Geographical distribution of Shanti Swarup Bhatnagar Awardees

The Shanti Swarup Bhatnagar Prize for Science and Technology (SSB) is one of the highest multidisciplinary science awards in India conferred each year on Indian scientists below the age of 45 years. In 1992, Council of Scientific and Industrial Research (CSIR), which instituted this Award in 1958, compiled the biographical details and professional profiles of 259 Awardees who had received this recognition from 1958 to 1991 (ref. 1). These data were used by Prathap[2] to create a thematic map showing the state-wise number of Awardees per million of population. At that time, Tamil Nadu showed the best performance on the per capita basis, followed by West Bengal and Karnataka. Since then, another 266 awards have been made with a total of 525 awards, of which 509 are male recipients and 16 are female. This list is now available on-line[3]. Table 1 shows a summary of the awards made in each category and the share of the awards made category-wise in seven broad areas.

In the latest list[3], States or Union Territories are shown against each recipient and some arbitrariness is seen. Geographical distribution is not consistently based on the state of birth of the Awardee or the institution where the Awardee is residing. Prathap (1990 – Engineering) is assigned to Singapore, which was his place of birth, although all his work for the award was done in Karnataka. Gundabathula Venkateswara Rao (1989 – Engineering) is shown against Kerala where he did most of his work. Kalyanmoy Deb (2005 – Engineering) is the lone recipient from Tripura, the place of his birth. Many recipients are shown against foreign countries (e.g. USA, Belgium, etc.) and these have been grouped under the 'various' category. This is removed from consideration when the analysis is performed later, as we are interested only in the dispersion within India. Unlike earlier[2], we now look at the geographical dispersion of the Awardees state-wise using GDP data rather than population data for a more meaningful perspective. The nominal gross state domestic product (GSDP) for Indian States and Union Territories[4] for 2014–15 is used for this purpose for the two periods considered, i.e. 1958–1991 and 1992–2016. Maharashtra has the highest GSDP of about US$ 250 billion, followed by Tamil Nadu (US$ 150 billion), while Lakshadweep has the lowest GSDP of US$ 60 million.

Table 2 shows the dispersion of SSB Awardees using the Awardees per billion US dollars of GSDP criterion for the two distinct phases. Karnataka, Delhi and West Bengal are at the top of the list of

Table 1. The SSB Awards made against each category

Category	Recipients	% Share
Biological sciences	93	18
Chemical sciences	91	17
Earth, atmosphere ocean and planetary sciences	46	9
Engineering sciences	75	14
Mathematical sciences	67	13
Medical sciences	59	11
Physical sciences	94	18
Total	525	100

Table 2. Dispersion of SSB Awardees using Awardees per billion dollars of GSDP criteria

	SSB Awardees			SSB/$b	
State/territory	1958–1991	1992–2016	SGDP US $b	1958–1991	1992–2016
Karnataka	27	60	100	0.27	0.60
Delhi	21	23	67	0.31	0.34
West Bengal	38	35	120	0.32	0.29
Goa	1	2	7.3	0.14	0.27
Tripura	0	1	4	0.00	0.25
Seemandhra	18	16	77	0.23	0.21
Maharashtra	24	49	250	0.10	0.20
Kerala	9	11	59	0.15	0.19
Uttar Pradesh	33	25	150	0.22	0.17
Odisha	1	5	40	0.03	0.13
Tamil Nadu	37	16	150	0.25	0.11
Madhya Pradesh	3	4	75	0.04	0.05
Telangana	6	3	64	0.09	0.05
Assam	1	1	24	0.04	0.04
Rajasthan	7	3	85	0.08	0.04
Gujarat	3	3	110	0.03	0.03
Punjab	7	1	47	0.15	0.02
Bihar	1	1	60	0.02	0.02
Andaman & Nicobar Islands	0	0	0.92	0.00	0.00
Arunachal Pradesh	0	0	2.1	0.00	0.00
Chandigarh	0	0	4.3	0.00	0.00
Chhattisgarh	0	0	27	0.00	0.00
Dadra and Nagar Haveli	0	0	0.36	0.00	0.00
Daman and Diu	0	0	0.16	0.00	0.00
Haryana	4	0	58	0.07	0.00
Himachal Pradesh	1	0	12	0.08	0.00
Jammu and Kashmir	1	0	13	0.08	0.00
Jharkhand	0	0	26	0.00	0.00
Lakshadweep	0	0	0.06	0.00	0.00
Manipur	0	0	2.1	0.00	0.00
Meghalaya	0	0	3.3	0.00	0.00
Mizoram	0	0	1.5	0.00	0.00
Nagaland	0	0	2.7	0.00	0.00
Puducherry	0	0	3.1	0.00	0.00
Sikkim	1	0	1.8	0.56	0.00
Uttarakhand	3	0	18	0.17	0.00
Total	247	259	1665.7	0.15	0.16
Various	12	7			
Total	259	266			

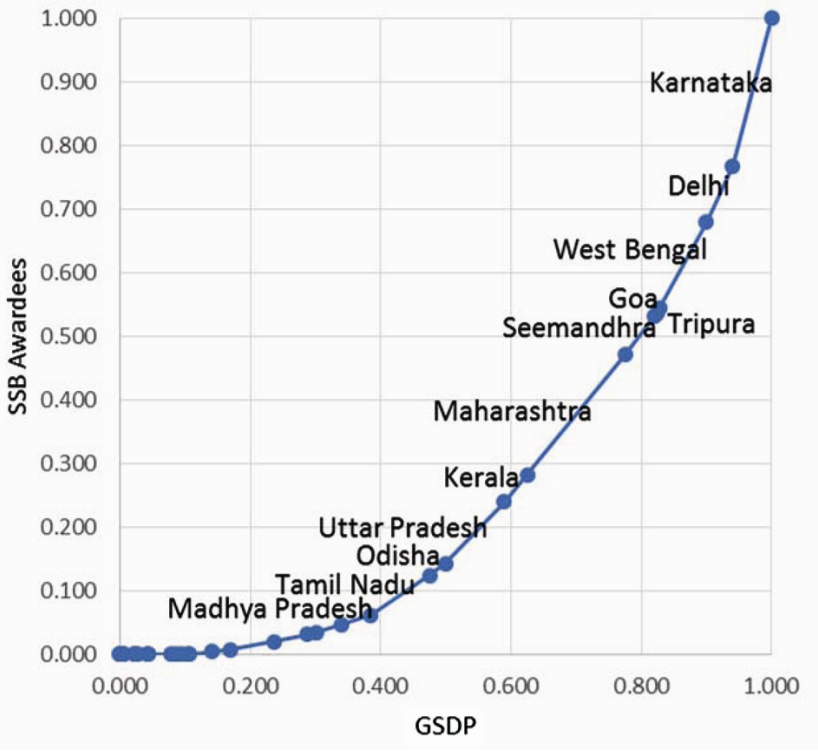

Figure 1. State-wise dispersion pattern across India during 1992–2016 shown using a cumulative Lorenz curve.

Awardees during the period 1992–2016. On a GSDP basis, it was West Bengal which headed the table in the 1958–1991 phase, while Tamil Nadu was prominent on a per capita basis[2]. As many as 18 States and Union Territories drew a blank during the period 1992–2016, while there were only 14 such states in the earlier 1958–1991 phase. Five states which found a place in the earlier phase are no longer represented. Some of the 'big' states, e.g. Haryana, Chhattisgarh and Jharkhand, are missing in the current phase. We see a growing concentration of awards in Karnataka (from 27 to 60) and Maharashtra (from 24 to 49). Tamil Nadu (from 37 to 16) and Uttar Pradesh (33 to 25) show significant decline in their share over these two phases. It is clear that a crucial role is played by the location of premier institutes in certain states – for example, the Indian Institute of Science, Bengaluru, Karnataka may top the list of institutes that have Awardees and thus Karnataka is on the top of the list.

Figure 1 shows graphically the state-wise dispersion pattern across India during the 1992–2016 phase using a cumulative Lorenz curve. It is important to note that underlying these patterns is the presence or absence of premier research institutions and universities in the States and Union Territories. A better dispersion of such units of assessment is needed.

1. *Bhatnagar Laureates (1958–91)*, Publications and Information Directorate, CSIR, New Delhi, 1992.
2. Prathap, G., *Curr. Sci.*, 1993, **65**(7), 575–576.
3. https://en.wikipedia.org/wiki/List_of_Shanti_Swarup_Bhatnagar_Prize_recipients
4. https://en.wikipedia.org/wiki/List_of_Indian_states_and_union_territories_by_GDP

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Need for reliability assessment of parent product before redesigning a new product

As companies increasingly invest on the development of new products, and in the redesigning of existing ones in order to meet the ever emerging and rapidly changing customer demands, they continue to face an extremely competitive and cost-cutting war. Since today's product design works are mainly focused on the redesigning of existing products, most especially for complex products and systems, their properties are expected to be of higher technical content, reliability requirements as well as design characteristics[1].

Redesigning of existing products which has become one of the most critical topics in the development of new products, is aimed at the creation of products that meet both the customer requirements as well as the product reliability index by adjusting, replacing or making changes to the existing predecessor designs until all the new requirements are met. To improve product reliability and quality during the product redesigning phase, and to create novel product(s) for the customers, deliberate efforts must be made to identify and analyse the failure information of the existing or parent product, and the result converted into appropriate design knowledge. Identification of the failed product component is most critical to achieve improved product quality and reliability[2].

Failure mode and effect analysis (FMEA) is the method most commonly used for identifying and analysing failures. This was introduced by the United States aerospace industry as a structured and systematic method with apparent reliability and safety requirements[3]. It has proven to be a popular engineering