

International Conference on Innovation Driven Economic Growth in Asia focusing on India

November 27-29, 2019

Venue

Goa University, Taleigao Plateau, Goa

ABSTRACTS

Edited by : Prof. Mohsin Ullah Khan

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(1st July 1920 - 24th August 2016)

Dr. A. R. Kidwai

**Past Chairman,
Zaheer Science Foundation
Formerly Governor,
Bihar, West Bengal & Haryana
Ex Member,
Rajya Sabha
Ex Chairman,
UPSC**



Chairman
Zaheer Science Foundation,
4, Udyan Marg, New Delhi 110001

MESSAGE

I am happy that Zaheer Science Foundation is organizing Conclave of scientists on “Innovation driven economic growth in Asia focusing on India” to be held on November 27-29, 2019 at Goa University, Goa.

The conclave will be attended by more than 50 delegates from Russia, Finland, Australia and Kuwait, who will present very useful papers of topical interest based on their research experience covering a wide gamut of emerging areas of science & technology. In fact the conclave will go a long way in fulfilling the mandate of Zaheer Science Foundation for the promotion of science and technology in the Country, namely meeting the challenges and utilizing the opportunities which have emerged from the globalization of the world economy. It will also promote greater understanding and interaction between the scientists, educationists and parliamentarians of the region covering Russia and Europe.

I take this opportunity to thank the sponsors of the Conclave namely, Department of Science and Technology (DST), Council of Scientific and Industrial Research (CSIR), New Delhi, Knowledge and Awareness Mapping Platform (KAMP), Noida, ALM Industries Limited, Saharanpur, U.P. which is being organized in partnership with UNESCO regional Office, New Delhi. I would like to thank all the members of the Governing Council for their help and support they have extended to make the two ends meet. I would also like to express my gratitude towards Ms. Kamaljeet Kaur and Ms. Suman Gulalia for all the secretarial assistance in organizing this prestigious international conference without their cooperation it was not possible to achieve this huge task.

A handwritten signature in black ink, appearing to read 'Mohsin Ullah Khan'.

(Mohsin Ullah Khan)

S.N.	CONTENTS	Page No.
1.	Chairman's Message	3
2.	Technical Program of the Conference	7-16
3.	Government Interventions in Promoting Innovation Driven Economies in Asia Focusing on India <i>Mohsin U Khan</i>	17
4.	Innovation based start-ups for economic growth <i>KSMS Raghavarao</i>	18
5.	Public-Private Partnership and Technology for Sustainability: Case Studies <i>Amitava Das</i>	19
6.	Tracing the ecosystem for start-ups in India: Analysing opportunities and challenges <i>Tabassum Jamal, Kasturi Mandal, Avinash Kshitij</i>	20-21
7.	A path to leadership in innovation for a developing country in Asia <i>Oleg Golichenko</i>	22-23
8.	Research Publications and Commercialization of Patents Generated by the Academic Sector in India <i>Rupinder Tewari, Mamta Bhardwaj, Amandeep Sandhu</i>	24-25
9.	Government Mediated R&D Incentivization of Private Sector in India: A Case Study <i>Radhika Trikha, RupinderTewari</i>	26
10.	Intellectual Property protection and Innovations are key for Socio Economic Development of Nations. <i>H. Purushotham</i>	27
11.	Role of Intellectual Property Rights in Technology Transfer from University Innovation System Policy Opportunities in India <i>B K Sahu</i>	28-29
12.	Path-Dependence Effect in Science and Technology Policy: Case of Russia <i>Svetlana Kirdina-Chandler</i>	30-31
13.	Dual Chain for Technology Innovation and Intervention <i>Sandeep Singhai, HK Sardana and Ritika Singh</i>	32-33
14.	Developing Strategy for Exploiting Intellectual Property Rights for Innovation, Entrepreneurship and Development: A Case Study of India's National Intellectual Property Rights Policy 2016 <i>Sujit Bhattacharya and Umang Gupta</i>	34-35

15.	A case study on strengthening Transnational Research Ecosystem in India <i>Mamta Bhardwaj</i>	36
16.	How is China Planning to become the Global Innovation Superpower? <i>H.R Bhojwani</i>	37
17.	Need for S & T Interventions & Reforms in School Education in India <i>Puneet Kumar</i>	38-39
18.	Strategies for food security and viability of Indian agriculture under changing climatic conditions <i>Rajvir Singh Rathore</i>	40-41
19.	An ICT Policy for the University System and Some ICT-based Innovations <i>Zahid H. Khan</i>	42-44
20.	An Overview and Future Perspectives on Digitalization and STI and Education Policies in Industrialized and Developing Economies <i>Torsti Loikkanen</i>	45
21.	The impact of ICT technologies on local communities' organization <i>Solosina Maria</i>	46-48
22.	Uneven distribution of ICT technologies in Asia and Russia <i>Shchepina I. N</i>	49-51
23.	Development of molecular methods to control microorganisms in food and beverages <i>Syromiatnikov M.Y., and Popov V.N.</i>	52-53
24.	Role of Symbiotic Nitrogen Fixation in Global Food Security <i>M. Irfan Qureshi</i>	54
25.	The study of the socio-environmental conditions of the cities of Russia and India, affecting the sustainable development of the territory. <i>Sergei A. Yeprintecv</i>	55
26.	Different Source of Irrigation and Cropping Pattern: A Study of Determinants and Productivity <i>L.Krishnan and R.Ravikumar</i>	56-57
27.	Tariff Estimation for Sustainability in Rural Water Supply: A Case Evidence from Rural Households of Coimbatore District, Tamil Nadu, India <i>R. Manikandan</i>	58-59
28.	Innovation for a low carbon, climate resilient and green development <i>Ram Boojh</i>	60-61

29.	Transforming S&T Policy in India: Changing dimensions and emerging challenges <i>Naresh Kumar</i>	62-71
30.	R&D ecosystem for innovation in the Renewable Energy Sector in India: The case of Marine Energy <i>Avinash Kshitij, Kasturi Mandal and Tabassum Jamal</i>	72-73
31.	Nanotechnology and Emerging Health Safety and Environment Issues <i>Mirza Umair Beg</i>	74-75
32.	Technological Solutions to Manage Solid Wastes: Innovative Treatment of Biowastes around the Source of Generation <i>R.S. Praveen Raj</i>	76
33.	Nutritional Status of Pre-School Children: A Comparative Study <i>Urmila Bhaina and Harapriya Samantaraya</i>	77
34.	Environmental mercury discharged from a chlor-alkali industry and its impact on terrestrial and biotic systems at the contaminated site, Ganjam. <i>Jhilli Prabha Prusti and A. K. Panigrahi</i>	78-79
35.	Climate Change Impacts on Agriculture and Food Security <i>Fahima Khanum</i>	80-81
36.	Policy framework for promoting medical innovations for access to health: The initiatives of the Indian Council of Medical Research, Department of Health Research, New Delhi, India <i>Sadhana Srivastava</i>	82
37.	Prosperity and Depression – the Growth Performance of Innovative Capitalism <i>Ulrich Witt</i>	83
38.	STI policies, national innovation system and framework conditions: Their impacts on innovation performance in Hungary <i>Attila Havas</i>	84-85
39.	Measuring Public Innovation in Europe. The Starpin Methodology <i>Annaflavia Bianchi</i>	86-89
40.	First Announcement	90-95
41.	List of Delegates	96-102

Technical Program

International Conference on

“Innovation driven economic growth in Asia focusing on India”
Organized by Zaheer Science Foundation in collaboration with
Goa University. In partnership with UNESCO

November 27- 29, 2019

Venue: Goa University, Taleigao Plateau, Goa

Technical Program

Program will comprised of invited lectures, contributed papers presentation and extensive discussions

First Day, Wednesday 27 November 2019

(Venue: Goa Business School Auditorium, Goa University)

9:30-10:00	Registration
10:00-11:00	Opening Session
	Welcome Address:
	Prof. Mohsin Ullah Khan Chairman, Zaheer Science Foundation Professor, Plekhanov Russian University of Economics, Moscow, Russia
	Opening Addresses
	Dr. G. Thyagarajan Formerly Director CSIR Labs & Member ZSF Governing Council New Delhi
	Dr. Akhilesh Gupta, Head- Policy Research Cell Department of Science & Technology, Government of India, New Delhi
Chair	Prof. Varun Sahni, Vice Chancellor, Goa University, Goa

	Dr. Shekhar C. Mande, Secretary, DSIR and Director General, Council of Scientific & Industrial Research, Government of India, New Delhi
Chief Guest	Sh.Satya Pal Malik Hon'ble Governor of Goa State, Goa
	<i>Vote of Thanks</i>
	Prof. P K Sudarsan Vice Dean, Goa Business School, Goa University, Goa
11:00 -11:30	High Tea
11:30-1:00	<i>Session 1</i>
<i>Science, Technology and Economic Development</i>	
	Chair: Dr. G. Thyagarajan, Formerly Director CSIR Labs & Member ZSF Governing Council New Delhi
1	Speaker: <i>Dr. Akhilesh Gupta, Head- Policy Research Cell Department of Science & Technology, Government of India, New Delhi</i> Title: Science, Technology and Innovation ecosystem in India: current status and way forward
2	Speaker: <i>Prof. Mohsin Ullah Khan, Chairman, ZSF Professor, Plekhanov Russian University of Economics, Moscow, Russia</i> Title: Government Intervention in promoting innovation driven economics in Asia focusing on India
3	Speaker: <i>Dr. KSMS Raghavarao, Director, CSIR-CFTRI, Mysore, India</i> Title: Innovation based start-ups for economic growth

4	<p>Speaker: <i>Dr. Amitava Das, Director, CSIR-Central Salt and Marine Chemicals Research Institute, Bhavnagar, Gujarat</i></p> <p>Title: Public-Private Partnership and Technology for Sustainability: Case Studies</p>
5	<p>Speaker: <i>Dr. Tabassum Jamal, Formerly Chief Scientist NISTADS, New Delhi & Member Governing Council, ZSF</i></p> <p>Title: Tracing the ecosystem for start-ups in India: Analysing opportunities and challenges</p>
6	<p>Speaker: <i>Dr. Manoj Kumar Patairiya, Director CSIR-NISCAIR, New Delhi, India</i></p> <p>Title: Promoting the Spirit of Innovation</p>
1:00-2:00	Lunch Break
2:00-3:30	Session 2
Technology Commercialization	
	Chair: <i>Dr. H. R. Bhojwani, Formerly Head Technology Utilization, CSIR, New Delhi, India</i>
1	<p>Speaker: <i>Prof. Oleg Golichenko, Chief Research Associate of the Central Economics and Mathematics Institute of Russian Academy of Sciences, Moscow, Russia</i></p> <p>Title: A path to leadership in innovation for a developing country in Asia</p>
2	<p>Speaker: <i>Prof. Rupinder Tewari, Coordinator at DST-Centre for Policy Research at Panjab University, Chandigarh</i></p> <p>Title: Research Publications and Commercialization of Patents Generated by the Academic Sector in India</p>
3	<p>Speaker: <i>Dr. Radhika Trikha, Sr. Scientist-D, Assistant Coordinator DST-Centre for Policy Research, Panjab University, Chandigarh</i></p> <p>Title: Government Mediated R&D Incentive of private sector in India: A case study.</p>

4	<p>Speaker: <i>Dr. H. Purushotham, Head, National Research Development Corporation, DSIR Enterprise, Ministry of Science and Technology , Govt of India</i></p> <p>Title: Intellectual Property protection and Innovations are key for Socio Economic Development of Nations.</p>
5	<p>Speaker: <i>Dr. B K Sahu, Manager & Head, National Research Development Corporation, DSIR Enterprise, Ministry of Science and Technology, Govt of India</i></p> <p>Title: Role of Intellectual Property Rights in Technology Transfer from University Innovation System Policy Opportunities in India</p>
3:30-3:45	Tea/Coffee Break
3:45-5:00	Session 3
Science and Technology Policy	
	<p>Chair: Prof. Zahid H. Khan, Former Professor of Physics and Director/ Advisor, FTK Centre for Information Technology, Jamia Millia Islamia (a Central University), New Delhi, India</p>
1	<p>Speaker: <i>Dr. Svetlana Kirdina-Chandler, Head of Sub-Division for Evolution Social and Economic Systems, Institute of Economics, Russian Academy of Sciences, Moscow, Russia</i></p> <p>Title: Path-Dependence Effect in Science and Technology Policy: Case of Russia</p>
2	<p>Speaker: <i>Dr. Sandeep Singhai, Principal Scientist, CSIR-CSIO, Chandigarh,</i></p> <p>Title: Dual Chain for Technology Innovation and Intervention</p>

3	<p>Speaker: Dr. Sujit Bhattacharya, Chief Scientist CSIR-National Institute of Science Technology & Development Studies, New Delhi & Dr. Umang Gupta, CSIR-NISTADS, New Delhi</p> <p>Title: Developing Strategy for Exploiting Intellectual Property Rights for Innovation, Entrepreneurship and Development: A Case Study of India's National Intellectual Property Rights Policy 2016</p>
4	<p>Speaker: Dr. Mamta Bhardwaj, Sr. Scientist-C, DST-Centre for Policy Research, Panjab University, Chandigarh</p> <p>Title: A case study on strengthening Translational Research Ecosystem in India</p>
7:00	Dinner at The International Centre, Goa hosted by KAMP Noida, Delhi
<p>Second Day, Thursday, 28 November 2019 (Venue: Goa Business School Auditorium, Goa University)</p>	
10:00-11:00	Session 1
<p>Innovation, Environment and Education Impact on Production System</p>	
	<p>Chair: Prof. Rupinder Tewari, Coordinator at DST-Centre for Policy Research at Panjab University, Chandigarh</p>
1	<p>Speaker: Dr. H. R. Bhojwani, Formerly Head, Technology Utilization, CSIR, New Delhi, India</p> <p>Title: How is China Planning to become The Global Innovation Superpower?</p>
2	<p>Speaker: Dr. Anis Ansari, IAS Rtd., Formerly Agricultural Production Commissioner, U.P. Govt., Lucknow</p> <p>Title: Science & Technology Research in Uttar Pradesh</p>

3	<p>Speaker: <i>Mr. Puneet Kumar, Secretary, KAMP (KAMP Planning and Monitoring Committee) Knowledge and Awareness Mapping Platform [KAMP], Noida</i></p> <p>Title: Need for S & T Interventions & Reforms in School Education in India</p>
4	<p>Speaker: <i>Dr. Rajvir Singh Rathore, Deputy Director General, U.P. Council of Agricultural Research (UPCAR), Lucknow</i></p> <p>Title: Strategies for food security and viability of Indian agriculture under changing climatic conditions</p>
11:00-11:15	Tea/Coffee Break
11:15-1:30	Session 2
<i>ICT Policy and its Role in Economic Growth</i>	
	Chair: Prof. Oleg Golichenko, Central Economics and Mathematics Institute of Russian Academy of Sciences, Moscow, Russia
1	<p>Speaker: <i>Prof. Zahid H. Khan, Former Professor of Physics and Director/Advisor, FTK Centre for Information Technology, Jamia Millia Islamia (a Central University), New Delhi, India</i></p> <p>Title: An ICT Policy for the University System and Some ICT-based Innovations</p>
2	<p>Speaker: <i>Dr. Torsti Loikkanen, Senior Researcher and Consultant in Industrial Innovation and STI Policies, Sapar Oy/Ltd, Helsinki, Finland</i></p> <p>Title: An Overview and Future Perspectives on Digitalization and STI and Education Policies in Industrialized and Developing Economies</p>
3	<p>Speaker: <i>Dr. Maria Solosina, Lead Specialist, Interfaculty Research Laboratory of Economics and Management, Voronezh State University, Voronezh, Russia</i></p> <p>Title: The impact of ICT technologies on local communities' organization</p>

4	<p>Speaker: <i>Dr. Yash Pal Kathuria, Secretary, ZSF, New Delhi</i></p> <p>Title: Some aspects of making India a global manufacturing hub</p>
5	<p>Speaker: <i>Prof. Irina Shchepina, Professor, Department of Informational Technology and Mathematical Methods in Economics, Voronezh State University, Voronezh, Russia</i></p> <p>Title: Uneven distribution of ICT technologies in Asia and Russia</p>
1:30-2:30	Lunch Break
2:30-3:30	Session 3
<i>Innovation in Health Safety and its contribution in Economic Development</i>	
	<p>Chair: <i>Dr. Torsti Loikkanen, Senior Researcher and Consultant in Industrial Innovation and STI Policies, Sapar Oy/Ltd, Helsinki, Finland</i></p>
1	<p>Speaker: <i>Dr. G. Narahari Sastry, Director, CSIR-North East Institute of Science & Technology, Jorhat, Assam</i></p> <p>Title: Deciphering the economy of health for healthy economy</p>
2	<p>Speaker: <i>Dr. Mikhail Syromiatnikov, Associate Professor, Department of Genetics, Cytology and Bioengineering, Voronezh State University, Voronezh, Russia</i></p> <p>Title: Development of molecular methods to control microorganisms in food and beverages</p>
3	<p>Speaker: <i>Dr. M. Irfan Qureshi, Associate Professor, Proteomics & Bioinformatics Lab, Department of Biotechnology, Faculty of Natural Sciences, JMI University, New Delhi</i></p> <p>Title: Role of Symbiotic Nitrogen Fixation in Global Food Security</p>
3:30-3:45	Tea/Coffee Break

3:45-5:00	Session 4
Brain Storming Session	
	<p>Moderator: <i>Dr. Mohsin Ullah Khan, Chairman ZSF, New Delhi</i></p> <p>Co-Moderator: <i>Dr. Abdul Wasi Khan, PG Department of Animal Science, Faculty of Applied Sciences, MJP Rohilkhand University, Bareilly</i></p> <p>Title: India's cooperation in Science & Technology Policy with Russia and other developed countries</p>
<p>Third Day, Friday, 29 November 2019 (Venue: Goa Business School Auditorium, Goa University)</p>	
10:00-11:00	Session 1
Environment and Water Resources	
	<p>Chair: <i>Dr. Svetlana Kirdina-Chandler, Head of Sub-Division for Evolution of Social and Economic Systems, Institute of Economics, Russian Academy of Sciences, Moscow, Russia</i></p>
1	<p>Speaker: <i>Prof. Sergei Yeprintcev, Associate Professor, Department of Geoecology and Environmental Monitoring, Voronezh State University, Voronezh, Russia</i></p> <p>Title: The Study of the socio-environmental conditions of the cities of Russia and India, affecting the sustainable development of the territory</p>
2	<p>Speaker: <i>L. Krishnan, Ph.D-Research Scholar, Department of Economics, PSG College of Arts & Science/Bharathiar University Coimbatore, Tamil Nadu.</i></p> <p>Title: Different Source of Irrigation and Cropping Pattern: A Study of Determinants and Productivity</p>
3	<p>Speaker: <i>Dr. R. Manikandan, Assistant Professor, Department of Economics, Bharathiar University, Coimbatore, Tamil Nadu, India.</i></p>

	Title: Tariff Estimation for Sustainability in Rural Water Supply: A Case Evidence from Rural Households of Coimbatore District, Tamil Nadu, India
4	Speaker: <i>Dr. Ram Boojh, Director, Mobius Foundation, New Delhi</i> Title: Innovation for a low carbon, climate resilient and green development
11:00-11:15	Tea/Coffee Break
11:15-1:00	Session 2
<i>Panel Discussion</i>	
<i>Science, Technology & Innovation Policy and its impact on Economic Growth</i>	
	Moderator: <i>Prof. Mohsin Ullah Khan, Chairman, ZSF Professor, Plekhanov Russian University of Economics, Moscow, Russia</i>
	Panelists: Dr. H. R. Bhojwani Dr. Yash Pal Kathuria Dr. Tabassum Jamal Dr. Seema Wahab Dr. Torsti Loikkanen Prof. P K Sudarsan Prof. Reg Henry, Australia
1:00-2:00	Lunch

2:00-3:00	Summing Up
	Prof. Yash Pal Kathuria Prof. Z. H. Khan Dr. Tabassum Jamal
3:00-4:00	<i>Valedictory Address</i>
	Chair: Prof. Mohsin Ullah Khan, Chairman Zaheer Science Foundation
	Address: Mr. Guy Broucke, Section Chief and Programme Specialist, Natural Sciences, UNESCO Office in New Delhi
	Valedictory Address: Dr. T. Ramasami, Former Secretary, Department of Science and Technology, Govt. of India
	<i>Vote of Thanks</i>
	Dr. Yash Pal Kathuria, Secretary, ZSF , New Delhi

GOVERNMENT INTERVENTIONS IN PROMOTING INNOVATION DRIVEN ECONOMIES IN ASIA FOCUSING ON INDIA

Dr. Mohsin U Khan

Chairman,

Zaheer Science Foundation,

4 Udyan Marg, New Delhi-110001

Abstract

India and China are the fast emerging economies in the world. It is more based on technological improvements rather than by using factor inputs such as labor and capital. Recent estimates of total factor productivity growth lend some empirical support to this hypothesis. There are also reports of number of innovations emanating from the two countries. Both the countries have become increasingly integrated with the rest of the world although China has a better record than India. In China the post 1993 acceleration was concentrated mostly on industry, which contributed nearly 60% of China's aggregate productivity growth. In contrast 45% of the growth in India in the second sub-period came from service sector. The presentation discusses science and technology policies of India over the period and analyzes its impact on the growth of Indian economy in various sectors like drugs and pharmaceuticals, aeronautics, R&D services, architectural and engineering services and communication services. Globalization and internationalization of R&D has also played an important role in the economic growth with the large number of foreign companies who have established their R&D Centers in India are filing their patents in India and US.

INNOVATION BASED START-UPS FOR ECONOMIC GROWTH

Dr. KSMS Raghavarao

Director

CSIR-Central Food Technological research Institute,

Mysore 50 020, India

Abstract

Indian Economy and markets are witnessing significant changes, Food processing sector is no exception. 4th Industrial revolution is round the corner. In fact, it is started already in some sectors. However, this revolution is going to be different from the earlier ones especially in terms of variety in industry & services besides speed at which the changes are taking place. Everybody started acknowledging the fact that future belongs to young start-ups, innovation/innovators, disruptive thinking, out of the box thinking. Big industrial giants are collaborating with start-ups round the world. Start-ups and micro scale industry have potential to create large-scale employment in line with the ambitious plans of the Government.

For achieving the objective of establishing successful start-ups, innovation is the key. Total/complete innovation, which are affordable, sustainable over long time and versatile with universal applicability. The effort at CFTRI in this direction will be shared especially in establishing incubation centers in particular and promoting Mysuru as next innovation hub of Karnataka in general. A few cases studies of successful start-ups will also be presented.

PUBLIC-PRIVATE PARTNERSHIP AND TECHNOLOGY FOR SUSTAINABILITY: CASE STUDIES

Dr. Amitava Das

Director

CSIR-Central Salt and Marine Chemicals Research Institute, Bhavnagar, Gujarat

Abstract

In recent times, India has experienced rapid growth and diversification of industries and its structures. Indian government is advocating strongly of 'Self-reliant India' and 'Inclusive Growth', while discussing more emphatically on public-private partnership. Government of this country has increasingly emphasizing the role, as well as the scope for Public Private Partnership (PPP) in taking India to the league of those countries who controls the global economy. It is generally argued that the PPP model is the most favoured model for project execution in India in areas like infrastructure, health and education. However, there are ample scope for implementation of the PPP models for addressing the unmet challenges in other areas too with a clear goal of addressing the issue of employment generation and livelihood improvement.

CSIR- Central Salt and Marine Chemicals Research Institute (CSMCRI) is one of the 38 National Laboratories under the auspices of Council of Scientific Research (CSIR) and in the forefront of those public funded laboratories that has the mandate to work for indigenization of technologies that address the need of the Indian Industries—be it corporate/ Medium/ Small/ Micro Scale Enterprises—while addressing the issue of job creation, livelihood generation and inclusive growth. The most crucial issue is the identification of the problem, setting the roadmap for the implementation and choosing the right industrial partner who has the zeal and ability to translate the technology to a commercially viable one.

In this presentation, two examples of PPP model shall be discussed, in which CSIR-CSMCRI has successfully implemented with appropriate technology/engineering partner. Firstly, taking a relatively matured technology on Seaweed Cultivation and Down Stream Processing to a start-up as the industrial partner and work together to develop a globally competitive product while addressing the issue of job creation, livelihood generation for coastal ladies of the fishing community—specifically from the Mandapam (Tamil Nadu) region. Another example is taking proof of concept to an engineering partner for addressing the issue of Spent Wash Management for Molasses based Indian Distilleries while addressing the issue of sustainability and environment.

TRACING THE ECOSYSTEM FOR START-UPS IN INDIA: ANALYSING OPPORTUNITIES AND CHALLENGES

Dr. Tabassum Jamal* Dr. Kasturi Mandal, Dr. AvinashKshitij***,**

**Dr. Tabassum Jamal, Formerly Chief Scientists, CSIR-NISTADS, K.S. Krishan Marg, New Delhi*

***Dr. Kasturi Mandal, Senior Scientist and Assistant Professor, CSIR-NISTADS, New Delhi*

****Dr. Avinash Kshitij, Senior Scientist, NISTADS, K.S. Krishan Marg, New Delhi*

Abstract

The start-up ecosystem in India primarily comprises of entrepreneurs, supporting organisations which includes Incubators, Accelerators and Mentors, funding support from angel investors, venture capitalists, private equity investors etc; research and knowledge organisations to help start-ups to gain scientific and technological knowledge industry knowledge, develop business plan needed to offer innovative product, process and services.

India is not new to the Start-up ecosystem; in 1980 it witnessed the start-up revolution in IT enable sector, which later on became multinational companies. The emergence of internet and telecom technology encouraged the local entrepreneurs to grab the opportunity and start scale business. As per NASSCOM report “Indian Start-up ecosystem Maturing-2016” the tech-start up base in India is expected to grow twice as much to reach an estimate 10500 (approx.) by 2020. India is the 3rd largest start-up ecosystem in the world as per Department of Industrial Policy and Promotion (DIPP) report. As per “Global Start-up Ecosystem Ranking Report 2015” Bengaluru is the Indian city to be ranked within the best twenty start-up eco systems across the world. It reports that 35% of Indian start-ups functioned from the state of Karnataka. Since the last 5 years, India has achieved its success in the creating Start-up ecosystem as the Government of India started the Start-up India/Stand up India scheme on 15th of August 2015 to promote Bank Financing for start-ups and offer incentives to boost entrepreneurship and job creation. Various other initiatives enabling and complementing the Start-up Mission are ‘Make in India’. ‘Skill India’, ‘Digital India’ etc. For example through Digital India Mission, the Government aims to connect rural area by optical network (fast network) that create opportunities for tech-start-ups to enter the rural market, particularly for start-ups related to healthcare, education, etc..The core of the initiative is the effort to build an ecosystem in which start-ups can innovate and excel without any barriers for it takes 360° approach to enable start-ups, to provides a comprehensive learning program, set up research parks, incubators and start up Centres across the country by creating a strong network of academia and industry bodies. More importantly, at Government level a ‘Fund of Funds’ has been created to help start-ups gain access to funding. Start-up India mission also includes Learning Programmes, Facilitated Patent filing, Easy Compliance Norms, Relaxed Procurement Norms, incubator support, innovation focused programmes for students, funding support, tax etc.

With this at the background the present paper will bring out several facets of the Start-up Ecosystem in India which will be based on data collected from around 3000 start-ups in India who have registered in the Start-up Mission of the Government of India. The analysis of the data reflect majority of the start-ups are located in the states of Karnataka, Maharashtra and. Delhi Policies have been drafted and implemented for the start-ups and respective states have also been mandated to devise state specific polices. A deeper investigation into such state specific policies for start-ups also bring

out how state governments have been instrumental in developing the ecosystem for start-ups in India. The state of Maharashtra, one among the most entrepreneurial states in the country targets to develop 15 incubators in collaboration with industry and academia, attract Rs. 5000 crore (INR) Angel and investment fund and incorporate 1 lac start-ups. The state government of Karnataka, in its policy for start-ups mainly focus on the *i4* (IT, ITES, Innovations and Incentives Policy 2014-2019). Its objective is to stimulate the growth of 20,000 technology based start-ups including 6,000 product start-ups by 2020 in Karnataka. It also aims to achieve creation of 6 lakh direct and 12 lakh indirect new employments in the sector, mobilize Rs. 2,000 Crore (INR) funding for investment in start-ups through Government intervention alone, by leveraging the Fund of Funds proposed to be put in place by the State Government, facilitate generation of at least 25 Innovative Technology solutions with a social impact in sectors like Health care, Food Security, Clean environment and Education for all etc. An examination of mechanism and pathways for start-ups in India is attempted through analysis of the policies and provisions made for start-ups in India. The paper also includes a sectoral analysis of the start-ups in India from the data collected which indicates that majority of the start-ups are in technology enabled IT sector followed by healthcare services and education sectors. The paper concludes on lessons for start-ups in India for future ecosystem by identifying the challenges that still exists for start-ups in India.

Keywords: Start-up ecosystem, innovation, policy, entrepreneur

A PATH TO LEADERSHIP IN INNOVATION FOR A DEVELOPING COUNTRY IN ASIA

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Abstract

If a late-developing country follows an innovation path, we must proceed from the fact that the enterprises of this country lack innovative capacity. Therefore, they need to succeed in technological catch up with developed countries (Miao et al. 2018). Generally speaking, the country's path to leadership of innovation can be divided into two stages: the investment or catching up one and the stage driven by ingenious innovation. The content of the policy areas and actors' activity comply with the country's stages of development including the resource stage, investment stage, and the stage grounded in the country's innovations (Porter, 1990). The development of the national innovation system should provide a fundamental basis for a country to pass these stages and win leadership on each of these stages (Golichenko, 2016). The stage-based approach to determining policy dimensions and measures for carrying out these policies allows the state to promote the process of the co-evolution of absorption capacities (Castellacci and Natera, 2013). The results of the process enable increasing the innovative capacity of enterprises and the national innovation system as a whole (Hu and Mathews, 2005).

According to the methodology of the study, the national innovation system is represented as three interconnected macro blocks. These are the business environment and the market; the environment generating new knowledge; and mechanisms for transferring knowledge (Golichenko 2013). In this study, the block of mechanisms of knowledge transfer is decomposed into three interacting channels of knowledge transfer: open information channels; those of a transformation of open knowledge into pre-competitive and competitive one; and channels of commercial knowledge transfer. The use of the channels depends heavily on the models of innovative activity firms. In the paper, two basic models of the actors' behavior are considered. The first one corresponds to the investment stage of the country's development. The main driver of the stage is the technology catch-up. The second type is associated with the development driven by ingenious or radical innovations.

For the late-developing country using global market technology in catch-up processes, the active usage of open knowledge transfer channels and commercial knowledge transfer channels is of utmost importance. Moreover, as the practice shows (OECD, 2014, 2016), to achieve large-scale processes for creating innovative products, the domestic enterprises must actively invest in R&D. The driver of the country's development is external demand. Hence, it is impossible to organize the catching-up of technologies in the country without establishing the interaction of domestic markets with modern global value chains (GVCs). In the paper, the block of business and market environment is decomposed according to the hierarchy of GVCs (Amador and Cabrial, 2016). The enterprises of the catching-up country are the easiest to integrate into the GVCs that have a modular production system. The GVC of some types of R&D-intensive products gives useful examples of such chains whose openness and fragmentation provide favourable opportunities for a catching-up country.

The step to the next level of innovation leadership is a transition to the driven by ingenious innovation. However, there is a danger that the country having coped successfully with the passage of many phases during the investment stage will become “stuck” on it. It means that it will not be able to move to the next stage. It is therefore essential to create the necessary institution conditions and resources supporting the transition to the stage.

At the stage, the demand-pull policy should influence innovation by reducing barriers to innovation activity and stimulating demand-pull (Edler, 2007). It ought to facilitate both the origin of new markets and the reconstruction of established markets (OECD, 2011b). It is worth noting that the public policy of technology push has to encourage the firms whose activities are related to high technologies (Edler and Fagerberg, 2017). It forces the firm to shape a particular knowledge base that is hard to imitate or replicate by its competitors (Grimpe and Kaiser, 2010). The uniqueness of the research knowledge base is enhanced by the usage of tacit knowledge of a firm. Strengthening the knowledge base is facilitated by the organizational capability and routines of the firm that allow efficiently managing this base.

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RESEARCH PUBLICATIONS AND COMMERCIALIZATION OF PATENTS GENERATED BY THE ACADEMIC SECTOR IN INDIA

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Abstract

As per international rankings (<https://www.scimagojr.com/countryrank.php?year=2018>), India is amongst the top 5 nations in the parameter of 'Research Publications', but fares poorly (50th rank) in the generation of 'Patents' (<https://www.internationalpropertyrightsindex.org/country/india>) and their commercialization. As the academic sector [Higher Education Institutes (HEIs) and National Research Laboratories (NRLs)] is the major contributor of above mentioned parameters, it is imperative, we understand the generation of research publications, patents and licensing of patents by the academic institutes. DST-Centre for Policy Research at Panjab University, Chandigarh undertook a study of 904 institutes, comprising of 351 HEIs (based on NIRF rankings) and all the national research labs (553) for the period of 2010-16 (<https://dst.gov.in/sites/default/files/FULL%20BOOK-Chandigarh.pdf>).

The study revealed a large number of institutes published a sizable number of research publications, however, only a handful of institutes namely, IISc-Bangalore, ICT-Mumbai, first generation IITs, IICT-Hyderabad, NCL-Pune, NIPER-Mohali, etc. contributed significantly in the domains of research publications as well as patents generation (Granted patents). Field wise categorization of the data revealed that IISc-Bangalore tops in the fields of Physics and Engineering, whereas, IICT-Hyderabad and NCL-Pune led in the fields of Pharma/Drugs and Chemical Sciences respectively.

In the second phase, the study was extended to examine the licensing of the patents granted to 904 institutes by checking the working/non-working status of the patents from the Form-27 filed by the applicants. A total of 1961 patents were granted to the institutes during the period 2010-17. This figure is abysmal by global standards. CSIR led in patents commercialization followed by DRDO, ISRO, IITs, ICAR and DBT. Low commercialization rate of patents could be largely attributed to poor Technology Readiness Levels (TRLs) of the technologies/products and less than desired efforts put in by the inventors and the applicants. In order to stimulate Translational Research Ecosystem in India it is suggested that a) Indian researchers and scientists be made patent savvy, b) create 'Patent Cells' in research oriented institutes, c) establish 'Patent Trust System', d) strongly implement compulsory licensing and e) filling of the Form-27 by the patentee.

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GOVERNMENT MEDIATED R&D INCENTIVIZATION OF PRIVATE SECTOR IN INDIA: A CASE STUDY

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Abstract

In the current century, research and innovations have become a key parameter for nations economical and societal growth. Research and innovations are money intensive programmes. Most developed and innovation based economies like USA, China, Japan, Germany and South Korea are spending over 2% of GDP in R&D, whereas developing nations like India contribution in R&D is 0.69% of GDP. Moreover, in the innovation based economies the share of private sector investments in R&D is more than the public sector. In comparison, public sector's share of gross R&D expenditure, of developing countries including India is nearly 70-80% and the rest accrued by private sector. To stimulate private sector's R&D investments, Government of India (GoI) has taken substantive steps by floating various incentivization schemes, in the form of direct and indirect tax incentives, patent related incentives and financial support for carrying out R&D. This chapter discusses the incentivization schemes of India and a few select countries, and also mentions a few notable suggestions for strengthening private sector R&D incentivization landscape emphasizing on enhancing tax deduction and exemptions on R&D expenditure, widening the scope of benefits to be incurred on different expenditure heads, introduction of risk guarantee schemes and special tax benefits for joint research projects.

INTELLECTUAL PROPERTY PROTECTION AND INNOVATIONS ARE KEY FOR SOCIO ECONOMIC DEVELOPMENT OF NATIONS

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Abstract

In the current knowledge economy Intellectual Properties, Innovation, Incubation, Entrepreneurship and Startups are key drivers for economic development of Nations.

In this presentation policy initiatives taken by various agencies of Government of India for promotion of innovations along with few case studies from National Research Development Corporation will be presented with the impacts they have made on the economy.

ROLE OF INTELLECTUAL PROPERTY RIGHTS IN TECHNOLOGY TRANSFER FROM UNIVERSITY INNOVATION SYSTEM POLICY OPPORTUNITIES IN INDIA

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Abstract

In the changing paradigm of innovation, creation, protection and management of intellectual property (IP) are the key factor in successful knowledge management. This economy is heavily driven by innovations and technological competitiveness. Management of Intellectual Property Rights (IPRs) and its strategies would determine positions of universities, industries and academies in the global arena. Its role in global equilibrium emanating from changing technologies need to be understood by professors, researchers, scientists, technologists, managers, governments and industries. The growth of any knowledge based industries is driven by the creativity and knowledge of their people. The effective IP management, which provides incentives for innovation and creates structures for sharing the results, is the key to unlocking this human potential. In recently after implementation of National IPR Policy 2016, the University Grant Commission (UGC), advised universities and affiliated colleges to provide Intellectual Property Rights as a part of their elective system and harmonize IP culture in the universities. As per UGC, *“Creations of mind such as inventions, designs for industrial articles, literary, artistic work, symbols, names and images etc. are protected by IPR. It is normally of two types: Industrial Property Rights and Copyright. The importance of IPR was first recognized in Paris Convention for the Protection of Industrial Property (1883) and the Berne Convention for Protection of Literary and Artistic Work (1886). IPRs should be protected to encourage the creator and also striking a balance between the innovators and public interest by creating an awareness where creativity can flourish.”* Keeping in view the importance of IPR which recognizes the work of the creator, universities need to establish and create an ecosystem of IP culture with institutional policy guideline and awareness to faculties, students and researchers. This will create incentives in the form of tax concessions to encourage research and development (R&D) in the university system. It is also critical to strengthen the Make in India, Startup and Digital India schemes. So, it is expected to lay the future roadmap for intellectual property in India, besides putting in place an institutional mechanism for implementation, monitoring and review. The objective of the IPR policy aimed at fostering innovation, cutting delays in clearing patent, trademark and copyright applications, protecting traditional knowledge and encouraging entrepreneurship and also bring India's IP regime in line with global standards and help improve its ranking in the World Bank's Ease of Doing Business index and innovation index of the country and also important for the government to formulate incentives in the form of tax concessions to encourage research and development (R&D).

In recent time, Govt of India notified that, Higher Education Institutions (HEIs) have to set aside at least 1 per cent of their total annual budget for funding and supporting innovation and startup related

activities through creation of “innovation fund”. The institutions across will also need to create pre-incubation and incubation facilities which will have to be available 24X7 for the students and faculty of all disciplines. The government also plans to rank all major educational institutions and universities on indicators related to promotion of innovation and entrepreneurship development. The Ministry of Human Resource Development (MHRD), Govt of India launched a policy guidelines called “the National Students and Faculty Startup Policy 2019” – to this effect, which also stated that students and faculty will be allowed licensing of IPR from the institute and will be allowed to work part-time for the startups during study. According to this policy, HEIs, student entrepreneurs will also be allowed to sit for exams even if they are below the permissible minimum attendance. Students and faculty will also be allowed semester and year break to work in the startups and then re-join the programme. The institutes can also take 2 per cent to 9.5 per cent equity/ stake in the company based on the support provided and use of institutes’ of IPR. It was also advised to MHRD’s innovation cell and AICTE to work actively with education departments of all state governments to ensure that this policy is implemented in all major educational institutions and a regular feedback mechanism should be established to understand emerging challenges and steps should be taken to ensure that a robust entrepreneurial ecosystem is developed in educational institutions. Along with the policy framework, Government also launched the Atal Ranking of Institutions on Innovation Achievements (ARIIA) to rank all major educational institutions and universities on innovation and entrepreneurship development amongst their students and faculties. The rankings aim at setting direction for HEIs towards streamlining and establishing a strong startup ecosystem in campus and region, measuring innovation and startup ecosystem based on input, process, output and outcome based parameters, and uplifting India’s position in the global innovation index from 57th to top 30 in five years. The framework policy will facilitate the MHRD in bringing uniformity across HEIs in terms of Intellectual Property ownership management, technology licensing and institutional startup policy. In order to raise the understanding level of Universities on IPRs, Innovation, Incubation, Entrepreneurship and Startups and to assist implementation of the above guidelines, towards this end, the Government has identified higher education as a major growth engine. The Government aims to transform into a global knowledge and education hub by (i) strengthening existing state universities, (ii) establishing new premier national universities and (iii) inviting top national private universities to establish their campuses in the state. In view of the above, the Government has taken up various initiatives in the fields of faculty development, R&D and innovation, employability and entrepreneurship, e-learning, smart campuses, international rankings, and etc. In view of the above, it is the high time to strengthening ecosystem of the university by creating institutional ecosystem in capacity building of Intellectual Property issues, creating innovation, technology business incubator, IP cell through institutional guideline in IPRs.

Keyword: IPRs, Technology Transfer and University Innovation

PATH-DEPENDENCE EFFECT IN SCIENCE AND TECHNOLOGY POLICY: CASE OF RUSSIA

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Abstract

Objective of the paper: to analyse the effects of the transitional post-Soviet period of the 1990s on the existing national innovation system of Russia and to assess it the present stage of development.

Methods: the study used traditional methods of analysis, synthesis, description, analogy, systematization, and historical approach, and institutional analysis based on the categorical apparatus of institutional X-Y matrixes theory (Kirdina, 2014).

Results: the paper is an attempt to understand the problems of the modern national innovation system (Lundvall, 2010) through the prism of the 1990s, which became the cause of its imperfections. It is emphasised that the systemic problems of the economy in that period made innovative development impossible, which led to the loss of intellectual capital of the country. The abrupt transition from a planned to a market economy without a smooth adjustment, accompanied by the reduction in public spending on research (Cooper, 2006; Golichenko, 2014), led to the paralysis of innovation in the real sector of the economy, and reduction of high-tech industries. The negative influence was also produced by privatization, destruction of production chains due to the collapse of the Soviet Union, as well as domestic structural adjustment of the post-Soviet economies (Roffey, 2013). In this regard, the author investigated the peculiarities of the Russian innovation system from the standpoint of institutional approach, including the problems of staff and investment resources deficit, and the historical dominance of the state in the organization of scientific research (Mindeli, Vasin, 2014). Activity of the state is studied on the basis of the Russian venture capital analysis. The conclusions are formulated about the centralisation of the institutional structure of scientific research and development (McCarthy at al, 2014; Kramin at al, 2016; Lenchuk, 2016). The possible directions of the national innovation system improvement with a view to achieve more effective results are specified.

Scientific novelty: the diagnostics of the problems of modern national innovation system is made in the context of institutional transformation of the Russian economy in the post-Soviet period (Kamko, Kirdina-Chandler, 2018).

Practical significance: the main provisions and conclusions of the research can be used in scientific and teaching activities in terms of the issues concerning the essence and principles of the national innovation system formation, as well as by specialists of state structures for elaborating the strategies of innovative development of the country.

Keywords: National innovation system; Russia; Institutional analysis; Theory of institutional matrices; Venture capital; Path dependence–effect

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DUAL CHAIN FOR TECHNOLOGY INNOVATION AND INTERVENTION

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Abstract

With a stable and strong political establishment in India a paradigm shift towards development politics-cum-policy which leads to transformation is expected. For perspective, in the last five years, the implementation of the Government policies in a technology enabled manner with the operational websites, online registrations, digital and social media for creating awareness; swachta and swasth Bharat missions; Namami Gange missions; Make in India; Start up India has painted a beautiful picture of India in the 21st Century.

However, this transformation has to be inclusive for the deprived. Thus the initiatives taken by the Government need to be analysed in this context. Even though the stated vision is “Sabka Saath Sabka Vikaas” (along with all) but has this been reflected in the actions taken to modernize India or are the unprivileged still dependent on the subsidies and other such socialist measures.

Technology has played a key role in the implementation of the policies initiated over the years in India. The Research Policy in India has been updated from time to time as it is true that, large scale and radical technological shifts rarely take place without public intervention, while incremental innovation is normally carried out by firms without any explicit support from the government (Chaminade and Esquist, 2010). The Patent Laws have been modified post-TRIPS to protect the innovation. The National Innovation System has also evolved and Planning Commission has this been replaced by Niti Aayog. These underline the importance of technology, which is well recognized by the leadership, in meeting the development goals of the country once considered black box. It is well stated by (Rosenberg, 1982; 1994), that how to transform the results of the research activity into products or processes that can be used in the economy was considered to be a black box.

Technology innovation has boosted with the number of patents and publications increasing every year. The present inflow of FDI, rise on R&D spending, setting up of incubators and accelerators have contributed to it. The STI approach emphasises the fact that firms do not innovate in isolation but with continuous interactions with other organisations in the system (at regional, sectoral, national and supranational levels) (Edquist, 1997; 2005; Lundvall, 2016). However, the outreach of this has been minimal in spite of the focus on Technology intervention by the public and private sector. Public-private partnership (PPP) has been defined in several ways by researchers and practitioners with each definition varying slightly from each other (Abadie and Howcroft, 2004; Cuttaree and Mandri-Perrott, 2011). Through PPP schemes, the private sector's skill and management expertise is employed in delivering public infrastructure projects (Skietrys et al., 2008). This concept has been employed in diverse areas of PPP arrangement ranging from different infrastructure sectors, project models and stages within the PPP arrangement (Osei-Kyei and Chan, 2015). Around the world, public-private partnerships (PPPs) have become increasingly popular ways to deliver large-scale public infrastructure projects. Between 1985 and 2010, PPPs have been used to procure more than 2,000

highways, bridges, rapid transit lines, schools, hospitals, prisons, and waste and water treatment facilities, with a combined capital value of over \$700 billion (Siemiatycki, 2012). The PPP model takes into account the risk, revenue, patent rights sharing mechanism through contractual agreements and also in some cases cost sharing. But the model still lacks the approach to financing as part of PPP which is very much required for turnkey projects. Moreover, the transparency and public accountability is missing from such partnerships.

This paper proposes a novel conceptual “Dual Chain” model. The model defines innovation and intervention, it has identified the stakeholders and the relationship between them in the present scenario. This model will help both the researchers and the academicians to understand the Technology market as well as it is beneficial for the larger output to the economy. It will allow the practitioners to have a better perspective and opportunities yet unseen will be visible to them.

Systems approach when applied to PPP model it suggests that on system of public domain interacts with the other system of the private domain to create wealth for the economy. The same systems approach is the genesis for the Dual Chain model but this has far better implications for the country.

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DEVELOPING STRATEGY FOR EXPLOITING INTELLECTUAL PROPERTY RIGHTS FOR INNOVATION, ENTREPRENEURSHIP AND DEVELOPMENT: A CASE STUDY OF INDIA'S NATIONAL INTELLECTUAL PROPERTY RIGHTS POLICY 2016

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Abstract

The 21st Century knowledge based economy calls for new approaches to create and exploit knowledge, thinking beyond the established models of innovation and commercialization. The intangible assets of companies are becoming more important than their physical assets with IPRs providing the means to own these types of assets. This is leading to new type of aggression with firms are at increasing competition to create or acquire intellectual assets. The institutionalization of Trade-Related Aspects of Intellectual Property Rights (TRIPs) agreement in the World Trade Organisation (WTO) has embedded intellectual property rights (IPRs) in global trade.

Intellectual property rights, particularly patents are shaping many new technology industries predominantly the IT and telecom industry. New and Emerging Science Based Technologies such as nanotechnology, biotechnology, synthetic biology, robotics, etc increasingly rely on intellectual property for their development and growth. Intellectual property on one hand is creating the incentive for innovation but are also infringing in many cases the intellectual commons of our public domain. As the valuation of intellectual asset increasing in a technology field particularly in a product class the chances of abuse also increases. It is seen that IPRs are, in many cases leading to market distortions and are coming in conflict with competition laws, thereby disturbing the balance between the two laws which effectively should complement each other as both aim to enhance economic growth and consumer welfare [UNCTAD, 2016].

Thus it becomes imperative for a country to strategically protect its IPR and also create roadmaps for development of this institution. This makes a strong case for a country to create policy document that can provide a strategy for the country, a roadmap to develop a robust IPR system. Can enable creation of instruments that can promote innovation, creativity and development; enhancing the capacity of enterprise and public institutions to create and exploit IPR. TRIPs agreement and ever increasing role of IPR in technology and trade among others has raised many issues that challenges a country's governance and regulation mechanisms. Access and affordability of medicines, infringement against traditional knowledge, new barriers that are artificially created through abuse of IPRs particularly effect countries like India. Policy document should provide clarity on conflicting issues. It is also important that the policy document strengthens institutions that can safeguard against unfair monopoly infringement against traditional knowledge, and exploit provisions that can help in enhancing economic and social welfare. Thus the policy document should provide guidance for

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developing institutional mechanisms that can help to properly exploit IPR and address contentious issues and disputes.

This has motivated many developed and developing economies to articulate an IPR policy document. A cross examination of the policy documents of these countries show similarity as well as uniqueness in its strategy for development of IPR system, policy focus grounded on the country's overall strategy of economic development and social welfare. India has recently articulated an IPR policy document, National Intellectual Property Rights Policy, 2016 (hereinafter, the NIPR policy) titled as "Creative India, Innovative India". Bringing a policy document gives an important signal of India's intention to develop IPR as a strategic instrument. The policy document has drawn attention to some of the key issues that need to be addressed to develop IPR ecosystem that can align itself with the country's new policies for promoting innovation, entrepreneurship and inclusive development. To what extent the policy document is able to address these aspects needs a critical examination. The present paper is centered in this direction. The paper examines what types of new opportunities this policy document provides, what are the types of gaps/failures it intends to address, what would be the instruments that would help in exploiting these opportunities among others. It examines closely the implementation framework to see whether the objectives and directions are addressed in terms of roadmap for implementation or gaps if any. The paper concludes by suggesting some policy directions that further strengthen this policy document.

A CASE STUDY ON STRENGTHENING TRANSLATIONAL RESEARCH ECOSYSTEM IN INDIA

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Research publications and Patents are two important parameters for judging the Science, Technology and Innovation (STI) ecosystem of a nation. In India, universities are the important pillars of generating research publications and patents. This nation enjoys impressive global ranking in the domain of research publications. However, its patent profile needs fresh impetus for the improvement. India is among the top 5 countries (Rank-5) in the indicator of 'Number of Publications (Scimago Journal & Country Rank, (<https://www.scimagojr.com/countryrank.php?year=2018>), but its global ranking hovers in forties (Rank-50) in the indicator of Intellectual Property Rights (IPR) according to the International Property Rights Index (IPRI) Report 2019 (<https://www.internationalpropertyrightsindex.org/country/india>). The rankings in both parameters (research articles & IPRs) reflect the reluctance of Indian researchers to convert their academic excellence into technologies/products/patents. To boost the patent ecosystem of Higher Education Institutes, it is imperative to understand the patents and publications of the universities of India. In order to achieve this, it is imperative that we understand the ecosystem of Research and Development (R&D) of Higher Education Institutes (HEIs) and R&D labs in India. Considering the fact, Department of Science & Technology (DST)-Centre for Policy Research (CPR) at Panjab University, Chandigarh undertook a study to analyse the research publications and patenting profile of 904 institutes of India comprising of top HEIs (351) and all national R&D institutions (553). The HEIs include Institutions of National Importance (INIs), universities, engineering institutes, Pharma institutes and private universities based on the national rankings released in 2016. The national R&D labs, included in this study, have been established under 27 ministries of Govt. of India and 2 independent departments under Prime Minister of India. The study is further analysed on the basis of various fields such as Engineering, Chemical Sciences, Pharma & Drugs, Physics, etc. As per the study, a large number of institutes published a sizable number of research publications, however, only a handful of institutes namely, IISc-Bangalore, ICT-Mumbai, first-generation IITs, IICT-Hyderabad, NCL-Pune, NIPER-Mohali, etc. contributed significantly in the domains of research publications as well as patents generation (Granted patents). On the other hand institutes like IIT-Kharagpur, University of Hyderabad-Hyderabad, BHU-Varanasi, Indian Association of cultivation of Science, etc. are publishing good number of research publications but lagging in patents generation. This limitation is being attributed to the lack or absence of 'Translational Research Ecosystem' (TRE) in their respective institutes. The TRE of first-generation IITs, IISc-Bangalore and national research institutions can be adopted by other institutes to strengthen the commercial applications of their applied researches.

HOW IS CHINA PLANNING TO BECOME THE GLOBAL INNOVATION SUPERPOWER?

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Abstract

China and India became Republics at the same time-China in October 1949 and India in January 1950. At that time both had comparable per capita income and similar composition of GDP.

The first three decades for China were a disaster marked by famines, cultural revolution that led to disruption of the economy, education and society. India too faced problems of war, famines and alienation from the West. However its economy grew steadily and it managed to create a viable national innovation system.

Over the next three decades China embarked on a planned technology led economic development. The paper examines the policies and programmes that enabled China to become the factory of the world by the end of the first decade of the Millenium.

Emboldened by its success, China aspires to become the global innovation superpower in the fourth decade of the Millenium. The paper studies the plans, policies and strategy it has put in place to achieve this ambition

The paper concludes with policy suggestions for India to embark on an Innovation led economic growth.

NEED FOR S & T INTERVENTIONS & REFORMS IN SCHOOL EDUCATION IN INDIA

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Abstract

The education system of India is one of the largest of its kind in the world. More than 102.8 million people come under this education system. Elementary education in India has been emphasized to increase the literacy percentage of the country. India's post-independence period has seen the launch of various schemes by the Government to promote education among the masses and to achieve universalization of elementary education in the country.

The constitutional and legal statements that appear time to time are as follows:

- Constitutional mandate, 1950 - "The State shall endeavour to provide, within a period of ten years from the commencement of this Constitution, for free and compulsory education to all children until they complete the age of 14 years."
- National Policy of Education, 1986 - "It shall be ensured that free and compulsory education of a satisfactory level is provided to all children up to 14 years of age before we enter the twenty first century".
- Unnikrishnan Judgment, 1993 - "Every child/citizen of this country has a right to free education until he completes the age of fourteen years."

The Right of Children to Free and Compulsory Education (RTE) Act, 2009, represents the consequential legislation envisaged under Article 21-A, means that every child has a right to full time elementary education of satisfactory and equitable quality in a formal school which satisfies certain essential norms and standards. No. of beneficiaries under Adult Education Programme (Sakshar Bharat) is about 19,283,075 comprising of 6,057,019 males and 13,226,056 females. The student population in India is 315 million and according to Census over 3.3 million of them are above 30 years.

Looking at the quality and scope of Science and Technology education in India, there is a non-uniformity in the teaching pedagogy. Focus on Rote learning and memorization, characterized by a neglect of higher mental abilities such as critical thinking, problem solving and creative ability. There are many Socio-economic issues which needs to be addressed to increase quality in education to create enabled manpower. Since, India is a diversified country, state as well the union governments are in a constant endeavour to fill this gap and to provide every citizen of the country quality as well as affordable education.

Creating enthusiasm among students to learn science is the most widespread activity in India being carried out at present. The government is popularizing the discipline by means of popular science articles, organizing lectures, through various scholarship schemes and through the establishment of

science centre's etc. Needless to say the significance of ICT enabled technologies plays a great role if ICT in bringing quality in education.

In a nutshell, the Indian education system has a lot of scope for innovation and growth. Many schemes, assessments and quiz have been introduced by the government and other organisations to assess and identify the talent among students. But there is a dire need to provide an opportunity or platform for the students to nurture and pursue their interests. A platform which is mechanised to assess the analytical thinking, logical reasoning, critical thinking and other skills through specified parameters is needed to bridge the gap in bringing India as the Leader in the field of Education.

*One such initiative called **Knowledge and Awareness Mapping Platform (KAMP)** has been introduced to identify, capture and amplify scientific temper among students by Knowledge Alliance of Council of Scientific and Industrial Research – National Institute of Science Technology and Development Studies (CSIR-NISTADS), a constituent laboratory of CSIR, Department of Scientific and Industrial Research, Govt. of India and M/S Nysa Communications Pvt. Ltd. The vision is “**To identify and capture Scientific and Technological temperament in students to make India -A Global Leader in the Field of Science, Technology & Humanities**”.*

KAMP is aimed and developed to provide easy, objective, measurable and unbiased mapping of knowledge and awareness levels on various basic topics, with focus on Scientific Temper. Based on the algorithm designed and developed by CSIR-NISTADS, KAMP would support in identifying the talent at primitive stage and nurturing them in their areas of strength by bringing students to the mainstream of. The outcome of the KAMP will provide a comprehensive advisory not only to the young students but also to schools, teachers and parents.

There is a dire need to identify the current level of education before scientific interventions, policy reforms can be suggested. Through KAMP, collection and sharing of scientific data, interactions with eminent scientists and field trips to various scientific and research organizations will support the promotion of student learning by providing realistic, complex environments for student inquiry and tools to support research.

KAMP provides a platform to nurture the inherent talent of the students by creating “Junior Scientist Clubs” (JSC) in all districts of India. It focus on long-term, academically-focused relationships between members and eminent scientists, technologists, researchers, entrepreneurs etc. KAMP Junior Scientist Clubs gives an opportunity to the students to connect with the research laboratories and organisations and work and create their own research projects. Through JSC they share their work with the wider scientific and innovative community.

STRATEGIES FOR FOOD SECURITY AND VIABILITY OF INDIAN AGRICULTURE UNDER CHANGING CLIMATIC CONDITIONS

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Food security (is) a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs for an active and healthy life. Over 97.5% of food needs, as measured by calories consumed, come from the land and less than 2.5% comes from aquatic environment. Therefore, most of our food reserve will have to come from the terrestrial system, which will pressurise soil resources more to ensure our food security. Climate change has already caused and will continue to cause changes in temperature and rainfall patterns, changes in soil formation processes and soil properties. This has led to considerable concern that the climate change could compromise food security, which would lead to an overall decline in human health.

It is estimated that due to climate change, the effect on crop yields for three timescales (2035, 2065, and 2100) at minimum and maximum changes in temperature and rainfall will be significant and pulses will be affected more as compared to the other field crops. Though, the direct impacts of climate change on monsoon season crops would be small but these crops will become more susceptible to increased incidence of weather extremes such as changes in rainfall pattern and its intensity, duration and frequency of drought and floods, diurnal asymmetry of temperature, change in humidity, and pest incidence and virulence. Similarly, winter crop production will become comparatively more vulnerable due to increase in temperature, asymmetry of day and night temperature, and higher uncertainties in rainfall during the crop growing period. The effects of climate change on food production are not limited to crops, but, will also affect food security via its direct or indirect impact on other components of the production systems, particularly; livestock production as it is very closely linked with the crop production. Further, it is estimated that by midcentury (2021–50), districts in Rajasthan, Gujarat, Madhya Pradesh, Karnataka, Maharashtra, Andhra Pradesh, Tamil Nadu, Eastern Uttar Pradesh, and Bihar exhibit very high vulnerability. Whereas, districts with low and very low vulnerability are located along the west coast and southern and eastern parts of the country.

Despite having a huge potential for striving to the needs of the ever growing population, agriculture is facing various challenges such as small and fragmented farmlands, deteriorating soil health, declining water resources, change in rainfall pattern, increasing temperature, inadequate storage facilities, lack of processing and packaging facilities and marketing network at local level. Increased cost of inputs and declined factor productivity, the agriculture has become an unviable venture. Consequently, a large number of farmers and farm labourers are migrating from this sector.

Globally, the workforce employed in agriculture has decreased from 45 percent in 1991 to 31 percent in 2013, but, about 1.1 billion people still derive their livelihood from agriculture. According to the International Labour Organisation (2019), agriculture sector in India employ about 44 percent of the workforce and majority of them are not very educated and properly skilled, hence, are unable to make the most out of their farming. According to the United Nations Fund for Population Activities (UNFPA), about 67 percent of the population in India is aged 15-64 years while 27 percent is aged 0-14 years. Thus, this offers both a challenge and an opportunity to skill the youth as well as the existing workforce in order to improve their productivity and enhance their family incomes. As per the Agriculture Census 2015, Indian farmers have very small landholdings (1.08 hectares). Thus, the only way to feed the rising population as well as augment incomes of farmers from a very low base, would be to raise per unit productivity by using improved seeds and modern technologies.

Therefore, there is a need to adopt an holistic approach to exploit vast opportunities such as diverse agro-ecological situations, fertile soils, huge surface and ground water resources; well developed research and extension network; capability for adoption of S&T; enterprising farming community, large domestic market and access to global market for agriculture development. Thus, more focus is required on precision farming; organic farming; horticulture; livestock and dairying; fisheries; apiculture; sericulture; grading and standardization of produce; processing, value addition and packaging of products; development of cold storages and supply chain for marketing.

Under the national level programme named as Sankalpse-Siddhi aimed for doubling farmer's income by the year 2022, the National Agricultural Research System (NARS) of the country has taken up various initiatives for application of farm technologies in farmers field. Region specific Bankable Integrated Farming System models developed in 14 agro-climatic us regions have indicated 2-3 times higher income than existing farming systems. Thus, the model with field crops, horticultural crops, livestock, fishery, poultry, vermicompost, mushroom production, apiculture, sericulture found more remunerative in comparison to the traditional farming system need to be scaled-up with the help of modern technologies.

AN ICT POLICY FOR THE UNIVERSITY SYSTEM AND SOME ICT-BASED INNOVATIONS

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Abstract

Computerization in Indian universities started in the 1960s under a programme of the University Grants Commission, establishing Computer Centres to facilitate researchers to carry out computational work required in their research and to provide basic computer training to the interested faculty, office staff and research scholars. In the subsequent decades new technologies like computer networks, Internet, worldwide web (www) and e-mail were developed, which gave rise to the nomenclature - 'Information Communication Technology (ICT)'. The use of ICT in institutions of higher learning in India started taking shape from the year 2000 onwards when the importance of 'websites' for universities was realized as the reservoir of authentic information and its dissemination to the public. This was followed by the use of ICT in teaching & learning and research, development & implementation of Management Information System (MIS), and implementing e-governance in the university.

During the years 2000 – 2014 many ICT-based initiatives were taken in our university, Jamia Millia Islamia, which include Campus-wide Network with OFC cabling, setting up of WiFi connectivity, development of the university's Website/Portal, setting up a Data Centre and development of a University Management information system (MIS), provisioning of e-Mail facility, enhancement of the Internet Bandwidth, and setting up of IT Security in the campus. During the implementation and usage of the above-mentioned facilities, we came across various issues for which suitable ICT policies were framed which are briefly mentioned in the following:

- *Content on Website:* The 'content' for the university's website being a sensitive matter, the university decided as to which information should be put on the web and which should not be kept in the public domain. Also, the content pertaining to the historical background of the university had to be thoroughly scrutinized by an expert historian before posting it on the website.
- *Location of the Website Server:* As a matter of policy of the Government of India, Ministry of Communications & IT, the website of the university had to be hosted only on a server located in India.
- *Internet Traffic Management and Sharing of Internet Bandwidth:* Considering the limitation of the Internet bandwidth, suitable hardware & software were acquired for Internet traffic management and a suitable mechanism for sharing the Internet bandwidth was adopted.
- *E-Mail IDs:* As a policy, e-Mail IDs were created for all faculty members, administrative officers and all such office staff that needed it for official work of the university, under a cloud-based Google Apps e-mailing facility provided freely by the Google. This facility was also extended to all retired faculty of the university. For students e-mail IDs were created under a scheme of the Microsoft Corporation who provided free e-mailing facility for students.
- *Replacement of PCs and Software:* A policy was made that after every five years PCs provided to faculty members and office staff will be replaced if there is a genuine need for a higher version

machine. Also, it was decided that every newly appointed faculty member will be provided a PC along with the necessary software.

- *Sharing of General Use Software:* It was decided to buy an adequate number of licenses of all such common use software that are required in the university departments or individual PCs and upload the same on a specific server placed at the University's FTK CIT, which could be accessed by the students, faculty and other staff as per their requirement.
- *Shelf Life of the University Records:* After careful examination of all kinds of records in the university, a policy was framed to decide the shelf life of each kind of records and an Ordinance was framed by the university to this effect.
- *IT Security:* Identification of viruses and malware threats and attacks and malicious hits on the university's gateway has been an issue of great concern. To overcome such problems, the university acquired the necessary antivirus and other software/ hardware to detect the threats and attacks on its network get rid of the same before they affect the network and the computing devices. Also, an advisory was issued to all concerned departments and offices for the steps that they should take to save their computers, laptops and mobiles from viruses and malware malicious attacks.
- *Strategic Location of Data Servers:* Taking into consideration the calamities like fire and earthquake, it was decided to take the backup of the data on the MIS Data Servers in the FTK CIT of the university on a remote server of C-DAC Noida, which was done twice a day.

This as a whole may be considered as the 'IT Policy of the University System', which is applicable to any other university in India or elsewhere.

During the years 2000 – 2014, the FTK CIT did some IT-related innovations that are worth mentioning. Here we have highlighted some of the important innovations that were done by the committed team at FTK CIT.

File Tracking System (FTS):

This is a very important and useful system, indigenously developed by the university's FTK Centre for Information Technology, through which files moving from one office to another can be tracked. From the FTS data it was revealed that during a year there were ~ 60,000 files under circulation in the university sent through FTS tracking number. Information about the concerned files and action taken thereon can be tracked by the concerned persons from their own desktops. This not only facilitates the efficiency in the system, but also saves thousands of work hours of the employees.

E-Governance in the University System:

This is another innovation that we introduced in our university after the implementation of various modules of the MIS. Using e-governance, an employee in the university can generate the following information through self-service accounts of the MIS from his/her own desk, viz., Personal Profile, Leave Details, Pay Slip, Pay Bill Register, PF Loan Balance, PF Ledger for GPF & CPF, Income Tax calculation and other income details, and Form 16. These services are available on 24x7 basis.

Managed IT Services (MITS):

For streamlining the maintenance of IT hardware and software, the university implemented an efficient system of MITS by replacing the old system of AMC where different vendors were given the responsibility for maintenance of computers & peripherals and software separately. With the

implementation of MITS, there was a significant improvement in the services, which is very crucial for any large organization.

Analysis of Data pertaining to University Admissions:

We collected the data pertaining to university admissions for the sessions 2005-2006, 2006-2007, 2007-2008, 2009-2010, 2010-2011 and 2011-2012 from the University MIS. The results were critically analyzed and based on our findings recommendations were made to the university administration. This is the first such effort in the university system to critically examine the outcome of admission of students to various courses, to draw useful conclusions, based on which appropriate action was taken by the administration.

Although no effort has been made here to evaluate quantitatively the economic benefits of the above-mentioned initiatives, one may at least qualitatively infer its advantages. For instance the use of File Tracking System saves thousands of manpower hours to get the latest status of their files and action taken thereon as one has not to run from post to pillar to know the status of their files. In the same way, the admission-related data help the university to do away with unpopular ineffective courses that add to financial losses the university. Increasing the number of seats to courses that are in great demand is economically beneficial for all concerned. Similarly, the adoption of e-governance in the university system not only makes the lives of the students, faculty and other employees comfortable, but it also leads to bringing efficiency in the system which, in turn, leads to economic benefits.

AN OVERVIEW AND FUTURE PERSPECTIVES ON DIGITALIZATION AND STI AND EDUCATION POLICIES IN INDUSTRIALIZED AND DEVELOPING ECONOMIES

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Keywords: Global megatrends, Foresight; Digitalization, Artificial Intelligence, Automation, Robotization; Socio-economic and ecological impacts; Education, vocational education and training, life-long learning; Evidence Based Science, Technology and Innovation (STI) Policies

Abstract

Digitalization is a major technological megatrend with thorough social and economic impacts worldwide. Digitalization consists of various digital technologies like artificial intelligence, industrial internet of things, robotics and automation. *The first purpose* of this paper is to give a short overview on the current and future developments of digitalization. Digitalization will be discussed in the context of other global megatrends, such as demographic changes, migration, mobility and brain-drain, climate change, and political instability. Among hot debates of digitalization are its impacts on nature of work and jobs, employment effects due automation and robotics, and impacts on future occupation and skill composition. The challenge is how far we can foresee these impacts, let alone to predict them. In government policies digitalization and its impacts relate to most public policies, and *the second purpose* of this paper is to discuss challenges digitalization poses to various government administrations. As opportunities to benefit from digitalization and adapt to “the digital era” are closely related to innovations and for example to the creation of new business concepts, the paper analyses impacts of digitalization in the context of STI and education policies. The personal motivation of the Author to analyse impacts of digitalization is inter alia in the contribution to The EFT Issues Paper “The Future of Work and Skills in ETF Partner Countries”, commissioned by The European Training Foundation (ETF)³. With this background the paper considers policy recommendations to develop education, vocational education training and life-long learning systems in ETF partner countries vis-à-vis corresponding recommendations to industrial and developing countries, as concluded in many policy documents of the OECD, the European Union, and other international organizations and individual countries.

³ Available in: <https://www.etf.europa.eu/en/publications-and-resources/publications/future-work-and-skills-etf-partner-countries>. ETF member countries are in South Eastern Europe and Turkey: Albania, Bosnia and Herzegovina, Former Yugoslav Republic of Macedonia (today North Macedonia), Kosovo, Montenegro, Serbia and Turkey; in Eastern Partnership: Armenia, Azerbaijan, Belarus, Georgia, Republic of Moldova and Ukraine; Russia; in Southern and Eastern Mediterranean: Algeria, Egypt, Israel, Jordan, Lebanon, Libya, Morocco, Palestine, Syria and Tunisia; in Central Asia: Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan.

THE IMPACT OF ICT TECHNOLOGIES ON LOCAL COMMUNITIES' ORGANIZATION

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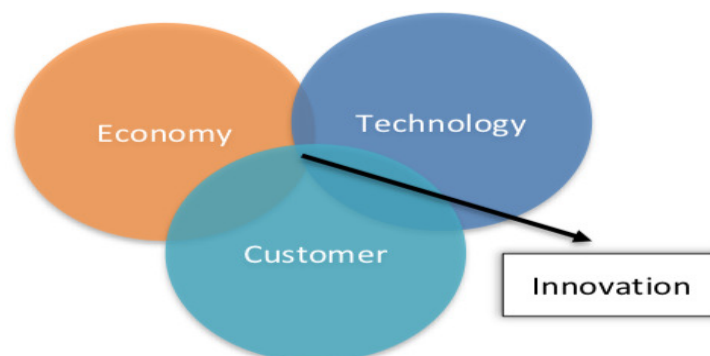
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Abstract

For the last two decades information and communication technologies (ICT) have dramatically changed our world bringing transformative and even revolutionary opportunities for society. Implementation is an important part of promoting and distributing innovations. How to use these new opportunities in everyday life and projects? We focus on implementation of ICT to local communities' life and projects.

ICT for organization of local communities means a kind of technologies which people could use for solving their community problem. In everyday discourse now, the popular vision of community has moved beyond simple living in one neighborhood; it includes now other connectors between people who share similar social, religious and cultural characteristics as well as identities⁴. Look at the process of creating local community projects though design thinking⁵ framework trying to understand where ICT could be used.



Picture 1. Innovation in Design Thinking Approach⁶

Design thinking provides a creative approach to problem solving that aligns well with the objectives and processes of community-led innovation. It is a people- and customer-centric approach to drive innovation. Design thinking focuses on understanding the needs of potential customers. The design thinking cycle includes some stages: of Inspiration, Ideation and Implementation is a solutions-based approach to solving customer problems⁷. Think of inspiration as the problem or opportunity that motivates the search for solutions («analyze», «observe», «problem definition»; ideation as the

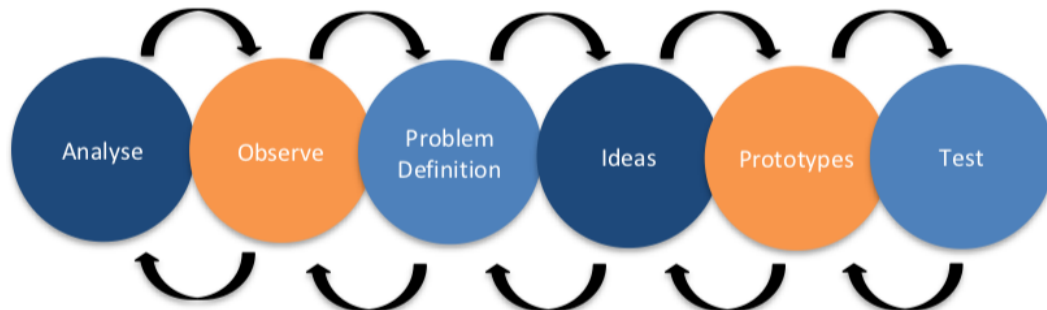
⁴Manoj JhaCommunity organization in split societies *Community Development Journal*, Volume 44, Issue 3, July 2009, Pages 305–319, <https://doi.org/10.1093/cdj/bsp022>

⁵What is Design Thinking? - <https://www.ideo.com/blogs/inspiration/what-is-design-thinking>

⁶ Apple, Google, Tesla are doing it! Will Design Thinking save us all? - <https://zulla-consulting.com/wp-content/uploads/2018/02/Design-Thinking-22022018-1.pdf>

⁷ Steve Blank Driving Corporate Innovation: Design Thinking vs. Customer Development - <https://www.forbes.com/sites/steveblank/2014/07/29/driving-corporate-innovation-design-thinking-vs-customer-development/#63f8aef4770a>

process of generating, developing, and testing ideas («ideas», «prototypes»); and implementation as the path that leads from the project stage into people's lives («test»)⁸.



Picture 2. Cycle of design thinking projects⁹

Let's take a look at some Russian project cases from local communities' life. The result of our project consulting session for villages built on the design thinking principles became some project initiatives where ICT are used. It is community **WhatsApp chat**, **community meetings** (including on-line consultation from different specialists in project management and local development, urbanism, community management).

For big cities **apartment communities** one of Russian housing companies (Liga ZHKH) created a **IT service** DOMA.AI(<https://doma.ai>), where there is a chat for house residents, an application for housemasters like Uber for taxi drivers, a service for monitoring money flow of your porch and house too etc. We think project development process was also based on design thinking principles.

For local economy there are cases of Russian villages located 130 km away from Moscow where farmers created **virtual currence**. Small village farmers have problems with receiving bank credits, own cryptocurrency help them to receive money and accelerate village economic turnover¹⁰.

Design thinking approach for a project aimed to solve local community problems is based on understanding local community needs. ICT help to solve a problem faster (for example, to know about community events, to give some news for others, to pay for something etc.). A community in some ways is a microcosm of a nation. Maybe some Russian case decision and project approach when ICT technologies works is possible to use in India and other countries for local problem such as food security, education, access to potable water, health care facilities and housing.

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Abstract

Modern society is at the threshold of revolutionary changes, caused by drastic innovations. Digitization prevails ubiquitously. Information and communication technologies (ICT) are at the heart of innovations in digital sector. ICT is a good example of the worldwide implementation and penetration of technologies into people's lives. There are many emerging technologies (IoT, machine learning, block chain, artificial intelligence, platforms and etc.) announced. Each of them entails opportunities for the growth and development of society, businesses and economy. As these technologies are just emerging, it's burdensomely to predict their evolution and diffusion. But for governments and businesses it's becoming vitally important to realize their place in this digital world in order to compete and survive in a sustainable manner. There is a variety of different indicators, measuring the information society already created. Network Readiness Index¹¹ and Digital evolution index¹² are under special attention within the current research. Digital planet report¹³ and our analysis of the Network Readiness Index overlap in terms of the understanding of the pace of change, which is the key to reveal the types of «digital behavior» in different countries. Readiness to exploit opportunities, pushed by ICT, is very different across selected Asian countries and Russia (see table 1).

Table 1. The pace of change in Networked Readiness index (2001–2016)

Country	Year		
	2001–2002	2016	2001-2016
Singapore	8	1	-7
Japan	21	10	-11
Thailand	43	62	+19
India	54	91	+37
Russia	61	41	-20
China	64	59	-5

¹¹ The Networked Readiness Index 2016.

http://www3.weforum.org/docs/GITR2016/WEF_GITR_Chapter1.1_2016.pdf

¹² Digital planet 2017.–<https://btca->

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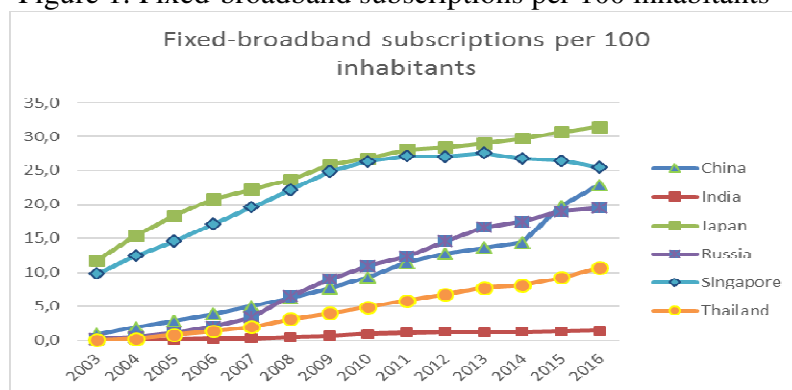
¹³ Digital planet 2017.– <https://btca->

[prod.s3.amazonaws.com/documents/305/english_attachments/Digital_Planet_2017_FINAL.pdf?1504890120](https://btca-prod.s3.amazonaws.com/documents/305/english_attachments/Digital_Planet_2017_FINAL.pdf?1504890120)

Taking into account how this propensity's evolved for 15 years, it's inevitable to conclude, that Singapore and Japan are stand out countries (both highly digitally advanced and exhibit high momentum, leaders in driving innovation). Russia and China are break out countries (low-scoring in their current states of digitalization but are evolving rapidly). Thailand and India are in a watch out countries' group (countries face significant challenges with their low state of digitalization and low momentum; in some cases (as NRI), these countries are moving backwards in their pace of digitalization). Similar results are announced in the Digital planet report (for the digital evolution index), according to which supply, demand, institutions and innovations are the key drivers of the changes.

Supply is the infrastructure, the ability to have an access to the ICT technologies. Unevenness of diffusion of fixed-broadband subscriptions per 100 inhabitants and percentage of individuals using the Internet (figures 1,2) displays a remarkable difference among Asian countries and Russia. Japan and Singapore are stable leaders, demonstrating a «moderate pace» in its' ICT infrastructure evolution, what is the evidence of the digital maturity of these stand out countries. Russia and China, being in a breaking out group, confirm their breakthrough development (Russia deserves a special attention within the ability to achieve for 15 years the level of Japan and Singapore, being in the tail at the beginning of 2000s). Thailand and India have passed a less productive way, showing one of the lowest levels of ICT adaption without an outstanding growth.

Figure 1. Fixed-broadband subscriptions per 100 inhabitants¹⁴



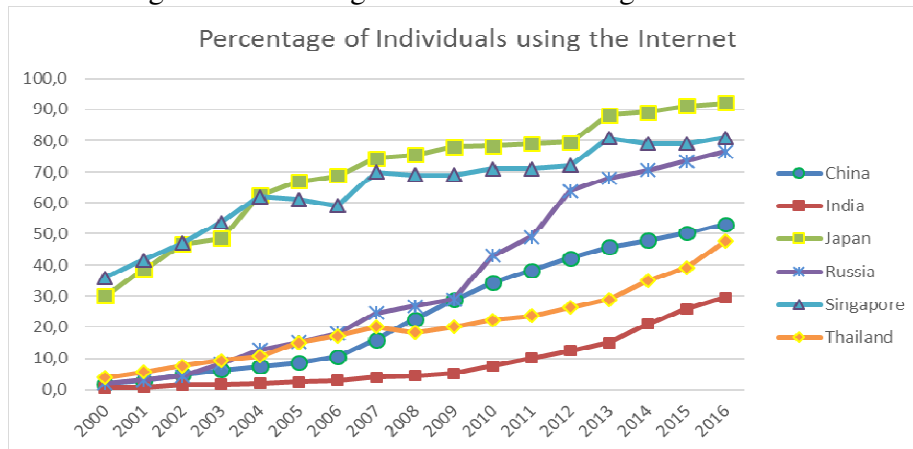
Why should we pay that much attention to ICT technologies development and their evolution? ICTs are fundamentally important for realizing the potential in the absorptive capacity of the digital technologies, already capturing modern society. It's been already proved, that ICT technologies have a significant impact on the companies' and regions' activities.¹⁵ ICTs improve firm's productivity.¹⁶ Technologies have already transformed our society, changing ways of communications, purchasing behavior and etc. According to the opinion polls, 79% of respondents from Russia harness Internet as the first place, when they need information, for India this number is even more – 83%, for China – 74%, for Japan – 79%, for Singapore – 90%, for Thailand – 78%.

¹⁴Based on Measuring the Information Society Report 2018 – ITU. <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/misr2018.aspx>

¹⁵ Savage, S. J. and D. M. Waldman (2009). Ability, location and household demand for internet bandwidth. *International Journal of Industrial Organization* 27 (2), 166–174

¹⁶ Bresnahan, T. F., E. Brynjolfsson, and L. M. Hitt (2002, February). Information technology, workplace organization and the demand for skilled labor: Firm-level evidence. *The Quarterly Journal of Economics* 117 (1), 33–76

Figure 2. Percentage of individuals using the Internet¹⁷



It is clear, that ICT technologies have brought transformative, even revolutionary opportunities, but over recent years we are increasingly observing the challenges and disruptions that accompany the exploitation of those opportunities. To capture these opportunities it's needed to understand the factors, accelerating these technologies, which are really unique for each country, what advanced economies and developing economies ought to prioritize (innovation for the former and institutions for the latter). It also could be economic sustainability, social inequality, cognitive abilities of the population, media, geography, urbanization, country size, people's behavior and attitude to the technologies, policy restrictions. Many institutional and economic reasons are hidden behind the uneven distribution of technologies, and many of them can be brought down to the balance between possible and permissible for each specific country.

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¹⁷Based on Measuring the Information Society Report 2018 – ITU. <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/misr2018.aspx>

DEVELOPMENT OF MOLECULAR METHODS TO CONTROL MICROORGANISMS IN FOOD AND BEVERAGES

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Abstract

Foodborne diseases (FBD) cost in India is about \$28 billion or around 0.5% of the country's gross domestic product (GDP) every year (Smeets, 2017). The burden in South-East Asia alone, including India, is about 150 million cases and 175 000 deaths, with India having the highest mortality (60 000 to 70 000 deaths in 2016) for children less than five years of age. The number of FBD cases in India is expected to rise from 100 million to 150 – 177 million in 2030 compared to 2011 (Smeets, 2017). The main causes of foodborne illness in India are bacteria (66% of cases) (Khare, 2018). The aim of this project will be the developing of genetics methods for rapid microbiological control of food, beverages and drinking water based on multiplex TaqMan PCR.

During the implementation of the State Contract (14.577.21.0257) at Department of genetics, cytology and bioengineering of Voronezh State University (Voronezh, Russia), we have developed methods of genetic identification of microorganisms that lead to spoilage of products with a high content of sugar and fat, such as mayonnaise and sugar syrup. High-throughput sequencing was applied by us for identification of microorganisms that contaminate the dairy products and dietary supplements. Studies have been conducted to identify the species composition of bacteria contaminating the chickens and pigs meat. Also, during the implementation of a methodologically similar project of the Russian Science Foundation (16-14-00176), we have developed genetic systems for the identification of pest insect and entomophages using PCR-RFLP and mutagenic PCR-RFLP. The results of the researches were published in the rating international journals (PubMed ID: 30467735, 30395245, 29690376, 29382048, 29118620, 28043329 etc.). Many DNA sequences are deposited in the GenBank.

We propose the implementation of a research project in collaboration with Indian research groups. The project will include 3 stages. Initially, it will be necessary to carry out a screening of microorganisms (bacteria and eukaryotic microorganisms) that the most frequently contaminate the different types of food and water in India region. We will use two main methods: first, the microbiological seeding with subsequent isolation of bacteria colonies and DNA barcoding of isolated microorganisms, and second, the high-throughput sequencing of food and beverages microbial communities (DNA metabarcoding). The DNA of microorganisms from both food substrates and beverages will be isolated. The frequency of certain taxa of bacteria in Indian food will be assessed. In our opinion, data about the contamination of certain types of bacteria unique to India's food will have the publishing potential. We will try to identify certain serotypes of bacteria in Indian region that important for human health by the genetics methods. In the second stage, molecular markers (primers and TaqMan probes) will be developed for identification of the most important for human microorganisms for their rapid identification by TaqMan qPCR. The sensitivity and specificity of the developed TaqMan qPCR methods will be evaluated. At the last stage, it is planned to develop a multiplex TaqMan qPCR for simultaneous identification of 6 or more microorganisms in one reaction.

In addition, the project can be expanded to develop molecular methods for the identification of the most dangerous serotypes of bacteria, as well as bacteria that are resistant to antibiotics. The main advantage of the developed methods in comparison with classical methods of bacteria identification in foods and beverages is the speed of analysis (1 day instead of 5 days). In addition, the use of this method will be cheaper than the use of classical microbiological methods.

The results of the project will have both fundamental and practical importance and will deepen knowledge in the field of agriculture, medicine and food science. Moreover, the results of the project have the potential for commercialization in India in two directions: development and sale of TaqMan qPCR kits for control of food products, drinking water and beverages or creation of a specialized laboratory for control of such products. In the future, the project may be extended to the development of TaqMan qPCR kits for identification of pathogens of plants and farm animals.

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ROLE OF SYMBIOTIC NITROGEN FIXATION IN GLOBAL FOOD SECURITY

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Abstract

Nitrogen is one of the most critical nutrients for all life forms. It is the component of protein, DNA, hormones, secondary metabolites, chlorophylls, etc. The atmosphere has very high abundance of nitrogen in gaseous form yet it the most scarce in available for the organisms. Nitrogen undergoes many different transformations in the ecosystem; nitrogen fixation is such remarkable process that makes it available to primary producers. The World demand for nitrogen (N) fertilizer nutrient use in year 2020 is projected to be 118763 thousand tonnes. This demand would be fulfilled mainly through application of nitrogenous fertilizers which are associated with a number of problems in the ecosystem. Nitrogenous fertilizers are attributed to better global crop productivity. However, nitrogen is also considered responsible for water and atmospheric toxicities due to production of nitrogen oxides. Global nitrogen fixation contributes 413 tera grams (Tg)of reactive nitrogen to terrestrial and marine system annually. One of the major process for nitrogen fixation is biological nitrogen fixation (BNF) including symbiotic form carried out by specialized microbes called as *Rhizobium spp.* and *Bradyrhizobium spp.* which forms symbiotic associations, N-fixing nodules, mainly with roots of leguminous plants. In this process, atmospheric nitrogen is reduced to ammonium compounds. This process has large impacts on sustenance of global food security. On the other hand, there are many environmental factors and pollutants which adversely affect the symbiotic association between both partners hence net amount of symbiotically fixed nitrogen. The impact of some metals on symbiotic nitrogen fixing partners and projected impacts on global food security has been discussed in the light of results obtained through multiple OMICS studies.

Key words: Biological nitrogen fixation, Symbiotic nitrogen fixation, multi-OMICS, Global food security

Proposal for scientific cooperation

Topic of the Project: **“The study of the socio-environmental conditions of the cities of Russia and India, affecting the sustainable development of the territory.”**

Project Manager:

Sergey A. Yeprintsev,

PhD Geography Associate Professor at Geocology and Environmental Monitoring Department,
Voronezh State University

Project participants:

Semyon A. Kurolap, Doctor of Geographical Sciences, Professor, Dean of Recreational Geography, Regional Geography and Tourism Department at Voronezh State University

Oleg V. Klepikov, Doctor of Biological Sciences, Professor

Vladislav N. Kalaev, Doctor of Biological Sciences, Professor

Urbanisation is an important process which typically takes place as counties become industrialised. Meanwhile, along with the positive effects, urbanisation and industrialisation entail the spread of acute social and economic problems in modern cities - environmental pollution, increased morbidity, reduced social comfort while expanding traffic flows, etc. Every year we are seeing an increase in the problems outlined above.

The main goal of the project is to study the patterns of formation of social and ecological conditions, that affect the balanced and sustainable development of the territory.

During the project implementation, it is planned to conduct the following **outputs and outcomes**:

- The Evaluation of anthropogenic pollution (including genotoxicity of the environment) of cities in Russia and India, affecting the environment-related morbidity of the population.
- The research of social factors (transport load, the natural framework of the territory, quality of medical care, economic conditions, etc.) determining social and environmental safety.
- The study of micro-climatic conditions influencing the environmental safety and sustainable development of the territory.
- Development of a model for optimizing the social and environmental conditions of cities in Russia and India, which determine the sustainable development of the territory.

For the successful implementation of the project, it is proposed to submit a joint grant application with Indian scientists to the RFBR science competition and other research funds, to search for other sources of funding. At the same time, scientific publications with the results of the research will be prepared, and joint articles in major scientific journals will be published

Direction: Environmental pollution, hazardous chemical sludge and sewage management for clean and green ambience.

DIFFERENT SOURCE OF IRRIGATION AND CROPPING PATTERN: A STUDY OF DETERMINANTS AND PRODUCTIVITY

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Sub theme :Agriculture

Abstract

Irrigation is a vital component of agricultural production in many developing countries. In 1997-99, irrigated land provided two-fifths of crop production in developing countries, and accounted for about one-fifth of the cultivated area. The divergence in these statistics reflects the high crop yields and multiple cropping that are achieved through irrigation. Indian agriculture groundwater is the main source of irrigation in India, especially in Tamil Nadu having outpaced surface irrigation since the late 1970s. Second, in recent years, there have been widespread concerns about groundwater overexploitation in many parts of the country. Groundwater is gaining importance as a source to meet the needs of India's ever-increasing population, for drinking as well as industry and irrigation. Government and donors have traditionally justified allocation of water to agriculture on grounds of food security and rural development these examined below, followed by a brief overview of relevant aspects of the international consensus that has emerged in water management policy. Furthermore, recurrent droughts, introduction of high-yielding varieties and an incentive-oriented agricultural pricing policy paved the way for the extensive use of groundwater for irrigation. Besides the equity issue, the paper also examines farmers' perceptions with regard to groundwater regulation, power tariff and the coping strategies to deal with declining availability of water. Worldwide, withdrawals of water for household and industrial use quadrupled between 1950 and 1995, while withdrawals for irrigation only doubled in the same period. In terms of future demand in developing countries, non-agricultural demand for water is forecast to increase by 100 percent between 1995 and 2025 and agricultural demand to rise by only 12 percent. However, the agriculture sector is often wastage and inefficient use of water at the point of consumption (i.e. at farm level) encouraged by subsidised low charges for water use or low energy tariffs for pumping. It is often claimed that the charges made for irrigation water, fail to signal the scarcity of the resources to farmers. This situation may persist because of entrenched interests, political problems associated with price reform, practical difficulties in measuring and monitoring water use, and social norms, e.g. perception of water as a free good and access to water as a basic right. These low charges can have an adverse impact on the effectiveness of irrigation systems and water use. They result in poor maintenance and consequent inefficient operation of existing irrigation systems, limited capacity for improvements or investment in new infrastructure, and waste of water at the farm level. Investment in irrigation systems are perceived to have failed to address the changing needs of irrigation services because rehabilitation of existing systems was mostly carried out of restore original project objectives. This type of rehabilitation is often inappropriate as it tends to ignore desirable changes in cropping patterns and irrigation techniques and thus allows low water-productivity practices to continue. Cost and time overruns in irrigation projects as well as public opposition to large dam building project have further eroded the confidence of funding agents in irrigation investments. Considering the negative aspects of irrigated

agriculture (e.g. salinity, water logging, health hazards, and groundwater exploitation), it can no longer be taken for granted that irrigation is a protected, preferred practice and that its negative externalities will be accepted unconditionally. Furthermore, it is claimed that the subsidies provided for irrigation water tend to favour the wealthy and thereby exacerbate inequalities in resource access and wealth distribution in rural areas. Even then, due importance has not been given over the plan periods to develop this source in a sustainable manner. As a result, the country has been facing water scarcity problems in most regions and also depriving wells adequate recharge. Therefore, the cost of production reduced ultimately higher rate of returns on investment. Obviously, their profit revenue and net return on investment is high. And the core objective of the study to analyse the cropping pattern in different types of irrigation. The contribution from irrigated agriculture to achieving this goal will be critical as irrigation provides a powerful management tool against the vagaries of rainfall.

Key Words:Source of Irrigation, Ground Water, Cropping Pattern, Productivity

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TARIFF ESTIMATION FOR SUSTAINABILITY IN RURAL WATER SUPPLY: A CASE EVIDENCE FROM RURAL HOUSEHOLDS OF COIMBATORE DISTRICT, TAMIL NADU, INDIA

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Abstract

Article 21 Constitution of the India, Access to clean and protected drinking water has been treated as a fundamental right of all the people (Ramachandraiah, 2001). Provision of Drinking water supply and sanitation to the rural population in India is facing a serious challenge and responsibility of the state in India. A number of rural water supply policies and programmes exclusively dealing with providing drinking water to the rural people have been initiated by central and state governments. Census 2011 data indicate that all India level, the coverage of safe drinking water in the rural areas is around 73.23 percent only.

Pricing of rural water supply primarily aims at achieving sustainable rural water supply. Mobilization of financial resource is necessary to achieve this. This responsibility of the state lies in creating the required sources in villages and leaving the responsibility of operation and maintenance with the Panchayats. Designing appropriate tariffs for water help to achieve twin objectives: pricing of bids wasteful use of water and reduces the quantity of water that is wasted and contributes to protect the environment. Secondly, it facilitates revenue collection, in turn enables meeting O & M costs and recovers initial capital investment.

The study mainly focuses on analyze the cost aspects, factors influencing water use, the problems confronting rural households in procuring water at the household level and to outline an alternative method of calculating tariff for rural water supply. Coimbatore district in the state of Tamil Nadu is chosen for this study. This study used multistage sampling method viz., systematic, stratified, proportionate random techniques was used to select sample villages. 342 sample households were selected across 4 taluks, 3 blocks, 4 village Panchayats and 31 habitations.

This study finds that, as part of an outlining alternative strategy, estimation of tariff rates for rural water users with and without house service connections were done separately. Inculcation of user pay principle will help achieve sustainable use of existing schemes. Two separate tariff rates for rural water supply based on the primary survey information have been worked out: a) a rate ranged between Rs. 22 and Rs. 44 as per capita per annum for recovering replacement cost and O & M cost for the all the study villages except hill area, and b) a rate Rs. 40 per household per month for recovering O & M cost and maintaining quality for those having house service connections.

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INNOVATION FOR A LOW CARBON, CLIMATE RESILIENT AND GREEN DEVELOPMENT

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Abstract

Ecological crisis in terms of climate change, air and water pollution, biodiversity loss, deforestation, natural disasters and many more are mainly the manifestations of an unsustainable economic growth over past many decades. The unprecedented scale of environmental problems is affecting every one of us, however it is the poor who are more vulnerable. The environmental crisis has threatened the already fragile and vulnerable life support systems of the planet adversely impacting the lives and livelihoods of millions. The so called development based on overexploitation of natural resources is one of the main cause of environmental problems. However, poverty and underdevelopment are also adversely impacting the environment. The global environment debate has mainly revolved around the consequences of development on environment. The concept of sustainable development has evolved from this debate in order to harmonize development with environment.

Climate change is considered as the most pressing global challenge today. The Paris agreement envisaged capping the temperature rise to 2°C and make efforts to limit the rise to 1.5°C. However, the recent IPCC (Intergovernmental Panel on Climate Change) Special Report on the impacts of global warming of 1.5°C, clearly states that warming of 2°C poses greater risks than previously believed. Human activities have already caused approximately 1.0°C of global warming above pre-industrial levels, which is likely to reach 1.5°C between 2030 and 2052, if it continues to increase at the current rate. Thus there is hardly a decade's time available for global warming to be kept to a maximum of 1.5°C, beyond which even half a degree will significantly worsen the risks of drought, floods, extreme heat and poverty for hundreds of millions of people. These risks can be substantially reduced by limiting warming to 1.5°C which requires drastic emission reductions by 2030 and carbon neutrality by around 2050. The goal of halting the global warming to the level of 1.5°C requires unprecedented transformation and innovation in the sectors such as energy, land, urban, and industrial systems, including measures to achieve "negative emissions" by removing carbon from the atmosphere. Another area of action is that of adaptation which can significantly reduce the negative consequences of climate change. Demand for climate action is growing worldwide. The global movement of school students started by the Swedish girl Greta Thunberg in August 2018 outside the Swedish Riksdag (parliament), holding a sign that read "Skolstrejk för klimatet" (School strike for the climate) has found worldwide support. The School strike for climate (also known as Fridays for Future, Youth for Climate and Youth Strike 4 Climate) is being observed worldwide by youth who are boycotting classes to take part in demonstration to demand action to prevent further global warming and climate change.

Transitioning from the current development pathway to a low-carbon, climate-resilient one will require significant investment and innovation in carbon intensive sectors. The experience has shown that developing new green products and services can provide opportunities for new markets and is economically sound as well. Corporate and entrepreneurs can play an important role in driving green growth and promoting greener behaviour across the supply chains. Commitments made under the

Paris agreement and Sustainable Development Goals (SDGs) are key drivers of green growth in many countries. The Nationally Determined Contributions (NDCs) that countries have prepared as their commitment for climate action, are promoting green growth in almost all the key development sectors. Apart from the government, the corporate are promoting green supply chains, as a source of investment in low-carbon, climate-resilient infrastructure, and as leaders in innovation in clean technologies and resource efficiency. Many companies across the world are setting their carbon neutrality goals and targets in consonance with the SDGs and Paris and agreement. These require adoption of a whole range of new and innovative technologies and processes. Industrial emissions account for around 30% of the total global greenhouse gas emissions and any intervention towards carbon reduction by companies will go a long way in climate change mitigation. One of the example in this direction is that of the Low Carbon Technology Partnerships Initiative (LCTPi, <http://lctpi.wbcsd.org>) is a collaboration of more than 150 businesses and 80 partners from around the world, to accelerate the development of low-carbon technologies and scale up their deployment. An independent impact analysis by PwC shows that the LCTPi plans could deliver as much as 65 per cent of the necessary emissions reduction, while stimulating between US\$5 trillion and \$10 trillion of investment into the low carbon economy and creating between 25 million and 45 million jobs around the world each year.

There is tremendous potential for moving towards circular economy from the linear one which has almost no interconnected value chains in the production industries at the besides sales. The circular economy model will bring transformation to a zero waste green growth by reduce, reuse and recycle. The fourth Industrial Revolution- Industry 4.0, or IIOT (“Industrial Internet of Things”) are helping in a major way in moving towards the circular economy and in decarbonizing the industries through digitization. The global competitive landscape is steadily shifting towards digitalisation of all activities and using big data analytics to raise cost efficiency, quality, and production speed. The potential of IIOT in circular economy is tremendous by way of “smart manufacturing” allowing the gathering of data along the lifecycle of a material, understanding the material input, and considering the end-of-life of a material, instead of putting it to landfill. This can help establish production processes with zero extracted raw material, net-zero emissions, and 100 per cent recycling. This is necessary to keep products, materials, and components at a high level of a value, and multiple lifecycles—the foundation of a circular economy. As Industry 4.0 technologies are being implemented worldwide, a virtual image of all production processes and entire supply chains can be designed. This date through an open access channel, can be used by the skilled product designers to integrate secondary materials from all different industries into their design process. That would be a whole new way of value creation through data for climate innovation. It might take decades until IIOT technologies reach their full potential and provide circularity in the production industries. The electronics industry which is dependent on rare earths and emission-heavy metals will not be manageable by additional extraction, therefore will need urgent action towards circularity. It is estimated that circularity could bring reduction in greenhouse gas emissions to the tune of 23% by 2030 and up to 44% by 2050.

TRANSFORMING S&T POLICY IN INDIA: CHANGING DIMENSIONS AND EMERGING CHALLENGES

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Abstract

Over the year focus of research is shifted from basic to applied research by translating basic science into product manufactures. The Economic Survey 2018 (GoI), laid emphasis on the central role of science, technology and innovation (STI) and called for boosting innovation by doubling of spending on research and development (R&D) to ensure efficient delivery of science and technology led solutions. The current Indian STI policies are an outcome of four phases; 1947–1970 (optimism in “policy for the sciences), 1970s–1990 (critical evaluation of policy for the sciences), post 1991 (new economic reforms, liberalization, and globalization) focusing on exploring the growth of S&T and STI policy 2013, emphasized creation of wealth from derived knowledge by means of scientific entrepreneurship. It requires to revisit S&T policies for strengthening R&D system and to encourage culture of S&T entrepreneurship. Therefore, the paper presents an overview of innovation policy framework, innovation priorities and emerging challenges by assessing STI role in the enterprise development in the Indian context.

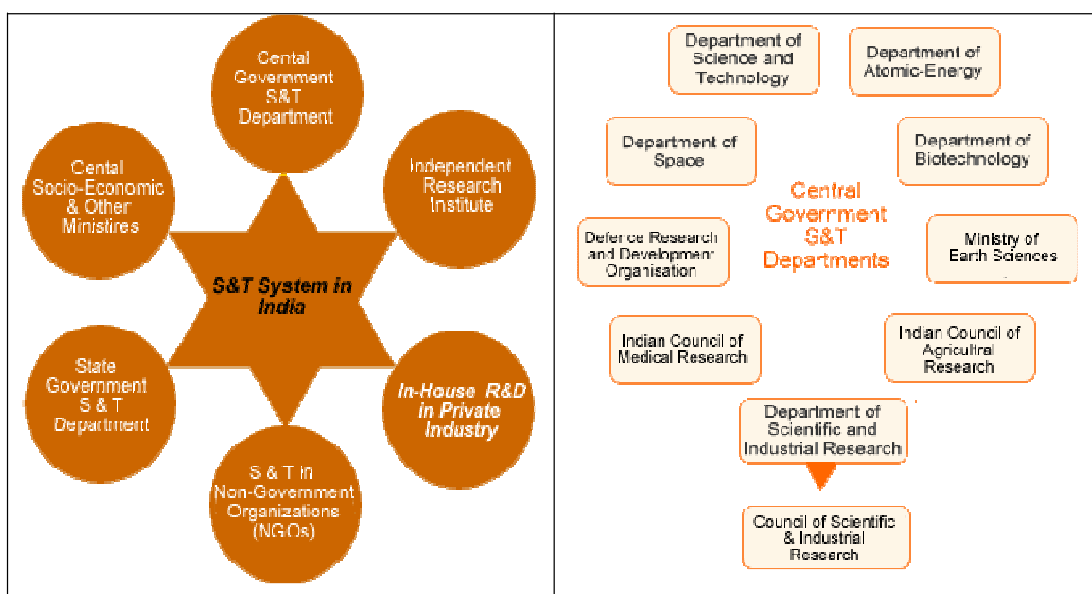
Introduction

Scientific competence plays an imperative role in economic development process and nurtures advancements in scientific and technological (S&T) research. Over the years, India’s innovation strategies have been evolved from well-defined S&T policies and a sense of nationalism which constituted a strong base of S&T capabilities in India, despite paucity of resources after independence. This was reflected in the determination of India's great visionary leaders when Indian Science Congress, Calcutta (1938), Nehru said:

"I realized that science was not only a pleasant diversion and abstraction, but was of the very texture of life, without which our modern world would vanish away.....It was science alone that could solve these problems of hunger and poverty, of insanitation and illiteracy, of superstition and deadening custom and tradition, of vast resources running to waste, of a rich country inhabited by starving people."

These visionary lines reflects the comprehensive approach and how scientific temper and knowledge can be a guiding instrument of a nation's growth. The constitution of India also envisaged scientific temper under Article 51A which states "it shall be the duty of every citizen of India.....to develop the scientific temper, humanism and the spirit of inquiry and reform. Accordingly, after independence the Government of India focused to develop scientific infrastructure to expand S&T capability to meet the demand of S&T professionals. For achieving the goal an integrated and strong S&T system was established (Figure-1) for developing a systematic infrastructure in India.

Figure-1: S&T Establishment and Structure in India



Established Department of Science & Technology (DST) was an outcome of the policy initiative with objectives of promoting new areas of S&T and to play the role of a nodal department for organizing, coordinating, S&T policy formulation and promoting S&T activities in the country.

India registered a considerable growth in S&T infrastructure and developed capability in S&T research. In terms of research publication the European Union (EU) and USA published largest share of world's total scientific publications, however, share of India's S&T output about 5% to the world S&T output. According to a report (DST, 2015), between 2009 and 2013, India's S&T scholarly output has increased at a high 13.9% annual growth rate, reaching 4.4% of the world's 2013 output. India's output attracted 3.4% of the world's citations in 2013, but remains cited 25% less than world average while in 2016, China's share was about 18.6 percent of the international total output. China published over 426,000 scientific studies indexed by Elsevier's Scopus database as compared to USA, which published 409,000 papers. Bhargava (2015) opined that the apathy of successive Central governments towards science and technology continues in numerous ways. The premier national scientific agencies have been made to languish, and no effort has been made either to formulate a national S&T policy. Despite, constituting a huge S&T base India lagging behind in terms of S&T output. Therefore, the present paper provides an assessment and overview of India's S&T growth and the nature and purpose of S&T policy and presents a collective and critical manifestation on the means and ends of Indian research and S&T/STI policy.

Objectives

The paper attempts to focus on the contemporary challenges in S&T policy in India to meet the challenges of emerging issues in respect of commercialization of innovation in the era of market reforms and globalization. The focus of the paper intends (i) how the emerging factors influencing the research system (ii) what institutional changes are being introduced and implications relating to 'science as public good' verses 'science as market good.

R&D intensity

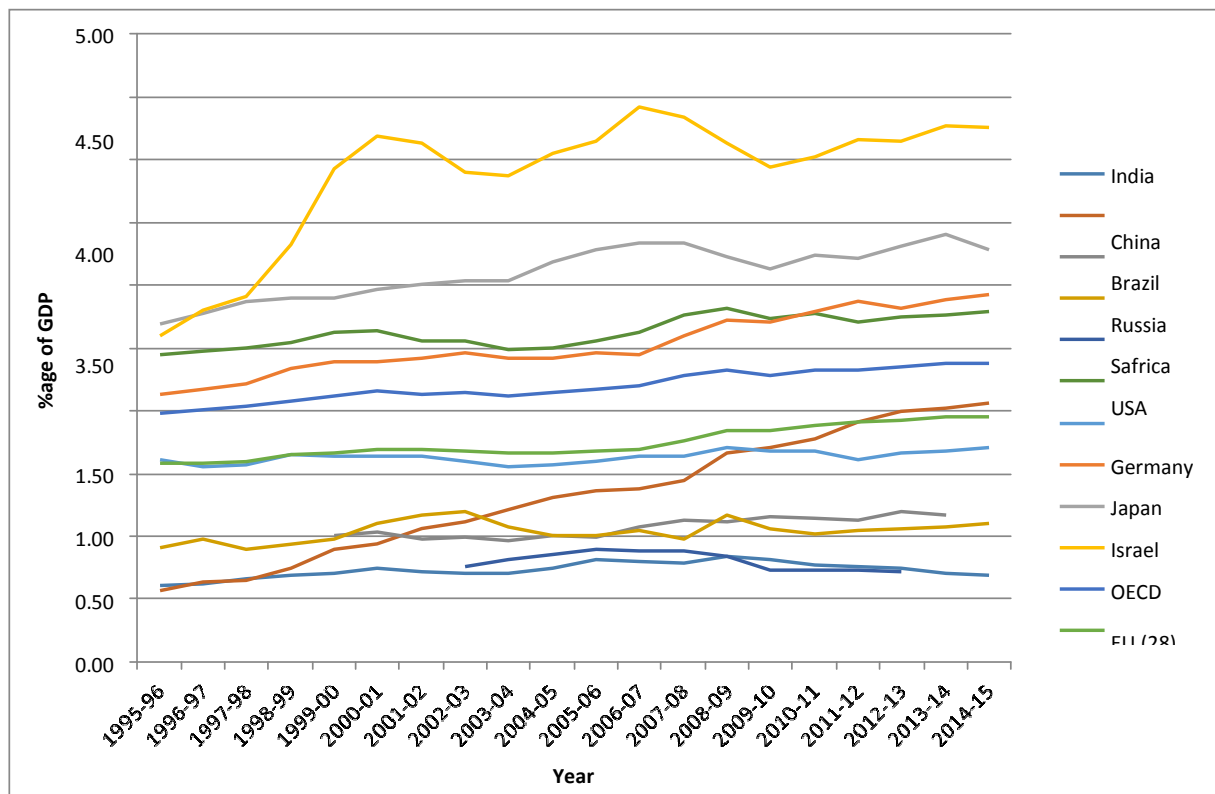
R&D intensity generally reflects a firm's industry sector, product knowledge, manufacturing, and technology, and is an indicator that can be used to gauge the level of a company's investment to stimulate innovation in and through basic and applied research. Investment on R&D is thus to scale or increase productivity (e.g., factor productivity) as well as an organization's salable output. It is critical to track R&D investment in the knowledge, technology and thinking that drives innovation in countries. Besides, SDG-9 calls on governments to promote sustainable industrialization and innovation by ramping up spending on R&D and increasing the number of researchers, stated by Silvia Montoya (2016). The top five R&D performers in absolute terms (R&D expenditure) are all developed economies: United States followed by China, Japan, Germany and Republic of Korea. Each country or region trying to increase their R&D activities and by setting their own spending targets: the European Union (EU) target to raise overall R&D investment to 3% of GDP by 2020. According to UIS data, only six countries worldwide have managed to surpass the 3% target, and three are smaller EU economies: Denmark, Finland and Sweden. These, in turn, lag behind Japan with 3.6% and Israel with an impressive 4.1%. And all of them trail behind South Korea – the world leader – with 4.3%. Austria, Germany and Switzerland hover around 3% as does the biggest spender of all: the United States.

Few countries in other regions compete with these proportions. In Central and Eastern Europe, Slovenia leads with 2.4% compared to the Russian Federation at 1.2%. In Central Asia, the figure hovers around 0.2%, as in the case for Kazakhstan. Morocco tops the league in the Arab States with just 0.7%. Brazil is the leader in Latin America, with 1.2%, while India leads in South and West Asia with 0.7%. In Africa, the African Union is aiming for 1%, but only Kenya, Mali and South Africa approach the target.

China is achieving an astonishing average annual growth rate of 18.3% in R&D spending, compared to just 1.4% across the rest of the world's upper-middle-income countries, according to UIS data. China's R&D spending only amounts to 2% of its GDP, but this means that the country is pouring about PPP\$369 billion into this sector each year. As the share of global R&D expenditure by high-income countries fell from 88% in 1996 to 69.3% by 2013, China alone filled that gap, increasing its share from 2.5% to 19.6%. This means that China is increasingly approaching the United States, which accounts for almost 30% of global R&D expenditure.

Globally, there were almost 1,083 researchers for every one million people in 2013. However, the share of researchers in middle-income countries, excluding China, fell from 17% to 15% between 1996 and 2013 – a worrying downward trend with global implications for sustainable development. India trails behind among BRICS region and even spending less than South-Africa (Figure-2).

Figure-2: Comparative expenditure on R&D as percentage of GDP



Source: <https://data.oecd.org/rd/gross-domestic-spending-on-r-d.htm>

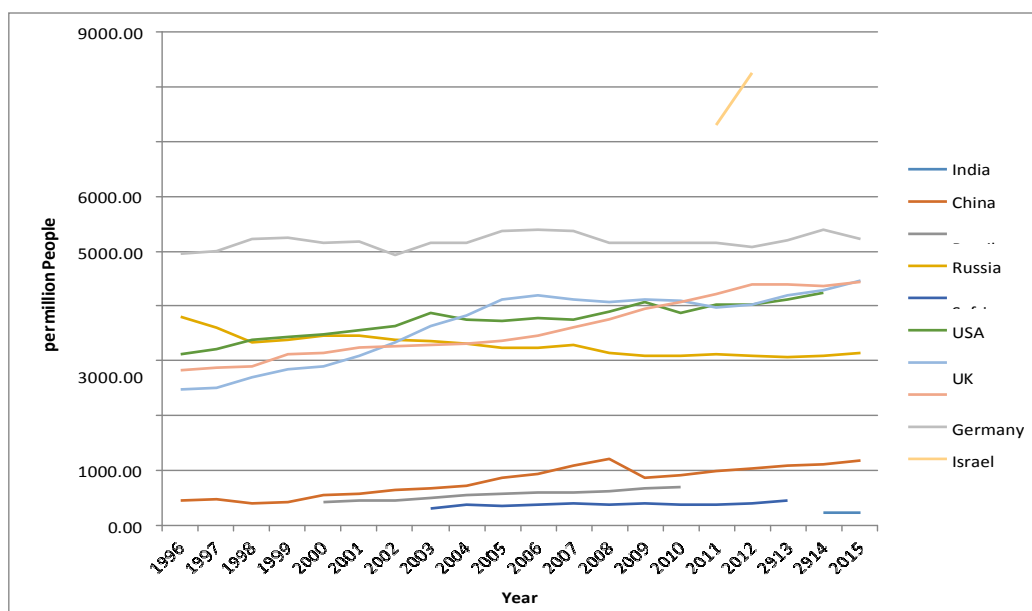
Statistics on science and technology (S&T) personnel are key indicators for measuring the knowledge-based economy and its developments, for example, providing information on the supply of, and demand for, highly qualified science and technology specialists. According to Eurostat (2017), the number of researchers in the EU-28 has increased in recent years: there were million researchers (in full-time equivalents (FTE)) employed in the EU-28 in 2015 (see Figure 1), which marked an increase of 443 thousand (or 32.2 %) when compared with 2005. The number of researchers almost doubled between 2005 and 2015 in Portugal, Ireland and Greece, while the number fell in Finland and Romania.

Among the non-member countries, the number of researchers in China (excluding Hong Kong) reached 1.52 million in 2014, which was slightly higher than in the United States (1.27 million; 2012 data); both of these values were below the total number of researchers in the EU-28 in 2014. During the period 2005 and 2014, the number of researchers in Turkey more than doubled, while the number almost doubled in South Korea. The only non-member countries among those for which data are shown in Figure 1 to report a reduction in their number of researchers between 2005 and 2015 were Russia and Iceland.

An analysis of R & D personnel by sector in 2015 shows that in the EU-28 there was a high concentration of researchers in the business enterprise sector (49 %) and the higher education

sector (39 %), while 12 % of the total number of researchers were working in the government sector. The relative importance of the different sectors varied considerably across the EU Member States, with business enterprises accounting for three fifths or more of all researchers in Sweden, Austria and France (2014 data). By contrast, the government sector employed the highest share of researchers in Romania (38 %). A majority of researchers working in Portugal (66 %), Greece (65 %), Latvia (64 %), Cyprus (61 %), Lithuania (59 %), Slovakia (59 %), the United Kingdom (58 %), Estonia (58 %) and Croatia (56 %) were employed within the higher education sector, and this sector also accounted for the highest share (although less than 50 %) of all researchers in Spain, Italy and Luxembourg. In terms of its number of researchers, the private non-profit sector was the smallest in all EU Member States; its highest share (8 % of all researchers) was recorded in Cyprus, while the next highest share of researchers employed in the private non-profit sector was in Italy (4 %). Following the investment on R&D pattern India had lowest R&D personnel (Figure-3).

Figure-3: R&D researchers per million people



Source: <https://data.worldbank.org/indicator/SP.POP.SCIE.RD.P6?end=2015&start=1996&view=chart>

Evolution of S&TI policy in India

The genesis of India's S&T policy goes back to 1958 with Scientific Policy Resolution (SPR) aiming to "foster, promote and sustain" the "cultivation of science and scientific research in all its aspects". The SPR emphasized the use of the scientific approach in all activities of the country. Subsequently, the Technology Policy Statement (TPS) of 1983, articulated to attain technological competence and self-reliance at a time of constraints on import of technology, followed by the Science and Technology Policy (STP) of 2003 intended science and technology (S&T) together by emphasizing the need for investment into R&D to address national problems by means of integrating programmes of socioeconomic sectors with the national R&D system. The STP aimed S&T governance, investments, strengthening of S&T infrastructure and human resource development for development of a comprehensive national system of innovation. This

was followed by STI policy 2013, to accelerate the pace of discovery and delivery of science-led solutions for faster, sustainable and inclusive growth. The STI thus seeks to focus on both people for science and science for people and combine the benefits of excellence and relevance. This was considered “S&T for the people” that could be the new paradigm of the Indian STI enterprise.

Historically, the Indian S&T policy-making process emerged from four different phases (i) optimistic phase: 1947–1970; policy for the sciences exerted from political-bureaucratic termed as “policy for science,” focusing on creating a basic infrastructure for S&T in the country, including the expansion of the university sector to supply the necessary human resources. As a result science organization such as DAE and CSIR, DRDO were established. (ii) From optimism to critical evaluation: 1970s–1990. During the period technology licensing was liberalised, the government undertook massive efforts to promote domestic R&D efforts with objectives absorptive, learning and technology generating capacity of firms and the National R&D Programme was initiated. (iii) 1991 --2010; new economic reforms for exploring the growth of S&T with emphasis on R&D investment and corporate knowledge-based industrial and research operations in particular, has changed significantly with the roles of the private sector, public-private sector partnerships and international collaborations in education and R&D were become more important and may in the long term imply a major transformation of the higher education and R&D system in India. and (iv) S&T for the people: 2010 onwards; science-led solutions by developing science based entrepreneurship. This was oriented to drive both investment in science and investment of science-led technology and innovation in select areas of socio-economic importance. Emphasis was to bridge the gaps between the STI system and the socio-economic sectors by developing a symbiotic relationship with economic and other policies.

The progress illustrates how Indian S&T policies evolved over period of time and influenced R&D system; from basic science to 'science as public good' to 'science as market good'. The last phrase 'science as market good' was coined lately in Indian context which emphasis translating basic scientific knowledge into product. To promote science based entrepreneurship

Innovation-Entrepreneurship Ecosystem

The patents and researchers are a by-product of growth of S&T in India (Chaurasia, 2016) and Landers (2016) found an interconnections between entrepreneurship and science (Landers, 2016). S&T innovations can be the path of India's economic growth and development as argued by Dr. A P J Abdul Kalam. He also felt that India should leverage its young ignited minds for the same. While the western world has been able to harness the power of human imagination in S&T by building a strong connect between industry and academia, India has, by far, lagged behind. This gap needs to be narrow down to bring together both industry and academia acknowledge by means of collaboration and inter-mobility of the professionals. Recently industry and academia have come together to meet country's need and consequently the industry has funded research projects to research organization like CSIR, ICMR and ICAR R&D labs and universities, such as the IITs, NITs, to develop commercial sable technology innovations. Though the support is limited to some top institutes which requires expansion to the average institutes for developing a big pool of industry academia knowledge. The linkages and ecosystem of S&T in India is illustrated in Table-1:

Table-1: DST Innovation-Entrepreneurship Ecosystem

Role	Main Stake holder	Approach	Paradigm
Policy building	Government	Evidence based	Innovation ecosystem
Strengthening Human Capacity	Academic , entrepreneur and local Community	Talent attraction and support	Proactive measures
Strengthening	Institutional capacity	H.EIs, university	Knowledge
Deployment of	Technology solutions	Industry, Society,	Government
Participative	Convergent	solutions	Societal interventions
Government and	society, NGOs	Micro-enterprise	support system

Source: Adopted from Gupta, A, Innovation and Entrepreneurship Ecosystem in India, DST, New Delhi

In spite of significant achievement in S&T India's Science, Technology and Innovation (STI) policy has always been a part of criticism on the part of output in terms of translating scientific knowledge into product. Subhra Priyadarshini (2013) argued that academics and science policy makers seek to alter not just the basic semantics of the ambitious document but also how it outlines funding in science versus research output. The balance, they say, must now tilt towards output, primarily through the promotion of science entrepreneurship, which implies that Science policy must promote enterprise.

To some degree, these criticisms appear to rest on a fictitious separation between foundational science, patents, and innovation (Donald, 1997). For promoting scientific entrepreneurship the shift in patentability standards can be the means to open doors to entrepreneurial activity for economic stability and growth (Landers, 2016). Thus, to create a new paradigm for the policy to work, India's industry leaders will have to get involved in a bigger way in academia to provide direction to the engineering and technology departments of institutes and universities, according to Narasimha (2013).

Initiative for Developing and Harnessing Innovations

Government of India initiated a number of policy initiative to promote innovation and translating them into product. Accordingly, to encourage researchers for translating scientific knowledge into entrepreneurship a programme National Initiative for Developing and Harnessing Innovations (NIDHI) was announced in the Year 2016-17. The programme intended to convert Knowledge back to Economic Growth and Societal Good. National Centres of Innovation such as National Centre for Aerospace Innovation and Research and Innovation (NCAIR) with support from DST and Boeing Corp at IIT Bombay, Biomedical Engg and Technology Centre (BETC) with support from DST and Rajiv Gandhi S&T Commission of Govt. of Maharashtra at IIT Bombay, Technology Business Incubator for Medical Devices & Biomaterials at Sree Chitra Tirunal Institute for Medical Sciences & Technology, Trivandrum, an autonomous Institute under DST and so on. This aimed to translate innovation into entrepreneurship. This has led increased culture of start-up as shown in Figure-1.

Figure-1a: Technology driven start-up in major countries

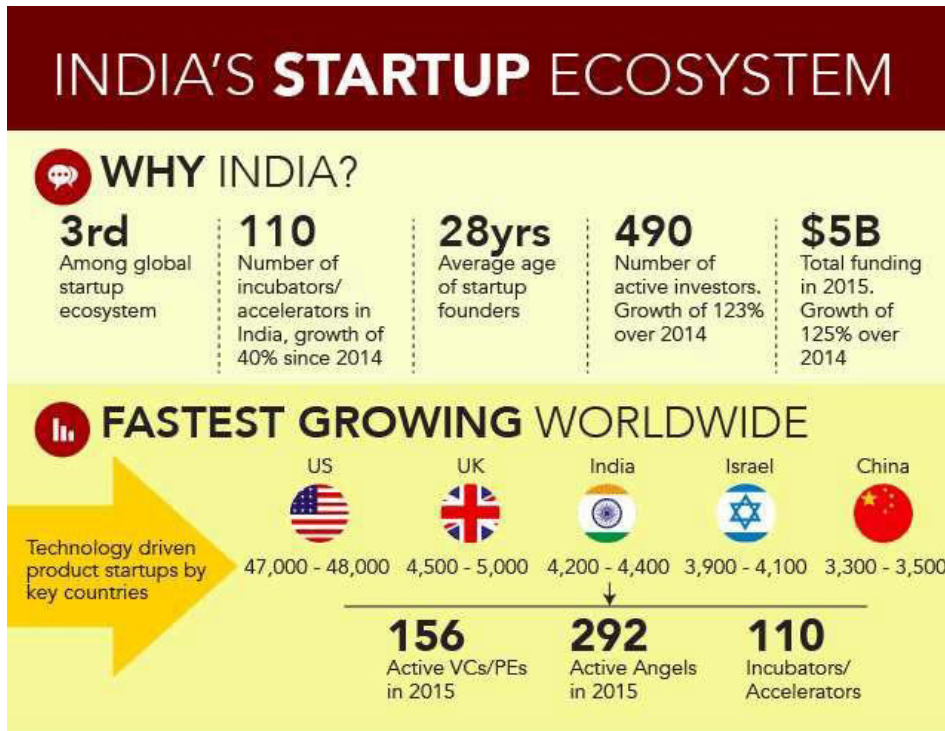
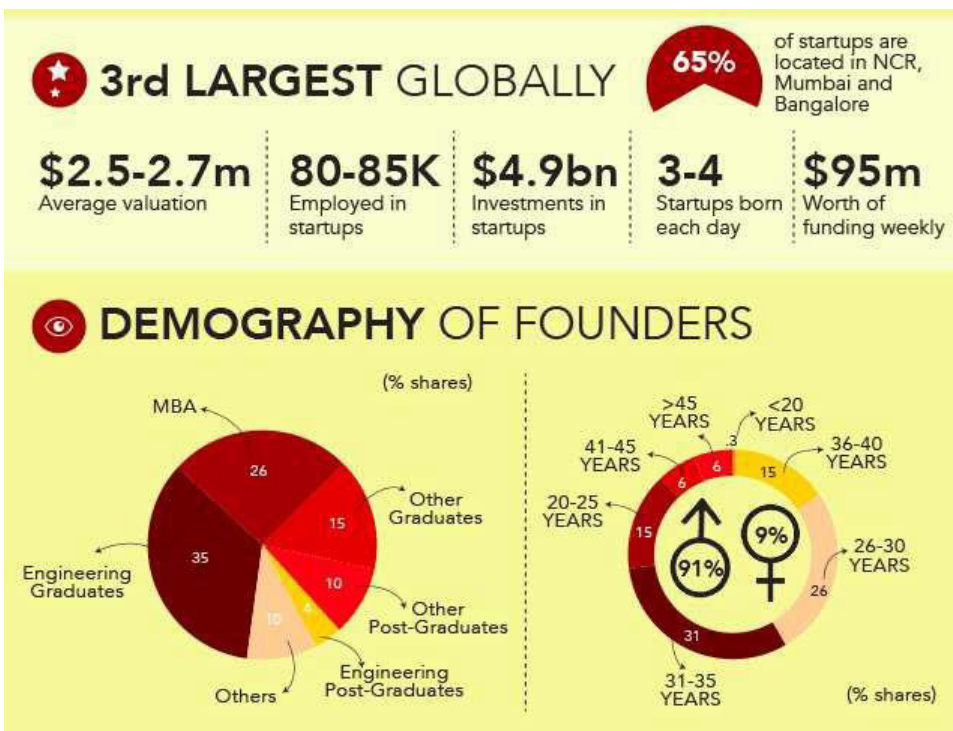


Figure-1b: Demographical distribution of Start-up founders in India



Source: Adopted from Gupta, A, Innovation and Entrepreneurship Ecosystem in India, DST, New Delhi

Similarly, bringing affordable Indian innovations in market Public Private Partnership (PPP) Programmes were initiated; Nano car and Reva electric car in automobile, Mobile App for farmers in agriculture, Health Care: Narayana Hrudayalaya, Bangalore, business-process innovation, low cost prosthetics and Mangal yan (Space Technology to Mars). The Economic Times Power of Ideas is an entrepreneurial platform in association with the Department of Science and Technology to seek, reward, nurture and groom business ideas by connecting them with relevant evaluators, mentors and investors.

Conclusions

India's competency has ceaseless where both industry and academia acknowledge the need for collaboration, however, trailing in S&T entrepreneurship culture but has not be able to develop desirable environment for manufacturing hub similar to China. This retarded the India's industrial competitiveness arising out of technological depth (and technological value addition) does not compare well with other NICs in Asia. However, programmes like skill India could be a key strengths in some of the skill-intensive sectors. Further, India is sound to undertake industrial activities that require both engineering skills and raw materials (automobiles and auto- components). While industrial policy resolutions/statements have given direction to the development of manufacturing enterprises. These processes have tried to ensure that India is able to develop a sufficiently robust manufacturing base and at the same time build a sound S&T infrastructure and create a high-skilled manpower base (Dhar & Saha, 2014). These have scripted the emerging economy story for India to a large extent. Recent innovation policies by the Government of India have been adopted at various levels and have the following broad objectives.

The R&D expenditure is meager and per million people R&D researchers are also very low, so the most important issue is to address the skill shortage and ensure supply of quality human resource for scientific research. Subsequent, develop innovative solutions for commercial applications – to bridge science-society divide for effective innovation system by linking S&T stakeholders both in the public and the private sectors. At the same time, there is a need to rejuvenate the science and technology innovation wave in India and develop scientific temper with an objective to create young innovators and entrepreneurs. Since, economic policies ensure sustained demand for innovations hence, innovation policies should ensure availability of broad- based skills to seize opportunities of specialization, industrial development and knowledge economy for achieving frontier R&D focused on pro-poor innovations.

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R&D ECOSYSTEM FOR INNOVATION IN THE RENEWABLE ENERGY SECTOR IN INDIA: THE CASE OF MARINE ENERGY

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Abstract

The energy system is the centre of economic development and social progress of any country. Development of energy system is of critical importance to achieve economic, ecological and social goals. Globally, India is the fourth largest consumer of energy in world as per EIA report, 2011 after USA, China and Russia. Its energy demand had been growing as a result of country's economic growth over the past several years. India's largest source of energy is coal and almost 44% of its total energy demand is met from coal based energy sources. The second largest source of energy is petroleum and in the rural area is still biomass almost 22%. However, it is now well established that the country can no longer afford such extensive usages of fossil fuel like coal and petroleum which is threat to these resources and environment as well. Policies and programs have been framed and implemented to promote use of renewable energy which is considered to be a clean and sustainable resource. Solar and wind energy programs are now in place but we also need to harness from the vast marine coastline the country is blessed with as the ocean has huge potential to supply energy in many forms. One of the major advantages of ocean energy over other forms of energy is that it is renewable in nature and continuously available throughout the year. The renewable energy resource in the ocean comes from six distinct sources, each with different origins and requiring different technologies for conversion: waves; tidal range; tidal currents; ocean currents; ocean thermal energy conversion (OTEC); and salinity gradients. Given the long-term energy need through this abundant source, ocean energy sector can play a meaningful part in achieving energy security in coming decades. Presently over 100 different ocean energy technologies are currently under development in more than 30 countries, most of which are currently at the initial stage of commercialization. It therefore becomes imperative for India to explore this resource for the future energy requirement. This paper makes an attempt to map the national innovation capabilities in marine energy sector from the perspective of innovation system framework which brings in a broader set of actors and institutions as shaping the innovation process. It is a fact that the marine renewable energy sector is less well developed than other energy industries but comes with both opportunities and challenges. The lack of an established industry structure can make entry into the market uncertain for newcomers. However, this lack of structure also means that firms are potentially more likely to create and get opportunities than is possible in other energy industries that are developed and more mature. The paper analyses the role of various actor and agencies in development of technologies for harnessing ocean energy in India and highlights through its analysis that to meet the future challenges, a major transformation of energy system will be necessary for which major shift in our energy policy would be required.

Ocean is the integrated part for the Earth System. In this paper we consider all the marine energy actors and stakeholders in India related to different technologies like wave energy, tidal energy, ocean thermal conversion, salinity gradient, gas hydrate and algal fuel. This paper is based on combined innovation system approach of National systems of innovation and international

system of innovation. All the actor and agencies of this combined innovation system approach will be analysed.

It is a fact that the marine renewable energy sector is less well developed than other energy industries creates both opportunities and challenges to the firms and research institutes. The lack of an established industry structure can make entry into the market uncertain for newcomers. However, this lack of structure also means that firms are potentially more able to create and take opportunities than is possible in other parts of the energy industry that are developed and more mature. The paper is therefore important as it analyses the innovation capabilities in the marine energy sector in India and trigger thoughts for innovation driven economic growth in India.

Keywords: Innovation, technologies, energy, marine energy

NANOTECHNOLOGY AND EMERGING HEALTH SAFETY AND ENVIRONMENT ISSUES

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Abstract

The field of Nanotechnology developed at phenomenal speed in the last 2-decades and as a result manufactured nanomaterials are in use in a variety of industrial and household products. The nanomaterial is defined as the material between 1 and 100 nm in size, and a nanometer (nm) is one billionth or 10^{-9} of a meter. Nanomaterials have unique physical and chemical properties, e.g., ultra-small size, large surface area to mass ratio, and high reactivity, which is different from bulk materials of the same composition in microscale. In early 2000, nanotechnology was described as a broad-based, multidisciplinary field with wide applications in electronics, pharmaceuticals, and medical health, cosmetics, energy, catalytic and material applications. Internationally science and technology policies were made, international conferences were held for the development and governance of this emerging technology¹. India was not lagged and established the Nanoscience and Technology Mission (NSTM) as early as in the 10th plan period (2002- 2007) by the Department of Science and Technology (DST) with an allocation of about 12 million USD budget. Subsequently, in 11th and 12th plan 250 and 162 million USD respectively were allocated for 'Nano mission' by the Union cabinet². Nano mission aimed to create an innovation climate for nanotechnology in the country, and currently, India is at par with other developed nations in the area of nanotechnology research and development. Kumar³ from Research and Information System for Developing Countries mentioned a list of top ten nanotechnology application areas for the developing countries including India, to address UN Millennium Development Goals. The list includes; 1) Energy storage, production, and conversion 2) Agricultural productivity enhancement, 3) Water treatment and remediation, 4) Disease diagnosis and screening, 5) Drug delivery systems, 6) Food processing and storage, 7) Air pollution and remediation, 8) Construction, 9) Health monitoring, and 10) Vector and pest detection and control.

Vance et al.⁴ compiled a list of 'Consumer Products Inventory' that currently listed 1814 products as nanotechnology-based products that are produced by 622 companies, located in 32 countries. However, a majority (71%) of product do not provide evidence for the use of nanomaterial (Vance et al., 2015). Interestingly, a large number of the listed products fall in the category of health and fitness (42%), and widely used nanomaterial is silver (24%). A large number of consumer products in the inventory (49%) do not disclose the composition of nanomaterial used, which is a cause of concern. During manufacturing and household waste nanomaterials are likely to end up in the environment polluting, air, water bodies and soil exerting unwanted effects. As a result, nanoparticles are beginning to come under scrutiny, and studies related to their potential adverse effects are increasing in recent years. Several studies indicated nanoparticles have different biological effects than the parent compounds. The knowledge about the interaction of nanomaterial with biological organisms is inadequate. Especially for the listed

consumer products dispensed in the liquid medium (about 29%, i.e., 528 products) are expected to come in dermal contact and require their health safety data.

The surface properties and the very small size of nanoparticles provide surfaces that may bind and transport toxic chemical pollutants, as well as possible being toxic in their way by generating reactive radicals and exerting oxidative injury in exposed organisms. Toxicological studies have shown that once in the body, nanoparticles can be toxic to exposed organisms. Extensive applications of nanoparticles are generating new concern for policymakers and environmental managers regarding possible toxicological effects and pathological risks to human health and the environment. With the advancement in analytical technologies, a majority of chemical pollutants are detected at extremely low levels, and the information is growing that certain chemicals prevalent in air and water bodies can exert deleterious effects on human health and also create ecological imbalance at very low concentrations. Contrary to lethality used as safety evaluation criteria; other endpoints like neurobehavioral changes, immunological disturbance, and endocrine disruption could specify previously unknown effects that are not recognized using current assessment criteria. The challenge for the regulatory bodies is to develop strategies to tackle emerging pollutants which were previously unseen before they become critical ecological or human health problems. The regulatory machinery of OECD and US EPA formed a consortium of scientists to evaluate their standard ecological test guidelines for their appropriateness in testing nanomaterial because of their specific properties. The consortium of scientist concluded that existing protocols are not useful as it is for nanomaterial safety, and exploratory research is needed to either modify the existing protocols or to draft new protocols altogether. An active Federal Government agency of US, NIST (The National Institute of Standards and Technology) is actively involved in the development of nanotechnology standard by participating in ASTM Committee E56 on Nanotechnology. There is a 'Nanotechnology Standards Database' hosted by the ANSI (American National Standards Institute) that invites private sectors and government experts to formulate nanotechnology standards with strong scientific basis to be adopted universally (ISO TC 229, *Nanotechnologies*). A working group under ISO TC 229 defined Health, Safety and Environmental Aspects of Nanotechnologies that lead to greater understanding between the key stakeholders in nanotechnology, especially consumers, researchers, regulators, and industry. However, the dilemma persists in spite of extensive research and revision of international test protocols, no single physical or chemical material property of nanomaterial perfectly correlates with their observed biological effects.

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TECHNOLOGICAL SOLUTIONS TO MANAGE SOLID WASTES: INNOVATIVE TREATMENT OF BIO WASTES AROUND THE SOURCE OF GENERATION

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Abstract

Integrated approach is essential for the effective stabilization and management of Municipal Solid Wastes (MSW) especially when the wastes are unsorted or partially sorted at source. The putrescible wastes in MSW needs to be treated or removed at the earliest for controlling further pollution and mal-odour. Though the Central Government Policy is centralized treatment of all kinds of municipal solid wastes, Treatment of biodegradable wastes in de-centralised facilities is found most suitable in India as it reduces the burden of collection and transportation cost besides avoiding further environmental pollution and inconvenience caused by transportation, treatment plant investments etc. However, dry wastes segregated after processing putrescible wastes processing are transportable and manageable in centralized units.

CSIR-NIIST has a bundle of technologies for the treatment of bio wastes and the package includes household level treatments, community systems and higher scales. Innovative anaerobic and aerobic methods developed at CSIR-NIIST for treating household wastes are targeted to manage biowastes at the source. The larger advanced biogas plants are aimed to manage putrescible wastes produced at community level. CSIR-NIIST has been successful in treating MSW in Anaerobic Leach Bed Reactor (ALBR) for the effective management of putrescible fraction of MSW in municipalities. ALBR developed by CSIR-NIIST is capable of treating biodegradable wastes - both 'legacy' type and daily collected one. Biogas and compost are produced during the stabilization, and it adds value to the treatment plant.

NUTRITIONAL STATUS OF PRE-SCHOOL CHILDREN: A COMPARATIVE STUDY

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Theme-2: Health Service in Urban and Rural Area

Abstract

Introduction: Human nutritional disorders have become a widespread public health problem among the under-privileged communities in many parts of the world. In India, the situation with respect to nutrition among the children varies from region to region due to difference in dietary habits, socio-cultural practices, economic status etc. The pre-school children are vulnerable, they succumb readily where the diet is ill-balanced and infectious diseases and infection are widespread. **Justification of the Study:** The justification of study confined to the socio economic conditions, their dietary practices and nutrition education of the parents which affect the growth and nutritional status of children. It's very difficult to study the status of children where the people have adopted their own living practices with regional and communal variations. As the rate of growth and development is fast and any stimulation along this line has its maximum effect during early childhood. **Objectives:** to assess the nutritional status of children, to ascertain the level of knowledge of communities people with regard to food and nutrition, To ascertain the level of consumption of major nutrients by the children, To find out health and nutrition practices of communities people, to study the impact of nutrition on health status of children. **Methodology: Sample:** a total number of 150 mothers and their pre-school children both Urban and rural area. **Area of Study:** the area selected for the study was confined to Boudh District of Odisha. One Urban and Two rural areas from Kantamal Block i.e. Kantamal Village and Badakusangh village. **Tool to be used:** The techniques used by three interview schedule and questionnaire for the purpose and observation study for the recorded. **Result:** Urban children depicted a better health status (Height, Weight, MUAC) than rural children. This might be due to better nutrition and health practices. Most of the mothers from both urban and rural believed in certain taboos and customs during pregnancy whereas urban mothers were weaning their children 7 to 12 months and rural mothers weaned their children little early. Boys received better health status than girls and the found both urban and rural mother prefer son than daughters as in Indian Culture son are more regarded than daughter. People will not change their beliefs and habits concerning food unless they are convinced that changes will benefit them and their children. Therefore, it is necessary to educate village families especially the mothers about the benefits of nutritious food, good child feeding practices and improved preparation of food. Nutrition and child health care education, if integrated into literacy programme, appreciable improvement in the nutrition pictures of the families could be achieved with maximum expenditure of the resources.

ENVIRONMENTAL MERCURY DISCHARGED FROM A CHLOR-ALKALI INDUSTRY AND ITS IMPACT ON TERRESTRIAL AND BIOTIC SYSTEMS AT THE CONTAMINATED SITE, GANJAM

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Abstract

The chlor-alkali industry M/S Jayashree Chemicals Pvt. Ltd., is situated at Ganjam, on the Bank of Rushikulya estuary about 1.5 km. Away from the sea, Bay of Bengal, on the East and 30 km. In the process of manufacture of chemicals the factory discharges the effluent containing mercury and chlorine, into the estuary and deposits solid waste (brine mud, enriched with mercury) on the adjacent land areas. Mercury is thus, discharged into the environment through effluent and solid waste routes, contaminating the adjacent aquatic and terrestrial ecosystems, respectively. This addition of mercury is the primary contamination. Secondary contamination occurs through the chimney into the atmosphere and its fall out by the process of precipitation. All these discharges collectively seem to cause a major environmental threat to crop production and also to fisherman engaged in fishing both in the river and also in the estuary. Chlor-alkali industries occupy an important place so far as pollution of the environment with mercury is concerned. Main aspect of pollution with regard to chlor-alkali industry was the release of mercury into the environment. Pollution occurs, due to careless, irresponsible discharge of the effluent in the vicinity of the industry and consequent discharge into River Rushikulya, enter into the paddy fields through irrigation, where the non-target organisms, like blue-green algae, inhabitant of the crop fields, suffer the most. The intensity of mercury pollution is decreasing with time, in and around the Chlor-alkali industry as evident from residual accumulation data in 2016 when compared to 2009 and 2011 data. The analysis of the effluent collected from two contaminated sites showed significantly high level in all parameters tested and the most important being the mercury level. The solid waste also showed very high level of mercury. The plants collected during 2011 showed significantly high level of residual mercury. However, the mercury level decreased significantly in 2016. The residual mercury affected the pigment content of the plant leaves collected from the contaminated environments and the values were significant when compared to respective control values. The plant pigments significantly depleted with the increase in mercury concentration and it was also opined that mercury is responsible for such a drastic depletion in pigment content. The terrestrial contamination still follows an upward increasing trend around the industrial site at Ganjam. Higher level of mercury was detected in some plants collected from the contaminated sites. Industrial fresh effluent and solid waste was brought to the laboratory and the parameters were studied. Plant leaf samples were collected for analysis of mercury. The specimen plants collected from the contaminated locality contained significant amount of residual mercury. The plants collected from the nearby populated localities also contained residual mercury. Significantly, it was observed that few plants collected from nearby locality did not have any residual mercury or if present that was not traceable. The plants having lowest residual mercury are - *Amarantus spinosus*; *Hibiscus sabdariffa*; *Luffa cylindrica*; *Zizyphus jujube*; *Vigna sinensis*; *Azadirachta indica*; *Justicia simplex*; *Acalypha indica*; *Psidium*

guayava; Momordica charantia. The plants either do not have residual mercury or if present not traceable are- *Solanum melongena; Ocimum basillicum; Phaseolus vulgaris; Dolichos lablab; Phaseolus mungo; Euphorbia prostrate; Cucurbita maxima; Oryza sativa; Croton sparsiflorus*. Significant depletion in pigment content was marked in the exposed leaf sample of some old plants. The depletion in pigment content in tested plants was only due to residual mercury. The residual mercury level in younger plants is decreasing day by day, which is a good indication from toxicological stand point. However, in perennial plants residual mercury concentrations significantly increased indicating availability of mercury in deeper layers of the contaminated area. The comparison of 2016 values with 2011 values indicated that the mercury contamination was at its peak in 2011 and the contamination decreased in 2016, which is a positive sign. The total removal of solid waste and top soil of the dumping site either for recycling or dumping elsewhere decreases the Hg burden of the area. Non availability of mercury in many plants and no change in pigment content in plant leaves are important from pollution stand point.

Key words: Chlor-alkali industry, mercury pollution, effluent, Solid waste, absorption, plant pigment.

CLIMATE CHANGE IMPACTS ON AGRICULTURE AND FOOD SECURITY

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“A threat to the food security is a threat to the very existence of mankind.” This paper explores how climate change by altering the temperature and weather patterns, precipitation patterns and increased occurrences of extreme events like hurricanes and floods, is negatively affecting the food security of countries, especially the tropical and low income countries. These vulnerabilities are further enhanced for developing countries like India, where people are highly dependent on climate sensitive sectors and do not have the resilience- necessary resources and the adaptive skills to cope with the challenge of climate change. India is highly dependent on the environment for food and livelihood, which makes Indians highly susceptible to climate change. The impact of climate change and its associated costs will fall disproportionately on the developing countries threatening to undermine the achievement of the Sustainable Development Goals of No Poverty and Zero Hunger, as climate change will reduce access to drinking water, affect the health of the people, especially the poor and pose a threat to food security. According to the IPCC Report “Climate-related risks to health, livelihoods, food security, water supply, human security, and economic growth are projected to increase with global warming of 1.5°C and increase further with 2°C.”¹⁸ These effects are more likely to be felt by disadvantaged and vulnerable populations, indigenous people and local communities dependent on agricultural or coastal livelihoods.

Climate change affects food security both directly as well as indirectly. It has a direct impact on food production by impacting the yield and indirectly through water availability, pollination services, pests, diseases, nutritional quality etc. It puts pressure on all the four pillars of food security, that is, availability, access, utilization and stability, which are studied in detail in the paper. Climate change impacts food availability through its effect on food production, processing, storage, distribution and exchange. According to the International Fund for Agricultural Development, at least 70 percent of the poor live in rural areas and most of them depend partly or completely on agriculture for their livelihoods. Agriculture is a primary source of livelihood for about 36% of the world’s workforce. In the heavily populated countries of Asia and the Pacific, this share ranges from 40 to 50 percent, and in sub-Saharan Africa, two-thirds of the working population still make their living from agriculture.¹⁹ Agriculture faces acute climate change related threats and if the agriculture potential is reduced the socio-economic impacts would be severe as agriculture is both a source of livelihood and food for people of the region. It provides the people with food to eat and sell to earn their livelihood. The current food system not only feeds the world population but also supports the livelihood of 200 million people.

The IPCC Report on Climate Change and Land says with high confidence that “pests, diseases, and vectors for both crop and livestock diseases are likely to be altered by climate change.”

¹⁸ IPCC, Global Warming of 1.5°C, 2018.

¹⁹ ILO, 2007.

About 50% of pests and vectors will change ranges by 2100 under the current GHG emissions. Some species could extend their reach till the poles and higher latitudes. This will affect disease management at both local and national levels and lead to crop losses. Almost 10-16% of global food harvest is lost to pests and crop diseases each year. Given the trans-boundary nature of food supply chains, a decline in food production will not only have implications at the local or national level, but also affect the availability and price of food in other regions of the world. Volatile food prices would have severe impacts on import-dependent developing countries, while consumers in large industrialized countries would be relatively unaffected.

If we want to achieve a world without hunger, malnutrition and poverty by 2030, it is imperative that we accelerate actions to strengthen the resilience and adaptive capacity of food systems and people's livelihood choices in response to climate variability's and extremes. This will require the development of policies and programmes that are aimed at climate change adaptation and mitigation in the areas of agriculture, disaster management, building up resilience of coastal communities etc. Such strategies should be gender sensitive including all the stakeholders and have a multi-sectoral approach. The integration of the Paris Agreement on Climate Change and the Sendai Framework on Disaster Risk Reduction is a very good policy framework to guide actions related to achieving the 2030 Sustainable Development Goals of Zero Hunger, No Poverty and Climate Action.

Keywords: Climate Change, Food Security, Agriculture, India.

POLICY FRAMEWORK FOR PROMOTING MEDICAL INNOVATIONS FOR ACCESS TO HEALTH: THE INITIATIVES OF THE INDIAN COUNCIL OF MEDICAL RESEARCH, DEPARTMENT OF HEALTH RESEARCH, NEW DELHI, INDIA

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Abstract

One of the major mandates of the Indian Council of Medical Research (ICMR), a constituent body of the Department of Health Research (DHR) is to support, promote and encourage bringing modern health technological tools to people to promote access to health care to Indian populations. This is done through encouraging new innovations related to diagnostics, treatment methods as well as preventive tools – vaccines etc. for communicable and non-communicable diseases. The major policy framework and support system has been established by the ICMR/DHR for translating the innovations into products/ processes of public health importance. These initiatives are executed through the Intellectual property Rights (IPR) Unit, Division of Innovations & Translation Research. These efforts were started way back in 1995 when the first Policy for ICMR Institutes to collaborate with the industry – *Contract Research, Consultancy, Technical Services* was brought out. This was subsequently revised in 2006 *Guidelines for Sponsored and Collaborative R&D* to make it inventor friendly. This has been updated as *Policy on Contributions and Partnerships* in 2018. The IP-related activities were started through the Technology Transfer Unit that was upgraded into a IPR Unit in 1999 with the mandate: i) Identification of new inventions and assess their potential for IP protection; ii) Process these new inventions for IP protection after due diligence analysis; iii) Manage IPR (patent) portfolio of the Council; iv) Product development through the NRDC, BCIL and own efforts; v) Support collaborative R&D through NDAs, MTAs, MoU etc. vi) Strengthen in-house systems capacity to capture, assess and protect new IP generated in Council; and vii) Disseminate the technologies generated by the Council through publications and other means. This Unit thus took up the responsibility of filing, maintaining and prosecuting the IP of ICMR in India and abroad besides making efforts to commercialize the Council's inventions through the NRDC, New Delhi and, later, through inhouse efforts. A comprehensive *Intellectual Property Rights Policy* was brought out and released by the then Hon'ble Minister of Health & Family Welfare in 2002. This was further revised in 2013. In 2015, guidelines were framed for filing *Patent Co-operation Treaty (PCT)* applications through a transparent and objective system to file patents abroad. These efforts by the IPR Unit over the last two decades have been largely successful. During 2010-18, a total of 86 patents were filed in India and 33 abroad from intra and extramural research. A total of 21 technologies were transferred to companies and some have reached the market. A total of Rs 1.43 crore has been generated by commercialization of its technologies between 2011 and 2018 almost half through internal efforts. The above initiatives will be discussed in the light of national and global developments in providing access to health care.

PROSPERITY AND DEPRESSION – THE GROWTH PERFORMANCE OF INNOVATIVE CAPITALISM

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Abstract

Capitalist economies can be seen complex adaptive systems. Such systems consist of a multitude of agents from whose individual adaptation efforts the adaptive behavior of the system as a whole emerges. A case in point is the way in which economic growth emerges as a collective outcome of individual adaptation strategies. As will be discussed, a complex adaptive systems perspective suggests that the process by which the bounds of the existing production opportunities are successively expanded in capitalism is unsteady and sometimes rather wasteful. Taking such a perspective on economic growth therefore requires turning away from the equilibrium theories of balanced growth (starting with Solow 1956) as well as the more recent endogenous growth theories à la Aghion and Howitt (1998). Once such a turn has been made, an important problem that appears on the screen is whether and how new economic growth can re-emerge after each crisis.

The unsteadiness of capitalist development is a longstanding theme of economic theorizing from Marx (1867) to Schumpeter (1934[1912]) to Keynes (1937). In contrast, the question of whether economic growth will prevail has only more recently gained increasing attention. It was raised as a consequence of observing secularly declining growth rates in the most developed economies since the 1970s (Durlauf et al. 2005, see also Maddison 2001, Chap. 3). From a complex adaptive systems point of view, an industry's contribution to national economic growth is the collective outcome of the efforts at the individual level to adapt to a critically changing environment. The interesting point therefore is how the results of individual adaptation efforts may have changed so that declining growth rates result at the national level. As will be discussed, an analysis of the typical individual adaptation strategies to capitalist crises can offer a clue for understanding what obstacles to growth have occurred and what can be done to extend possible limits of capitalist growth.

The argumentation in the paper proceeds as follows. Section 2 sets the frame by explaining why capitalism can be interpreted as a complex adaptive system. The vulnerability of the capitalist growth process to crises is then argued to be explicable as a typical feature of such systems. The key point is the role which mass production and its accumulation needs play for capitalism and its unsteadiness. Before starting a theoretical reflection on whether economic growth re-emerges as a result of the adaptive efforts undertaken during the crises, Section 3 briefly highlights the empirical growth record. The analysis suggests that some systematic change is going on as capitalist countries become more prosperous. Section 4 traces the cause(s) of that change. The specific adaptation strategies of industries facing a crisis are explored with respect to what they contribute to a re-emergence of economic growth. All discussed strategies involve some type of innovation, but these innovations differ substantially regarding their effect on economic growth. As will turn out, the differences between them also hint at what is changing when economies get more prosperous and what can be done when, as a consequence, their growth rates decline. Section 5 offers the conclusions.

STI POLICIES, NATIONAL INNOVATION SYSTEM AND FRAMEWORK CONDITIONS: THEIR IMPACTS ON INNOVATION PERFORMANCE IN HUNGARY

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Abstract

The paper explores several factors to explain an intriguing puzzle observed in Hungary: there are a large number of apparently relevant policy schemes to foster R&D and innovation activities, and yet, innovation performance is rather poor (indicated e.g. by the third or fourth lowest share of innovative firms in the EU in recent years, CIS data, various rounds).

It draws on the conceptual framework offered by evolutionary economics of innovation, and especially its systems perspective. (Fagerberg et al. (eds), 2005; Hall and Rosenberg (eds), 2010) This school stresses that innovation systems need several elements to operate successfully. Further, the major factor determining the overall innovation performance is not the performance of the individual components, but the type, intensity and quality of linkages and co-operation among them. It is also emphasised that STI policies should be devised carefully, in co-ordination with other relevant policy tools, and implemented systematically and efficiently. (Dodgson et al., 2011; Edquist, 2011; Fagerberg, 2016;

Multiple methods are applied to answer the main research question, including desk research, close reading of relevant policy documents and evaluation reports, interviews with policy-makers and other key stakeholders, as well as statistical analyses. To characterise this puzzle, first the breadth of policy measures is presented, followed by an overview of the economic and innovation performance in international comparison. Then six hypothetical explanations are considered in an attempt to solve the ‘Hungarian paradox’: a) STI policy measures are not co-ordinated with the broad objectives of an overall socio-economic development strategy; b) STI policy goals are not tailored to the needs (systemic failures) to be addressed; c) public STI funds are inadequate; d) the available public funds are spent in an inefficient way; e) STI policy measures are not evaluated regularly, and hence lessons cannot be learnt and policy measures cannot be improved; and finally, f) the framework conditions for innovation are unfavourable.

Several of these six factors need to be combined for a plausible explanation. The most important one of these factors, however, points outside the narrowly defined STI policy domain: the general framework conditions for innovations seem to play a decisive role. These conditions influence firms’ innovation activities with such a power that STI policy schemes cannot offer strong enough incentives to overrule the unfavourable framework conditions. This conclusion, however, should not be used as an excuse for overlooking the impacts of the current practices in STI policy-making: the efficacy and efficiency of this decision-making system has also been far from satisfactory. Combing these two major explanatory factors, there seems to be no ‘panacea’

or a ‘simple, quick fix’ to improve RTDI performance by introducing 2-3 new STI policy measures. On the contrary, substantial efforts are needed, based on a comprehensive approach. At a strategic level, major economic and STI policies need to be orchestrated, guided by an overarching socio-economic development strategy. Foresight processes could be used to underpin these strategies, as well as harmonise their main objectives. These dialogues can also highlight how RTDI processes can contribute to overall socio-economic development. Policies affecting RTDI processes and performance need also to be co-ordinated. Fundamental changes are required at the level of STI policy design and implementation, too: up-to-date decision-preparatory methods should be applied when devising and implementing STI policy measures, also assisted by recurring consultations with the major actors of the national innovation system. (Havas, 2019)

One of the above policy implications can be generalised: appropriate STI policies alone cannot be sufficient to improve innovation performance. Favourable framework conditions – a stable macroeconomic environment; endurable administrative and tax burdens; market conditions conducive to innovation; a sufficient supply of skilled people for RTDI projects; appropriate regulations and standards; effective IPR policies; etc. – are also needed. Thus, policies affecting these conditions should be aligned with STI policy efforts to make a difference.

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MEASURING PUBLIC INNOVATION IN EUROPE. THE STARPIN METHODOLOGY

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Abstract

Authors of the StarPIN research report 2018: The StarPIN team was composed by Annaflavia Bianchi, Giovanni Marin, Giulio Perani, Robbin Te Velde, Antonello Zanfei, and Emy Zecca.

Introduction: The poster is based on the *StarPIN* project – *Statistical Reporting on Public Innovation*– carried out for Eurostat by the Università degli Studi di Urbino Carlo Bo, Italy, with the support of Dialogic of the Netherlands. A theoretical and a methodological framework is proposed for enriching the measurement ability of public sector innovation, and the implications for data collection and analysis are discussed. A preliminary test of the framework is carried out by means of pilot applications to specific public services. The paper focuses on public service innovation as a key locus of value creation for society, choosing an object-based rather than the more commonly adopted subject-based approach. Issues concerning the measurement of public service innovation are addressed in statistical terms and consistently with the official public sector functions classifications. A particular emphasis is placed on web scraping to capture the technological level of websites used by public administrations, and to evaluate the degree of innovativeness of specific services within selected public functions. Data collected through web scraping are combined with administrative data at the level of individual services. Based on pilot applications to specific public services in a limited number of countries, the paper draws the lines for an extension of applications to potentially all public service domains and all EU member states.

Method and tools: The StarPIN approach relies on three conceptual pillars: (1) placing public service innovation at central stage, (2) adopting an object based approach, and (3) interpreting public innovation as an increase in public value. We derive these conceptual pillars from two largely complementary strands of literature (discussed in details in Chapter 3). The first stream of contributions – focusing on *public service dominant logic* – draws the attention of scholars and practitioners to the fact that services are the most important dimension of public sector activities. Hence it is this area that the analysis of public innovation must focus upon. Emphasizing this dimension of public sector activities is consistent with the widespread perception that service provision is a fundamental mandate of government at all levels, even in an era of shrinking public budgets. Moreover, the key role of public services also reflects a general trend that can be observed towards the “*servitisation*” of the economy as a whole. The second strand of literature – the one on *public value creation and co-creation* – highlights the need for a reflection on the economic and social consequences and outputs of public service development and the identification of aims pursued through public innovation. From this perspective, a focus on

public R&D expenditure and technology adoption makes sense only if associated with a consideration of actual usage/effects in terms of new or increased value created for the society, either considered as a whole or in its components.

The consistency between public functions, public institutions and public service classifications is discussed. The National Accounts' classification by Functions of Government (COFOG) has to be kept as the main reference for international comparison purposes. As an integration, the NACE (Nomenclature statistique des Activités économiques dans la Communauté Européenne) classification – not always easily matched with COFOG's divisions and groups – was replaced by the Classification of Products by Activity (CPA), where “activities” are just those included in the NACE classification, so a full consistency among the three classifications can be assured.

The project is based on the integration of statistical data, data collected through web scraping and administrative data, all referred to an identified service/institutional and geographical entity. The process through which services are identified and characterised in terms of innovativeness, and through which data are collected and organised was developed. While the analysis was conducted in view of its application to specific public sector domains, the method described can be applied to any category of public services. The steps described include: the identification of public services, in correspondence with extant classifications, and of institutions involved in their provision; the description of service characteristics that can be associated with different levels of innovativeness; the singling out of descriptive tools (a list of keywords and of logically grouped sets/“baskets” of keywords) that can be managed via web-scraping techniques; the running of web-scraping using appropriate techniques; the organization of results of data obtained through the web-scraping process; the validation process through the use of complementary data sources, including administrative data. *(A description of the web scraping source is provided in the full research paper and details of the preparation activities for setting and running the tool are organized in the User manual.)*

Results:

The main result of the research consists of the definition of the phases of the process for collecting data on public service innovation with the additional source provided by the web, which are:

- A. Identifying and selecting the public service
- B. Identifying institutions involved
- C. Capturing the degree of service innovativeness
- D. Defining the tools for web-scraping
- E. Running the web-scraping
- F. Organising the results according to the innovativeness indicator and analysing the process outcomes
- G. Validation phase and cross-sectional data analysis.

On this last phase, the innovativeness level score obtained through the described process is then ‘controlled’ checking its coherence with administrative and statistical data related to the service

studied and with the actions and phenomena related to it, statistically detected for correspondent geographical and institutional levels.

The StarPIN methodology shows potential in terms of data generation with implications for our knowledge and understanding of innovation in public sector innovation. The main results stemming from the pilot application of the methodology are shown and commented for 5 EU countries, with illustrative analyses based on the newly collected data. The bulk of data collection and elaborations refers to the Waste Management service domain, built and refined in two pilot countries in particular, Italy and the Netherlands, and extended to Portugal, Slovakia and Sweden. The pilot studies differ in terms of their coverage of municipalities in the examined countries. However it is shown that the methodology has the potential to capture at least part of the innovation phenomenon in this sector. Some expectations, based on previous surveys and data collections at a more aggregate level, have been largely confirmed, as in the case of the positive performance of Nordic countries. Nevertheless, the data allow describing a more substantial heterogeneity across countries in terms of innovativeness of service provision. Furthermore, the StarPIN methodology allows exploring innovation at a much more detailed and significant level, as it allows some inference on innovativeness of municipalities in the provision of individual services. Of course data can and should be aggregated using appropriate up scaling procedures, some of which are discussed in the paper. However, the richness of micro-level data can be exploited and, once aggregated at the regional and national level, data allow comparing the development and provision of specific services. A simple aggregation exercise carried out permits to produce a clear ranking of the 5 countries in terms of innovativeness of waste management services, and shows how regions are distributed around national means for each individual country. Although with a lesser depth, the methodology has been applied also to another service domain, Health homecare, and results are shown with reference to Italy, Netherlands and Portugal. The validation process and the cross sectional analysis of the newly collected data together with administrative data and statistical data which are connected to public service innovation in general and to innovation in the two pilot services in particular, are discussed in view of future applications and research work.

Future research steps:

The main difficulties to be faced had to do with the following domains:

- *Service specificities*: the distinctive technical and organisational features of each service translate into complex and specific terminology and jargon, making it difficult to identify the appropriate keywords to describe the characteristics of the service and its delivery systems. Further complexities arise from the heterogeneity of website structures which in turn affects the ability of researchers/data miners to capture information on the service;
- *Institutional characteristics*: the more or less hierarchical institutional setting and distribution of tasks and responsibilities across administrative levels; the size and organisation of the (public and private) entities providing the service;

- *Context specific characteristics and policies:* the tradition/style, effort, and quality of communication (the awareness for transparency/accountability). As the method is based on the description/illustration of the service provided, it might be biased by differences in the communication; strategy/tradition/style/institutional settings that are at least partially country and region specific;
- *Accessibility of statistical and administrative data.* This may require an in depth knowledge of the local language and of statistical and institutional structure involved in data collection and provision practices. The main difficulty in this respect is to identify and to involve local experts in the national definition of the steps for the methodology application.

A selection of potential directions for future development of the methodology are:

- a) further decrease the number of URLs for which the web-scraping does not succeed
- b) focus on technological levels of websites as innovativeness indicators
- c) potential application of machine learning for ex post definition of keywords and detecting new innovation levels
- d) possible application of web-scraping to user benefit search
- e) relying on open data as a service and as a means to access service contents

There is ample room for ameliorating data-collection and our understanding of public sector innovation. This is, of course, subject matter for future research and applications of this methodology.

First Announcement

Zaheer Science Foundation, (ZSF) in collaboration with Goa University organizes Conclave of Scientists, academicians and science administrators

on

“Innovation driven economic growth in Asia focusing on India”

Place: Goa University, Goa

November 27-29, 2019

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To encourage innovation driven economic growth for the advancement of India and the other South Asian and South East Asian countries. Researchers, academicians, people from industry and government departments are invited to share their experiences, recognize and define varied interface between technical change and market economy.

Various research perspectives might include:

- *Astronautics Research & its impact on Society*
- *Scientific and Technical Women force and their employment opportunities.*
- *New Drug Discovery and pharmaceutical industry*
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- *Information technology and Communication (ICT)*
- *Impact of science and technology on Technology Development*
- *Status of R&D in India and other countries: Organization and Structure of R&D; Science and Technology Policy and Technology Trade.*
- *Issues related to solid waste; management; water resources; traffic management and alternative sources of energy like solar energy.*
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- *Marine Sciences and Climatic change.*
- *Value addition in leather industry.*
- *Food safety and food technologies.*

Abstract of approximately 750 words (with references). Please mail one copy of your abstract to the address below. Abstract should include full contact details, including your name, institutional affiliation, mailing address, telephone number and the e-mail address.

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