Innovation: A key driver for sustainable development in Kerala

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Abstract

Kerala drew national and international attention for her achievements in social and human development and resilience in the face of recent disasters. However, rapid changes in the environment that affect the regenerating capacity of biophysical systems, spatial disparity in development, and underperformance in some of the sustainable development goals like industry, infrastructure, and innovation (SDG 9) are major emerging challenges of the state. Kerala's innovation score is 30.58 against the national average of 35.59. The development trajectory, hitherto followed and found to have brought out significant positive changes in Kerala society, perhaps warrants revisit. Innovation-driven development and knowledge-based action assume great significance in this context. The Kerala Development and Innovation Strategic Council (K-DISC) has taken initiatives to build a holistic innovation ecosystem in the state. Some of the important initiatives are the Young Innovators' Programme (YIP), One Local Government, One Initiative (OLOI), and the Recruit, Train, and Deploy (RTD) programme. In all these cases, the thrust is on solving problems drawing from local as well as global knowledge bases and building synergy across all knowledge

producing domains. This paper argues that the KDISC approach holds high potential to address Kerala's emerging development challenges, and the lessons learnt from these experiments will be useful for other states as well.

Keywords: *Kerala's emerging challenges, Sustainable Development Goals, K-DISC, Holistic Innovation.*

1. Introduction

Globally, there is a concern about the slow pace of growth meeting the sustainable development goal targets and the initiatives being undertaken both at the national and international level to address the problems. Among the three pillars of sustainable development, economy, social, and ecology, countries recorded progress in those goals out of 17 SDGs that are in line with national priorities, leaving out other sectors especially related to environment and climate change (D'Adamo et al., 2021; UN, 2023). This may accelerate further environmental degradation, jeopardising the development process itself. Currently, the SDGs primarily focus on discursive effects with a few isolated normative and institutional reforms. It is not yet a transformative force to lead the world in the path of sustainability (Biermann et al., 2022). In this context, it is suggested adopting locally best suited entry points following regional and national priorities and applying four levers - governance, economy and finance, individual and collective action, and science and technology to propel our actions along the entry points (GSDR, 2019). Actors from these levers must develop partnerships and establish novel collaborations to design and rapidly implement integrated pathways to sustainable development corresponding to specific needs and priorities of the country and, through that route, contribute to necessary global transformation (ibid.).

Although science has always been embedded in society, presently, there is a need for deep engagement to address sustainability issues and achieve the 2030 Agenda targets. There is a need to establish a factual basis, anticipate future consequences, and contribute to finding creative and transformative solutions for transitioning to sustainability. The problems are increasingly complex, complicated, and even wicked, which cannot be addressed by fact-based decision-making alone (GSDR, 2019). It requires a larger frame and systems perspective that can internalise social-ecological interactions. Therefore, the present emphasis

is on science- society co-learning mechanisms. Collaboration between science and technology personnel and societal actors at local, thematic, city, and national level is necessary to innovate sustainable solutions and develop, test, and practice new paradigms of development without compromising the ecology and equity dimensions. The UN 2023 Global Sustainable Development Progress report recognised that 'the potential for science, technology, and innovation to be applied to the Sustainable Development Goals is vastly untapped, and the institutional and other barriers that stand in the way of science, technology, and innovation progress must be recognised and lowered' (p: 56).

Kerala, covering 1.18% of India's land area and 2.56% of the country's total population (2011) and lying in the south-western corner of the Indian Peninsula, has carved out a niche for her achievements in the social sector and human development, primarily due to public action and affirmative government policy. Performance in demography, health, and education sectors has put the state on firm footing to strive for sustainable development (Parayil, 1996; 2000; Chattopadhyay and Franke, 2006, Isaac and Franke, 2021). The state is also well known for various innovative ideas like the People's Plan Campaign (PPC) for decentralised planning, civil society participation in development planning, and various other environmental safe-guarding actions. It has the distinction of meeting all Millennium Development Goal (MDG-2015) targets well in advance (Government of India, 2017). The state ranks first in India under the Sustainable Development Goals index as computed by the NITI Aayog and also in several other indices.

Table 1 Selected human development indicators of Kerala and India

Sl. No	Indicators	Kerala	Rank of Kerala in India	India
1	Population growth rate (annual) (2001-2011)*	0.48	1	1.63
2	Life expectancy at birth (2011-2015)*	75.2	1	68.3
3	Life expectancy-Female (2011-2015)*	78.2	1	70.0
4	Infant Mortality Rate (IMR) per 1000 live births (2016)*	10	1	34
5	Maternal Mortality Ratio (MMR) per lakh live births (2020)**	43	1	113
6	Literacy (2011)@	93.91	1	74.04
7	Female literacy (2011)@	91.98	1	64.6
9	Sex ratio (2011)@	1084	1	943
10	Incidence of poverty (2013)$	7.05	2	21.92
11	Human Development Index (HDI) (2019)#	0.782	1	0.645
12	Sustainable Development Goal Index	75	1	66
13	Per capita income (PPP INT$) 2019-20	11,153	9	7,333

*Source: *Health and Family welfare statistics in India, 2017; ** UN-NITI Aayog, 2021 @Census of India; $Reserve Bank of India, 2013; # Sub-national data base, Global Data Lab, hdi.globaldatalab.org; PPPINT$- Purchasing Power Parity in International dollar following conversion rate of IMF*

Kerala's resilience in the face of incidence of the Nipah virus in 2017, flood disaster in consecutive years of 2018 and 2019, and the unprecedented pandemic of Covid-19 in 2020 and 2021 drew worldwide attention and commendation. However, Kerala also faces a series of challenges related to demographic transition, aging, migration, unemployment, lifestyle diseases, declining productive sectors, and issues related to the human dimension of environmental change, including the impact of climate change and sea level rise. The ecological services that facilitated Kerala mode of development appear to be declining.

The development trajectory, hitherto followed and found to have brought out significant positive changes in Kerala society, perhaps warrants revisit in view of all-round change in all sectors that the state is undergoing, increasing planetary pressure, development gaps, and aspirational change of the new generation. In this context, innovation-driven development and knowledge-based action assume great significance for Kerala's growth and transformation, which is well recognized by the Government of Kerala (Government of Kerala, 2021). The Kerala Development and Innovation Strategic Council (K-DISC), a think-tank organisation established by the Government of Kerala, promotes innovations to cater to the present needs of Kerala. Some of these initiatives have brought out interesting results, that have the potentials to strengthen Kerala's journey towards sustainable development. The present paper aims to discuss some of the issues raised here and tries to highlight the innovation initiatives that the state has introduced at present.

2.0 Environmental challenges in Kerala

Kerala is experiencing rapid change in environment and also in social sector. These changes bring fundamentally a new set of challenges that cannot be simply viewed as a continuation of past concerns about the environment and sustainability. The changes reflect the human pressure on earth system processes that are local and also planetary, affecting the regenerative capacity of the biosphere. The changes and their impact are spatially differentiated and therefore warrant location specific understanding and appropriate intervention measures to ameliorate the situation. While the coastal area and lowlands are facing sea surge, floods, and the impact of sea level rise, the midlands are facing problems of productivity, water shortage, and the highlands are experiencing landslides and slope failure. Around 14 percent of the total area of the state is flood prone; 10 percent area is landslide prone; nine districts bordering the coastline are exposed to various coastal hazards; and there is recurrence of

drought severely impacting agriculture and drinking water conditions. There is also human wildlife conflict. Safe operating space in the state is decreasing over the years.

There is little debate about rising temperatures, which are now hovering around 1.5oC across the state (Gopakumar, 2011). Rising temperatures have serious implications on primary productive sector. Fast growth of urban centres has cascading impacts on temperature rise through urban heat islands with the expansion of surfaced areas and following the construction boom. As the ambient temperature is rising, there is a high consumption of electricity to run air conditioning machines. This affects in two ways. The higher demand for electricity will compel the state to draw from the national grid, which depends on coal-based production for the bulk supply. Secondly, the released heat from the houses will further contribute to increasing temperature. Besides temperature, there is an emerging problem related to rainfall, whose trend and pattern show perceptible change. The peak rainfall month is shifting. High-intensity rainfall interspersed by intervening dry periods now characterises the monsoon months. Droughts often follow floods. The incidence of climate-related disasters is on the rise. Storm surges and tidal flooding affect many areas along the coast. Sea level rise will further complicate this situation, particularly along the coastal tracts. Changes in land, land use, and water regime are major causes of concern. Loss of biodiversity, encroachment on river banks and wetlands, floodplain occupancy, removal of floodplain materials, river bed mining, cutting down of riparian vegetation, deterioration of ponds, tanks, and lakes all together reduce the water retention capacity of the state.

Deterioration of water quality is an alarming issue, which can severely impact human health and impinge upon the economy. The water-borne diseases increased by 35.6% from 2012 to 2016 in the state. Kerala's case of relatively better performance in the development sector during the past couple of decades but the growing deterioration of water quality is contrary to that hypothesized through the Environmental Kuznets Curve (Chattopadhyay, 2020). The drivers of these changes are primarily anthropogenic, and therefore require interventions at different levels, from individual to state, which is primarily a governance challenge.

3.0 Spatial gap in social and human development

The Kerala model is well appreciated for its potential to emerge as an alternative development narrative, however, there are certain limitations as indicated in some quarters. One of the issues often debated is that the general discussion on the 'Kerala Model' is mostly

based on aggregate average data with little reference to the spatial disparities. There are outlier communities lagging behind the central tendency, and certain social groups seem to have been bypassed (Kurien, 1995; Kabir, 2010; Chakraborty et al., 2010). Examining spatial variability of social development based on 25 indicators, it is found that life expectancy and male literacy are spatially most equitable, whereas, the population growth rate is most variable (Chattopadhyay, 2019). The distribution of SC and ST populations also varies widely. This analysis has brought out three broad trends in the context of spatial variability: (i) There is a north Kerala (Malabar) and south Kerala (Travancore) divide, which is primarily a product of political geography. The northern part still bears the brunt of colonial rule. (ii) The second factor is related to physiography. The topographic grain of the state is longitudinal. The settlements are ribbon-like and in a continuous chain from one end of the state to the other end along the coastal plain and midlands. The degree of development performance diminishes from the coastal plain in the west to the highland region in the east. The areas characterised by rugged topography and steep slopes are found to be lagging behind. (iii) The third factor underpinning spatial variability is related to the concentration of social communities. The fishing community lives mostly along the coast and backwaters. They are lagging behind compared to other communities living in adjoining areas. Similarly, a high concentration of SC ST populations is found in the interior districts within the Western Ghats. Apart from these locational factors, privatisation of education and health sectors has enhanced spatial variability. On one hand, government services tend to reach the deprived areas and reduce spatial disparity, on the other hand, growing private investment contributes to spatial inequality. This trend has increased, especially after globalisation/ economic liberalisation. The government's withdrawal from social service sectors may worsen the situation. Future challenges of social resilience in Kerala will be to reduce these spatial disparities.

Human environment relationship varies spatially. The spread of human settlements irrespective of land character has brought serious challenges both in the case of natural resource management, and also for service delivery. Future development initiatives in Kerala need to take these issues into account.

4.0 Kerala's position under SDG in India

The UNDP-NITI Aayog report (Government of India 2021 a & b) noted that India's overall SDG index stood at 66, ranging from 52 for Bihar to 75 for Kerala. The index is computed on

a scale of 0 to 100 for each goal and also for the composite index, aggregating all goals together. The States and Union Territories are divided into four groups: aspirants (0 - 49), performers (50 - 64), front runners (65 - 99), and achievers (100). Fifteen states fall in the category of frontrunners with a composite SDG index of 65 and above. Although, Kerala recorded the highest overall SDG index, disaggregating the data for each of the 16 SDGs, it is found that Kerala occupies the top position only in the case of SDG 2 (zero hunger) and SDG 4 (quality education). Both these goals are part of the human development sectors, for which Kerala, traditionally, has an edge over other states in the country. In fact, Kerala falls under the category of 'Performing' states with an SDG index value of <65 for SDG 5 (Gender equality), SDG 8 (Decent Work and Economic Growth), and SDG 9 (Industry, Innovation, and Infrastructure). Among all 16 SDGs, Kerala recorded the lowest score (60) for SDG 9.

Table 2: SDG for development sectors and Kerala's position

| SDG	Development sector	Kerala, index (Rank)	Highest index attained and (State)
SDG 1	No poverty	83 (III)	86 (Tamil Nadu)
SDG 2	Zero hunger	80 (I)	80 (Kerala)
SDG 3	Good health and well being	72 (XIV)	86 (Gujarat)
SDG 4	Quality education	80 (I)	80 (Kerala)
SGD 5	Gender equality	63 (II)	64 (Chhattisgarh)
SDG 6	Clean water and sanitation	89 (VIII)	100 (Goa)
SDG 7	Affordable and clean energy	100 (I)	100 (15 states)
SDG 8	Decent work and economic growth	62 (XII)	78 (Himachal Pradesh)
SDG 9	Industry, Innovation and Infrastructure	60 (IX)	72 (Gujarat)
SDG 10	Reduced inequality	69 (XIII)	78 (Himachal Pradesh)
SDG 11	Sustainable cities and communities	75 (XVII)	91 (Punjab)
SDG 12	Responsible consumption and production	65 (XXIII)	99 (Tripura)
SDG 13	Climate action	69 (II)	70 (Odisha)
SDG 14	Life below water* (for coastal states only)	53 (VI)	82 (Odisha)
SDG 15	Life on land	77 (VI)	93 (Arunachal Pradesh)
SDG 16	Peace, justice and strong institutions	80 (V)	86 (Uttarakhand)
SDG 17	Partnerships to the goals	Not computed at the state level	

Based on increase in area under mangrove and development of aquaculture only. Quality of coastal waters not considered due to lack of a fixed standard

Source: NITI Aayog (2021): SDG India Index and Dashboard 2020-21, Partnerships in the decade of action. Government of India, New Delhi.

5.0 Innovation index of Kerala

Innovation score of Kerala was 30.58 against the all-India average of 35.59 as evident from sustainable development goal index computed by NITI Aayog (Government of India, 2021). Karnataka, with an innovation score of 42.50, is the leading state in India. While the correlation between human development index and innovation score is weak, the SDG index has a moderately positive correlation (r= 0.49) with innovation score.

Fig 1. Correlation graph SDG composite index and innovation score. Fifteen front runner states have been considered.
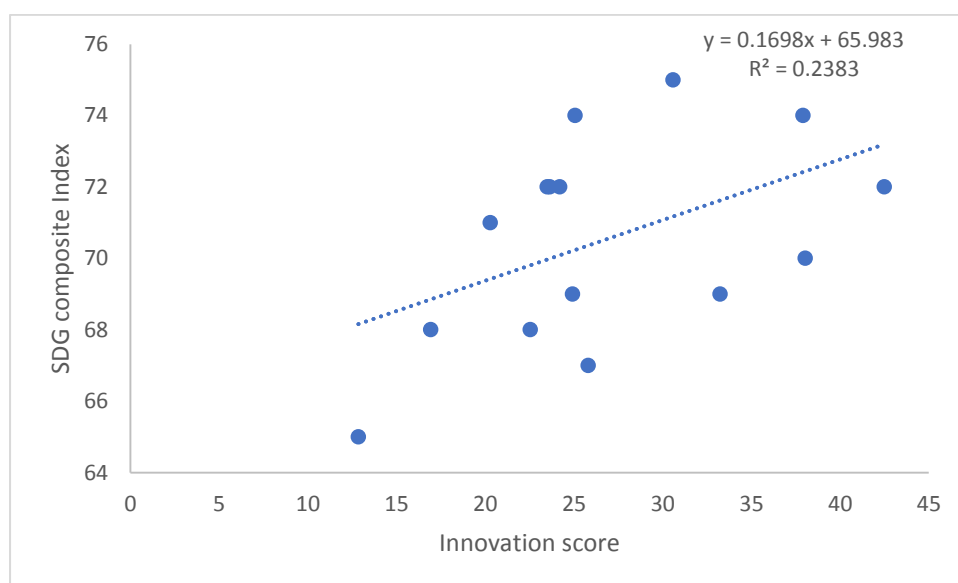

The recent innovation survey data is not comparable with that of the previous survey. Nevertheless, the present situation deserves attention. India's performance is appreciable in the global innovation index. The country has moved from the 60th position in 2017 to the 46th spot in 2021 (Kapoor and Sinha, 2022). Based on 50 indicators grouped under five pillars, namely, human capital (15 indicators), investment (6), knowledge workers (6), business environment (15), and safety and legal environment (8) under the enabler dimension, and 16 indicators grouped under two pillars, namely, knowledge output (9), and knowledge diffusion (7) under the performer dimension, it is found that Karnataka tops the list with an 18.01 India innovation score and Kerala with an India innovation score of 13.67 ranks 8th among the major states in India (Fig 2). The enabler index score of Kerala is 18.17, and that for the performer is 9.17. Kerala is underperforming and using only 50% of her capacity for innovation as manifested in the efficiency level (0.505) worked out as the ratio

between performance index (9.17) and enabler index (18.17). Apart from human capital, Kerala has not shown much improvement in other pillars. However, there are significant achievements in the case of start-ups and entrepreneurs, as the state ranks first in the country in these two cases (John, 2021). The state has to take special initiatives both in the case of knowledge output and knowledge diffusion.

There are certain criticisms about the formulation of the India Innovation Index and the indicators used for the purpose. The present innovation index is largely industry-oriented and higher education-centric. Such an approach inspired by the developed countries is being questioned (Fargerburg et al., 2010). It is now argued that the relationship between innovation and development can not be properly understood if looked through only the industry and high-tech lens. Innovation is a powerful force for growth; however, to consider it only from the perspectives of developed countries or ignore the innovative ideas generated at the local level by the people to sustain their livelihoods may not be appropriate and will bring a partial picture. Globally, there is a conceptual shift, and the other dimensions of innovations are now recognised. This point is further discussed in the following section, and the K-DISC initiatives are positioned within the ambit of the changed paradigm. (Fig-2).

Fig 2: Innovation score under different pillars
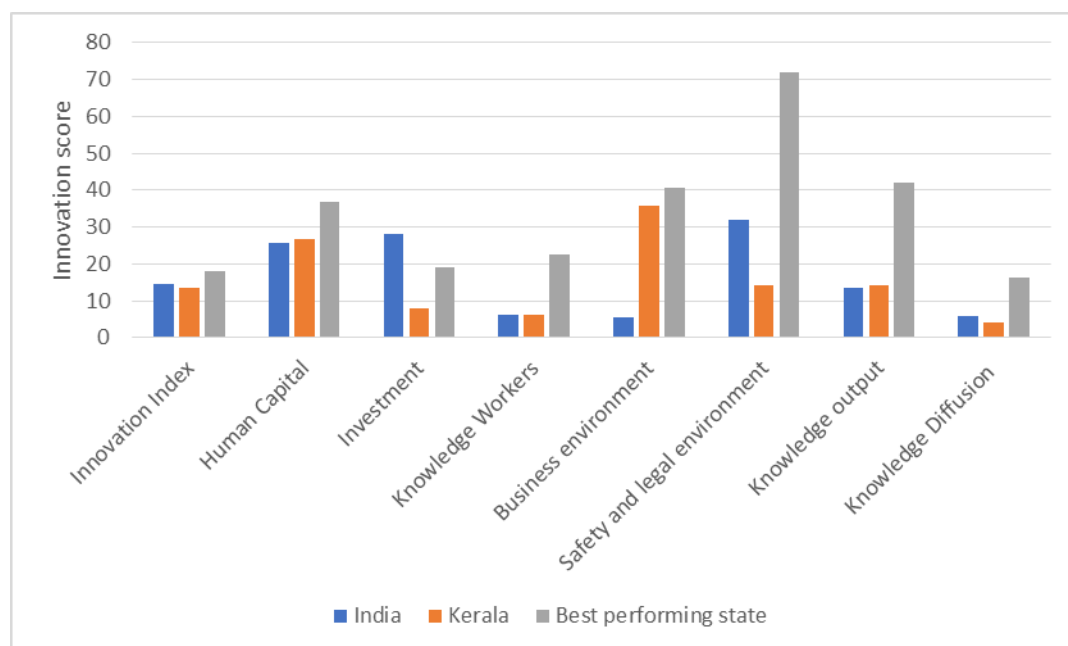
6.0 Innovation and Sustainability

Innovation is a normal human endeavour, part of the evolutionary process of human civilisation. It may be construed as an attempt to try out new or improved products, processes, or ways to do things and includes not only technological new products and processes, but also improvements in areas such as logistics, distribution, and marketing (Fargerburg et al., 2010). The transformation of ideas into innovation requires a flow of information, technology, and experience among the various stakeholders necessitating an innovation ecosystem. An innovation ecosystem is the evolving set of actors, activities, and artefacts, and the institutions and relations, including complementary and substitute relations, that are important for the innovative performance of an actor or a population of actors (Granstrand, and Holgersson, 2020). There are several studies highlighting the importance of innovation for sustainable development and their close relationship (Kuzma et al., 2020; Huang, 2021). Innovation is an important development mechanism, especially if encouraged by public policy or voluntary initiatives, and has now emerged as a main tool for achieving sustainability (Adams et al., 2015). There is a bidirectional causal relationship between economic growth and innovation. The role of innovation in sustainable development is well recognized both at the central and state government levels (Government of India, 2020; Kerala State Planning Board, 2021).

Considering the pursuit of environmental, economic, and social development, the three pillars of sustainable development, the spectrum of innovation encompasses all branches of knowledge - natural sciences and engineering, life sciences and medicine, social sciences and humanities, law, and more - and also organisations. Innovations should generate positive economic, social, and environmental outcomes in tandem and gradually, they should be mainstreamed. Organisation is an important component in the innovation ecosystem. The ability to propose innovative product, service, or process solutions is a valuable skill and can be converted into a range of valuable organizational resources. Therefore, higher levels of innovation imply significant and positive effects on the performance that the organization obtains in the environmental, social, and economic dimensions of sustainability. In a resource-constrained world, society will have to grapple with the question of proper resource allocation for development. The practice of promoting innovation at the grass roots is necessary to fully utilise the full potential of the indigenous knowledge bases by engaging the local communities in the process and applying cutting edge science and technology to solve

local problems. The recent paradigm of innovation shifted from mere technological innovation towards a broader dialogue between scientific research, technological innovation, and social development (Stilgoe et al., 2013). Moreover, besides achieving scientific and technological progress and economic growth, the goals now aim for ethical and social fulfillment, therefore achieving a sustainable transformation (Pandza & Ellwood, 2013). The enabling environment for sustainable development also requires community-led initiatives and multi-stakeholder partnership through collaborative innovation (Dzhunushalieva and Teuber, 2024). A holistic innovation ecosystem is expected to internalise all these dimensions and provide creative and transformative solutions, necessary for sustainability. There are four core elements in a holistic ecosystem: strategic, total, open, and collaborative (Chen, Yin and Mei, 2018). Holistic innovation ecosystem tries to integrate convergent thinking of natural sciences and divergent thinking of social sciences under a common strategy.

7.0 KDISC Innovation Initiatives

The Kerala Development Innovation Strategic Council (K-DISC) concentrates on non-linear innovation policies with the objective of building a holistic innovation ecosystem in the state (Sekhar and Unnikrishnan, 2023). It has taken up several initiatives for innovation. We shall discuss here 3 of them, namely, YIP (Young Innovators' Programme), OLOI (one local government, one initiative), and RTD (Recruit, Train, and Deploy) programme. While YIP is mainly for student teams, the OLOI concentrates on empowering local self-government organisations, and the RTD is primarily meant for engineering college students. These programmes attempt to address heterogeneous social spaces and try to integrate knowledge produced in various domains of society. In all the cases, the thrust is on problem solving drawing from local as well as global knowledge bases. Together, these three programmes have the potential to engineer mega change in Kerala's development trajectory.

7.1 Young Innovators Programme (YIP)

This flagship project of K-DISC is perhaps one of the most innovative initiatives to democratise innovation and integrate real-life problem-solving methodology into the curriculum of student teams in the age-group from 13 to 37. Building around 30 themes covering almost all the sectors, from agriculture to age related issues and education, this project aims to instil critical thinking in young minds, and expose them to innovation methodologies, ideation, and entrepreneurship. Innovations by Youth with Disability (I-

YwD) are also brought under this initiative. The YIP partner ecosystem now spreads over 8049 institutes under the government, government aided and private sectors covering schools, colleges, university departments, professional colleges, research institutes, skill training centres and other such educational institutes. Schools comprise around 75% of these institutes. There were 60 participants under the category of Innovations by Youth with Disability cohorts. Female members formed 22% of this group. There were also initiatives to file patents. There is also an initiative to organize YIP club involving schools, colleges, and other stakeholders to address a common problem. This programme is in tune with the UN CRC (1989) proclamation to recognize young people as valuable members of communities with the right to express their views and have those views considered by others, including governments and other authorities. Involving school students in the YIP club will facilitate exercising their rights in many ways and meaningfully engage them with adults and adult-led organizations for innovation in partnerships. It will also pave the way to maximize young people's agency within social and political structures; transform adult and institutional perceptions of young people in dialogue with young people; and generate new policy processes and organizational forms (Swift and Collin, 2021).

7.2 One Local Government One Idea (OLOI)

The 'One Local Government, One Idea' (OLOI) programme aims to empower local self-government institutions (LSGIs) in Kerala through local-level innovations. It has succeeded in create an ecosystem for nurturing ideas generated from the grass-roots level. So far, training has been imparted to 19,603 persons at different administrative levels. Elected representatives comprise around 40% of trained personnel. Organisational set-up formed for the purpose includes the National Consultative Group (NCG), Bottom-Up Consultative Group (BCG), and District Innovation Councils to nurture innovation at the district and sub-district levels. A Community of Practices (CoP) has been formed with over 1500 experts across 27 themes. A Social media platform named 'Noothakam' was also set up for facilitating discussion among CoP members. There is also an online platform developed for local self-government institutions (LSGIs) to submit developmental issues that require innovative solutions. The pilot phase focuses on 12 distinct problems falling under 8 thematic areas submitted by 60 LSGs, shortlisted from the problem statements originally proposed by 215 LSGs. These themes encompass problems such as sanitation in water-logged areas, priorities for the elderly, enhancing the support system of Buds Schools, tackling

unemployment, addressing bird flu concerns, resolving market-related issues related to agricultural products, improving clam processing methods, addressing aqueduct depletion, managing flooding challenges, enhancing liquid waste management, and ensuring access to safe drinking water. Support of the domain institutions was ensured to curate the problems submitted by LSGIs considering the current situation of the problem, needs, preferences, and aspirations of the beneficiaries, and to define the scope and boundaries of the problem. There are arrangements for review by expert panels and preparation of a Detailed Project Report (DPR). The goal is to identify and implement innovative solutions that can effectively address the pressing issues, thereby enhancing community well-being and promoting sustainable development. Solution-hunting hackathons focusing on themes like waste management and elderly care are currently underway. From the initial submissions for waste management solutions, 30 were selected for the final round, with 6 projects being shortlisted for further development. The Elderly Care Hackathon is underway with support from administrators.

As a part of building the Block Innovation Clusters, 498 institutions have been identified in 14 districts. District-wise CoP meetings were conducted in all 14 districts, and necessary measures were taken to communicate the concept of the innovation ecosystem and to initiate the operationalization of the CoP ecosystem in close cooperation with the Kerala Institute for Local Administration (KILA).

7.3 Recruit, Train, and Deploy

This programme is conceived to integrate skill enhancement, and solutions for real-life problems into engineering curriculum. It holds immense potential for shaping highly competent professionals. For the overall growth of students as knowledge workers of today, it is imperative to develop basic skills like collaboration, critical thinking, and analytical capabilities. Incorporation of innovation and real-world problem-solving into the curriculum can facilitate the development of these skills. Integrating real-life problem-solving activities ensures that engineering graduates become proficient in applying their skills to tackle complex challenges effectively. RTD programmes further augment this by providing practical training and exposure to real- world scenarios, preparing students for the demands of the professional sphere. By embracing these opportunities, engineering education can produce graduates who are knowledgeable and equipped with the practical skills and mindset necessary to thrive in dynamic and evolving industries. It is proposed to have a two-

dimensional approach-a stream of compulsory courses for the development of basic skills required for all engineering professionals and another stream of elective courses for developing skills required for making them employable. The first stream can be positioned in the form of Community-engaged learning (CEL) a pedagogical approach that integrates academic content with real-world community needs, which is gaining momentum on various campuses. The second stream can be integrated with the Recruit Train Deploy (RTD) programmes, linking it with the industry elective courses and internships. The programme includes execution of social innovation projects as part of the course work from the beginning of the course.

The K-DISC initiatives are potent to trigger the transformational change and system-level interventions, that are essential to meet the challenges ahead. Societal stakeholders, including companies, will need to pool resources and share knowledge in increasingly productive partnerships that stretch across and between value chains. This new paradigm needs to incorporate a number of aspects, like vision and leadership, multi-level focus, value chain integration, stakeholder involvement, and integration with the 4IR.

8.0 Conclusion

Kerala is experiencing intense change in environment, development, and people's aspirations. While the state has achieved significantly in some of the sustainable development goals, especially, related to social sectors, in the case of several other goals, the state has to take further initiatives. There are spatial gaps in human development, and several issues related to the environment, including climate change impact. The present set of problems requires innovation led solutions. As innovation for sustainability has to occur at the same time on multiple levels and in different dimensions, a holistic innovation ecosystem approach is necessary. In this context, the K-DISC initiatives are significant and hold high potential. The lessons are also useful for other states as well.

Acknowledgement

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