REALISING INVESTMENT POTENTIAL FOR INDIAN STATE-SPECIFIC BIOTECH INDUSTRIES

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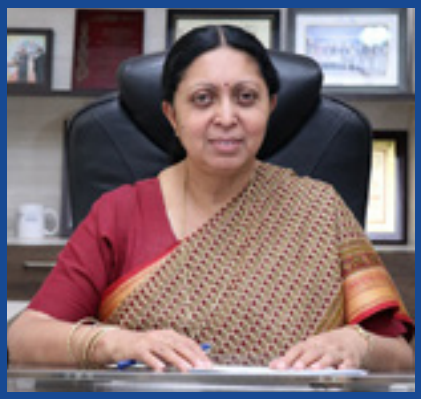
AN AFFILIATE NETWORK OF HARVARD BUSINESS SCHOOL



Dr Renu Swarup

Secretary,
Department of Biotechnology
Ministry of Science & Technology
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The Indian Biotechnology sector has entered into a new phase of growth, where the world now acknowledges the tremendous potential this sector holds to touch and transform lives. Successful development of contingent commodities such as Covid-19 vaccine, indigenous diagnostic kits etc. in such a short span of time has been a great service to mankind amidst the pandemic. The Department of Biotechnology (DBT) and BIRAC have been at the forefront to enhance the innovative capabilities and potential of the nation.

Indian ecosystem's response to Covid challenge is evident from the contribution to first in class discovery and biomanufacturing at the forefront of vaccine development for Covid 19. Government of India's Mission program COVID Suraksha and Covid-19 Research Consortium steered by DBT and BIRAC has accelerated the development of various Covid 19 solutions.

The country is gearing towards becoming a world recognized Innovation Hub and Bio-manufacturing Hub, with notable contributions from individual states. Many states already have a formal Biotech policy in place and others are on the path to formulate the same. Department of Biotechnology's Make In India (MII) Facilitation Cell housed at BIRAC along with Invest India is actively engaged in activities such as connecting with States & helping them draft biotech policies; promoting, foreign direct investments; developing the manufacturing sector etc.

It is the right time to undertake this important activity of mapping the State-specific investment potential, which would highlight the strengths and areas of improvement for different states with regard to biotech policies and would also serve as a guidance for new policy initiatives, investors to assess potential at state as well as national level.

We need to work together to scale the biotech innovaton ecosystem, attract investments and promote innovation at national & global level. Biotechnology, a sunshine sector is expected to have cascading multiplier impact on India's economy target of USD 5 Trillion by 2024-25. This will help achieve dual targets of launching novel indigenous biotech products worldwide along with driving India towards a $150 Billion bioeconomy and a $100 billion biomanufacturing hub by 2025.

Amit Kapoor

Honorary Chairman
Institute for Competitiveness

Over the last few years, India has laid a policy emphasis on innovation as a growth strategy. The fact that India has been instrumental in the development of the COVID-19 vaccine validates the success of this policy emphasis. As we arrive into the new decade and explore means of recovering from the shock of a pandemic, it has become even more crucial to strengthen the economy's innovative capacity.

The Biotechnology sector is one of the few areas where leveraging on its success can push for the development of novel commodities, services and procedures. Thus, this report is a document that will highlight the investment potential that lies amongst the subnational biotech industries. It can act as a guide for the potential investors to find the strengths and weaknesses of the state-level industry along with the production of commodities where they enjoy a comparative advantage.

The presented framework and the set of indicators have evolved as a result of extensive deliberations on possible means to better capture the innovation landscape. This process has evolved from constant stakeholder interactions with sector-level experts such as BIRAC and The Biotechnology Innovation Organization.

I am certain that the study will enable development of India's Biotechnology Industry by helping States identify its strengths and weaknesses and being an indelible tool for corporations to make investment decisions.

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Executive Summary

As the world is heading towards the anticipated phase of normalcy, the Indian biotechnology sector has had a game-changing influence in accelerating towards the same. With the successful launch of indigenous vaccines such as Covishield and Covaxin, millions of Indians have been vaccinated and thus have been protected from the adverse effects of the Coronavirus.

The capacity of these Indian companies to produce vaccines on a mass scale has not only ensured the protection of millions but has also strengthened the diplomatic ties with the nation's neighbours by supplying broad shipments to Myanmar, Bangladesh, Nepal, Sri Lanka and the Maldives.

This major achievement showcases the tremendous capacity of the Indian Biotechnology sector. Leveraging on this, there is further potential that remains untapped and can hugely benefit the Indian economy. The sector still requires a consistent inflow of investment and a strong channel for technology transfer to promote innovation at the subnational level.

This report thus analyses the investment potential that lies within the state-specific biotechnology sector. By establishing a framework and through a thorough analysis of the state-level bioclusters, this report highlights the strengths and weaknesses of the states and where can the prospective investors focus to exploit the incredible potential.

Introduction

The COVID-19 pandemic has brought India's biotechnology industry, especially biopharmaceuticals into the limelight. The steady growth of the overall domain over the past few years, with projections estimating the Indian Bioeconomy to reach $150 Billion and a $100 billion biomanufacturing hub by 2025[1], has allowed industry leaders and the government to deliver immediate solutions for meeting healthcare challenges.

The Department of Biotechnology (DBT) has been instrumental in formulating a COVID 19 consortium with the aim of developing medical equipment, therapeutics, drugs and vaccines to counter the virus. DBT and Biotechnology Industry Research Assistance Council (BIRAC) have also collaborated to help start-ups scale their COVID-19 healthcare prevention and treatment solutions. Regulatory processes have also been streamlined – DBT and the Drug Controller General of India have created the Rapid Response Regulatory Framework which fastens the diagnostic drugs and vaccines approval processes[2].

This ability of the Indian biotechnology industry to hold its ground against global leaders has been made possible with the focus on innovation over the past few years. India has seen a steady growth of biotechnology entrepreneurs and start-ups, dedicated government support, increasing options for venture capital and growing demand for healthcare solutions within the general public. This has prompted the major chunk of the Indian biotechnology industry to be accounted for by the Bio-pharma sector (currently captures 64 percent of total Indian biotechnology revenues). Nonetheless, bio-agriculture (14 percent market share), bio-services (18 percent market share) and bio-industrial (6 percent market share) have also been showing signs of expanding beyond their current boundaries[3].

The drive for innovation prompted to a great degree with the growing demand for newer products, has also been stimulated with extensive government support. India, in 1986, was one of the first countries to realise the potential of biotechnology and have a government unit dedicated solely for the promotion of Biotechnology. Since then, the Department of Biotechnology has aided in the creation of at least 17 Centres of Excellence in Biotechnology at several academic institutes across the country and developed 8 biotechnology parks and incubators across regions (as of 2019). The creation of BIRAC furthered this growth with a dedicated focus on enhancing research and innovation in the biotech industry, especially at the start-up stage. Since its inception in 2012, it has supported 784 start-ups, aided in the generation of 144 products and technologies, and funded 50 Bio-incubators – promoting basic and high-level biotechnology research and commercialisation of products[4].

Along with the support provided by DBT and BIRAC, the focus on "Aatmanirbhar Bharat" has brought back the limelight to creating products and services by Indian manufacturing houses with standards at par with the global standards/ leaders. The Indian biotechnology industry is committed on its focus on Make in India – the initiation of human trials on India's indigenously developed vaccine candidate for COVID-19

[1]Swarup, R. (2020, October 30). Transforming the biotech innovation ecosystem.

[2]Department of Biotechnology. (n.d.). COVID 19 : Delivering immediate solutions for meeting healthcare challenges.

[3]Invest India. (2020). Biotechnology. Retrieved from https://www.investindia.gov.in/sector/biotechnology#:~:text=The%20Indian%20Biotechnology%20industry%20that,industrial%2C%20and%20Bio%2Dinformatics

[4]BIRAC. (2020). Our impact. Retrieved from https://www.birac.nic.in/

shows Indian biotechnology's potential to compete with global players. DBT has also created a national consortium for indigenisation of resources for biopharma products to reduce India's dependency on import of critical products signifying targeted government interest to develop the domestic biotech manufacturing industry. Nonetheless, given the knowledge-centric nature of the industry, cooperation and collaboration in research and commercialisation of products with international partners becomes a key step in moving ahead. The way ahead for the Indian biotech industry would be to develop indigenous research processes in tandem with international development programmes with international allies since technology transfer and knowledge flow becomes a crucial component of research and development.

Focus on the Indian States and Attracting Biotech Investments

As India prepares to capitalize on the altering nature of global value chains, states become relevant stakeholders by forming the new investment hotspots for the country. Strong investment-led growth in biotech output at a disaggregated level will play a critical role in boosting the overall biotech output in the country. An increasing number of Indian states have made sincere efforts towards creating a Biotechnology policy that would facilitate and promote innovation in the sector.

While there are some states that have an established biotech policy and also perform well in the market for Biotech products, there needs to be a more intensive analysis of how other states could develop their biotech industries. All states owing to their different inherent strengths and competitive advantages, a one-size-fits-all policy will not succeed. So far only 20 states and two union territories have a biotech policy in place. Improving the chances of investments cannot be wholly established from the top level. It requires active contribution from the state-level authorities and identification of biotech thrust areas based on the state's core growth drivers.

Considering this, the Indian states need to be assessed on various parameters required for an investment-led growth for the local biotech industries. This report, therefore, will focus on evaluating the state-level biotech policies and the range of incentives provided to business ventures. To showcase the strength of a biotech policy, insightful case studies will be presented to analyse the range of incentives provided to firms. Based on those incentives, the performance of states will then be assessed that would signal towards their efficiency in the implementation of provisions under the policy.

It would be followed by a detailed analysis of the local biotech clusters. This would help in identifying the products that the states have the efficiency in producing. The objective of both policy and cluster analysis is to provide an insight regarding which states must be viewed as investment prospects and which products can be capitalized.

The findings emerging from the analysis would highlight the best-positioned states in terms of innovation, business environment and presence of strong local biotechnology industry. Thus, the recommendations would include focus areas to guide potential investors towards the best-performing and emerging states.

Analysis of Biotechnology Policy Systems: Indian state-level perspectives

The high economic value generated by biotechnology and myriad sectors interrelated in the larger industry has led it to be a focal point on the political agenda of several major economies. The need to drive innovation along with harmonizing inter-sectoral regulations highlights the importance of a strong and targeted biotechnology policy. From the larger perspective, policymaking in the domain of biotechnology revolves around four major areas. These four areas and sub-sections become the benchmark of developing strong biotechnology policies –

Figure 1:
Areas of policy intervention in biotechnology

Development of Skilled Workforce and Knowledge Systems

The development of a strong knowledge base becomes crucial for the enhancement of biotechnology industries due to its intensive knowledge-centric nature. With biotechnology being practised across several sectors such as agriculture, energy, manufacturing, pharmaceuticals etc. the interrelation of these scientific disciplines become extremely necessary. In order to develop region-specific biotechnology knowledge bases, policymakers need to focus on –

- Promoting high level basic, industry-oriented and applied research
- Development of industry-ready workforce
- Facilitating easy knowledge flow between academic institutes
- Providing incentives for talent retention especially in specialised, high research fields

[5]Reiss, T. & Dominguez-Lacasa, I. (n.d.). Indicators for benchmarking biotechnology innovation policies. Fraunhofer Institute for Systems and Innovation Reach

Facilitation of Knowledge Transference and Commercialisation

Concerning facilitation of knowledge transmission, the need to interlink industry and academic bodies becomes the focal point. The current discussion on expanding research and development shows that the work done by academic institutes and biotechnology companies occur in silos with very few incentives to collaborate.

- Streamlining regulatory processes for easy collaboration between academia and industry systems
- Developing incentives for academia-industry cooperation
- Promotion of innovation and adoption of biotechnology for new industrial applications

Of the above incentives, Indian Union and State Governments can take inspiration from the following American legislation that transformed the discourse of tech transfer and innovation, especially in the field of live sciences.

Bayh-Dole Act: Introduction

The University and Small Business Patent Procedures Act of 1980, better known as the Bayh-Dole Act of 1980 was a revolutionary step to bring a necessary impact in the field of IPR in the twentieth century. It is a piece of American legislation that allows universities or non-governmental organizations that receive federal funding to possess the ownership of their respective inventions rather than assigning them to the federal government. The condition that comes along with this ownership is that the institution must commit to the commercialization of that invention (Schacht, W. H, 2012).

Bayh-Dole Act and Promotion of Innovation: Stronghold of Biopharma industry in San Diego, US
In this segment, it will be presented how the Bayh-Dole act managed to spur innovation in the biopharma industry in San Diego, California. It is to be noted that Bayh-Dole in itself was not the only factor but other significant factors contributed to this growth in innovation. To present the growth of this industry as a cluster in San Diego, this report will use the concept of Porter's Diamond Model.

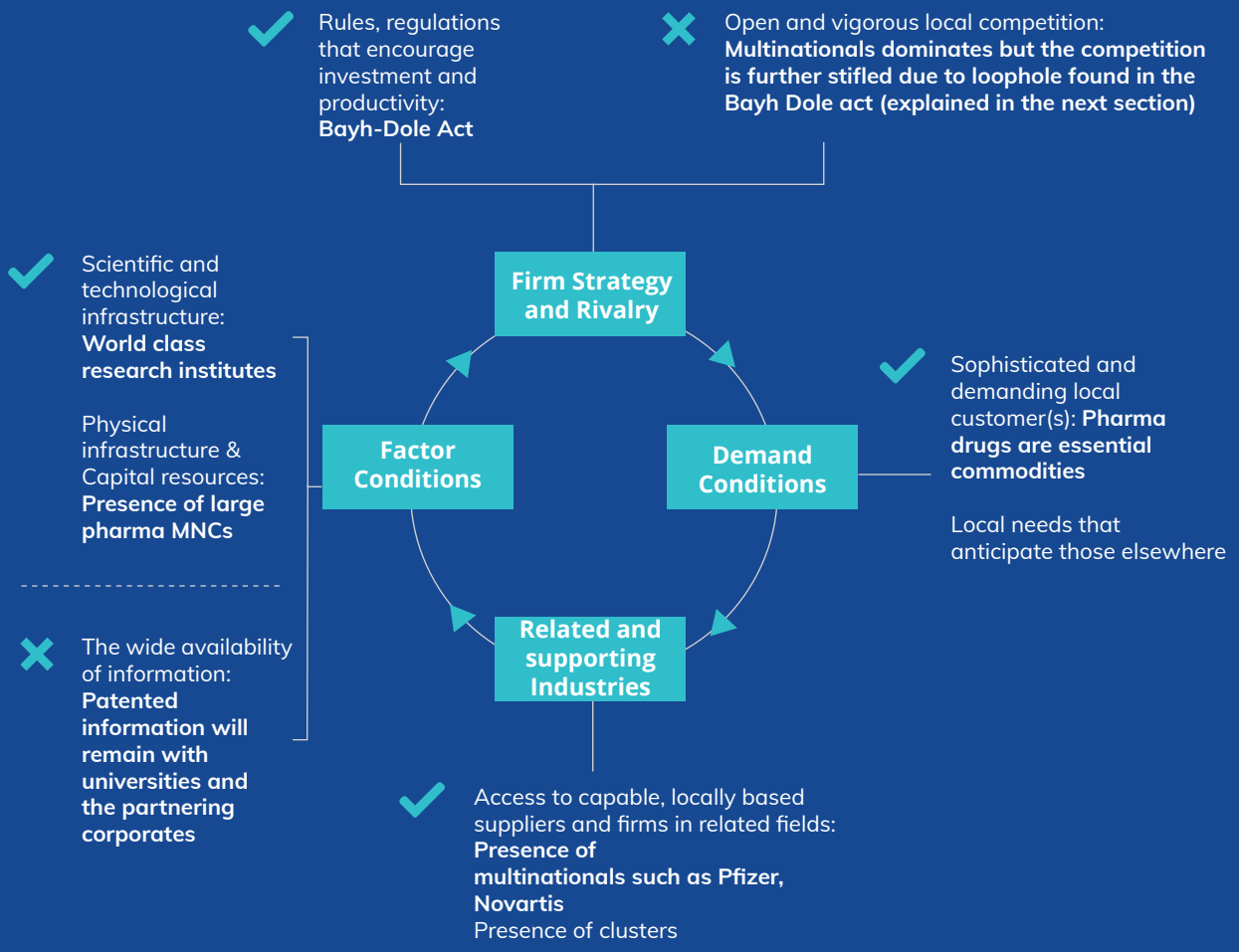
The Porter Diamond model is designed to assess the national competitiveness. The Porter Diamond model bases its assessment on four elements:

- **Factor conditions:** They are factors that enhance the possibility of innovation. These are basic requirements needed for a competition to thrive such as capital resources, physical infrastructure, natural resources, etc.
- **Demand conditions:** Consistent demand from local customers. Creation for local needs that could be anticipated elsewhere.
- **Related and supporting industries:** Access to capable, locally based suppliers and firms in related fields. Presence of clusters instead of isolated industries.
- **Firm strategy, structure and rivalry:** Laws, policies and regulations that promote competition in the country. This also includes the presence of local competitors for industries/sectors in the domestic economy.

The biopharmaceutical industry in San Diego is a perfect example to present the application of Porter's diamond model. The industry has strong competitors in the market and the demand for their products will remain consistent. San Diego is a leading national centre for R&D in the field of biotechnology/ pharmaceuticals (Porter, 2001). The most important factor that makes the industry so competitive in the region is the presence of the cluster of biopharma companies. There is a strong establishment of companies specializing in life sciences and multinational companies such as Pfizer, Novartis, Johnson & Johnson, etc. The strength of this cluster is complemented by the presence of world-class research institutes who specialize in the field of life sciences. San Diego's research institutes rank in the top 10 nationally receiving funding from the National Institutes of Health (NIH) (Lütolf-Carroll, Pirnes and Withers LLP, 2009). These institutes/universities thrive due to consistent support provided by the NIH, a government agency, in the form of regular funding.

Diamond Model: Explaining competitiveness of the San Diego Biopharma Industry

Hence with the introduction of the players involved in this cluster, the Diamond Model will explain how the competition has been sustained in this industry.



The above diamond model presents the chain of factors that stimulate the functioning of the Biopharma industry in San Diego.

While it is necessary to have the presence of such factors, it is also essential that the three stakeholders involved; i.e. the government, universities and the corporates share mutual trust. Trust and competitiveness go hand in hand. If a stakeholder trusts the others, the transfer of technology/product will be easier and quicker. Lack of trust often leads to several problems in the market:

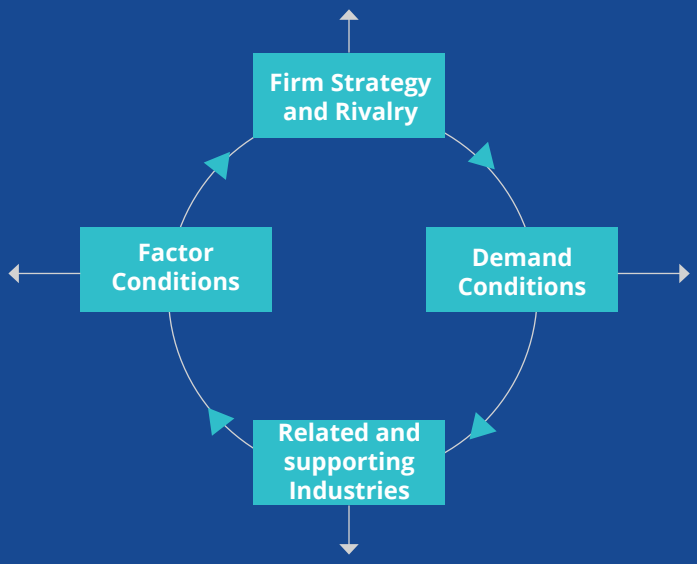
- **The context for Firm Strategy and Rivalry:** Lack of trust in regulators (government) disrupts the smooth functioning of the market. A negative perception of the regulators often hurts the production process.
- **Demand Conditions:** if the consumers do not trust the producers regarding quality and price, it often leads to a fall in sales. This would further lead to a slowdown of investments and consumption.
- **Factor Conditions:** Inadequate/ arbitrary policies lead to erosion of trust. Also, rent-seeking authorities create an atmosphere of corruption.
- **Related and Supporting Industries:** Lack of trust leads to non-sharing of knowledge. An over-regulated economy is also a sign of an absence of trust which leads to hesitation on industries' behalf to continue production.

The role of trust in diamond model

The bayh-Dole act has managed to instill confidence amongst universities and corporates. This has led to a smooth transfer of technology

The Bayh-Dole act gives the freedom to academia to own their IP and use it accordingly. Academia has exercised that freedom by further researching on IP or licensing them with the corporates.

The implementation of this act has been consistent and as a result, the trust that both corporate and academia share for government remains strong.



The goods discussed in this example are pharmaceutical drugs. These goods are essential. The companies being MNCs have a wider reach. Being popular gives confidence to the consumers to buy from them.

But it has been observed that there has been differentiation in terms of price of these drugs which may be a cause for loss in trust (discussed later).

The implementation of the bayh-dole act has been strong but there has been no overregulation.

Although the trust amongst stakeholders is high, it must be noted that the sharing of knowledge remains limited (more details in the next section).

The above model suggests how the Bayh-Dole act has empowered all the stakeholders involved. They also share strong trust due to the consequences of this act. This makes the industry in San Diego more competitive due to proper coordination between all the stakeholders.

Trust and Competitiveness: How the Bayh Dole Act has empowered various stakeholders

This chain of government reforms, academic research and product commercialization by corporates makes the development of biopharma products an organized process. The Bayh-Dole Act is, therefore, a crucial part of this process. It empowers the institutes with respect to ownership of IP and gives them the freedom to transfer it to the corporates. The corporates (with specialization in producing such goods) successfully commercialize them with supplementing industries and services.

Application and Marketization of Biotechnology Products

With biotechnology being majorly perceived as a scientific discipline, the economic perspective with respect to the commercialisation of bio-based products is often lost. It has been observed that biotechnology suffers from a "Valley of Death" problem which refers to lack of funding of a developing technology/discovery/product that shows viability but is too nascent for an actual validation of its commercial potential. This is exacerbated due to the tremendous time gap between original discovery and actual marketization due to a large number of testing, additional research that is required during this period.[6]

Even after the product is launched in the market, the industry continues to face problems due to public apprehensions in using biotechnology-based products. For instance, the debate surrounding genetically modified crops' health and environmental security concerns as well as regulatory challenges has severely diminished formal demand as well as innovation in this specific domain.[7] Furthermore, collaboration and demand from other non-biocentric industries are also minimum. Policymakers, hence, need to set market conditions to promote innovation and development –

- **Developing social acceptance for biotechnology**
- **Providing fiscal incentives for the transition of bio-based products from the laboratory to the market**
- **Creating public-private partnerships to build alternative funding mechanisms for biotechnology companies**
- **Identifying economic sectors and industries that could benefit by adopting bio-based products and processes**
- **Retention of industry leaders and companies in the biotechnology sector**
- **Harmonisation and standardisation of legal requirements on a national and global scale for the easy market flow of products.**

[6]Linton, J. & Xu, W. (2020). Understanding and Managing the Biotechnology Valley of Death. Trends in Biotechnology – Cell Press Reviews.
[7]Bera, S. (2019, June 20). Inside India's genetic crop battlefield. Livemint. Retrieved from https://www.livemint.com/industry/agriculture/inside-india-s-genetic-crop-battlefield-1561054298998.html

Development of small, medium, and start-ups in the biotechnology sector

Innovations in the field of biotechnology cannot only occur with industry leaders; the contribution SMEs and start-ups become crucial to driving innovation. The smaller companies play important roles in acting as bridges between larger industries and research organisations. Often, they also play the role of suppliers to the larger industries, thereby bringing newer industries into the fold of biotechnology. In order to facilitate the development of these industries, the policy goals for governments should be –

- Assisting and incentivising the formation of biotechnology start-ups
- Drive investment in the early - stage research and development of biotechnology industries
- Improve factor conditions, supplier and buyer power for the small and medium biotech industries
- Seek to develop bio-based industries in synergy with the region's competitive advantages

The Government of India through its "National Biotechnology Development Strategy 2015-2020" has sought to develop India into a world-renowned biotechnology and bio-manufacturing hub.

Its major aim is to develop the knowledge-based processes by building a skilled labour pool, revamping the knowledge environment, improving research opportunities, promoting discovery and commercialisation research as well as re-orienting regulatory processes to promote the development of biotech industries.[8]

While the national policy is future-oriented, the implementation of its goals depends majorly on state initiatives.

Hence state biotechnology policies and identification of focus areas becomes pivotal for the development of region-specific biotechnology competitiveness.

In order to analyse region-specific policy strengths, the following sections to carry out a state-specific policy analysis.

[8]Department of Biotechnology. (2015). National Biotechnology Development Strategy.

State-level Biotechnology Policies and the Benchmarking Process

Based on the above-benchmarking process to evaluate biotechnology policies, a similar checklist has been prepared to assess the twenty states and their respective policies. This benchmarking checklist consists of seven pillars that would cover all the incentives that a successful policy incentive can provide to any business venture.

Focus on Thrust Areas	
Infrastructure & Operations	
2.1	Capital Subsidy
2.2	Lease/Rental Subsidy
2.3	Electricity/Power Subsidy
2.4	Focus on Biotech Clusters
2.5	Establishing new infrastructure e.g., Labs, clinical trial testing facilities etc.
2.6	Establishing scientific databases
Finance	
3.1	Interest Subsidy
3.1	Tax Incentives
3.3	Promotion of venture capital/equity funding for bio projects
3.4	Incentives for export-oriented bio industries
3.5	Power/Other FoP incentives
R&D	
4.1	R&D Support
4.2	Patent Assistance
4.3	Focus on Emerging Technology
MSME & Start-up Support	
5.1	Market Development Assistance for MSMEs
5.2	Quality Certification for MSMEs
5.3	Mentoring Assistance for Incubators
Skill Enhancement	
6.1	Focus on Workforce
6.2	Focus on realigning curricula with industry standards
6.3	Training programmes
6.4	Fellowships
6.5	Development of technology aggregator/other forms of industry-academia collaboration
6.6	Faculty Development Programmes
Regulatory Devices	
7.1	Bringing about cooperation in government departments to support biotechnology growth
7.2	Streamlining regulatory processes through processes like single window clearance, web portal etc.

The ability to identify such policy incentives and implement them through subsequently successful schemes have tremendous influence on the development of biotechnology.

All the twenty states with an established biotechnology policy were assessed based on the above policy activities. Karnataka stands out as the leading state which ticks the most boxes and thus, provides the most policy incentives to business ventures. The state's current biotech policy is its third iteration after launching the previous two back in 2001 and 2008. For those states who aspire to become the next investment hotspot for the biotech sector can certainly analyse and learn from Karnataka's policy.

Telangana, Assam and Uttarakhand are the next few states that come close to providing a wide range of incentives to attract prospective investments. Unlike Karnataka, all three states have launched their five-year policies post-2015. As a result, these states have evaluated the previous policies and included as many incentives that the state could provide.

Based on the above checklist, the next section would look at two case studies to analyse and highlight the strengths of state-level biotech policies. Karnataka has been chosen for the case study due to it being the obvious leader and Telangana is the aspiring state whose policy shall be analysed as it is due to end by the year of 2020 and provides a strong range of incentives.

Karnataka Case Study: Driving Innovation

Karnataka has always been the front-runner in the biotechnology sector with its first biotechnology policy being launched in 2001. The 2001 Millennium Biotech Policy I and 2008 Millennium Biotech Policy II helped strengthen and build infrastructure by developing incubators, common instrumentation facilities and research centres.

The most recent iteration, the Karnataka 2017-22 Policy envisages the states' biotechnology sector to increase its market share to 40-60% of India's biotechnology industry, reaching USD 40-60 billion by 2025 with Biopharmaceuticals being the largest component

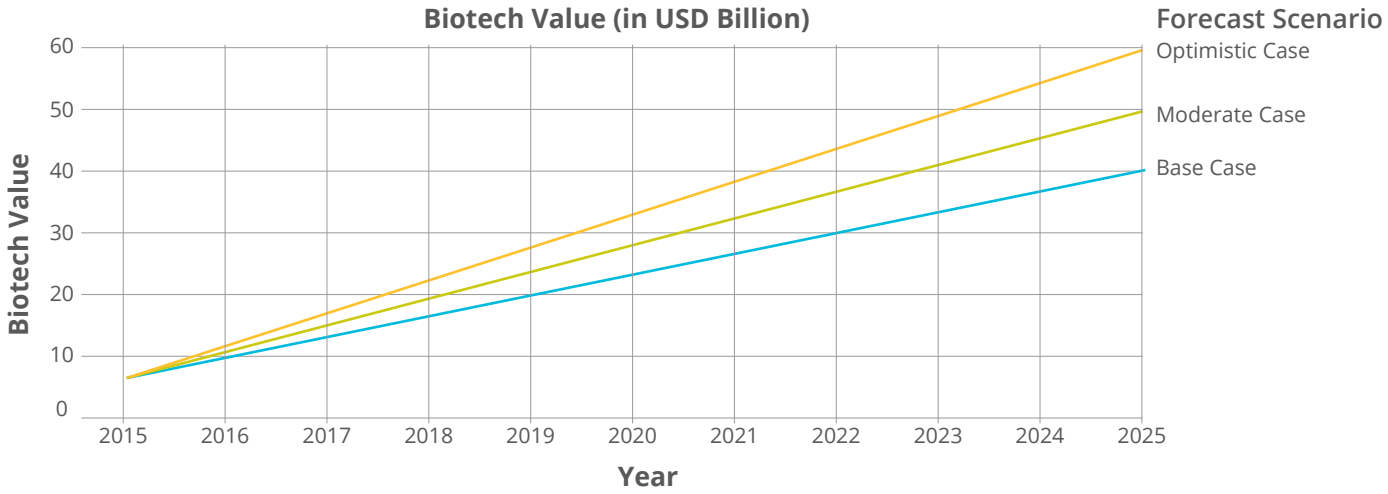


Figure 2: Karnataka Biotechnology Sector Growth Forecast-2025

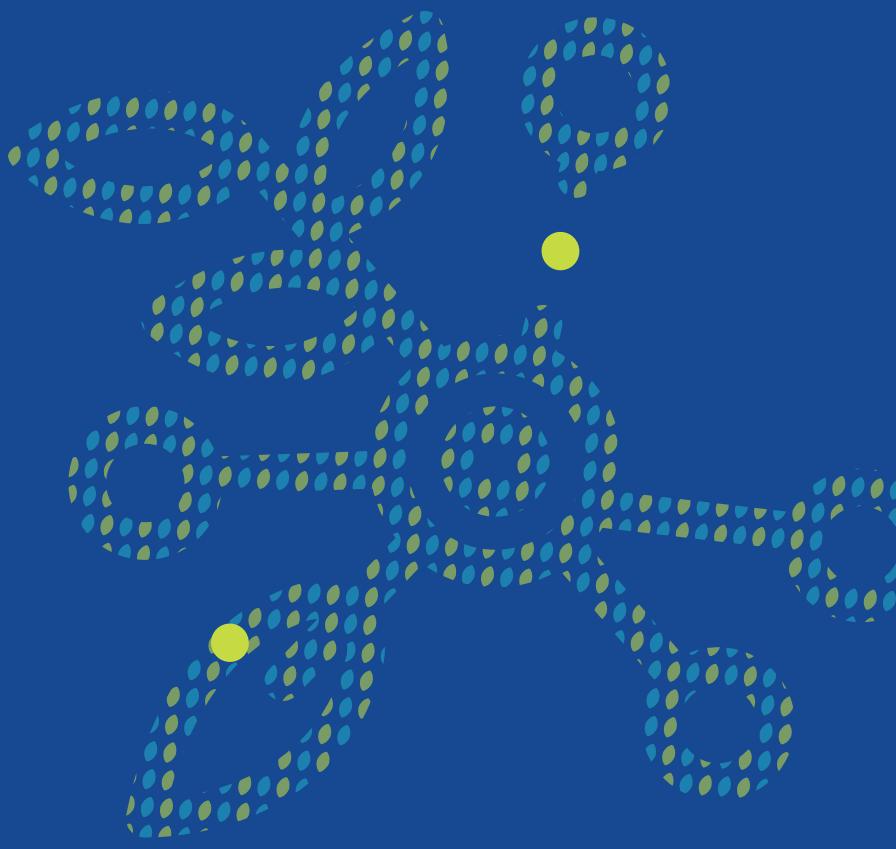
In order to achieve this ambitious target, the State Government aims to develop Karnataka as a major biomanufacturing hub by investing in the strongest foundations of science and technology which would, in turn, attract investments. And while the earlier Biotech policies focused on Biopharma, the current edition tries to leverage Karnataka's superior IT capabilities to develop Bio-IT technologies and solutions.

Transitioning from the 2008 Millennium Biotech Policy to the current iteration; there is a conscious shift from an investment-driven stage to an innovation-driven stage. This is being attained via the following measures:

- Streamlining the administrative processes for businesses to invest in biotechnology. This includes single-window clearance, approval tracking system and a grievance redressal cell.
- Establishment of a web platform for dissemination of information related to the biotech sector
- Launching the Biotechnology Skill Enhancement Programme to develop a skilled workforce by reorienting curriculum to make it industry-ready. Science-based academic fellowships to be offered at the higher education level.
- Providing state funding to academic scientists and technologists and forging partnerships between biotech clusters and academic institutes – creating a technology aggregator to showcase innovations
- Developing funding mechanisms for biotech start-ups through K Bio-Venture Fund, Grand Challenges Karnataka, Mentorship Cell and marketing channels.

Along with the above measures, the Karnataka Government has rolled in major incentives with an aim to attract significant investment.

One of the most important steps that were taken in the above direction was to expand the definition of a Biotech company including a start-up. Expanding the scope of a definition would allow more firms to fall under the ambit of Karnataka Biotechnology and Information Technology Services (KBITS), Department of IT, Biotech (BT) and Science & Tech (S&T), Government of Karnataka. Furthermore, this means that now more companies could enjoy the benefits of the incentives provided under the Karnataka Biotech policy.



Apart from the basic fiscal incentives, the Department of IT, BT and S&T offer a range of extensive incentives to the companies in the biotech sector classified under the Biotech Policy. Financial support has been provided to companies pertaining to standardization certificate and patent registration. This would allow firms to achieve legitimacy while promoting their innovation. And finally, new marketing incentives will financially support the firms to showcase their products on an international platform.

Being a leader, Karnataka covers all the major aspects of a biotech policy that would ensure the successful development of a venture and thus create a strong case of attracting prospective investments. Its incentives range from the establishment of a biotech company to successfully market its product on a global level. Therefore, other states must aspire to prepare and form their biotech policies that provide 360-degree coverage and supports any business venture right from the first to the last step.

Karnataka Biotech Policy: What Others can Learn

Karnataka's policy has covered the most number of incentives and to ensure that the benefits of such incentives could be maximized, the policy has expanded the definition of biotechnology units. Expansion of this definition allows more firms to be eligible for the incentives while generating significant employment opportunities.

Telangana Case Study: A Comprehensive Intersectoral Policy

Just after a year since its inception, Telangana introduced an extensive policy (2015-20) covering the entire range of Life Sciences including biotechnology, pharma, nutraceuticals and medical devices. This is a deviation from other states where the focus has been solely on Biotechnology. Life sciences is an umbrella which covers a closely-knitted set of industries with similar enabling and facilitating factors.

The policy has envisioned some long-term objectives with an approach to bring all-round sectoral development. This includes enhancing the competitiveness of the biotech sector by attracting new investments worth approximately USD 3 billion by 2020. The objective of such augmented investment is proposed to bring amplified results:

- To be valued $13.5 billion by 2020 and to capture 20 percent share of the $100 billion market opportunity of India by 2025.
- To achieve the exports target of 50,000 crore INR by 2020.
- Generating an additional employment opportunity for 50,000 skilled personnel in the sector.
- Bridging the gap between industry, academia, and R&D institutions by promoting applied R&D and innovation and by strengthening of quality infrastructure

The strength of Telangana's biotech policy is that the Government has identified five thrust areas where investments could be diverted towards. These thrust areas are well-defined that it gives investors a plethora of options where they can capitalize. A wide range of thrust areas will always give confidence to the investors as they can diversify with their options, thus opening up new avenues for the creation of firms and employment opportunities.

Pharmaceuticals such as Drug discovery & development, Generics, Active Pharmaceutical Ingredients, Formulations and Injectibles

Medical Devices such as Implants, General Devices, Diagnostics and imaging equipments, Ophthalmology, and Ancillary Component Suppliers

Biotechnology such as Biologicals and Bio-similars, Vaccines, Medical Biotechnology, Agricultural biotechnology, Industrial Biotechnology, Marine Biotechnology, Nanotechnology, Regenerative Medicine and Clinical Research

Nutraceuticals such as Research and Manufacturing Organizations for nutrition products, R&D/ Science Parks for Functional Foods, Prebiotics & Probiotics categories. The companies / institutions will be classified based on their line of activities - R&D, Manufacturing and Allied Groups. R&D and Science parks will also be treated as R&D units and will be entitled to privileges of an R&D unit.

Bio-Services such as Contract Research Organizations, Contract Manufacturing Organizations, Contract Research and Manufacturing Organizations, Clinical Data Management Services, Bio-Informatics, R&D / Science Parks and Lab Space Providers, Instrumentation and Analytical Equipments, Facility, Design and engineering support services

Along with the thrust areas, another domain which gives strong credibility to this biotech policy is the varying list of incentives. The main focus of incentives revolves around Research & Development.

The State Government provides financial support to promote research at the local levels. However, most importantly the policy aims at collaborative research where private and public entities work together to innovate for the industry and also allow commercialization of research processes, products and services.

Further, special scholarships are being offered to attract global talent for the conduct of breakthrough research in the State. Thus, the incentives ensure that it covers funding while augmenting the size of the skilled workforce.

For a newly established state, Telangana's life sciences policy can be qualified as a well-designed document that not just focusses on biotechnology but also aims to promote other complementary fields to boost their chances of attracting significant investment. The strength of this policy lies in its recognition of thrust areas allowing multiple avenues for boosting the overall investment, employment and exports. Now, with the policy reaching to its end, the State Government has envisioned to double the value of the life sciences sector from 50 Billion USD to 100 Billion USD. This would also result in the generation of 4,00,000 new jobs in the sector. This development will be based on Hyderabad's growing popularity as a pharma hub with the city called the 'Vaccine Capital of the world'. Thus, the future of the life sciences and biotechnology in particular have a promising future in Telangana.

Telangana Biotech Policy: What Others can Learn

The policy's actual strength lies in its clearly defined range of thrust areas. Diversification of thrust areas always presents an opportunity for new investment prospects to enter the market and thus promote innovation in domains that might have been untouched. This could also promote a new wave of specialised job opportunities thus attracting the best talents from all over the world.

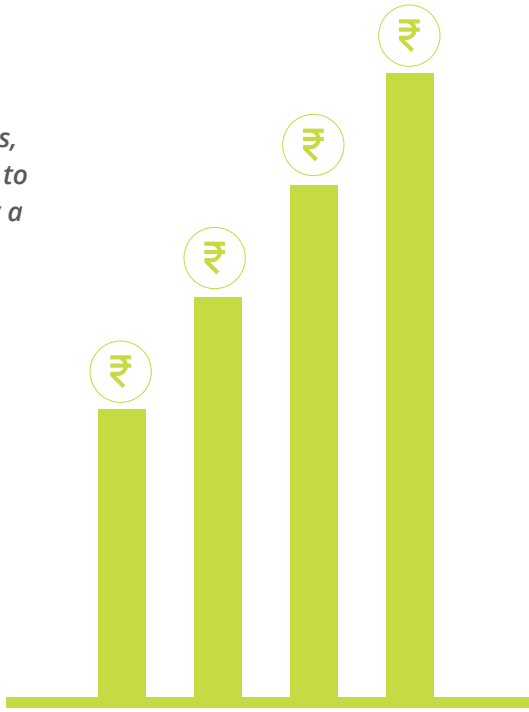
From Policy to Performance: Analysing State-Specific Biotech Implementation

After establishing a robust policy with a long-term vision for the Biotechnology sector, the focus now must turn to the overall performance. Based on the above set of incentives as prescribed by the policy checklist, various pillars and indicators will be analysed & assessed. The state-level performance in the next section will determine how far have the State Governments successfully implemented their respective biotech policies. For those states that do not have an official biotech policy, their performance in these domains could be a signal and therefore could reorient their sectoral strategies in the future.

Research Methodology: Indicator Analysis

Investment in Biotechnology
State Competitiveness Assessment Framework

To understand and analyse the key investment points across the Indian states, a comprehensive framework has been established. The framework is devised to capture certain preconditions along with facilitating factors that would allow a flourishing investment ecosystem for the biotechnology sector.



The assessment will be carried out at the state level and is based on the list of indicators that have been carefully selected to include all the critical aspects required for making a sound investment decision.
For easier comprehension of state-level performance, the indicators will be grouped under their relevant pillars. Pillar-wise performance indicates the areas where a particular state is leading or lagging. Thus, from the perspective of an investor, these pillars could easily list the strengths or weaknesses of the particular local biotechnology industry.

Chosen set of Pillars & their Rationale

- **Business Ecosystem:** Provision of an efficient business ecosystem can help states attract businesses. This particular pillar sheds light on the core infrastructure and funding facilities, and how states manage in terms of creating such an ecosystem.

- **Knowledge Workers:** Assembling a skilled workforce to ensure the highest levels of innovation and competitiveness. And both these qualities are driven by a group of individuals who are actively engaged in the fields of science, technology, design and business management.

- **Research & Development:** Private and public funding measures the financial standing of a state and what amounts it spends on Research & Development. Such funding holds the capacity to evolve ideas into novel commodities, processes and services that would further enhance the biotech business opportunities.

- **Safety & Legal Environment:** In order to attain higher levels of innovative entrepreneurial activity, governments must enact and enforce fair and open procedures while securing property rights and regulating the markets efficiently.

- **Export Performance:** The Biotechnology export performance of states needs to be mapped to assess the impact of the above pillars. This pillar aims to cover both the relative export growth and the reach of the export footprint.

Following the analysis from the above set of pillars combined with the insights from the local cluster data; actionable policy recommendations would be provided category-wise. This would allow states to focus clearly on certain aspects to improve their investment prospects.

Business Ecosystem

This pillar assesses the business environment for Biotechnology in the Indian states by considering the presence of facilitating infrastructure, ease of conducting business and availability of innovation-based ventures. A strong performance in this area gives the first sign of confidence to any investor to capitalize in a particular market.

From nurturing a young business to fully operational biotech projects, the objective of this pillar is to capture all and point out the clear leaders.

Business Infrastructure

Business infrastructure includes those facilitating factors that provide the nurturing support to new businesses and enhance their competitiveness to thrive in the market. Department of Biotechnology provides a range of infrastructural facilities for the successful growth of local businesses. This includes the presence of Biotechnology Parks, Biotechnology clusters and most importantly Incubation centres for new business ventures. While all the states may not have all these facilities, the investors need to recognize where does the basic supporting infrastructure position.

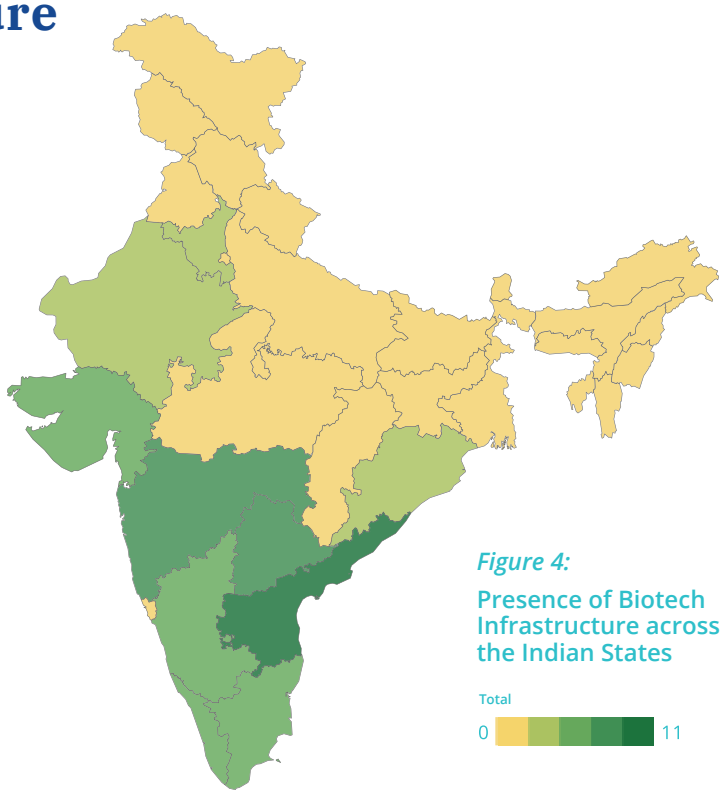


Figure 4:
Presence of Biotech Infrastructure across the Indian States

It is abundantly clear that the infrastructural facilities are concentrated in the Southern and Western regions of the nation. And the absence of any facility in any of the North-East states and central states such as Bihar, Chhattisgarh & Madhya Pradesh is a worrying sign.

Facilities such as Biotechnology incubation centres require some major prerequisites which would enable successful nurturing of entrepreneurship and scaling technologies. As prescribed by BIRAC, some of the eligibility requisites include the presence of competent academic/research organization with adequate expertise and infrastructure to support incubation activity. States such as Andhra Pradesh, Telangana, Tamil Nadu and Maharashtra are copious with capable research/academic organizations and thus lead the way for having the greatest number of Biotech incubators and parks.

Ease of Conducting Business

Post-establishing supporting infrastructural facilities, the focus now shifts towards factors that promote a conducive business environment. Steady funding of new ventures along with the presence of specialised manufacturing entities to maintain delivery of high-grade Biotech products is the two major features that this indicator will look into. This will be supported by the Ease of Doing Business ranks for the states that would encapsulate other general features needed for the durability of any flourishing business such as single window system, inspection enablers, utility permits & paying taxes.

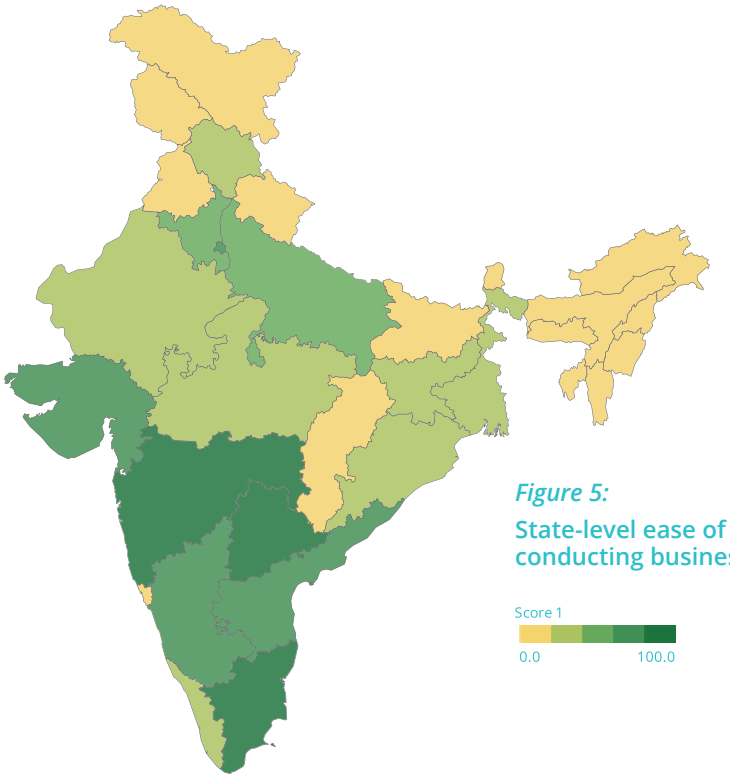


Figure 5:
State-level ease of conducting business

Maharashtra, Telangana and Karnataka are the leading states that provide a conducive ecosystem for the Biotech industries to thrive. Maharashtra has the highest number of high & medium-tech manufacturing entities. The purpose of such entities is to ensure sustained production of high-quality products while upholding the economies of scale.

At the other end, apart from north-east states, Kerala stands out as an odd example that performs poorly in this domain. The state has one of the lowest high and medium-tech manufacturing entities along with being ranked low in the ease of doing business. This raises questions about the state's credibility as a Biotech investment destination. Thus, major long-term commercial and industrial reforms are required to boost its chances of attracting any potential venture.

Segment-Based Projects

After establishing their business, entrepreneurs look for projects that are innovative and deliver strong returns. This indicator will therefore focus on special projects under the National Bio-Pharma Mission and the Bio-Kisan scheme. Such segment-specific projects require the desired knowledge and specialisation. Therefore, the states that do well in this domain certainly hold the knowledge, talent and resources to carry out such specialised ventures

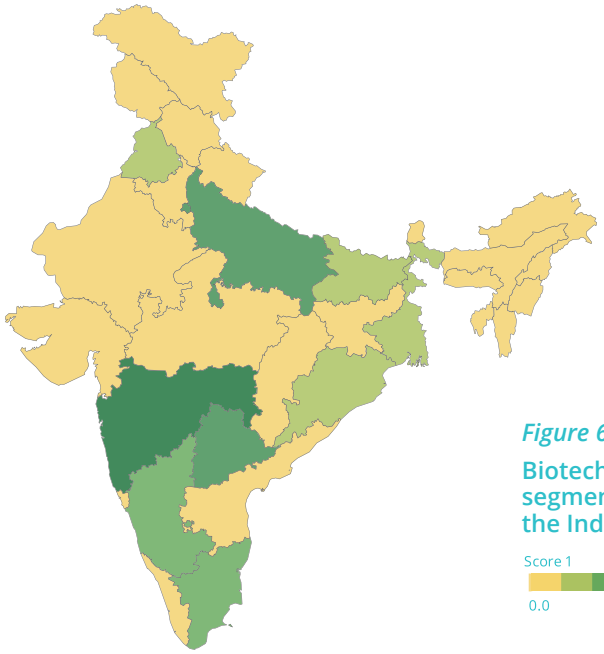


Figure 6:
Biotech Projects-segment-wise across the Indian States

Once again **Maharashtra** ends up as the top-performing state with the highest number of projects under the National Bio-Pharma Mission allotted. **Karnataka**, **Telangana** and **Tamil Nadu** also feature owing to the high volume of projects under their direction. However, out of all the economically strong states, **Gujarat** stands out as a poor performer, with just a single Biopharma project and no Bio-Kisan project under their supervision.

Bringing such specialised projects under the domain of state-level Biotechnology industries is crucial for its overall development. The National Biopharma Mission is a special programme that allows a stronger industry-academia collaboration to design and development of novel, economical and effective biopharmaceutical products and solutions. Similarly, Bio-Kisan as a scheme brings the entrepreneurs and farmers together to realize the technology required to generate agriculture and bio-resource related jobs and better livelihood safeguarding biotechnological benefits to small and marginal farmers.

Final Findings- Business Ecosystem

The indicator-level analysis shows that Maharashtra has excelled in all the above domains. The state has the second-highest number of combined infrastructural facilities, with the highest number of high & medium-tech manufacturing entities. And to back all these strengths, they are receiving the most projects under the National Bio-Pharma mission.

Besides all of this, Maharashtra Industrial Development Corporation (MIDC) has emphasized on creating infrastructural assets that could harbour sustainable innovation:

MIDC has planned to set up a dedicated Biotechnology Parks at suitable locations in the state (Nashik, Pune, Aurangabad and Nagpur, among others

Biotechnology Parks will be designed to have dedicated infrastructure including Common Effluent Treatment Plant (CETP, including collection and treatment), and Testing & Certification Labs

Such detailed attention to asset creation is probably something that many states are lacking. Investing in the above infrastructural facilities are bound to deliver long-term results with an amplified rate of innovation and thus ensuring that the firms who emerge from such facilities attain early competitiveness in the market. States from North-East are in a dire need to either introduce or upgrade their existing infrastructure that would support thriving biotech ventures. Poor infrastructure has hurt their case of attracting any biotech projects that would spur innovation and help in generating ground-breaking products.

Research Funding & Investment

A sustained funding channel forms a robust capacity for individuals and organizations to engage in the most forward-looking research and development endeavours. Both public and private sources contribute to such funding and thus benchmark the financial standing of a state. Research funding is one of the most crucial facilitating factors that help in developing the competence to continuously translate ideas into novel biotechnology products, processes and services that would generate, improve or expand business opportunities.

This pillar would attempt to assess the same standing by overseeing the presence of public and private R&D units combined with the average expenditure between 2016 to 2019 on research by the state government.

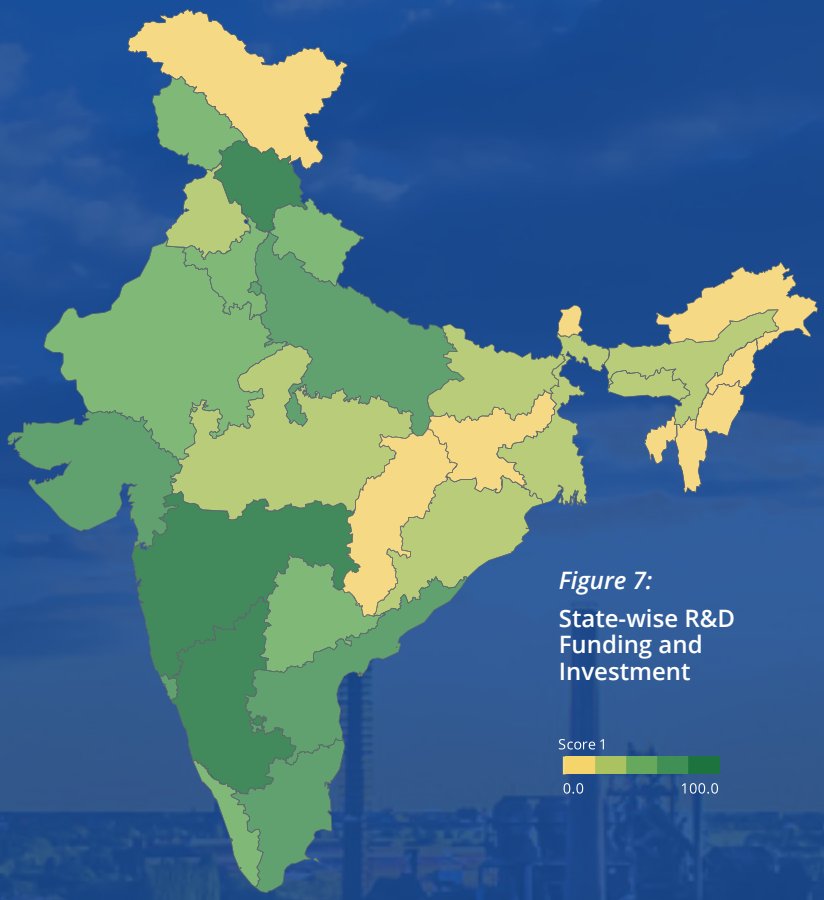


Figure 7:
State-wise R&D Funding and Investment

Maharashtra, Karnataka and Himachal Pradesh are the clear frontrunners. The former two rely on their firm record of research expenditure and the latter has a dense presence of public R&D units. As far as research expenditure is concerned most of the Western and Southern states have been the highest spenders. However, Northern and Central states have tried to plug the above gap, with Uttar Pradesh, Bihar and Madhya Pradesh being among the top ten states with the highest average research expenditure from 2016 to 2019. While the average expenditure on research might vary depending on State Government budgets, there is a more pressing issue that needs to be addressed.

It has been observed that majority of the R&D presence comes from the private sector with few states relying more on state-funded research units. Tripura, Jammu & Kashmir and Bihar are some of the states where the density of the publicly backed R&D units is at its highest with limited influence of any private R&D. On the other hand, Delhi & Sikkim have zero presence of public R&D units, with an over-reliance on private entities.

For consistent & long-term research output, states have to strike the right balance between private and public funding. In this regard, states like Nagaland, Kerala and Uttarakhand have found that balance with equal density for both types of R&D units. It is particularly imperative that funding measures are being planned where increasing returns on public investments is ensured by allowing public and private funding to complement each other.

Skill and Knowledge Presence

The development of state-specific biotechnology industry occurs largely in regions which have a skilled workforce to aid in the development of the outputs. Additionally, the presence of academic institutes that cater not only to the development of the skilled workforce but also partnerships with biotechnology companies. The industry as a whole being highly knowledge-intensive tends to agglomerate around such areas consisting of a large number of biotechnology academic institutes, knowledge workers and contractual/direct employees willing to work in the biotechnology sector. This pillar would seek to assess the state-specific strength in biotechnology focused labour force availability and presence of biotechnology academic institutes.

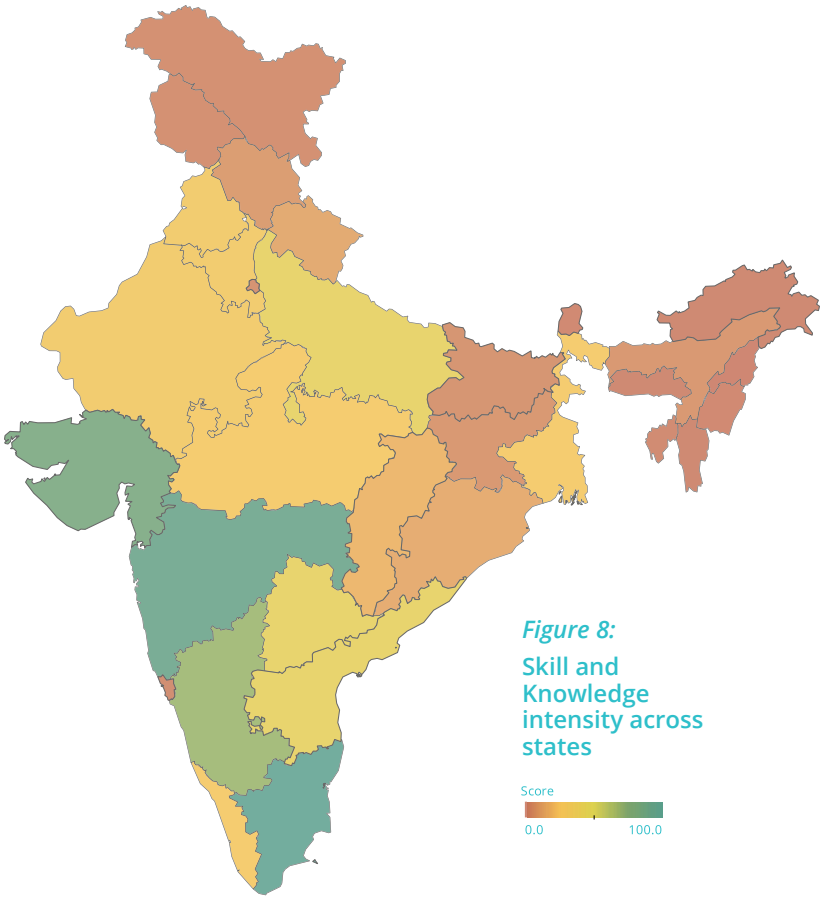


Figure 8:
Skill and Knowledge intensity across states

Regarding the overall presence of both skilled labour force and academic institutes, legacy industrial states such as Tamil Nadu, Maharashtra, Gujarat, Karnataka and Andhra Pradesh are the highest-ranked. With Southern and Western regions of India emerging as frontrunners, Uttar Pradesh, Rajasthan, Haryana and Punjab have also shown the potential to emerge as leaders in the biotech skill workforce and academic potential in coming years.

Concerning the workforce within the biotechnology sector, Tamil Nadu, Maharashtra and Gujarat seem to have the largest labour pool vis a vis other states. Apart from the southern and western regions, Uttar Pradesh, Haryana and West Bengal are also in the top 10 ranked states according to labour availability.

As per the distribution of academic institutes catering to developing a skilled workforce for the biotechnology industry, Maharashtra is the clear leader followed by Tamil Nadu and Karnataka. Apart from legacy industrial states, Rajasthan and Madhya Pradesh also have a large number of academic institutes. It would be prudent for these states to link these institutes with the existing industries to not only make the students industry-ready but also contribute to the expansion of regional workforce availability.

Safety and Legal Environment

Any scientific field such as Biotechnology thrives on innovation and perishes if that very innovation is not given the necessary protection.

In order to attain higher levels of innovative entrepreneurial activity, governments must enact and enforce fair and open procedures while securing property rights and regulating the markets efficiently. This pillar would look into the legal aspect of the investment process. From the protection of intellectual property to the effectiveness of the local legal system in dealing with civil cases. Out of the entire framework, this is the only pillar which does not specifically target any dimension of the biotechnology industry, thus providing a more general outlook needed for the protection of innovation in any business.

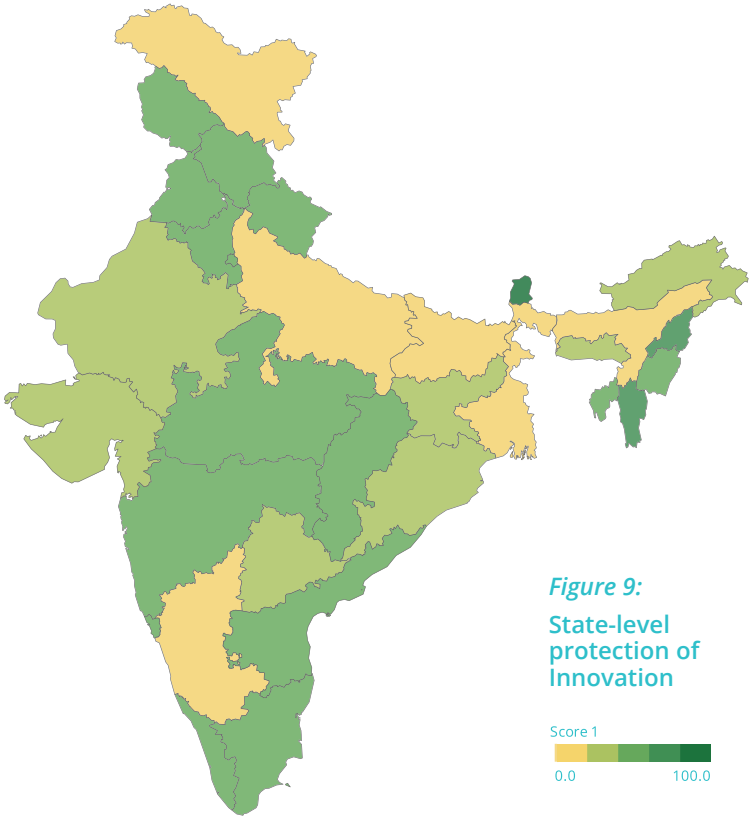


Figure 9:
State-level protection of Innovation

This pillar delivers some of the most surprising results. States from the North-East are some of the highest scorers with the top four being Sikkim, Mizoram, Nagaland and Manipur. Sikkim has been the clear leader owing to the least number of pending civil cases and having the highest density of special police stations that deal with cyber-crimes. Such factors often give the confidence to prospective investors to capitalize on a safer business environment that can assure the protection of valuable intellectual property. Karnataka, contrary to its performance in other pillars, has not performed well in this one. The state has recorded the highest incidence of crimes relating to domains such as information technology and intellectual property. However, this has been observed in the India Innovation Index 2019, where economically developed states such as Karnataka, Telangana and Tamil Nadu did not perform well in similar indicators. Underreporting of cases could be a major factor that drags such states behind, whereas strict reporting and higher density of law-enforcing agencies have benefited the North-East states.

Export Performance

Each state needs to have its policy measure, and understand its unique strength and valuable resources that are compatible with its Biotechnology industry, so that its subsequent output, that is, exports get a shot in the arm. By improving their export performance, local Biotech industries could potentially bring in a bigger number of job opportunities by opening to new markets and by involving entrepreneurial prospects.

Considering this, various parameters must be evaluated that are required for an export-led growth strategy and which accounts for the variations in performance. The following indicators will attempt to cover these parameters and thus find suitable investment destinations that could deliver with strong returns from trade.

Measuring Exports across various Indicators

To accurately compute state-level Biotech exports, this study relies on the data used by Institute for Competitiveness for mapping the Indian Biotechnology clusters[9]. From the NIC 2008 industry codes used to map local clusters, eleven closest 2-level HS Codes have been listed that would be used to compute Biotechnology exports. These HS codes reflect an aggregation of NIC codes and are closely associated with Bio-Manufacturing exports.

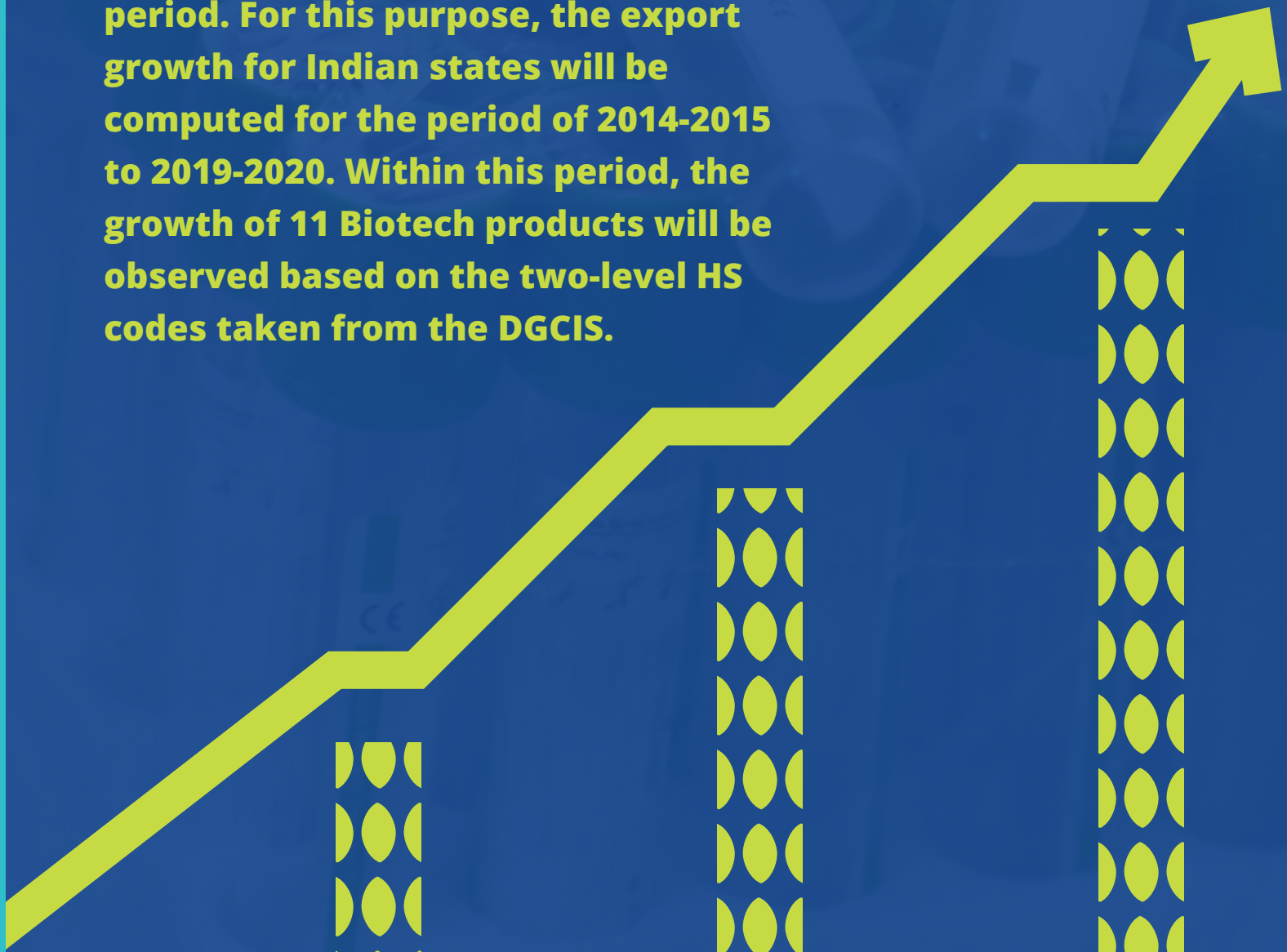
2-Level Codes	HS Description
22	Beverages, spirits and vinegar
28	Inorganic chem, organic-inorganic compounds of precious metals, isotopes
29	Organic chemicals
30	Pharmaceutical products
31	Fertilizers
32	Tanning or dyeing extracts, dyes, pigments, paints and varnishes, putty, and inks
33	Oils and resinoids, perfumery, cosmetic or toilet preparations
34	Soaps, waxes, scouring products, candles, modelling pastes, dental waxes
35	Albuminoidal sub, starches, glues, enzymes
38	Miscellaneous chemical products
40	Rubbers and articles thereof

[9]Assessing the Regional Competitiveness of the Indian Bioeconomy; BIRAC 2020

Using the above set of HS codes, three indicators will be further derived which will emphasize on various facets of export performance. Export growth for volume, Revealed Comparative Advantage for efficiency and Market Penetration Index for global outreach would assess the capacities of state-level biotech industries as exporters.

Export Growth

One of the most basic indicators to evaluate the Biotechnology export performance of a state is how much the export value for all its biotech products have grown in a given period. For this purpose, the export growth for Indian states will be computed for the period of 2014-2015 to 2019-2020. Within this period, the growth of 11 Biotech products will be observed based on the two-level HS codes taken from the DGCIS.



Exports are one of the drivers of economic growth. Generally, it has been observed that high and sustained economic growth is heralded by the adoption of more export-oriented and outward-looking policies. It is expected that a robust Biotechnology policy would translate into a strong output, one of which includes export-based output. And export growth is a simple signal towards a state's export performance.

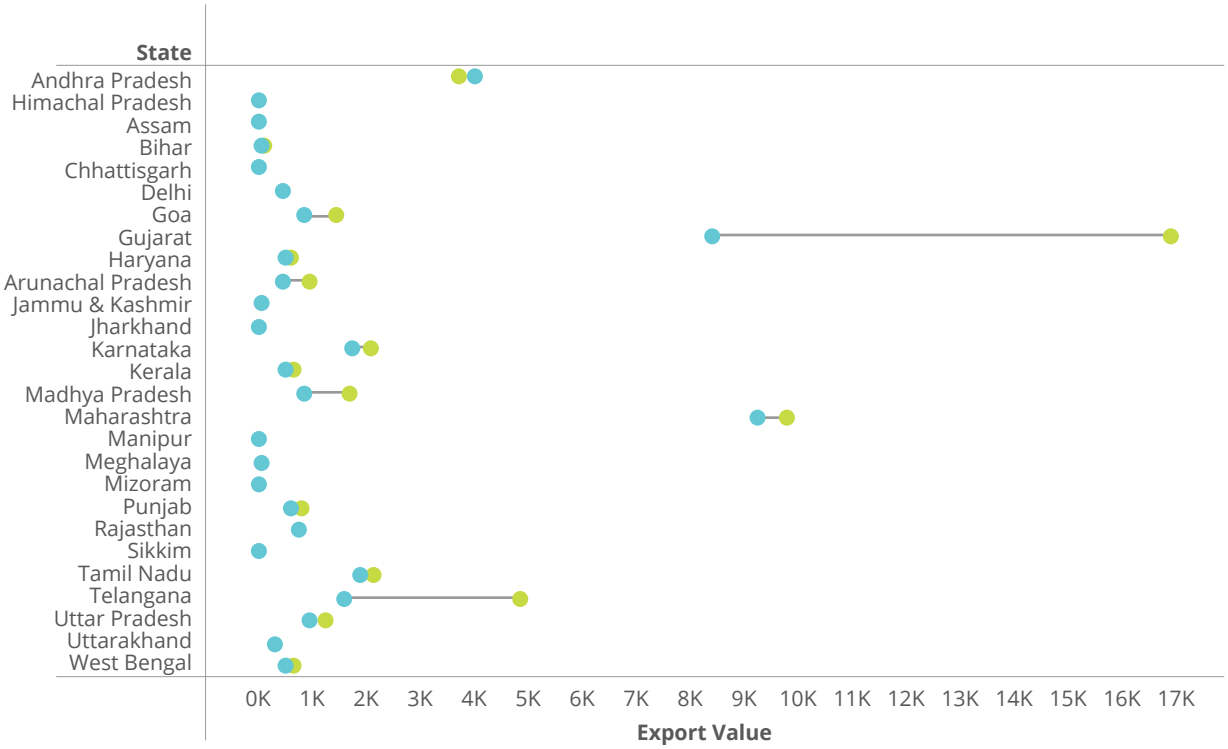


Figure 10: **Biotech Export Growth from 2014-2015 to 2019-2020 (Export Growth-Million USD)**

The above chart shows that only very few states have posted any strong Biotechnology export growth. Gujarat and Telangana are the only two states that have recorded any tremendous compounded annual growth, with Madhya Pradesh, Goa & Himachal Pradesh showing a marginal increase in their export values. While Maharashtra's export base is higher than all of the states, its growth hasn't been a strong as the likes of other legacy industrial states. Therefore, the government might want to look into other forms of incentives to boost export growth.

There are a few states that have also recorded a regressive growth in their export values, which is a worrying sign as it implies that their export is losing the appeal in the global market. Some surprising examples include Andhra Pradesh, Rajasthan and Delhi, thus, raising concerns for their respective Biotechnology industry. The former two states did not have any exclusive incentives prescribed under their Biotechnology policies that would promote export-oriented firms. Delhi does not have its separate Biotechnology policy. As a result, there are clear reasons why the state-level industries are not able to attain any sustainable export growth.

Revealed Comparative Advantage (RCA)

Having assessed the biotechnology export growth, producers and investors must also need to observe areas where a state-level industry enjoys its optimum competitiveness. This implies which products can an industry efficiently produce thus gaining the comparative advantage in the process.

What is Revealed Comparative Advantage ?

Revealed comparative advantage is a competent tool to calculate the relative trading advantage that a unit, in this case, a state vis-à-vis an entity, India, for a set of commodities. In other words, which products can a state efficiently produce and export when compared to the national level exports.

This is different from the conventional RCA as it observes the relative advantage between a nation's exports against the world-level exports.

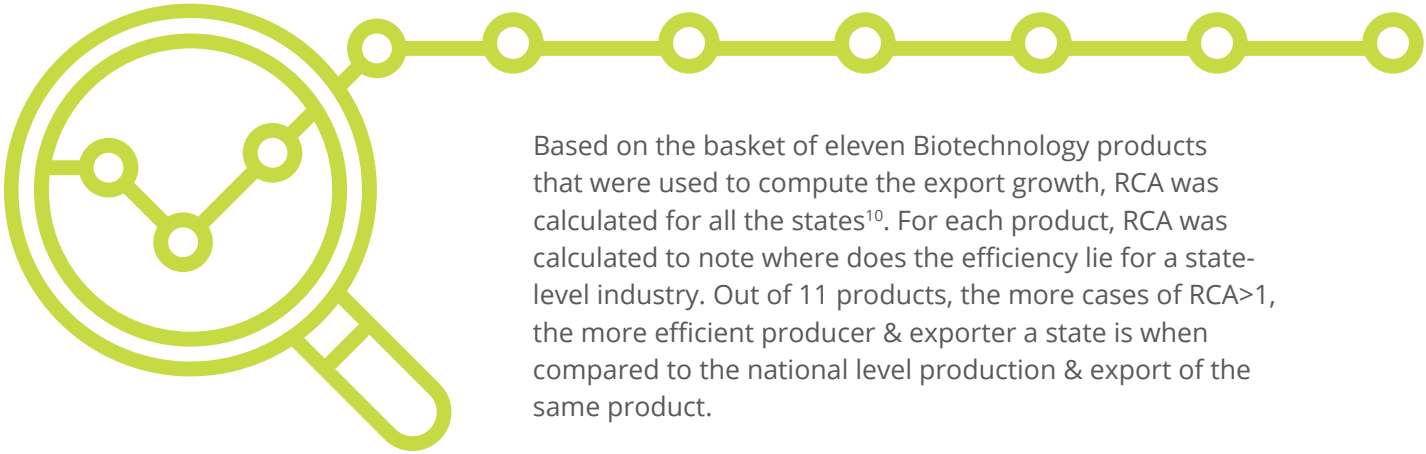
To read an RCA result, a state would attain comparative advantage for a given Biotechnology product, when the ratio of export of that product to its total exports of all Biotech goods exceeds the same ratio for the nation as a whole.

$$RCA_{ij} = (x_{ij}/X_{it}) / (x_{nj}/X_{nt})$$

where; xij & xnj are the values of State i's exports of product j and the national-level export of the same product. And Xit & Xnt represent the State's total Biotechnology exports and India's total Biotechnology exports. Therefore, when RCA>1, it is inferred that the state is a competitive producer and exporter of that product relative to the country producing the same product.

RCA would help the producers and investors in identifying the potential areas for investment and which of the products could add to a profitable export basket. Investing in these products would be the same as playing to the state-level industry's strengths. Any form of a comparative advantage gives a producing/exporting unit the capacity to sell goods at a lower price than its competitors and realize robust sales margins.

Analysis: Which States enjoy Comparative Advantage



Based on the basket of eleven Biotechnology products that were used to compute the export growth, RCA was calculated for all the states[10]. For each product, RCA was calculated to note where does the efficiency lie for a state-level industry. Out of 11 products, the more cases of RCA>1, the more efficient producer & exporter a state is when compared to the national level production & export of the same product.

[10]Data for Nagaland and Tripura was not available to compute their respective RCAs

Almost all the states had a product where the RCA exceeded 1. This implies there is at least a good that most of these states can produce efficiently when compared to the national production of the same product. However, out of the assessed list of states, Manipur and Mizoram did not have any products with an RCA>1. Thus, these states need to focus on improving the efficiency of both producing and exporting the given set of Biotechnology products.

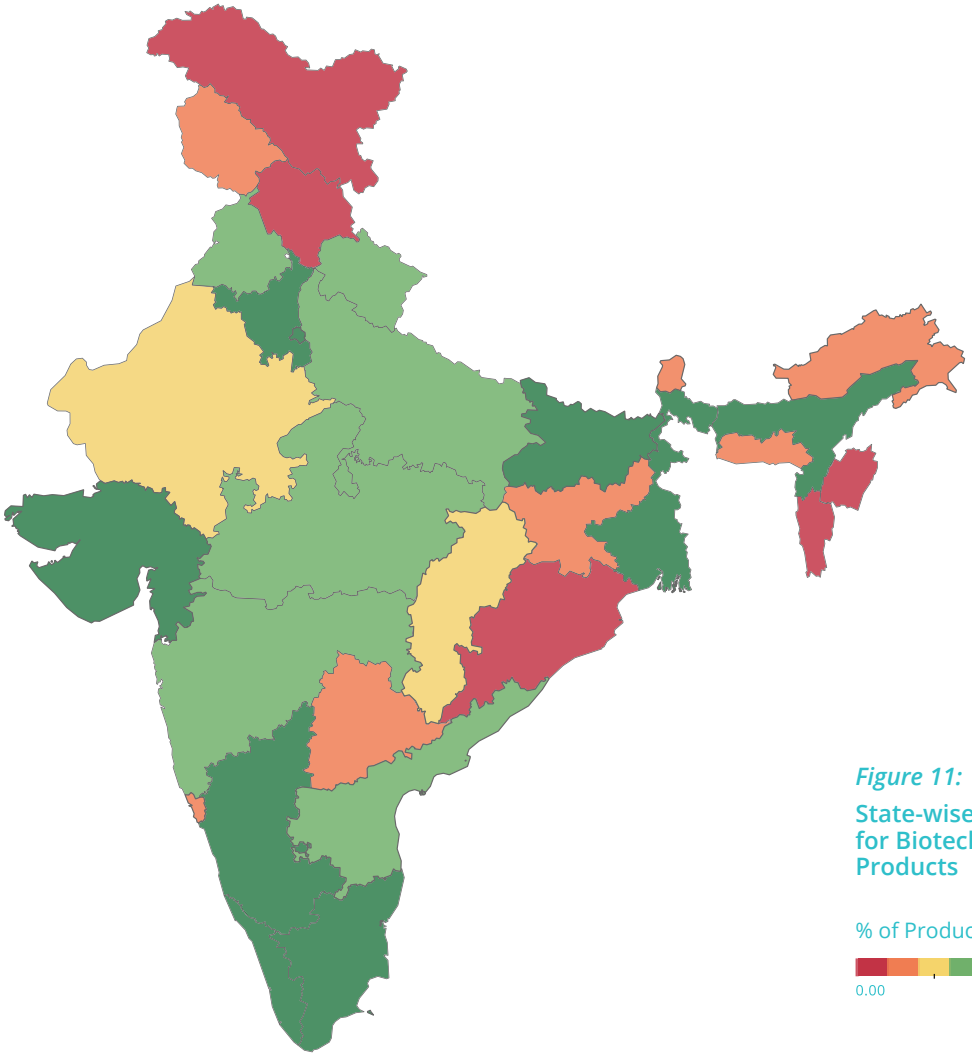


Figure 11:
State-wise RCA scores for Biotechnology Products

At the other end, there are four states, i.e. Haryana, Karnataka, Kerala & West Bengal with six products with an RCA>1. This is more than half of the total basket of Biotechnology products, thus, showcasing the tremendous amount of potential stored in their industries. Closely following them are states such as Assam, Bihar & Delhi with 5 products. Below is the list of products which enjoy a strong comparative advantage for the above set of states.

STATES	HS Code
Haryana	22: Beverages, spirits and vinegar 33: Oils and resinoids, perfumery, cosmetic or toilet preparations 34: Soaps, waxes, scouring products, candles, modelling pastes, dental waxes 35: Albuminoidal sub, starches, glues, enzymes 38: Miscellaneous chemical products 40: Rubbers and articles thereof
Karnataka	22: Beverages, spirits and vinegar 29: Organic chemicals 30: Pharmaceutical products 31: Fertilizers 33: Oils and resinoids, perfumery, cosmetic or toilet preparations 35: Albuminoidal sub, starches, glues, enzymes
Kerala	22: Beverages, spirits and vinegar 28: Inorganic chem, organic-inorganic compounds of precious metals, isotopes 33: Oils and resinoids, perfumery, cosmetic or toilet preparations 34: Soaps, waxes, scouring products, candles, modelling pastes, dental waxes 35: Albuminoidal sub, starches, glues, enzymes 40: Rubbers and articles thereof
West bengal	28: Inorganic chem, organic-inorganic compounds of precious metals, isotopes 29: Organic chemicals 31: Fertilizers 33: Oils and resinoids, perfumery, cosmetic or toilet preparations 34: Soaps, waxes, scouring products, candles, modelling pastes, dental waxes 35: Albuminoidal sub, starches, glues, enzymes
Assam	22: Beverages, spirits and vinegar 33: Oils and resinoids, perfumery, cosmetic or toilet preparations 34: Soaps, waxes, scouring products, candles, modelling pastes, dental waxes 38: Miscellaneous chemical products 40: Rubbers and articles thereof
Bihar	30: Pharmaceutical products 31: Fertilizers 33: Oils and resinoids, perfumery, cosmetic or toilet preparations 38: Miscellaneous chemical products 40: Rubbers and articles thereof
Delhi	22: Beverages, spirits and vinegar 30: Pharmaceutical products 33: Oils and resinoids, perfumery, cosmetic or toilet preparations 34: Soaps, waxes, scouring products, candles, modelling pastes, dental waxes 40: Rubbers and articles thereof
Gujarat	28: Inorganic chem, organic-inorganic compounds of precious metals, isotopes 29: Organic chemicals 31: Fertilizers 32: Tanning or dyeing extracts, dyes, pigments, paints and varnishes, putty, and inks 38: Miscellaneous chemical products
Tamil nadu	28: Inorganic chem, organic-inorganic compounds of precious metals, isotopes 33: Oils and resinoids, perfumery, cosmetic or toilet preparations 35: Albuminoidal sub, starches, glues, enzymes 38: Miscellaneous chemical products 40: Rubbers and articles thereof

Therefore, moving away from the traditional industrial targets, investors can now view the above states as a new group of prospects with the ability to produce and export at an economical rate and with a safe probability of receiving strong sales margins.

The region-wise analysis points out that it is the South-West Region, where a huge potential lies in terms of efficient production and export of Biotechnology products. Eastern region which includes states such as West Bengal, Bihar and Assam have strong cases of product export where they enjoy comparative advantage vis-à-vis national level exports.

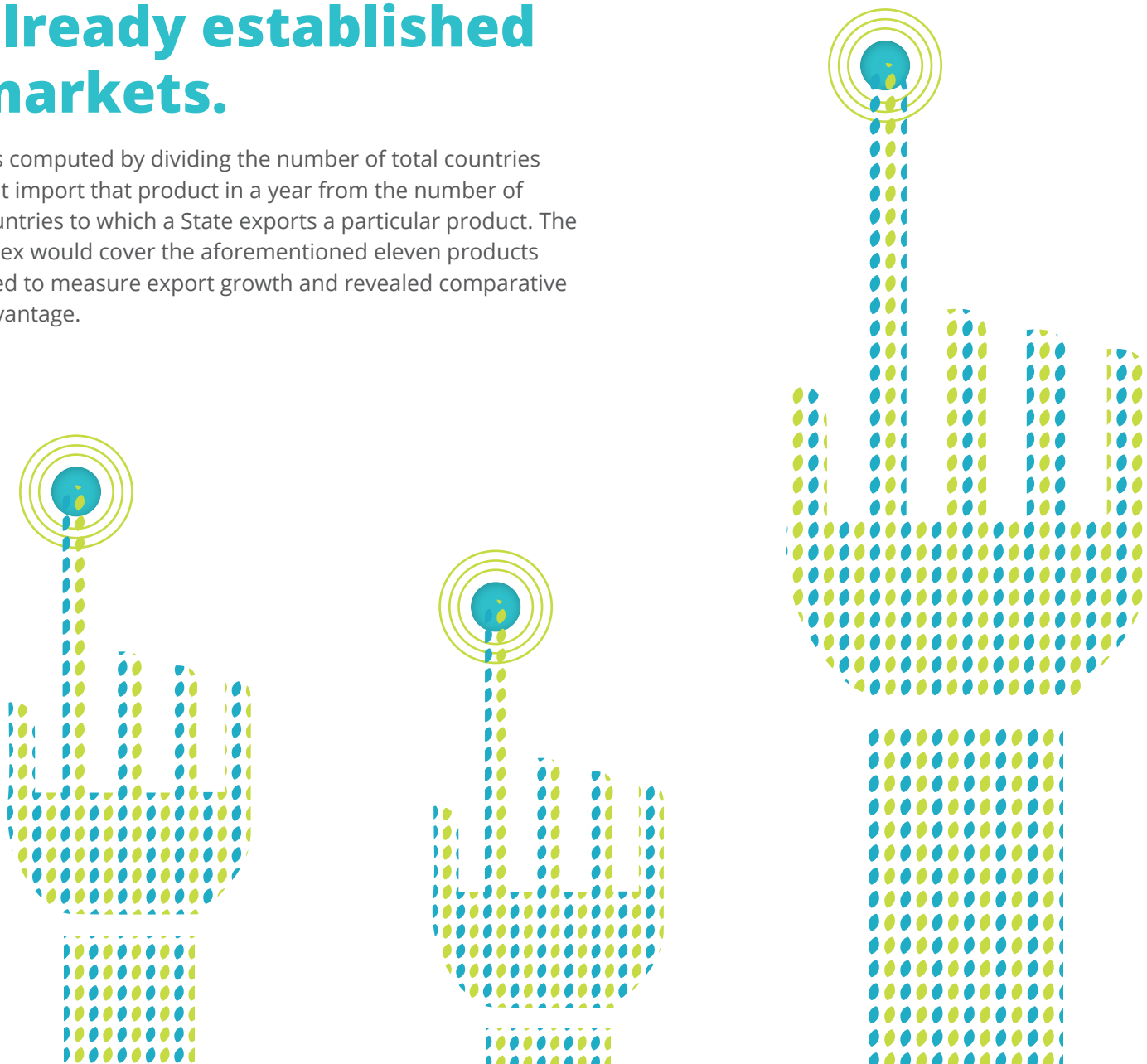
Both North-East and South-East regions need to focus on export-promoting factors that would enhance their respective efficiency in trading the Biotechnology products as compared to the national level exports.

Market Penetration Index

Apart from export growth and efficiency in the production of exportable products; it is essential to map the spread of the state's biotechnology products across the world.

Market Penetration Index is one such tool that measures the degree to which exports from a State reach already established markets.

It is computed by dividing the number of total countries that import that product in a year from the number of countries to which a State exports a particular product. The index would cover the aforementioned eleven products used to measure export growth and revealed comparative advantage.



From a policy and investment point of view, it raises a need to further assess why a state is not able to reach some potential markets, discover out how competitive its products are, and find newer likely markets for better geographic outreach.

Such a wide outreach also manages to diversify export destinations, which in turn, protects the local industries from possible trading shocks

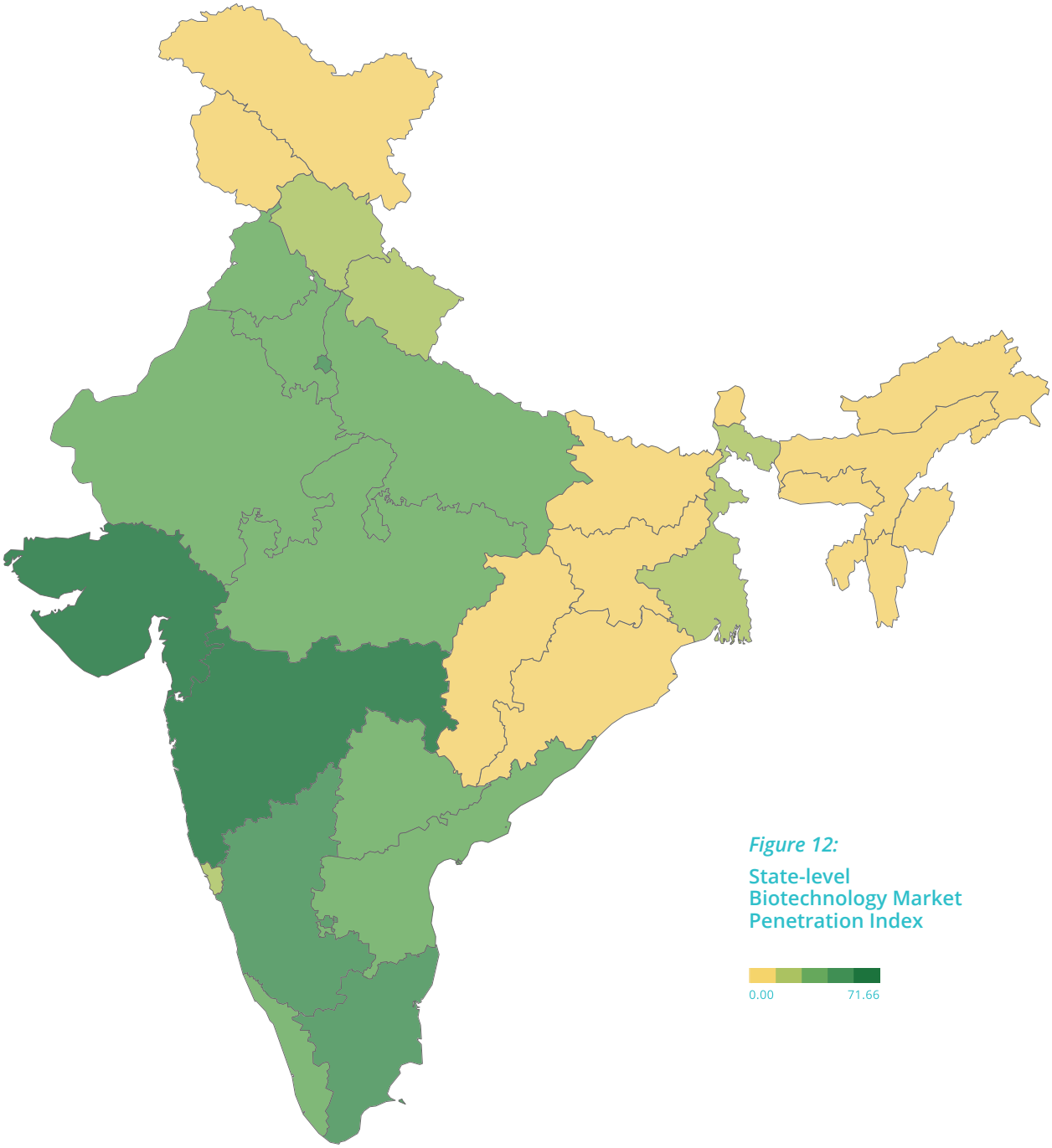


Figure 12:

State-level Biotechnology Market Penetration Index

Primary observations show clear leaders in Gujarat and Maharashtra. This is unsurprising as both these states finished as the top two in the Export Preparedness Index launched by the NITI Aayog. These states have provided market assistance-based incentives that would provide awareness and exposure for the biotech producers and exporters to showcase their products at a bigger platform.

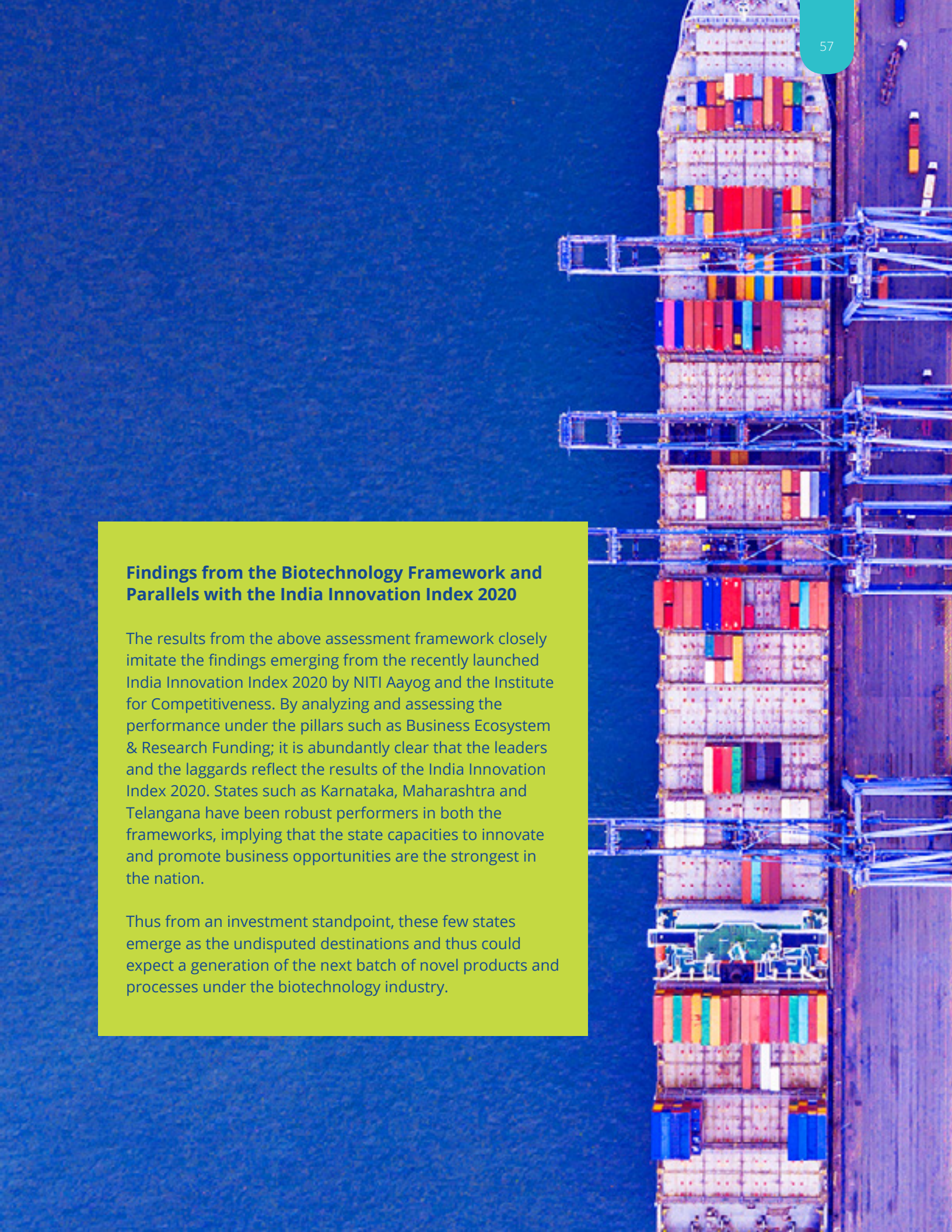
Except for West Bengal, almost all of the Eastern and North-East states suffer from poor scores in the index. While their respective Biotechnology policies might be assisting export-oriented businesses these states need to focus on how to make their exports more attractive at a global level. Their biotech exports may grow in volume however, it is essential to prepare the producers and exporters for the challenges that persist on a larger scale and what steps are needed to be taken such that their products sustain its desirability. Performing poorly in this index also exposes these states from global trading risks and as a result, there is a desperate need to diversify their export destinations.

Final Findings: Export Performance

After considering periodic export growth, efficient trading capabilities and market outreach, there should be clear options for the prospective investors to recognize the best-suited state-level Biotechnology industries. Export performance is one of the successful translations of an effective Biotechnology policy and therefore holds the ability to deliver stronger margins. Besides a strong performance in this domain adds to the popularity and builds a long-term trust for the products and the state-level industries producing them.

Gujarat stands out with a strong performance in all the above three indicators. When the state launched its Biotechnology policy in 2016, it realised the massive potential that its growing biotech exports held and envisioned to increase that turnover resulting in enhanced productivity and growth of Gross State Domestic Product (GSDP). Gujarat's overall strong export output has also been evident based on their performance in the Export Preparedness Index launched by NITI Aayog, where the state finished on top.

Therefore, there has to be a shift for the state Biotechnology policies to promote and push export-oriented businesses and thus provide a solid incentive for the state-level industry as a whole to design their products in that course.



Findings from the Biotechnology Framework and Parallels with the India Innovation Index 2020

The results from the above assessment framework closely imitate the findings emerging from the recently launched India Innovation Index 2020 by NITI Aayog and the Institute for Competitiveness. By analyzing and assessing the performance under the pillars such as Business Ecosystem & Research Funding; it is abundantly clear that the leaders and the laggards reflect the results of the India Innovation Index 2020. States such as Karnataka, Maharashtra and Telangana have been robust performers in both the frameworks, implying that the state capacities to innovate and promote business opportunities are the strongest in the nation.

Thus from an investment standpoint, these few states emerge as the undisputed destinations and thus could expect a generation of the next batch of novel products and processes under the biotechnology industry.

Assessing Local Biotechnology Industries:
Understanding the strength of Bioeconomy clusters

The 'Cluster' Phenomena of Biotechnology industries

The overall development of bio-manufacturing and bio-services both nationally and at the state level is intricately linked with the holistic growth of bioeconomy clusters. While region-specific incentives play a large role in establishing biotechnology industries, the ultimate expansion of a biotechnology industry depends on its proximity to knowledge sources and knowledge-intensive employment. Essentially, biotechnology clusters are a high concentration of organically grown biotechnology enterprises supported by an abundance of academic research, experienced and risk-taking biotechnology entrepreneurs, access to early and development stage capital funding, the supply of skilled labour force as well as the availability of testing and other specialised facilities.[11]

The typical flow of a biotechnology cluster occurs through the synchronisation of several inter-related parts. While certain parts like financial institutions, service institutions and government incentives keep the biotechnology cluster as the focal point; symbiotic partnerships with universities/research organisations, other industries, spin-offs/start-ups develop the nature of the cluster environment –

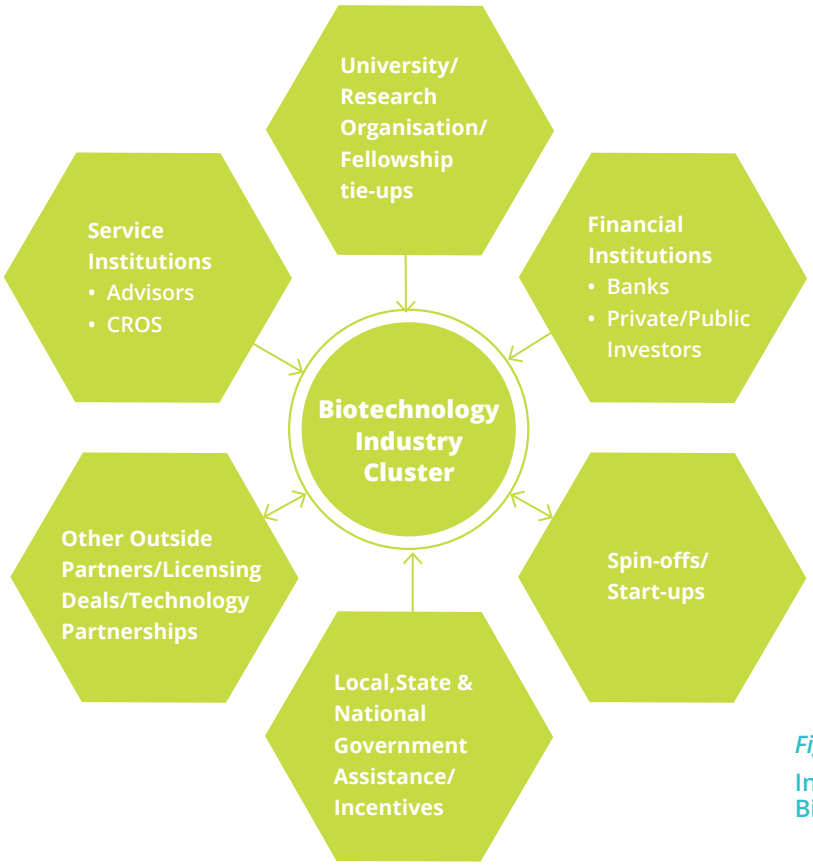
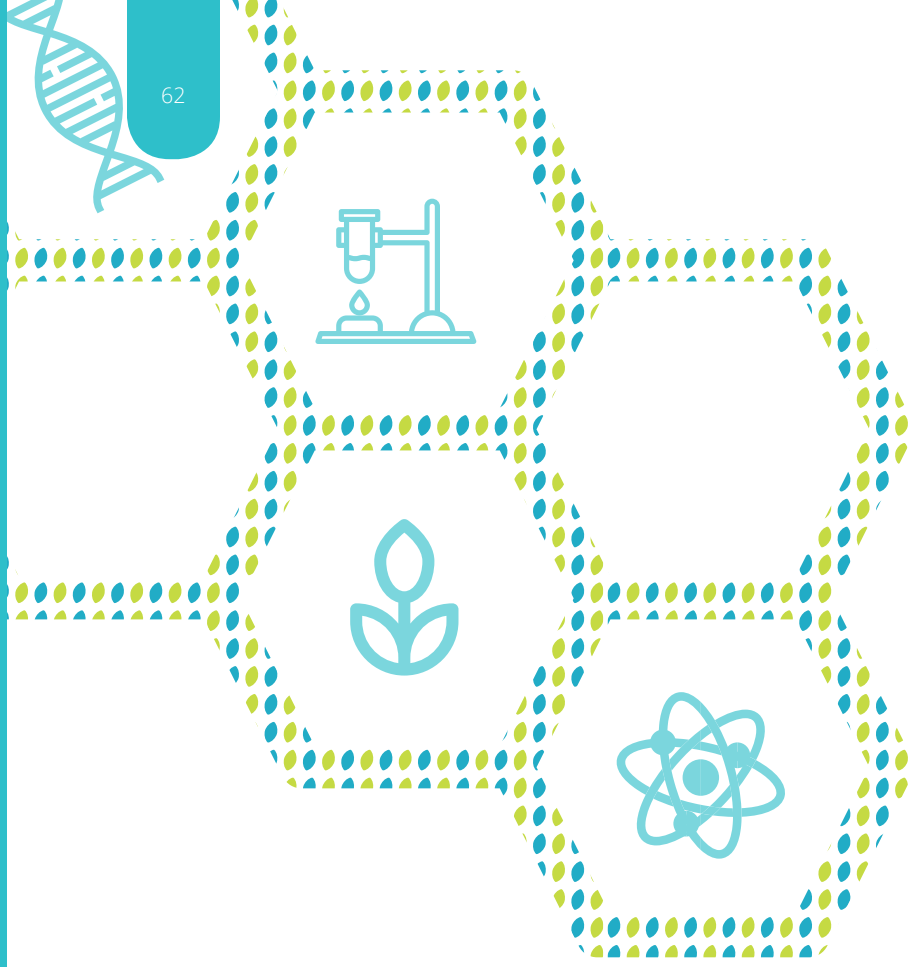


Figure 13:
Interactive flow of a Biotechnology Cluster[12]

[11]Shimasaki, C. (2014). Chapter 5- Five essential elements for growing biotechnology clusters. In Biotechnology Entrepreneurship – Starting, Managing and Leading Biotech Companies. Academic Press

[12]Domonkos, D. (2011). The conditions of and requirements for the formation of clusters in Biotechnology. Competition, 10(1), 118-131.



Biotechnology clusters in themselves are not secluded from the larger business environment – by developing backwards and forward linkages with several partner bodies, they allow all units to benefit from economies of scale and become drivers of competitiveness. Professor Michael E Porter's Cluster theory highlights that the benefits of developing clusters include (the same benefits are extendable to bio-clusters)[13]–

- **Fostering Productivity** – With the increasing growth of industries in proximity to each other, clusters would have the benefit of easy access to inputs, information and skilled labour force. Local supplier networks develop easily in such cases minimising transaction costs as well as helping allied businesses to emerge. Agglomeration of bio-industries promotes flow of market, technical and competitive information allowing all industries to take indirect benefit.
- **Forwarding Innovation** – In cases of well-developed bio-clusters which have strong partnerships with academic bodies, research and development can occur systematically allowing new product and process innovations. Growth of such clusters also translates into more demand for skilled labour force, leading to the indirect growth of universities, finishing schools which can help produce industry-ready workforce.
- **Furthering New Businesses** – In certain cases, well-grown Biotech industries have been known to generate spin-offs and invest in new start-ups in related or allied industries (for instance, Biocon). Growth of supplier industries also gets a huge push with relatively smaller industries being able to take the greater risk given the security of a consistent market base. The agglomeration of industries also attracts private and public investors who are more likely to invest in realising the business environment and market confidence in the clusters.

[13]Portter, M.E. (1998). Clusters and the new economics of competition. Harvard Business Review.

Hence, the benefits accrued to clusters also directly translates into the need for strengthening their functioning. Whilst the promotion of bio-clusters becomes the key goal, it should also be understood that certain states would be in a better position with respect to developing certain bio-products vis a vis their competitors. In such cases, the focus of the state governments should be on highlighting these competitive advantages and not seeking to develop all forms of the biotechnology industry. In tandem with this goal, the following sections highlight the strength of state-specific local biotechnology industry clusters. Additionally, future opportunities for states to develop their clusters have also been highlighted.

The Methodology of Evaluation: Cluster Strength Assessment Framework

Data and Methodology Used

The methodology for evaluation of cluster strength has been kept consistent with the Institute of Competitiveness's report "Assessing the Regional Competitiveness of the Indian Bioeconomy" for better understanding of the growth of state-specific clusters over time. In contrast to the previous report, this study analyses the strength of Indian bio-economy clusters using 2017-18 Annual Survey of Industries (ASI) and has used 2014-15 ASI data as the baseline to understand the growth. The industry codes used by the National Industrial Classification (NIC) 2008 (the most updated industrial classification) has been used to identify India's bio-industries.

The dataset used to calculate the industries categorised as "biotechnology industries" has been derived from European Commission's list of establishments related to Bioeconomy according to International Standard Industrial Classification of All Economic Activities, Revision 3. These codes were then translated to NIC 2008 codes. This process was followed due to a lack of understanding of the specific sub-industries and industry codes that can be defined as biotechnology specific industries.[14]

The ASI data extends to the entire country except for the state of Mizoram, and Union Territory of Lakshadweep. Since the 2017-18 and 2014-15 data has been used, the territory of Jammu and Kashmir has been considered as a whole.

NIC 5-digit code or sub-class has been used for the bio-cluster strength evaluation. The aggregated industry codes lead to these following 40 clusters that were used for the analysis. These cluster classifications have been kept similar to that used in "Clusters: The Drivers of Competitiveness" – a report by EAC-PM developed in alliance with IFC, to maintain homogeneity.

[14]For detail list of industry codes in defining biotechnology industries can be looked at https://competitiveness.in/wp-content/uploads/2021/02/Appendix.pdf

Cluster Classification for analysis	
Aerospace Vehicles and Defense	Aerospace Vehicles and Defense
Agricultural Products, Inputs and Services	Local Personal Services (Non-Medical)
Apparel	Local Real Estate, Construction, and Development
Automotive	Marketing, Design, and Publishing
Biopharmaceuticals	Medical Devices
Communications Equipment and Services	Metalworking Technology
Construction Products and Services	Oil and Gas Production and Transportation
Downstream Chemical Products	Paper and Packaging
Downstream Metal Products	Plastics
Environmental Services	Printing Services
Fishing and Fishing Products	Production Technology and Heavy Machinery
Food Processing and Manufacturing	Recreational and Small Electric Goods
Footwear	Textile Manufacturing
Furniture	Tobacco
Information Technology and Analytical Instruments	Trailers, Motor Homes, and Appliances
Jewellery and Precious Metals	Upstream Chemical Products
Leather and Related Products	Upstream Metal Manufacturing
Lighting and Electrical Equipment	Vulcanized and Fired Materials
Livestock Processing	Water Transportation
Local Entertainment and Media	Wood Products
Local Food and Beverage Processing and Distribution	

Bio-Cluster Strength Evaluation: Framework for Assessment

The framework used in the cluster strength framework has been kept consistent with the previous report and largely follows the conceptual antecedents of the EAC-PM report. The framework for evaluation uses these components –

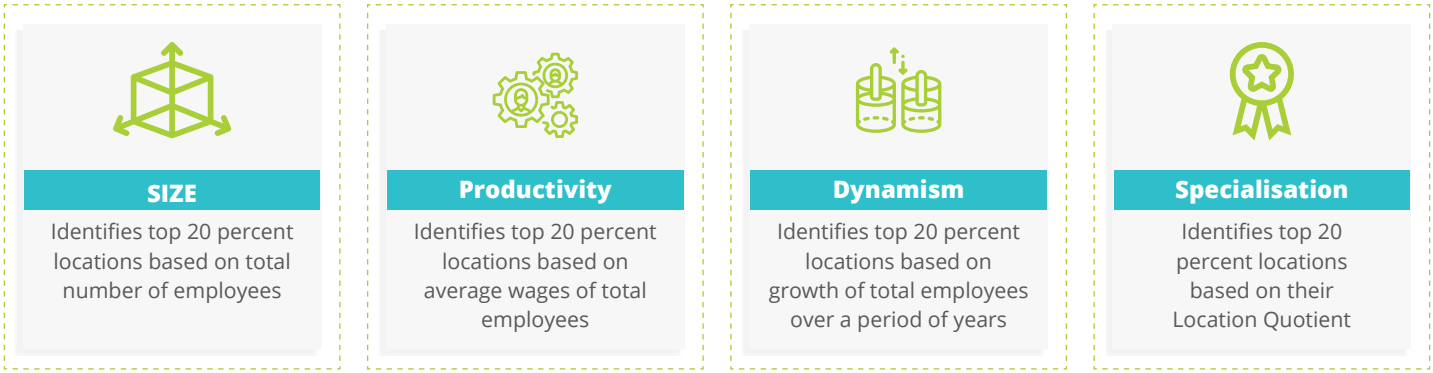


Figure 14: Framework for Cluster Strength Evaluation

- **Size** – The total employees considered for the analysis includes workers employed through contractors, supervisory and managerial staff as well as other employees (as per ASI classification). A higher number of employees highlights the growing market growth and linkages of the specific cluster.

- **Productivity** – 20 percent of the locations with the highest average wages for the workers considered in the size category have been used to analyse the productivity of the region-specific cluster.

- **Growth Dynamism** – The percentage change in employee employment growth from 2014-15 to 2017-18 in total employees for the defined bio-clusters is used to evaluate growth dynamism of the cluster.

- **Specialisation** – This indicator becomes especially important as it reflects how strong a region is in a bio-cluster category compared to other regions. Location Quotient or the ratio of the share of regional employment in a regional bio-industry compared to the share of the industry's employment in national employment measured the region's specialisation in the specific bio-cluster category.

These four indicators are compiled to reflect a single score through the four-star methodology. Each state that falls in the 20 percent of these indicators is assigned a cluster star with the strength of the region's cluster portfolio depending on the overall performance across all the cluster categories.

Cluster Evaluation of India's Bio-economy Clusters: Findings and Discussion of Results

Size and Growth Dynamism of the Bio-Clusters

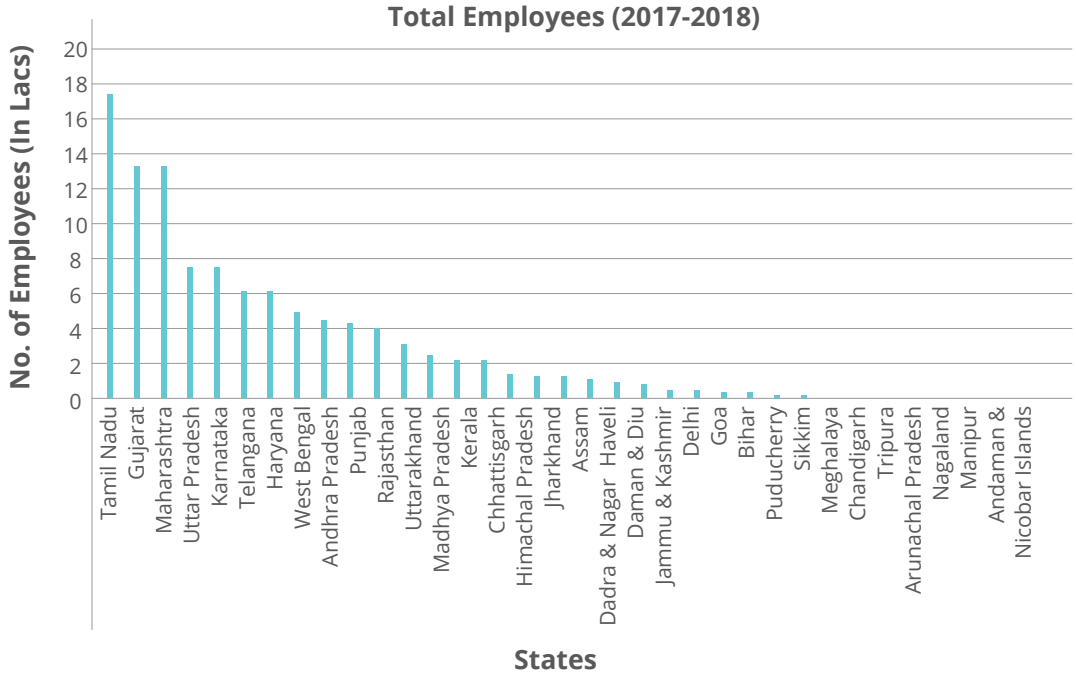


Figure: 15
Total employees across states

The distribution of the size of the bio-clusters signified by the total employees in the specific cluster across regions, highlights the states that have historically had strong industrial development have fared the best in this indicator. Tamil Nadu, Gujarat, Maharashtra, Uttar Pradesh and Karnataka are in the top 5 of the total employees' distribution for 2017-18. Whilst the states in the top 5 are the same as that of 2014-15, there has been a slight shift in ranks –

Rank	2017-18 Total employees top 5	2014-15 Total employees top 5
1	Tamil Nadu	Tamil Nadu
2	Gujarat	Maharashtra
3	Maharashtra	Gujarat
4	Uttar Pradesh	Karnataka
5	Karnataka	Uttar Pradesh

While Tamil Nadu ranks the highest in terms of total employees, a further subdivision of the category of employees highlight that the state is only ranked highest for the employment of direct and contractual employees. However, in the case of knowledge workers, Maharashtra ranks the highest, followed by Gujarat and then Tamil Nadu. Nonetheless, with knowledge worker employment accounting for only 10.93 percent of the total employment in Indian bio-clusters, Tamil Nadu has an added advantage.

While in terms of an absolute number of cluster-specific employees, legacy industrial states have done better, in terms of CAGR of employees from 2014-15 to 2017-18, smaller states such as Manipur and Sikkim have shown higher growth. However, apart from these states, larger states such as Gujarat, Uttar Pradesh and Punjab have fared better in terms of growth of employees as well. This highlights that smaller states can no longer bank only on organic growth to expand their cluster strength but would have to develop incentives to expand infrastructure and attract the workforce to their bio-industries.

The correlation between CAGR of total employees across 2014-15 to 2017-18 highlights that with an increasing number of employees, compounded growth of employees increases signifying a positive shift in the total employee bracket. While certain legacy industrial states have shown positive growth, three large states/UTs specifically Himachal Pradesh, Kerala and Delhi along with several north-eastern states have shown a negative decline in total employees over 2014-15 to 2017-18.

The growth dynamism analysis highlights that though Manipur and Sikkim have high CAGR in total employees compared to other states, their base level of total employees in their clusters are very low. It can be observed that Gujarat, Maharashtra, and Telangana have not only achieved a higher number of absolute total employees but also positive growth dynamism. In comparison to the previous report, Andhra Pradesh has shown positive growth dynamism, indicating an expansion of their clusters over a period of time.

While CAGR of total employees cannot be taken as a sole factor of the state's cluster performance, it is a positive sign that relatively smaller states such as Manipur, Sikkim, Nagaland, Uttarakhand have registered positive CAGR albeit at lower number of absolute total employees. This signifies greater policy focus and attention by Central Biotechnology bodies on hilly and north-eastern states can lead to slow but steady development.

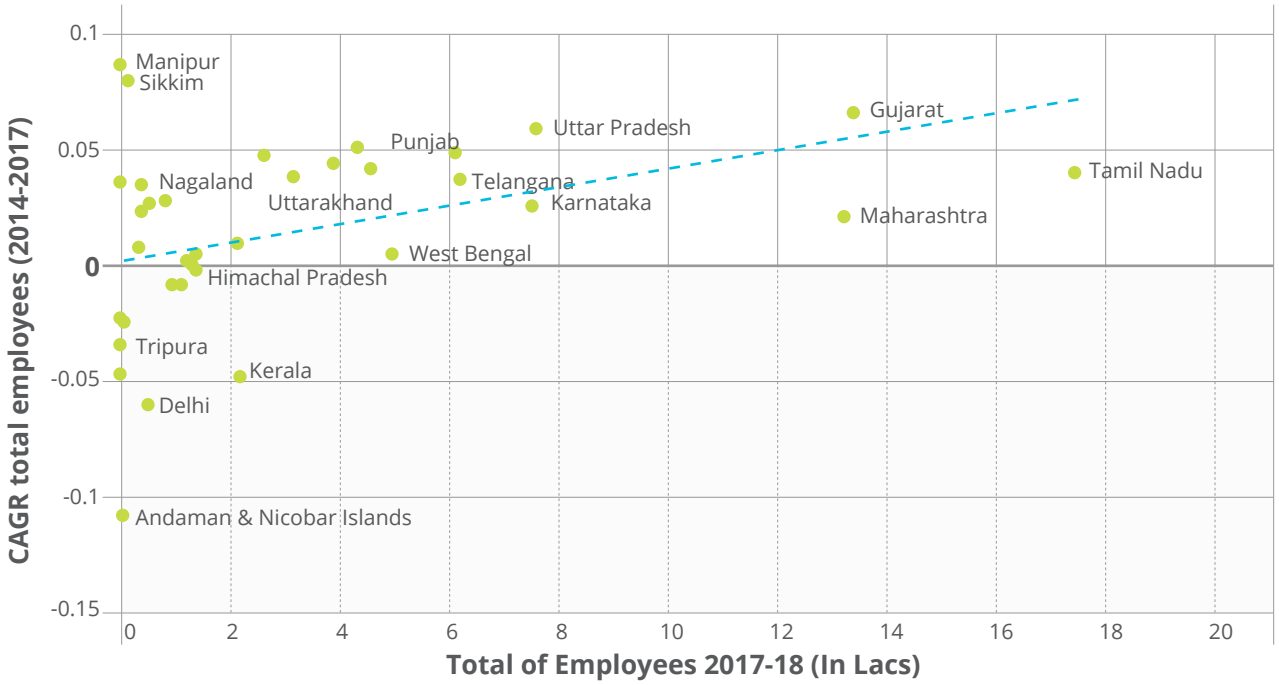


Figure 16: Relation between CAGR of total employees (2014-2017) and total employees (2017-18)

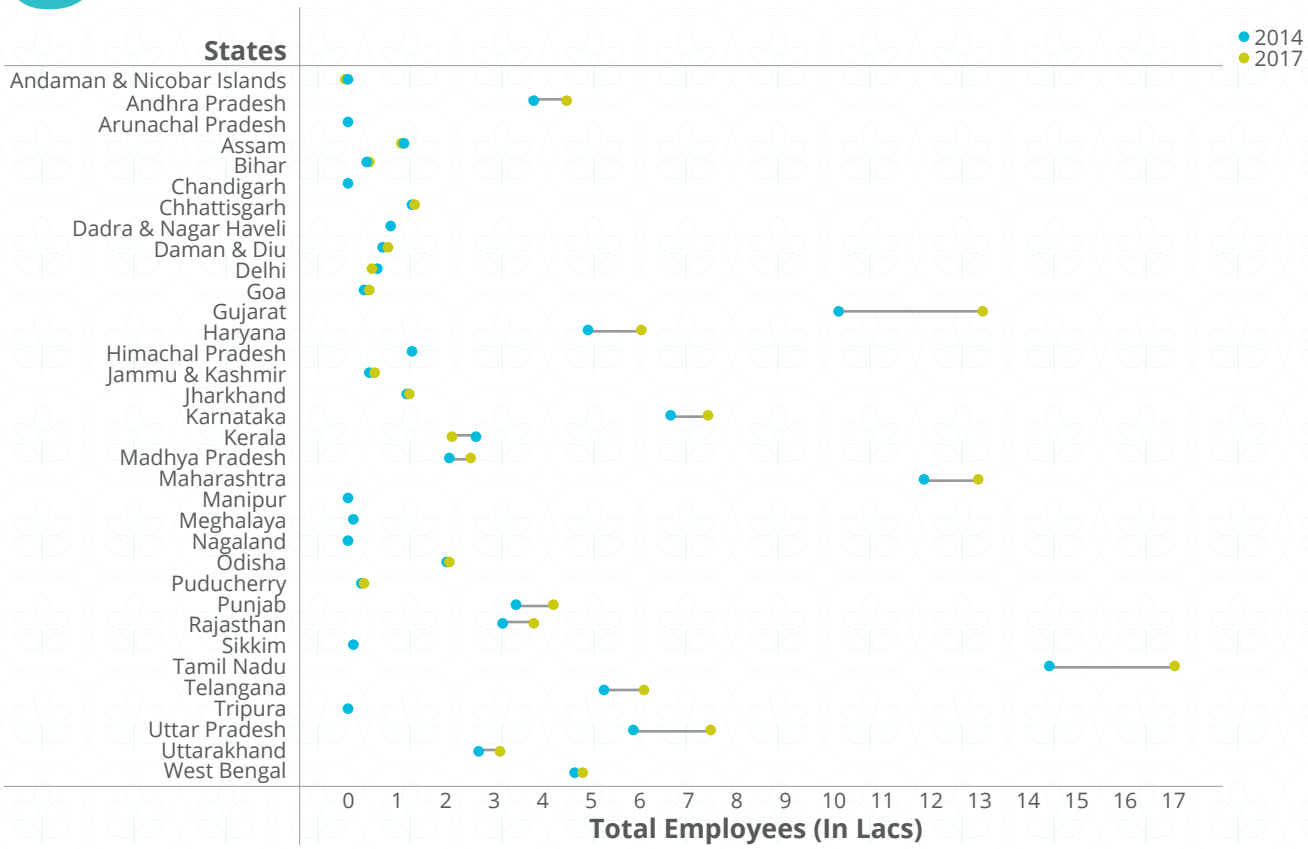


Figure 17: Growth of total employees across 2014-15 to 2017-18

The Productivity of the Bio-Clusters

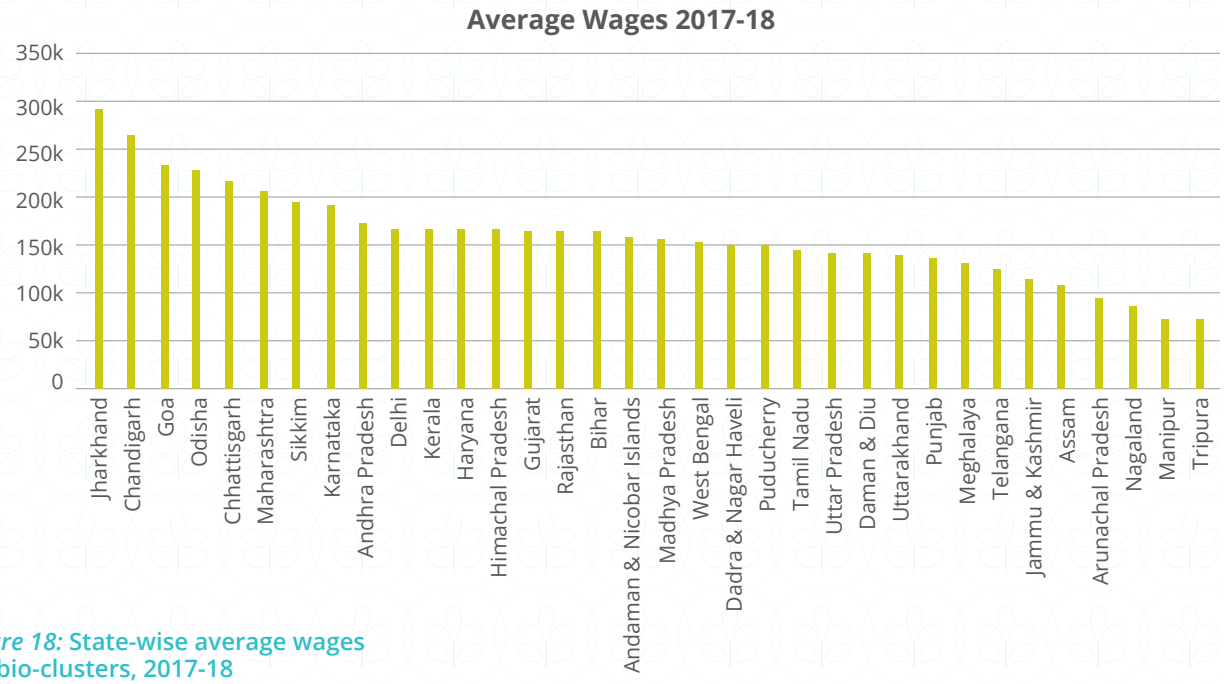


Figure 18: State-wise average wages for bio-clusters, 2017-18

The distribution of average wages of Indian bio-clusters across states reveals increasing disparity of wages over time.

The analysis highlights that the average wages of the highest-ranked state are at least four times more than the least-ranking state.

Additionally, a surprising 21 states have average wages below the national average for 2017-18 (Rs 161498.4). Interestingly states that have strong industrial growth such as Gujarat, Tamil Nadu, Uttar Pradesh, Punjab and Telangana provide average wages below the national estimate. While a larger number of employees tend to lower average wages, the high average wages of legacy industrial states such as Maharashtra, and Karnataka highlight the contrary.

The comparison of the top 5 highest-ranking states features significant changes over 2014-2015 to 2017-18 –

Rank	2017-18	2014-15
1	Jharkhand	Jharkhand
2	Chandigarh	Chhattisgarh
3	Goa	Goa
4	Odisha	Chandigarh
5	Chhattisgarh	Maharashtra

Jharkhand continues to consistently have the highest average wage over 2014-15 to 2017-18. This is not a new phenomenon, the 2009-10 Labour Bureau reports report that Jharkhand was the state where highest wages were paid to workers per working day. Nonetheless, disaggregation of the average wages provides certain interesting insights – it is because of the highest average wage paid to direct and contractual workers that Jharkhand has achieved its top rank. However, with respect to average wages paid to knowledge workers, Jharkhand ranks 12th compared to other states. According to the analysis of average wages paid to knowledge and production workers in bio-clusters, the states that fall in the top 10 of both these categories are – Goa, Maharashtra, Chhattisgarh, Odisha, Karnataka and Sikkim – highlighting a balanced approach of growth in productivity.

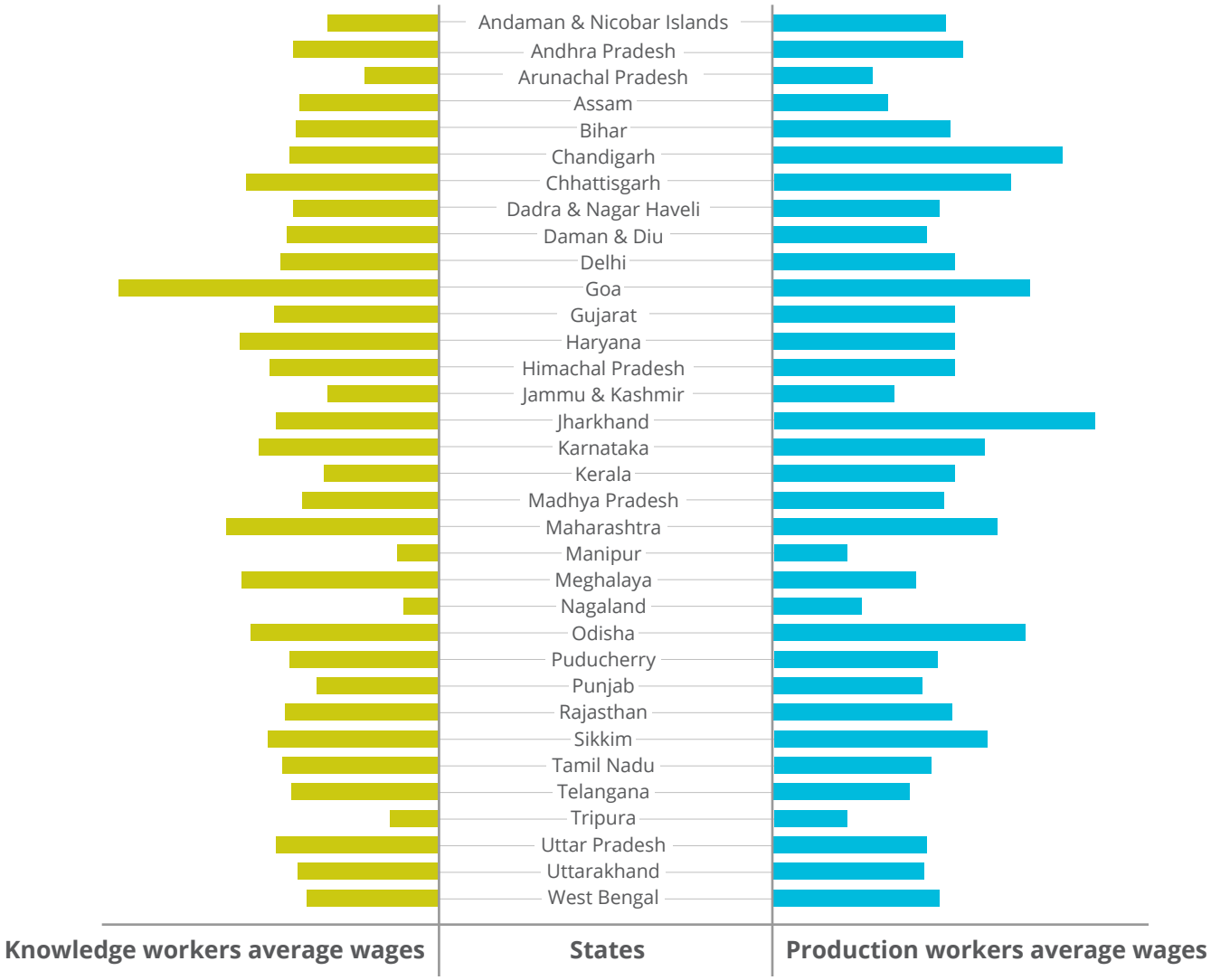


Figure 19: **Disparities in average wages for production and knowledge workers across regional bio-clusters (2017-18)**

While the national average wages for knowledge workers is approximately six times greater than the national average earnings for production workers in Indian bio-clusters, the disparity within these two categories remains immense. Regarding the regional difference of average wages paid to production workers, the wage disparity is approximately 4 times the average production workers' earnings of the highest-ranked state (Jharkhand) vis a vis the least-ranked (Tripura). In contrast, with respect to the regional difference of average earnings paid to knowledge workers, the wage disparity stands at an astounding 9 times the average knowledge workers' salaries paid to the highest-ranked state (Goa) compared to the least-ranked (Nagaland).

While the wage gap between production and knowledge workers is explainable on a larger scale due to difference in skill levels; the regional disparity in these two categories highlight a serious mismatch in wage levels for knowledge workers across regions. With states such as Gujarat, Tamil Nadu, Telangana, Andhra Pradesh and Kerala having average knowledge worker wages below that of the national average wages, it brings into question the lack of incentives for the skilled labour force to help improve the productivity of these regional clusters. Similar to the previous interlink between total workers and CAGR, there exists a positive relationship between the CAGR of average wages (2014-2017) and average wages (2017-18). This signifies higher the regional average wages, greater the compounded growth of average wages. With respect to the ranking of states as per the CAGR of average states, relatively smaller states and UTs such as Sikkim, Bihar and Chandigarh have registered the highest growth. Interestingly, this growth as reflected in Figure 21, is not because the states have a lower absolute average wage. It can be observed that Sikkim and Chandigarh not only have the highest growth of average wages over years but also a high positive shift in absolute average wages.

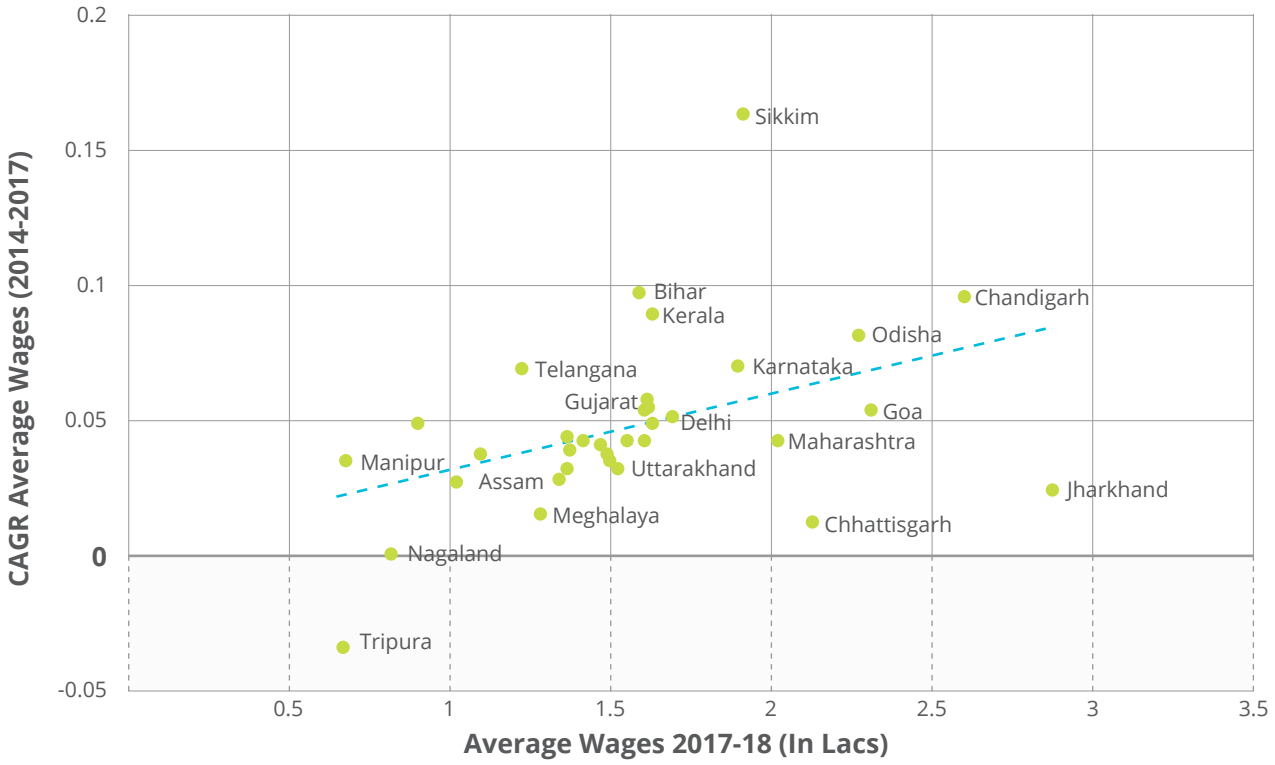


Figure 20: **Relationship between average wages (2017-18) and CAGR of average wages (2014-2017)**

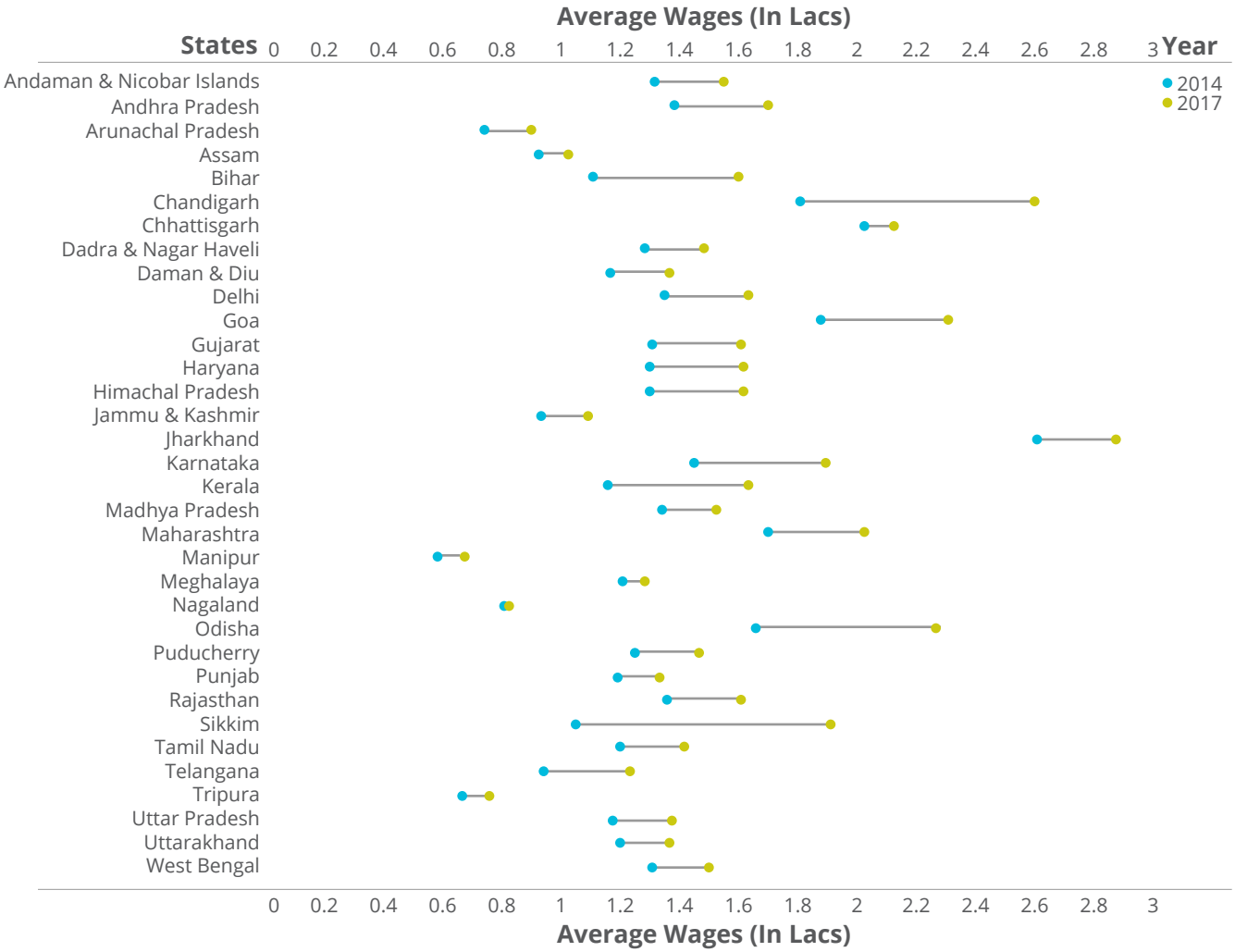


Figure 21: Growth of average wages (2014-2017

The Specialisation of the states in specific Bio-clusters

The specialisation of the states in certain bio-clusters is signified by its location quotient. This highlights the region's specialisation or comparative advantage in a certain bio-cluster in terms of employment. While the products listed below highlight the strengths of the state compared to other bio-clusters produced in the same region, it is not immediately translated to having good cluster strength in these cluster categories. With location quotient only being a guiding tool, the ultimate understanding of cluster strength of a region would be how the state enhances its comparative strengths by boosting number of units, employment, and average wages across production and knowledge workers for these cluster categories. The following table highlights top 3 cluster categories per state as per the ranking of the Location Quotient –

STATES	HS Code
ANDAMAN & NICOBAR ISLANDS	Wood Products Food Processing and Manufacturing Upstream Chemical Products
ANDHRA PRADESH	Fishing and fishing products Communication Equipment and services Water Transportation
ARUNACHAL PRADESH	Wood Products Food Processing and Manufacturing Upstream Chemical Products
ASSAM	Food Processing and Manufacturing Oil and Gas Production and Transportation Local Food and Beverage Processing and Distribution
BIHAR	Oil and Gas Production and Transportation Local entertainment and media Local personal services (non-medical)
CHANDIGARH	Local entertainment and media Production technology and heavy machinery Local real estate, construction and development
CHHATTISGARH	Upstream metal manufacturing Construction Products and Services Environmental Services
DADRA & NAGAR HAVELI	Medical Devices Plastics Textile Manufacturing
DAMAN & DIU	Plastics Recreational and Small Electronic Goods Downstream metal products
DELHI	Marketing, Design and Publishing Leather and related products Printing services
GOA	Water transportation Trailers, motor homes and appliances Biopharmaceuticals
GUJARAT	Jewellery and precious metals Environmental services Upstream chemical products

STATES	HS Code
HARYANA	Automotive Recreational and small electric goods Apparel
HIMACHAL PRADESH	Trailers, Motor Homes and Appliances Communications equipment and services Biopharmaceuticals
JAMMU & KASHMIR	Upstream chemical products Plastics Biopharmaceuticals
JHARKHAND	Upstream metal manufacturing Automotive Oil and Gas Production and Transportation
KARNATAKA	Aerospace vehicles and defence Apparel Local real estate, construction and development
KERALA	Water transportation Medical devices Fishing and fishing products
MADHYA PRADESH	Plastics Agricultural products, inputs and services Lighting and electrical equipment
MAHARASHTRA	Information technology and analytical instruments Metalworking technology Jewellery and precious metals
MANIPUR	Construction products and services Furniture Jewellery and precious metals
MEGHALAYA	Construction products and services Wood products Upstream metal manufacturing
NAGALAND	Wood Products Printing services Construction products and services

STATES	HS Code
ODISHA	Upstream metal manufacturing Local personal services (non-medical) Oil and gas production and transportation
PUDUCHERRY	Vulcanized and fired materials Downstream chemical products Plastics
PUNJAB	Recreation and small electric goods Metalworking technology Food processing and manufacturing
RAJASTHAN	Furniture Construction products and services Agricultural products, inputs and services
SIKKIM	Biopharmaceuticals Local food and beverage processing and distribution Local personal services (non-medical)
TAMIL NADU	Marketing Design and Publishing Footwear Local Personal services (non-medical)
TELANGANA	Tobacco Aerospace Vehicles and Defence Biopharmaceuticals
TRIPURA	Local real estate, construction and development Wood products Furniture
UTTAR PRADESH	Livestock processing Footwear Recreational and small electric goods
UTTARAKHAND	Downstream chemical products Trailers, motor homes and appliances Recreational and small electric goods
WEST BENGAL	Leather and related products Local entertainment and media Local food and beverage processing and distribution

Cluster Strength Analysis of Bio-Clusters across Indian states

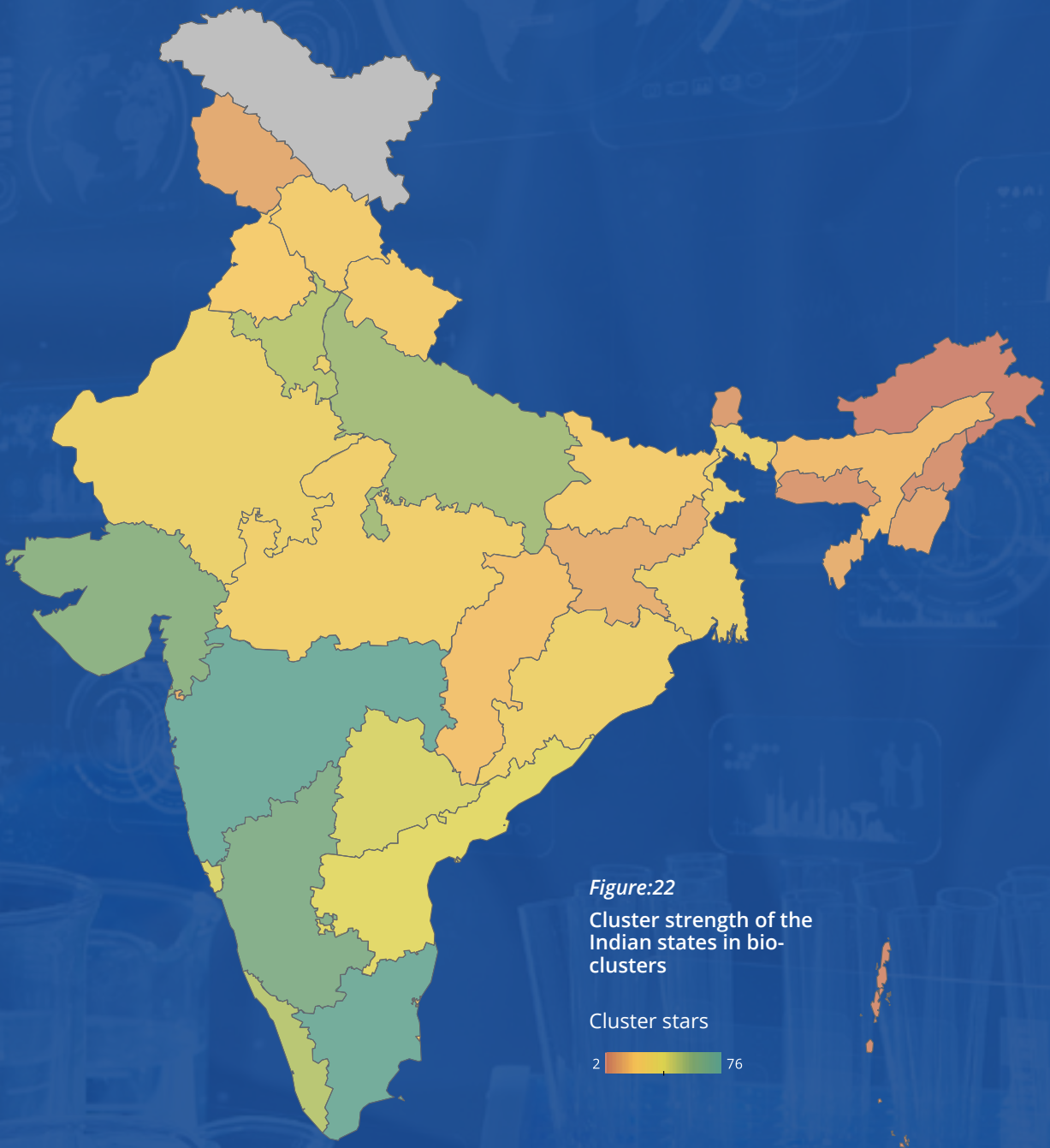


Figure:22

Cluster strength of the Indian states in bio-clusters

The cluster strength analysis highlights that Southern regions of India have again shown greater potential in creating a stronger bioeconomy portfolio than other states. However, Gujarat, Uttar Pradesh and Haryana have also shown a strong strength of bio-clusters, indicating the future scope of expansion. Andhra Pradesh, Goa, Gujarat, Karnataka, Kerala, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Telangana and Uttar Pradesh are the states with 4-star clusters with Karnataka having the highest number of four-star clusters amongst them. The list for the four-star bio-clusters are –

State with 4-star clusters	Cluster categories having 4-star cluster strength
Andhra Pradesh	Water Transportation
Goa	Water Transportation
Gujarat	Medical Devices
Karnataka	Aerospace Vehicles and Defence Environmental Services Fishing and fishing products Information technology and analytical instruments Local personal services (non-medical)
Kerala	Fishing and fishing products Water transportation
Maharashtra	Fishing and fishing products
Odisha	Local personal services (non-medical)
Rajasthan	Furniture
Tamil Nadu	Environmental services Local personal services (non-medical) Marketing, design and publishing Water transportation
Telangana	Aerospace vehicles and defence Marketing, design and publishing
Uttar Pradesh	Marketing, design and publishing

The bio-cluster portfolio of Indian states are as follows –

State name	Number of 1-star clusters	Number of 2-star clusters	Number of 3-star clusters	Number of 4-star clusters	Total Cluster stars
ANDAMAN & NICOBAR ISLANDS	2	1	0	0	4
ANDHRA PRADESH	10	6	4	1	38
ARUNACHAL PRADESH	2	0	0	0	2
ASSAM	9	4	0	0	17
BIHAR	12	3	2	0	24
CHANDIGARH	5	2	1	0	12
CHHATTISGARH	8	2	2	0	18
DADRA & NAGAR HAVELI	9	3	0	0	15
DAMAN & DIU	10	2	1	0	17
DELHI	13	3	3	0	28
GOA	15	5	4	1	41
GUJARAT	14	13	5	1	59
HARYANA	13	10	5	0	48
HIMACHAL PRADESH	8	4	3	0	25
JAMMU & KASHMIR	10	1	0	0	12
JHARKHAND	8	1	1	0	13
KARNATAKA	16	8	4	5	64
KERALA	17	4	5	2	48
MADHYA PRADESH	14	5	1	0	27
MAHARASHTRA	9	24	5	1	76
MANIPUR	7	2	0	0	11
MEGHALAYA	7	0	0	0	7
NAGALAND	5	0	0	0	5
ODISHA	13	2	3	1	30
PUDUCHERRY	10	3	2	0	22
PUNJAB	8	7	0	0	22
RAJASTHAN	12	6	1	1	31
SIKKIM	1	2	1	0	8
TAMIL NADU	17	12	6	4	75
TELANGANA	12	6	3	2	41
TRIPURA	9	2	0	0	13
UTTAR PRADESH	14	13	3	1	53
UTTARAKHAND	8	6	1	0	23
WEST BENGAL	12	8	1	0	31

Future Opportunities for Indian states to strengthen their cluster portfolio

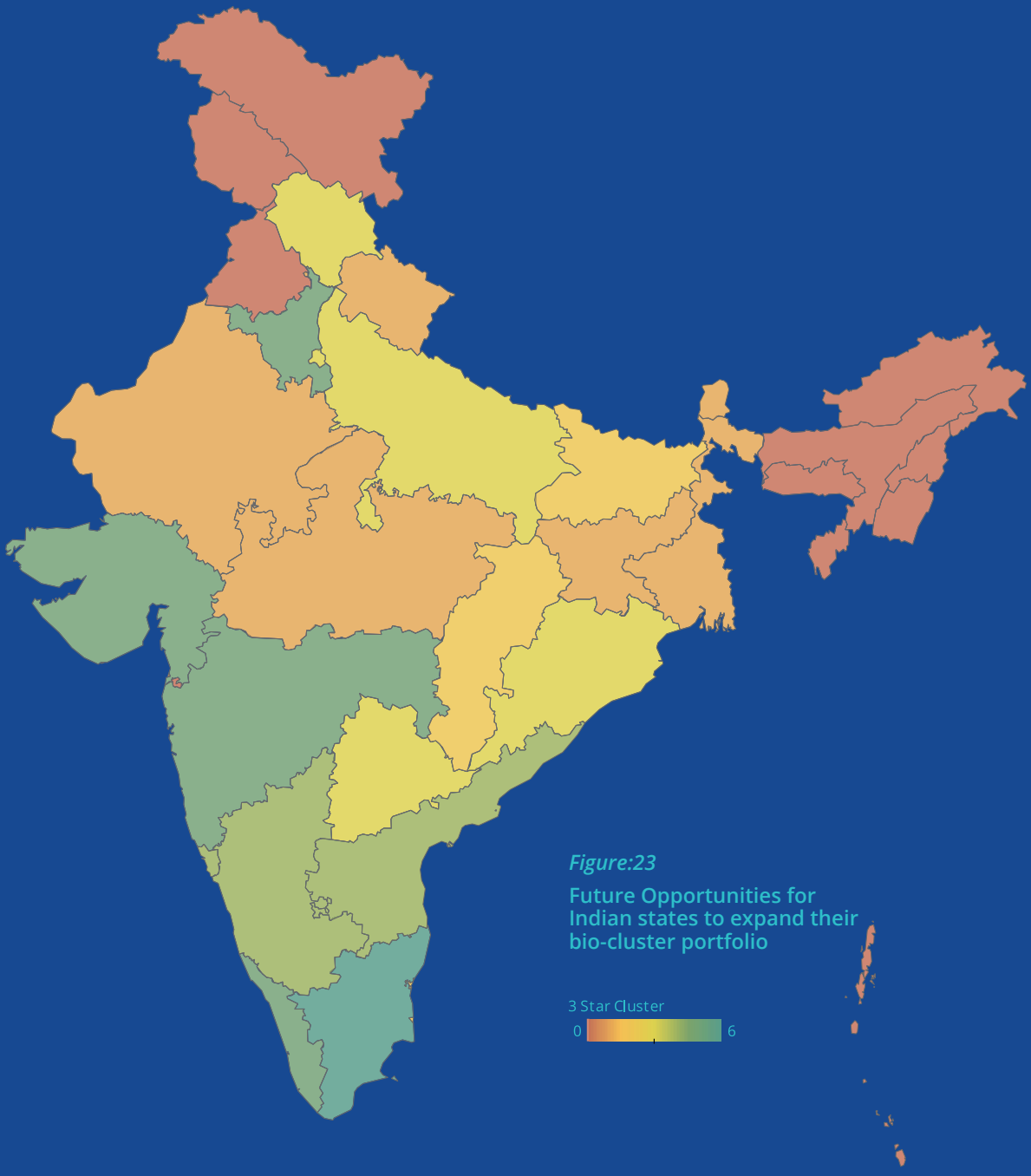


Figure:23

Future Opportunities for Indian states to expand their bio-cluster portfolio

The future area of growth in expanding and strengthening India's regional bio-cluster portfolio lies in transforming the 3-star clusters into 4-star clusters. The cluster strength analysis highlights that Southern states have the highest potential for expanding their bio-cluster portfolio with Tamil Nadu having the highest number of 3-star clusters. The future areas of growth are as follows –

States with 3-star clusters	Cluster categories
Andhra Pradesh	Communication equipment and services Fishing and fishing products Local entertainment and media Local real estate, construction and development
Bihar	Local entertainment and media Local personal services (non-medical)
Chandigarh	Local entertainment and media
Chhattisgarh	Environmental services Upstream metal manufacturing
Daman and Diu	Paper and packaging
Delhi	Footwear Leather and related products Marketing, design and publishing
Goa	Aerospace vehicles and defence Agricultural products, inputs and services Livestock processing Vulcanised and fired materials
Gujarat	Agricultural products, inputs and services Information technology and analytical instruments Jewellery and precious metals Local personal services (non-medical) Marketing, design and publishing
Haryana	Automotive Information technology and analytical instruments Metalworking technology Trailers, motor homes and appliances
Himachal Pradesh	Communication equipment and services Downstream chemical products Paper and packaging
Jharkhand	Upstream metal manufacturing
Karnataka	Leather and related products Lighting and electrical equipment Local food and beverage processing and distribution Local real estate, construction and development

States with 3-star clusters	Cluster categories
Kerala	Aerospace vehicles and defence Footwear Local entertainment and media Medical devices Vulcanized and fired materials
Madhya Pradesh	Upstream chemical products
Maharashtra	Automotive Downstream chemical products Information technology and analytical instruments Metalworking technology Production technology and heavy machinery
Odisha	Environmental services Fishing and fishing products Upstream metal manufacturing
Puducherry	Lighting and electrical equipment Metalworking technology
Rajasthan	Textile manufacturing
Sikkim	Local food and beverage processing and distribution
Tamil Nadu	Aerospace vehicles and defence Automotive Information technology and analytical instruments Jewellery and precious metals Medical devices Tobacco
Telangana	Biopharmaceuticals Communication equipment and services Downstream metal products
Uttar Pradesh	Livestock Processing Medical devices Recreational and small electric goods
Uttarakhand	Downstream chemical products
West Bengal	Tobacco

Policy Recommendations

Indian Biotech sector's ambition to reach 150 billion USD by 2025 is now facing a grave challenge due to the adverse economic impact of the Covid crisis. To finally meet that target, the extraordinary inflow of capital and funds are required and thus, this can only be achieved via a sustainable channel of investment. State biotech industries can, therefore, can play a vital role in attracting new investment opportunities that would enhance the overall biotech output while generating new employment opportunities. Based on the coverage of their biotech policies, their performance to boost investment and the presence of local biotech clusters derive some key observations. From these observations, this report presents a set of actionable policy recommendations that the policymakers at both national and subnational levels can both implement to boost the chances of investment inflow in the country.

Analysis of Biotech Policy and Learning for States

- States need to build their Biotech policies and consider creating segment-specific innovations and incentives. Karnataka Biotech Policy acts as a good learning point by focusing on their competitive strengths within the overall biotech industry and developing policy actions.
- There is a need to expand the definition of biotech units to bring in more investment and generate more employment opportunities.
- States should identify thrust areas and work towards attracting investment in biotech sector that enables generation of employment opportunities.

State Competitiveness Assessment Framework: Overall Recommendations

- Investing in the biotechnology infrastructural facilities such as incubation centres, biotech parks and bio-clusters are bound to deliver long-term results with an amplified rate of innovation and ensuring that the firms who emerge from such facilities attain a competitive advantage.
- With the rise of health challenges, translational research needs to become a necessity with hospitals and other medical institutes to be made equal stakeholders in the biotech industry. The data provided by such institutes could greatly advance clinical research in India.
- For consistent & long-term research output, states have to strike the right balance between private and public funding. It is particularly imperative that funding measures are being planned where increasing returns on public investments is ensured by allowing public and private funding to complement each other.
- Export performance is one of the successful translations of an effective Biotechnology policy and therefore holds the ability to deliver stronger margins. Therefore, there has to be a shift for the state Biotechnology policies to promote and push export-oriented businesses and thus provide a solid incentive for the state-level industry as a whole to design their products in that course.

Cluster Strength Analysis: Region Specific Recommendations

- With knowledge workers accounting for only 10.93 percent of total employment, states must provide incentives to attract and retain a high-specialised labour force in order to build the domestic biotechnology knowledge base.
- Smaller states can no longer bank on organic growth for the development of their clusters – targeted incentives need to be designed in collaboration with industry requirements along with the development of basic infrastructure to attract biotech investment.
- High regional wage disparity for production and knowledge workers highlights the lack of incentives to attract labour force within Indian biotechnology industries. State biotechnology boards/governments need to focus on developing academic curricula which fit industry requirements such that a larger percentage of the labour force can attain higher-skilled, paying employment.
- States should also provide financial incentives to autonomous graduate and technical skill schools within the biotechnology sector (e.g., Biocon Academy) to develop its workforce.
- States need to promote bio-manufacturing hubs (moving away from only bio-pharma). Within the biopharma clusters, greater focus should be on the creation of large-scale data bank and factory scale genomics. Greater linkages need to be developed between academic institutes and industries in bio-clusters.
- The advent of COVID-19 has brought into focus innovation challenges – States should promote the formation of state-specific biotech forums involving industry and academia such that there is easy transfer of R&D, innovation funding, and infrastructure sharing. Biotech start-ups need to be connected with larger firms to ease teething challenges and promote innovation.

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