declaration of human-wildlife conflict as a State Special Disaster, and the revised compensation rates that followed in 2025, move in the right direction.¹⁹ It is incomplete without the line.

Two honest cautions, because the proposal fails without them. The first is equity. A line drawn at the forest edge falls on smallholders and forest-dwelling communities, many of them tribal, whose tenure is already insecure under a weakly implemented Forest Rights Act. The line cannot be an eviction order. It has to come with secure tenure, and where a critical corridor parcel genuinely must be cleared, with the kind of fair, consent-based buyback already done at small scale in Keralam, as on the Thirunelli to Kudrakote corridor, where a Wildlife Trust of India project run with the state government bought about twenty-five acres from thirty-seven families who relocated with their prior consent, and the land then went to the Forest Department.²² The line is a planning instrument, not a notice to quit.

The second caution is capture, and it is the one that quietly inverts schemes like this. Compensation flows to whoever knows the scheme exists and can position themselves to claim it. Left unconditioned, that means the tribal smallholder who has farmed the edge for generations, and does not know the scheme exists or cannot file the paperwork, gets nothing, while the well-resourced farmer reads the rules, buys approved land next to the forest precisely because it is a conflict zone, plants the most raidable crop, and farms the compensation. The carrying cost of the wildlife becomes a subsidy for speculative land-buying by the comfortable, and the conflict zone expands instead of settling, because the incentive now points toward the edge.

Two conditions prevent it. Eligibility is frozen at the line, by tenure and by date: only cultivators with established tenure or recognised forest rights as of the cutoff can claim, and land bought or cleared inside the band afterward carries no compensation right, which kills the incentive to move in for the payout. And the scheme has to reach people actively, through gram-sabha enrolment and assisted claims in Malayalam and, where needed, in the relevant Adivasi languages, not through a portal that rewards whoever is most fluent in forms. Closing that information gap is part of the mechanism. Without these two conditions the whole proposal is not merely incomplete but regressive.

What Needs Delhi

Some of the work genuinely needs Delhi. The Forest Rights Act needs the tenure security its current implementation does not deliver, both for justice and because secure communities are often the most effective stewards of corridor land. And the Nilgiri Biosphere Reserve, India's first biosphere reserve, is administered under a central programme whose budget Kerala does not set.

The Restoration Compact

Call it a Kerala Ecological Restoration Compact, running 2027 to 2040, long enough to outlive more than one government and matched to the horizon the rest of this series uses. Four mandates, each with a first act that shows whether the thing is serious.

MANDATE	FIRST PROOF OF SERIOUSNESS
Restore high-range water systems	Map the priority shola-to-plantation conversion zones and fund a five-year removal and regeneration programme
Reconnect wildlife landscapes	Legally identify priority corridor parcels, with voluntary purchase, tenure security, and no-new-encroachment rules
Rebuild wetland capacity	Set area, hydrological-function and flood-buffer targets for Vembanad-Kol and Kuttanad
Socialise conflict costs fairly	Full, time-bound compensation inside a mapped eligibility band, with assisted gram-sabha claims and transparent public reporting

The first proofs matter more than the mandates. Each one is a map or a target, which is to say a public number that someone who was not in the room can check the following year. If the first year produces neither, the compact is not real.

The Story No One Has Told

Few, if any, tropical states have yet shown that it is possible to build a knowledge-intensive, research-capable, builder-led economy while restoring its ecological base instead of spending it down. The usual tropical arc runs the other way: destroy the ecology, build the economy, then try to buy the ecology back. That is the European story.

Keralam has the institutions, the civic culture, and the intact natural estate to try the harder version. If the rest of this series is right, that the state's future runs through precision industry, research depth, and patient builder capital rather than low-cost manufacturing sprawl, then that future is ecologically compatible in a way the sprawl path never was. The restoration argument sits inside the economic one: for Keralam specifically, building a serious economy and rebuilding an ecological estate are far more compatible than the conventional development story assumes.

Few tropical states, if any, have built a knowledge economy and left their ecological base larger than they found it. Keralam still has the chance to be the demonstration.

The estate does not end at the forest boundary, which is where the next essay begins. Kochi and Thiruvananthapuram sit on the edge of one of the planet's significant biodiversity hotspots. Singapore raised its green cover from about 36% in 1986 to close to 50% by 2010, not despite its development but as a consequence of taking the city seriously as something to be designed.²¹ A city that ignores the estate it sits in will consume it. A city that builds on it becomes somewhere people with a choice want to live, which is the only durable advantage a tropical city has left to win.

. . .



Hendrik van Rhee, East Indian or Malabar Kino (*Pterocarpus marsupium*), 1686. Wellcome Collection, Public Domain.

WHAT IT IS

“East Indian or Malabar Kino (*Pterocarpus marsupium*)”. Hendrik van Rhee (Dutch, 1636–1691), Amsterdam, 1686. Line engraving with watercolour, platemark 33.6 by 41.6 centimetres, from *Hortus Malabaricus*, the twelve-volume flora of the Malabar coast that van Rhee compiled while serving as the Dutch East India Company’s governor there. Wellcome Collection.

WHY IT IS HERE

The essay argues that Keralam is sitting on an ecological estate whose most careful early record was made by the apparatus that would later reorganise its forests. This plate is that record. Van Rhee assembled *Hortus Malabaricus* between 1678 and 1693 out of knowledge held by local physicians and scholars, chief among them Itty Achudan, an Ezhava vaidyan whose family manuscripts supplied much of the plant lore, and it remains the earliest systematic printed flora of the region. The tree in the plate is a native deciduous hardwood, the kind of species the essay says restoration should thread back through the plantations. Three centuries after it was drawn, an audit found that the state’s compensatory-afforestation fund had planted nothing on the land meant to receive it, and had spent money on vehicles.

WHAT TO LOOK AT

The annotations crowded into the top right corner, in a hand much smaller than the plant, each line tagged with its language: Lat., Mal., Bra., Arab. The line marked Mal. reads *Karintagera*, the same name as the Latin above it. It will not look like Malayalam to

a Malayali today, because it is Kolezhuthu, the script Kerala used then and has since abandoned. No press in Europe held type for it, so the engraver cut those letters into the copper by hand. Below them sit the Nagari of the Brahmin physicians and the Arabic of the Muslim ones. Four communities' names for one tree, on a plate made to send the tree to Amsterdam.

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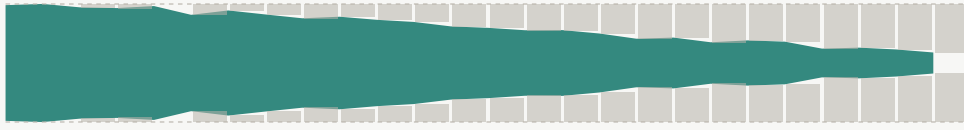
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PART 9

The City Keralam Forgot to Build

Keralam has the raw material most cities would pay to manufacture: backwaters, canals, forest edges, coastal frontage. Its cities are spending that asset down instead of building on it. From a series asking what Keralam 2040 would have to be.

The Thevara-Perandoor canal runs about ten kilometres through the middle of Kochi, past Panampilly Nagar, Kadavanthra and Kaloore, and near the city centre it is now a drain. You can follow where it goes by the smell before you reach the water. Concrete has crept to both edges. Near Ernakulam Junction station it shrinks to a few metres across, and a survey along its whole length found heavy encroachment, worst along the middle stretch, each encroachment either legal enough or ignored long enough to become permanent. People once used it to move goods by boat. In May 2025 the state approved a plan to widen it, and five other Kochi canals, to at least 16.5 metres.¹⁵

Most cities in the world would build a network like this from scratch if they could. Keralam inherited one, spent years narrowing it, and has now approved a plan to widen part of it again. The pressure that narrowed it, one parcel at a time, has not gone away.

The city is where everything the series has argued for so far either lands physically or does not land at all. Talent, clusters, research, capital. Each gap the series has named assumes a place where the work happens, where the people doing it choose to live, and where the firms that employ them can plan. That place is the city, and Keralam has not built it.

Keralam's cities are consuming the very asset that makes Keralam worth living in.

The wrong goal

The problem is not that Keralam plans its cities badly within the rules. The problem is the goal the rules serve.

The dominant planning paradigm in India, Keralam included, minimises harm. How little ecology can a project damage. How few people must it displace. How short can the clearance timeline be. Compensatory planting after the trees are cut. Setbacks measured from the waterway. Permitted floor-area ratios. These are all do-less-harm interventions, and they all assume the same thing: that the city exists to extract, and that limiting the damage is a side constraint bolted on afterwards. In much Indian urban policy, sustainability has become the polite name for that assumption. It softens the paradigm without changing it.

A regenerative paradigm asks a different question. Not how little harm can these cities cause, but what kind of life, ecological and social and economic at once, could they be designed to make flourish, and what would have to be true for that to happen by 2040. The goal of the system changes. Damage minimisation stops being the ceiling and becomes a trivial floor.

Changing the word changes nothing on its own. Changing the goal of the system is a different and far more powerful intervention, and there is a developed theory of why. Donella Meadows, in her essay on leverage points, ranked twelve places to intervene in a system in increasing order of power.¹ Near the bottom sit constants and parameters: subsidies, taxes, setback distances, FAR limits. Most urban policy debate in Keralam lives down there, arguing about the numbers in a master plan. Near the top sit the goals of the system, and above them the paradigm the goals come out of. Meadows' point was that effort spent at the bottom of the list moves almost nothing, while a shift at the top reorganises everything below it. Keralam's cities are an unusually clean illustration. Decades of fighting over parameters have not changed the trajectory, because the trajectory is set by a goal nobody is contesting.

In practice, a regenerative Keralam city would make four choices in the opposite order from today's development model: protect water before allocating frontage; map and restore canals before treating them as drainage; concentrate new density around transit and services rather than extending the ribbon settlement; and treat tree cover, shade, and flood absorption as public infrastructure with enforceable standards. The argument is not for less development. It is for development that leaves the place more capable than it found it.

*Sustainability is the polite version of the paradigm
Keralam's cities have been operating under. Regenerative
thinking is what would happen if the paradigm changed.*

The regenerative paradigm is also a better fit for Keralam than any imported template, which matters because the reflex when discussing city quality is to reach for Singapore or Zurich and copy. Keralam already has the three things regenerative planning depends on and most places have to manufacture: an

ecological asset base of genuine richness, a dense social fabric, and an unusually strong attachment between people and specific places. The planning system has been treating all three as constraints. They are the power source.

Place attachment is the engine, not the friction

Every planning agency in Keralam that has ever tried to acquire land has run into the same wall and given it the same name. Land acquisition is hard in Keralam. People will not sell. A road widening stalls for a decade over a few hundred metres. A waterfront project meets organised local resistance. In the standard account this is Keralam's congenital planning disease, the reason nothing large gets built, the cost of a politically mobilised population.

Read it through a different lens and it is the most valuable planning input the state has. The affective bond between people and the places they live in, what the planning literature calls place attachment, is a well-documented motivator of community participation and neighbourhood improvement.² Most planning practice treats public participation as a procedure to be designed and a box to be ticked. The research points elsewhere: caring about a specific place can help inspire people to act.

Keralam has this in unusual depth. The Gulf return migrant who builds a house in the exact panchayat he grew up in when cheaper and more convenient land was available. The diaspora that names a school or a hospital after a home village few outsiders could find on a map. The local body that defends a stretch of backwater from a resort project past the point of economic rationality. The current paradigm reads every one of these as resistance. A regenerative paradigm reads them as civic energy that, engaged honestly, would defend canals, restore waterfronts, and steward forest edges at a scale no planning department could ever staff or fund.

Keralam's place attachment has been read as friction by every planning agency that ever tried to acquire land. It is not friction. It is the civic energy a regenerative city would actually run on.

The institutional implication is specific and it is uncomfortable for the current model. It means planning processes that take residents' material and emotional relationships to particular places as inputs, not as obstacles to be consulted away. Not the stakeholder consultation as currently practised, which informs people of a decision already made and minutes their objections. Processes where the place-bond shapes the plan. This is slower at the front end and far more durable at the back end, because a plan that the people attached to a place helped write is a plan they will defend rather than fight.

What taking the city seriously actually looks like

It helps to have seen the alternative working, because otherwise the argument sounds utopian.

What I watched in Singapore is a city treated as a product the state is responsible for, and none of it is accident or climate luck. The Singapore River was cleaned over ten years. The money went into the water and into the access to it, not into building over it.³ The new towns, Tampines and Punggol among them, were planned comprehensively, as whole towns, by the Housing and Development Board. A single statutory authority, the Urban Redevelopment Authority, held city-wide planning power and the capacity to enforce it.⁴ The city is good because someone decided it was a competitive asset and built the institution to make it one.

What I know from Basel is quieter and more relevant. Basel is a city of under two hundred thousand people on the Rhine, and it is also where Roche and Novartis are headquartered, which makes it a centre of pharmaceutical research and close to the kind of economy this series has been arguing Kerala should build. It is not spectacular and does not try to be. The Rhine runs through the middle of it as an actively used public commons; on a warm day half the city swims home down the river. Cycling infrastructure runs continuously and goes where people actually ride. Building codes preserve the character of streets. Public transport runs to schedule precisely enough that people plan their lives around it. Zurich has owned the Sihlwald forest since the fourteenth century and, instead of continuing to log it, had it protected: since 2010 it has carried federal designation as a nature discovery park of national importance.⁵ None of this is glamorous. All of it adds up to cities that hold mobile international talent through functional quality of life, without spectacle.

Neither Singapore nor Switzerland started with what Keralam already has. Basel's beauty is built, civic, maintained. Keralam begins with backwaters, canals, forest edges, coastal frontage, and a climate that grows things whether you ask it to or not. A Keralam city that treated its waterways and forest edges as design inputs instead of obstacles would have an offer that no landlocked industrial city could replicate at any budget. That is an economic argument before it is an aesthetic one.

The failures not yet locked in

Some of the damage is reversible, but only if the state acts before today's parcel-by-parcel decisions become tomorrow's permanent geography. Four failures stand out. Each was a decision.

The waterfront is being privatised and concreted in ways that are hard to undo. Singapore cleaned up its river and opened the banks to the public within the same plan that redeveloped the city centre around them. The public edge and the commercial density were designed together.³ Once water frontage is in private hands and built over, reclaiming it for public use is politically and financially brutal. What this requires is not a guideline but planning law: a zoning category that prevents residential and commercial construction within a defined setback from water, paired with active public programming inside the protected zone so the space is used and therefore defended.

The canals are the clearest case, because the incentive that destroys them is so legible. Filling or covering a canal frees up land, and land has immediate monetary value to a local body and to a developer. Keeping the canal open as a public waterway has ecological and transit value, and that value reaches a budget only as a project, years after the damage: the Inland Waterways Authority of India spent ₹228.60 crore on National Waterway 3 between 1994-95 and 2014-15, and in 2025 the state approved a ₹3,716.10 crore plan to widen six Kochi canals and build the sewers around them.¹⁵ At the moment a parcel beside a canal is filled, none of that money is in the calculation. So the canals are filled, legally, rationally, one parcel at a time, and a transport and drainage and ecological asset that most cities would build from scratch is converted into plots and booked as growth. The scale of what is being spent down is on the record. Keralam has 1,687 kilometres of inland waterway; 205 kilometres of it was declared a National Waterway in 1993; in 2014-15 freight moved on thirty-seven of those kilometres and the other 168 carried nothing at all. How much of the network has been encroached is

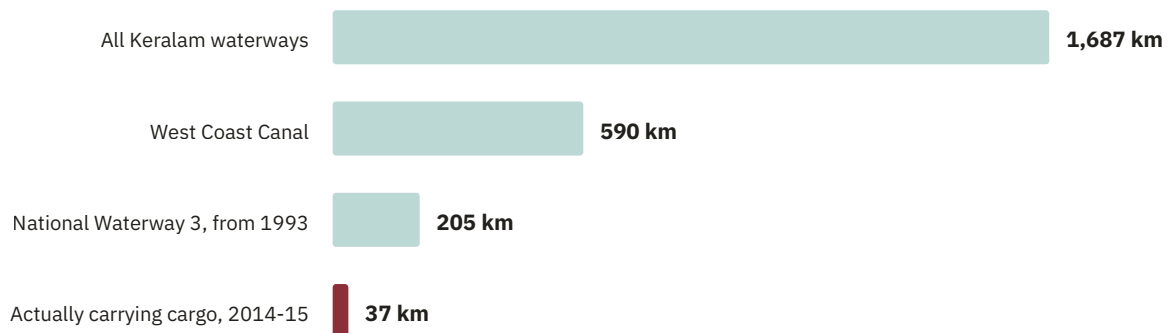
not on the record, because the boundaries of the waterways were never surveyed, so when the CAG audited it in 2015, the department responsible could not say. The one eviction it managed covered 7.86 kilometres and took seven years.⁶ The policy task is narrow and concrete: make the canal's value visible in the planning calculation so that keeping it open is not an act of charity by whoever happens to own the adjacent plot.

A canal is not a drainage problem. It is infrastructure that most cities would build from scratch if they could.

Density is the third, and Keralam's failure mode here is specific. The settlement pattern is already an almost continuous ribbon along the coastal and inland corridors, neither urban nor rural. Permits are granted parcel by parcel, so development sprawls further into agricultural and ecological land without ever producing the concentration that makes urban services, transit, water, sanitation, economically viable to provide. The answer is walkable density concentrated in nodes, with ecological corridors between them. Towers are not the point. This is exactly the problem Singapore's new towns solved deliberately, and the one Keralam fails to solve by default.

Green cover is the fourth, and the one most readily dismissed as decoration. It is not decoration; it is enforceable infrastructure. Singapore requires new developments in designated strategic areas to provide landscaped area at least equal to their site area.⁴ Zurich's city forest is zoned protection. Medellín built a network of urban green corridors that, by C40's account, cut average city temperatures by 2°C.⁷ In Keralam's climate the case is not abstract: Kochi already runs 4.6°C hotter than the rural land beside it before dawn in winter.⁸ The economic case follows directly: green infrastructure cuts urban heat and therefore cooling costs and lost productivity, absorbs stormwater and therefore flood damage, and lifts the value of adjacent property. These are measurable quantities, not sentiments, and a city that treats them as sentiments is leaving money and resilience on the table. Keralam learned the cost of treating water management as optional in 2018, when the floods turned out to be, in significant part, a planning failure rather than a purely meteorological one.⁹

Inland waterway in Kerala: the network, the stretch given national status, and the stretch that carries freight.

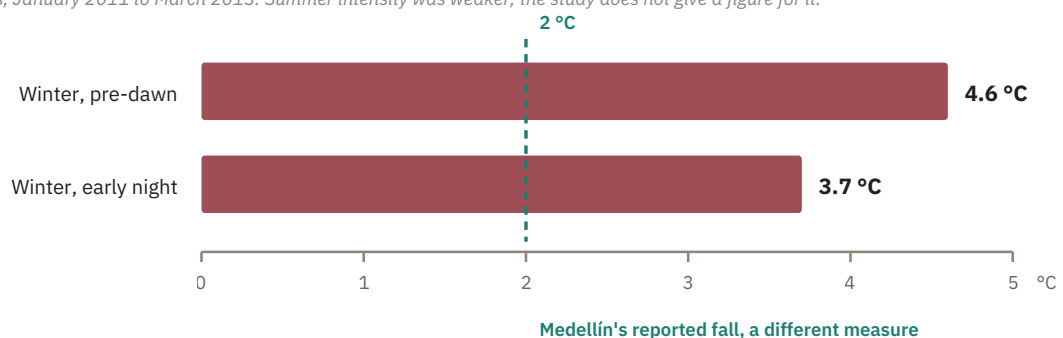


In 2014-15, 99.6% of all cargo on National Waterway 3 moved on the Champakkara and Udyogamandal canals. The CAG found the other 168 km "not being uti

The asset is the top bar. The use is the bottom one. Between them sit boundaries that were never surveyed, which is why the state cannot say how much of the network has been encroached.

Kochi's heat island: how much hotter the built-up city runs than the rural land beside it.

Twelve mobile surveys, January 2011 to March 2013. Summer intensity was weaker; the study does not give a figure for it.



The heat in Kochi is measured. Medellín reports a remedy: about two degrees off its average temperature from green corridors planted across the city between 2016 and 2019.

Backcasting a city from a future worth having

Keralam has done this once already, and the second essay in this series leaned on it for a different argument. God's Own Country took Keralam's natural beauty, which had not changed, and rebuilt the narrative around it. Kerala Tourism adopted the phrase in the late 1980s, and by 2019 the state counted more than 19 million tourist visits a year and put tourism's total revenue at about ₹45,000 crore.¹⁴ The same essay carried the warning that applies even more sharply here: the brand succeeded and the ecological

management did not keep pace, and the cities are now the clearest evidence of that gap. The lesson is about sequence. A narrative reframing works when the institutional infrastructure follows it, and fails when it stands in for it.

If the paradigm is the leverage point, the method that follows from it is backcasting, and Keralam does not have to invent it.

Forecasting starts from current trends and asks where they lead, which for Keralam's cities is a depressing exercise. Backcasting starts from a desired future state and asks what would have to be true at intermediate years for that state to become plausible. The same method works at the scale of a single company or of a whole city.

What backcasting at city scale produces is a picture of the place, held in common: what a society thinks the shape of its own territory is. Marshall, after Castoriadis, calls this a spatial imaginary. Keralam holds a vivid picture of its landscape and almost none of its cities, which is why a canal reads as a drain and not as a street. Where no explicit plan exists, Marshall argues, that picture may steer decisions anyway.¹⁰

In 2019 a group of citizens in Singapore wrote Vision 2050, a long-horizon climate action plan. What is worth taking from it is the method, not the content. It sketched Singapore as, in their words, a flourishing player in a regenerative and connective global economy in which our descendants thrive. Then it worked backwards from that 2050 picture to the moves required between now and then.¹¹ Two features matter for Keralam, and the plan's content, shaped by a city-state's peculiar constraints, is neither of them. The first is that it backcasts from a flourishing future instead of forecasting from present trends. The second is that it was written by citizens: a volunteer group answering a government consultation. It did not wait to be commissioned. It put a full alternative on the table, in writing, detailed enough that the state could adopt it or argue with it but could not simply ignore it.

Singapore is not the only template. France runs a permanent state institution for precisely this, the Commission Nationale du Débat Public, which can open public debate on major projects years before any permit is sought, and which Marshall describes as genuinely independent of government, business, and special-interest pressure.¹² No other country has copied it, and Marshall's guess at the reason is pointed: business and business-oriented governments perhaps see it as too open and democratic. A Keralam that wanted citizen deliberation to be more than a consultation ritual would not have to invent the institution that carries it.

That second feature is where Keralam's supposed disadvantage turns into its sharpest asset. A literate, civically engaged, opinionated population is exactly the population a citizen-led planning vision requires. The researchers, architects, ecologists, returnees, and residents who care about specific Keralam places already exist, and the place-attachment that the current paradigm treats as friction is precisely the energy that would write such a document.

A regenerative Keralam 2040 city plan does not need to wait for the state to commission it. It needs citizens to write it first.

What Keralam can do now

Within its current authority the state can do three things. It can put planning under one body with the power to hold the whole city, instead of splitting it across several bodies that each plan their own piece. Marshall, writing about sectoral planning in national governments, names the habit: "road engineers will plan road systems, water engineers will plan water systems".¹⁰ A city planned that way has no one responsible for the whole of it. It can write canal and waterfront protection into planning law, where it binds, instead of into guidelines, where it does not. And it can build one anchor project that shows the regenerative city working, because an argument made in concrete persuades where an argument made in policy papers does not.

The sequence matters as much as the project. Marshall describes one extreme of how projects relate to planning as the "free floating" project, promoted by a local or special interest with no acknowledged link to any wider frame.¹⁰ An anchor project needs a stated vision above it; without one it becomes the free-floating kind.

What requires federal change

Some of the binding constraints are central, and the shape of the money is the clearest of them. The Smart Cities Mission put about 80 per cent of proposed project cost into area-based development: one chosen district in each selected city, which for a retrofit had to cover more than 500 acres.¹³ Kochi's district ran about seven square kilometres, from Fort Kochi through Mat-

tancherry to the city centre, and its plan included a four-kilometre waterway and the rejuvenation of four canals. So the money could reach canals, but only those inside the chosen district. A city's canal network runs through every ward, and a programme built around one district cannot fund it whole. Coastal Regulation Zone notifications, set centrally, govern what Keralam may do along its own coastline, and the matching-fund requirements attached to central urban money fall hard on a fiscally constrained state. None of this makes the state-level moves pointless. It bounds how far they reach.

. . .

For the kind of economy this series has been arguing toward, the city is a precondition. You cannot build a world-class, research-heavy, globally connected firm in a place that talented and mobile people decline to live in, and you cannot build it in a place whose own residents have stopped feeling at home. The tourist who comes for the backwaters and finds a degraded waterfront does not return. The engineer weighing a relocation and finding the same does not arrive at all. A city is not an amenity that follows growth.

A later essay in this series will put a specific company on this ground and ask what the city, and everything underneath it, would have to be for that company to exist.

. . .



Utagawa Hiroshige, Hauling Canal Boats, Yotsugi Road (Yotsugi-dori, yosui hikifune), from One Hundred Famous Views of Edo, 1857. Cooper Hewitt, Smithsonian Design Museum, CCo.

WHAT IT IS

“Hauling Canal Boats, Yotsugi Road (Yotsugi-dori, yosui hikifune)”, from the series One Hundred Famous Views of Edo. Utagawa Hiroshige (Japanese, 1797–1858), 1857. Woodblock print in coloured ink on paper. Cooper Hewitt, Smithsonian Design Museum, accession 1941-31-278, which catalogues the artist under the older form Ando Hiroshige.

WHY IT IS HERE

The essay opens on a canal in Kochi whose designation in most planning documents is stormwater drainage. This print is the same object with the classification running the other way. Cooper Hewitt’s record notes that the Yotsugi channel was cut at the beginning of the seventeenth century to bring drinking water to Edo, that it became a freight route soon after, and that because it ran narrow and shallow the boats had to be pulled. A city built a canal for one purpose, found a second, and kept both. Keralam inherited a working network and reclassified it as a problem. The medium carries the rest of it. One Hundred Famous Views of Edo was cheap, printed in quantity, and bought by ordinary people to look at their own city. This essay turns on what Marshall calls a spatial imaginary, the picture a society holds of the shape of its own territory. Edo had one, by the thousand, in colour.

WHAT TO LOOK AT

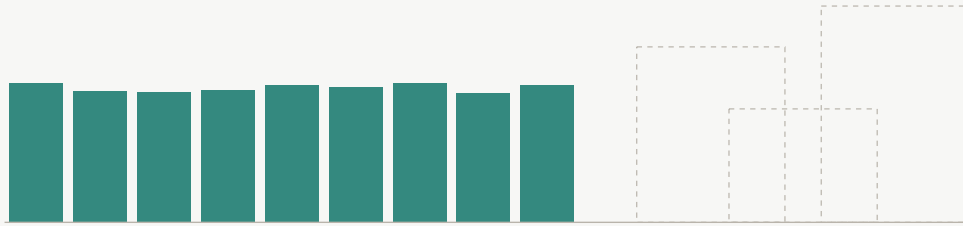
The yellow towpath. It follows every bend of the water, and it is the most deliberate thing in the picture: a road whose only purpose is to let the canal be used. Follow it down to the ropes, drawn taut from the shoulders of the men walking it to the bows of three loaded boats. Then look at the banks, planted with pine right to the waterline. Nothing here has crept to the edge.

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Your Turn, Keralam

Nine essays argued a case for what Keralam in 2040 would have to be. This one asks what you would do with it. Three questions, and an interview you can run yourself. From a series asking what Keralam 2040 would have to be.

This is an invitation to add your own view to the series. The series has argued that Keralam manufactured the hardest input a modern economy needs, then watched much of it leave. It has proposed answers: an apprenticeship system rebuilt on the literacy already achieved; research depth instead of publication counts; builders rather than investors; one industry chosen and built whole; an ecological estate restored rather than spent down; and cities that work with their water instead of paving over it.

It also leaves you with specifics. Thorium separated at Aluva and stockpiled, most of it still waiting for a use. A waterway network of 1,687 kilometres, whose one national waterway carried cargo along only 37 of them in 2014-15. An Irrigation Department unable to say how much of its canal network has been encroached upon because the boundaries were never surveyed. A civic machine capable of reaching almost any household in the state, but rarely asked to move an idea at the same scale.

Every one of those propositions is arguable. Several may be wrong.

What the series has not done is ask you anything.

The final essay will be my answer to the questions below. Yours will differ. If the answers that come back make a better case than mine, I will write a version of that essay built on them.

Why this is harder than it looks

There is an easy version of this exercise. Someone asks you to imagine a better future; you face no particular constraints; and you produce something pleasant and general. More jobs. Cleaner rivers. Young people staying.

This is the other version. You have just read nine essays of numbers, constraints and named institutions, several of which argue that the obvious answer is the wrong one.

Imagining freely and imagining against a dossier are different exercises. The second is harder. It is also the only one worth doing here.

You do not have to agree with any of it. The third question exists for readers who think the series has the wrong end of the stick.

What happens to what you write

I will read every response. I will not publish or quote anything with your name attached unless I ask you first, and answering does not subscribe you to anything.

You will receive one email asking you to confirm your address. I do not read or use your response unless you confirm it, and I delete it if you never do. It is a small check that keeps the conversation usable.

The question is not whether Keralam can become an imagined future elsewhere. It is what this particular place should become, and what it should refuse to become, with the institutions and landscape it already has.

Answer one question or all three. A paragraph is an answer. So is a page.

Three questions

Answer in as much or as little detail as you like.

The future worth choosing

It is 2040. What is one ordinary, observable fact about life in Keralam that would persuade you it has become a more capable place?

Describe what has changed: the work people do, the choices young people have, the way a town works, an institution people trust, a landscape restored, or something else entirely.

The choice that costs something

What should Keralam build, protect or stop doing in the next five years, even if it means giving up another attractive option?

Name the trade-off. A future becomes real when somebody is willing to choose between good things.

The dissenting question

What has this series got wrong?

Is the diagnosis mistaken, the evidence incomplete, the proposed direction unworkable, or the real opportunity elsewhere? Make the strongest case you can.

. . .

To send your answers, use the form at pramod.ch/essays/your-turn-keralam. The confirmation email described above comes from that form.

Glossary

The essays use Indian measures and Keralam institutions that a reader outside India may not know, and Singaporean and Swiss comparators that a reader in Thiruvananthapuram may not. Each entry gives the meaning a term carries in these essays, which is sometimes narrower than its everyday sense. The online edition explains each term where it first appears. In print, they are collected here.

BPCL

Bharat Petroleum Corporation Limited. An oil company majority-owned by the Union government; it runs the refinery at Kochi.

CAG

Comptroller and Auditor General of India. The constitutional auditor of government accounts, whose reports on Keralam are laid before the state legislature and set out what its audits found.

CAMPA

Compensatory Afforestation Fund Management and Planning Authority. Holds money paid by anyone diverting forest land, to be spent planting replacement forest.

CMFRI

Central Marine Fisheries Research Institute, headquartered in Kochi. A national marine research laboratory under the Indian Council of Agricultural Research.

EDB

Singapore's Economic Development Board. The agency that plans and recruits the industries Singapore decides to build.

The series uses it as a comparator for deliberate industrial selection: the EDB chooses sectors and then assembles land, training and tenants around them, rather than offering incentives and waiting to see who arrives.

ETH

ETH Zurich, the Swiss federal technical university. Used in the series as a model of a research institution anchoring an industrial region.

FAR

Floor area ratio. The total floor space a building may have relative to the size of its plot, and the main lever by which a city controls density.

GIC

One of Singapore's two sovereign wealth funds, which invests the state's reserves abroad.

IREL

Indian Rare Earths Limited. A Government of India enterprise, under the Department of Atomic Energy since 1963, which mines and processes the mineral sands on the Kerala coast.

JTC

Singapore's industrial land developer, which builds and manages estates such as Jurong Island.

KINFRA

Kerala Industrial Infrastructure Development Corporation. The state body that builds and runs industrial parks.

Distinct from Kerala IT Mission, which runs the Technopark and Infopark campuses. Essays in this series treat the two as separate instruments because they are: one develops land and shared industrial infrastructure, the other operates technology campuses.

KSHEC

Kerala State Higher Education Council. The body advising the state on university policy and reform.

NIRF

National Institutional Ranking Framework. The Indian government's official ranking of universities and colleges.

panchayat

The elected local government of a village or group of villages, and the lowest tier of India's three-tier local government.

Kerala devolved unusually large budgets and functions to this tier after 1996, which is why the series treats local bodies as a real instrument of state capacity rather than an administrative formality.

PLFS

Periodic Labour Force Survey. India's official household survey of employment and unemployment, conducted by the National Statistical Office.

remittances

Money sent home by workers living abroad. For Kerala this has been a larger and steadier inflow than most of the state's own revenue.

shola

Patches of stunted evergreen forest in the folds of the high Western Ghats, interleaved with grassland. Slow-growing and effectively unrecoverable once cleared.

UNFPA

United Nations Population Fund. The UN agency whose population figures the state's Economic Review cites for Keralam's share of people aged sixty and above.

Keralam 2040

Keralam built a society that expects literacy, public argument and dignity in work. It has not yet built the economy to earn those expectations. These nine essays follow the gap: graduates who cannot find work, industrial parks waiting on an institution that can hold a long bet, diaspora savings that become houses instead of firms. They argue for a domestic-led answer: apprenticeships that firms help design, research concentrated in a few domains, patient capital for builders, one industry built whole, an ecological estate restored, and cities that work with their water. The book ends by asking the reader for an answer.

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